The 4th IR is happening and this ground-breaking text comprehensively tackles the impact on teaching and learning. The book is fundamental reading for all teachers intending to be at the forefront of innovative technologies. A must read!

-Dr. Alpesh Maisuria
Associate Professor of Education Policy in Critical Education, University of the West of England, UK.

This book is revolutionary. It challenges all teachers to engage with highly stimulating pedagogical tools for the contemporary classroom, with reflective, innovative and critical thinking to the fore. Essential reading for all in Education.

-Dr. Robyn Moloney
Senior Lecturer School of Education
Macquarie University, Sydney, Australia.

An intercontinental partnership has developed a creative environment where innovative ideas have been shared and nurtured. This inspiring book offers universities and schools the opportunity to reshape educational policies and curricula: it favours innovative learning practices and provides a new dimension for global citizenship education.

-Gisella Langé
Ministry of Education, Italy.

DISCLAIMER: This project has been funded with support from the European Commission. This publication reflects the views only of the editor(s) and contributor(s), and the Commission and/or its units cannot be held responsible for any use which may be made of the information contained therein.

₹ 499

ISBN 978-88-350-5770-3

9 788835 057703

GRUPPO EDITORIALE
LA SCUOLA SEI

EDUREFORM HANDBOOK for INNOVATIVE PEDAGOGY

EDUREFORM HANDBOOK for INNOVATIVE PEDAGOGY

Edited

Ashutosh Biswal
Sanjeev Sonawane
Indra Odina
Letizia Cinganotto
Pratibha Patankar
Vidyanand Khandagale

EDUREFORM

Co-funded by the Erasmus+ Programme of the European Union

EDUREFORM HANDBOOK for INNOVATIVE PEDAGOGY

Edited

Ashutosh Biswal
Sanjeev Sonawane
Indra Odina
Letizia Cinganotto
Pratibha Patankar
Vidyanand Khandagale

EDUREFORM

Co-funded by the
Erasmus+ Programme
of the European Union

Stampato per conto della Casa Editrice La Scuola S.p.A.

First edition published 2022

ISBN: 978-88-350-5770-3

FOREWORD

It is generally agreed that educators play a vital role in rendering effective tutelage and bringing about educational reform. Thereby, the grounding of teachers to further instruct is a complex and multitudinous undertaking. More-over, this dynamic profession requires teachers to adapt to the new challenges, wherein teacher training must entail the knowledge of futuristic and compre-hensive pedagogical tools, not only during teacher education programs but also during Faculty Development Programs of in-service teachers.

The training programs for the in-service and pre-service teachers, aiming at their skill enhancement, must be incorporated with the pivotal requirements of Industry 4.0. Furthermore, the realignment of traditional pedagogies to the rap-idly transforming educational community implies the detection of answers to different learning needs. Besides this, educators, mastering project and prob-lem-based teaching pedagogies - and at the same time deploying pragmatic and cooperative learning practices - can empower students through heightened learn-ing outcomes and customizable mentoring support.

In light of the aforementioned and in line with the visualisations of the EDUREFORM project titled "**Mitigate the Impact of Fourth Industrial Rev-olution on Indian Society: Education Reform for Future and In-service School Teachers,**" a team of experts from Indian and European universities, is working meticulously on the promotion of innovative teaching-learning tools and aids that promote not only the enhancement of skills such as analytical, critical thinking and problem-solving but also instil humane values and ethics.

Not to mention, for appreciating the initiatives of EDUREFORM and for reinforcing its objectives, I would like to express my earnest gratitude to the Erasmus+ Programme and to the European Commission for co-financing the project. The whole idea of revamping and shaping the teacher edification in light of Industry 4.0, would not have been made possible without the consistent sup-port of the Erasmus+ Programme.

The book "Edureform Handbook for Innovative Pedagogy" lays out the in-novative and progressive pedagogical strategies which, the in-service and pre-ser-vice teachers can incorporate to reform the educational journey of the genera-tion Z and Alpha learners.

Dr Sangeeta Pant
Dean | Chitkara College of Education - Chitkara University Punjab
Coordinator of EDUREFORM Project

INDEX

Introduction 6

Acknowledgements 17

Chapter 1
Brainwork 18

Chapter 2
Pedagogy of Case Study 30

Chapter 3
Computational Thinking: A Pedagogical approach for Constructive Classroom 41

Chapter 4
Concept Formation for Enhancing Students' Analytical, Creative, and Critical Thinking Skills 59

Chapter 5
Debate for Critical Thinking and Communication 69

Chapter 6
EduScrum in Teaching Lessons 83

Chapter 7
Elisir and Poison 93

Chapter 8
FIESI Model for Productive Thinking 101

Chapter 9
Innovation pedagogy as a tool to solve challenges with teamwork 112

Chapter 10
Heads and Tails for Enhancing Students' Critical Thinking Skills 121

Chapter 11
Integrated and Interactive Lesson Plan 128

Chapter 12
MAX for Enhancing Students' Analytical Skills 145

Chapter 13
Micro-Learning Planer (MLP) 160

Chapter 14
Multi-Perspective Teaching: Nurturing Analytical, Critical & Creative Thinkers 177

Chapter 15
OPEN BOOK ENVIRONMENT (OBEnv): A Tool for Developing Critical and Creative Thinking 191

Chapter 16
Peer facilitated learning 206

Chapter 17
The product process analysis – A tool to develop critical, creative and systemic thinking skills 225

Chapter 18
Reflective Cheat Sheet 238

Chapter 19
TEAL (Technology Enhanced Active Learning) for STEAM, humanities and CLIL 253

Chapter 20
Becoming an Innovation Coach 264

Chapter 21
The Teaching Interplay for honing analytical, critical, and creative thinking skills - Instructing to Learn with In-service and Pre-service Teachers 275

Chapter 22
1+1=1 The path to the invisible 289

Chapter 23
Resilience and coping styles for transformative teaching and learning 295

Glossary of Terms 307

Biography of Authors 314

INTRODUCTION

The 4th Industrial Revolution (41R) is a fusion of advances in artificial intelligence, robotics, the Internet of Things, and more. As a result of this technological wave, the 4IR is paving the way for transformative changes in the way we live, work and are governed. In 2016, a City and Oxford University joint report estimated that 57% of jobs are at risk of automation. According to the McKinsey Global Institute, artificial intelligence could replace 800 million jobs by 2030.

As the economists Erik Brynjolfsson and Andrew McAfee – in The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies – have pointed out, the revolution could yield greater inequality, particularly in its potential to disrupt labor markets. With the growth of automation, artificial intelligence will replace workers across a vast spectrum of industries and sectors. Martin Ford – in the Rise of the Robots: Technology and the Threat of a Jobless Future – states that the jobs most at risk are those which are on some level routine, repetitive and predictable, as these tasks are possible to be replicated through Machine Learning algorithms.

Automation and robotics could be an asset for countries with economies characterized with low productive intensity and at the same time highly specialized labour force.

Conversely, in a country as India, characterised by high labour density and under skilled labour force, the 41R is likely to generate an earthquake in the labour market. Due to the low average age of the national population, every year the Indian labour market absorbs 12 million young workers. According to the PeopleStrong Report (2019), 1.5million jobs would be lost annually in the country due to automation. The risk is high, as the rise in employment rate could generate societal tension in a society which is already divided among multiple socioeconomic, geographical, and religious cleavages. It could erase the developmental steps undertaken by the country in the last 20 years. In this regard it is important to remember as the global number of people living under the poverty line has constantly decreased due to the stunning economic growth occurring in the country.

Coordinated by Chitkara University, EDUREFORM is a three-year project co-funded by the Erasmus+ Programme of the European Union, comprising four Indian universities, four European universities as well as two Secondary schools, and one SME, having expertise in the field of education. The final aim

of EDUREFORM is to promote consciousness and to empower Indian future and in-service secondary school teachers to mitigate the expected societal impact of the 4IR.

EDUREFORM consortium has compiled Pedagogical tools with the aim to reform school classrooms so that they are suitable to develop the human brain with the thinking competencies required for the fourth industrial revolution. In-service and future-teachers only can play the lead role to realize 4IR skills and competencies at school level. In-service and future teachers need to deploy innovative pedagogies related to 4IR skills and competencies. EDUREFORM research partners developed innovative pedagogical tools based on learning theory applications to achieve learning outcomes as analytical thinking, critical thinking, creative thinking, and problem-solving abilities. A succinct summary of 22 innovative pedagogical tools compiled by 11 EDUREFORM partners is narrated below to give readers an idea about the content of the book.

Chapter 1 *Brainwork* by Dr Niyati Chitkara, Dr Honey Chitkara, Ms Dolma Pathela, Ms Piyusha Sharma provides readers with a very functional pedagogical tool that enhances learners' investigation capabilities. The authors explain how the act of researching fosters in students a critical and inquiring approach towards the process of gaining knowledge. They prove the significance of implementing research-based activities in an Industry 4.0 society as it successfully meets the future world problems related to fast-paced technological and scientific advancements. In the chapter the authors list the steps to follow to ensure the proper usage of the pedagogical tool by the educator. An example of an assignment given by Chitkara International School is showcased in the chapter 'Tour de Fun – Creating Brochures for Favourite Theme Parks'.

Chapter 2 *Pedagogy of Case Study* by Pratibha Patankar presents the conceptual and theoretical background of 'Case Study' methodology and its direct linkage with the constructivist theory – based around the idea that each person reflects on the new ideas taking into account their prior knowledge. The foundation of case study relies on using real facts or cases and turning them into educational experiences via in-depth analysis. In addition, the chapter provides the reader with different literature that supports this methodology, and it outlines the different steps to adopt when implementing a case study in the classrooms.

Chapter 3 *Computational Thinking: A Pedagogical approach for Constructive Classroom* by Vidyanand Khandagale provides us with a well-suited tool in times of the 4th Industrial Revolution. In the 21st century, we are often faced with a dichotomy between technological thinking and human thinking. Nonetheless,

this chapter teaches us the traits and applications of computational thinking and how it can be an adequate pedagogical tool to promote deep thinking skills in secondary schools. In this chapter, the author presents the adequate environment to solve a problem by thinking scientifically and by following the computational thinking steps described. Thereby, students will be able not only to recognise common patterns in different scenarios and contexts but they will also be able to follow a set of instructions to reach a well-structured solution. In our current societies characterised by dynamism, interconnection, and promptness, being able to contextualise and recognise common trends and patterns is a required competence to thrive personally and professionally.

Chapter 4 *Concept Formation for Enhancing Students' Analytical, Creative, and Critical Thinking Skills* by Indra Odina and Anna Stavicka argues that Education 4.0 is the response to the current 4th Industrial Revolution phenomena, where humans and technology are converging to create new opportunities creatively and innovatively. The chapter explains that learning is becoming more and more student-centred where each individual is allowed to choose the most appropriate study method according to their needs. The authors claim that 'Concept Formation' is an excellent tool as it involves comparative thinking, symbolic representation, and logical reasoning. It lets the user understand how concepts are classified in regular life and how there are different rationales for different classifications. An example on how to implement the tool in the classrooms is given in the chapter by using the word 'bread' in different languages and where students are asked to provide different classifications of the same. The authors conclude the chapter by highlighting that categorising objects, ideas, and events, is a way for people and students to make sense out of the world which is a crucial skill in our current dynamic societies.

Chapter 5 *Debate for Critical Thinking and Communication* by Letizia Cinganotto challenges the reader to see beyond the commonly used definition of debate. Letizia argues that debates are widely used in classrooms, across countries and cultures. Nonetheless, she points out that it does not tend to be used as an inclusive nor cross-curricular pedagogy. The author thoroughly explains how to use 'debate' as an innovative pedagogy by listing new roles for the students and by specifying, step by step, how to effectively organise this exercise independently of the subject taught. Letizia points out the advantages debate has in the classroom and beyond. She pleads that in our current times, we are overcrowded and saturated with large amounts of information. Under these circumstances, being able to contrast information and to critically assess its source and veracity, is crucial to become responsible and socially aware citizens.

Chapter 6 *EduScrum in Teaching Lessons* by Wilko Reichwein presents a newly promising didactic approach originated from the IT industry and software development that is now extending into the education sector. EduScrum is based on the idea of the agile mindset where individuals have the attitude and are able to cope with the growing complexity of the work environment, professional or educational. The author explains that eduScrum is a project-management method for education and is very useful for project-based learning where students have to solve complex tasks in a structured manner without a teacher giving direct information about what they have to do. The teacher decides 'what' and 'why' to do a particular task, but it is the students who get to decide 'how' by applying self-organised learning and active participation. Furthermore, the chapter provides a clear picture of the working cycle of this project-based learning. Eduscrum is a tool that fits the needs of the 21st century as it makes students work collaboratively but it also makes them become the owners of their own decisions and strategies which is how most of the current job market is structured.

Chapter 7 *Elisir and Poison* by Patrizia Fazzini, Marco Ghelardi and Francesco Maria Marelli starts by reminding us of a widely known proverb 'We learn by making errors'. Nonetheless, the authors emphasize that this is often disregarded in the teaching practice and in the pedagogical field. Classrooms tend to be portrayed as spaces where mistakes and errors equal failure. In this environment, students develop a 'fear' of making mistakes which is detrimental to the learning process. 'Elisir and Poison' is a pedagogical tool that puts the error at the center of learning. It allows students to understand the importance of making mistakes and most importantly, they are capable of learning by navigating through errors. This methodology allows students to overcome the fear of inadequacy and failure which is key to developing creativity and critical thinking. This innovative pedagogy requires the teacher to challenge his/her bias when it comes to attributing error to underachievement and the authors provide us with a detailed manual to adequately apply this didactic approach in the classroom. Elisir and Poison proves teachers and students that removing boundaries and reconsidering the concept of the error, is an effective methodology to develop creative and inquiring minds.

Chapter 8 *FIESI Model for Productive Thinking* by Ashutosh Biswal and Kamakshi Raipure calls attention to the 21st century skills such as creativity and critical thinking, flexibility and innovation and how this part of human cognition is ignored in the classroom teaching/learning process. The authors also highlight the fact that students are not good in higher order thinking skills and one of the causes the authors identify is that the teachers' questioning style is initiated by a fact-based question followed by students giving a response. This

will result in rote learning or reproductive thinking and what this chapter calls for is the importance of a productive thinking process. The Productive thinking process has long been studied and the chapter provides a review of the related literature. The Productive thinking model (FIESI) has a foundation in cognitive theories and is based on other teaching models given for creative thinking, critical thinking, and productive thinking development. It has its syntax, focus, social system, support system, role of students/teachers and place layout. It provides a platform to combine creative and critical thinking at one place. The five phases of FIESI (Foundation-Ideation-Evaluation-Stabilization-Implication) are explained in the chapter to allow the reader to use this pedagogical tool in the classroom.

Chapter 9 *Innovation pedagogy as a tool to solve challenges with teamwork* by Essi Silvennoinen and Graham Burns. The authors introduce their chapter by explaining the various ways in which the Fourth Industrial Revolution is altering the job market. Graham and Essi emphasise that the skills required by employers do not tend to match those fostered in the classroom as teachers tend to use traditional approaches and methodologies not fitting our current times. Essi and Graham explain in detail how to use innovative pedagogies that will be recreated in the classroom, the conditions, and settings that the students will experience in the workplace. The authors want the reader to understand that skills such as collaboration, leadership, problem-solving, critical thinking are not only useful for the students in their professional life, but it will also allow them to become critical and conscious citizens.

Chapter 10 *Heads and Tails for Enhancing Students' Critical Thinking Skills* by Indra Odina highlights the importance of reflection and of experiential learning. The experiential activities often start with specific narrow skills and then move on to broad skills such as teamwork, communication, time management, emotional intelligence, or leadership, which is why adopting this tool in the classrooms is very beneficial. Besides critical thinking skills, the students develop their reflection skills, support their arguments, and give structured meaningful feedback by evaluating an event that has taken place and by outlining what they liked or disliked. By performing these activities, students reach the conclusion that there are no completely positive or negative matters – every coin has two sides. Every strength has within it the potential for weakness, and likewise every weakness has within it the potential for strength. This tool allows students to be critical in their thoughts, not falling on the danger of a single story or truth. Consequently, this will make them make good decisions not only in the classroom but beyond.

Chapter 11 *Integrated and Interactive Lesson Plan* by Dr Niyati Chitkara, Dr Parul Sood, Dr Sangeeta Pant, Ms Dolma Pathela, Ms Piyusha Sharma is a journey of of effective reinvention of one of the most widely teaching tools and practices: lesson planning. The authors start their chapter by outlining the relevant role lesson planning plays in making a teacher succeed in his or her profession. Lesson planning allows the teacher to identify all the relevant factors, resources, and requirements for an effective class delivery. Parul and Mansi go beyond the traditional lesson plan structure and present us with an innovative and interactive approach. Their innovative lesson plan is a two-way roadmap for ensuring the subject-enrichment of the student along with allowing the teacher to understand what works best for each of their students. When using this innovative and interactive lesson plan the teacher broaders his or her pedagogical skill set to encompass a wide range of learning styles. Furthermore, it becomes a student-centered approach that encourages active participation in the classroom while developing the critical, creative, and analytical thinking skills of the students.

Chapter 12 *MAX for Enhancing Students' Analytical Skills* by Indra Odina focuses on learners' capacity to take control over their learning, therefore, becoming autonomous. In the chapter it is highlighted that for a learner to gain autonomy, he/she has not only to develop a set of personal qualities, such as confidence, enthusiasm, taking and accepting obligation, and ability to take initiative, but he/she has also to possess a set of academic skills. These academic skills allow the user to identify learning goals and processes, to understand how to evaluate them and to manage well-grounded conceptions of learning while applying a substantial number of learning approaches. All these qualities outlined by the author will motivate the student to learn autonomously. This self-management approach is dominant and benefits from students' motivation, acquisition, and extension (from which it gets the term MAX). The aim of MAX is to elicit different opinions from the students about what they have learnt/found out, what they want to try out and what they would like to examine more in detail. The chapter also provides students' feedback after being taught with MAX and the reader is able to understand the benefits of using this innovative pedagogical tool from a user's perspective.

Chapter 13 *Micro Learning Planner (MLP)* by Sanjeev Sonawane and Vaibhav Jadhav focuses on the Micro-Learning process of learning. The authors start the chapter by outlining why this is a pedagogical tool that fits the current needs of the 21st century. As our societies are becoming highly technological, the way in which we assimilate information has changed throughout the years. online learning information is usually made up of tiny bits that ultimately make the individual achieve his/her learning objectives. The authors take the readers

through the literature review, outlining relevant studies that back that when received small chunks of information, students retained a wider amount of information. From these findings, Sanjeev and Vaibhav lay the foundation for creating the right learning environment to apply Micro-Learning as a pedagogical tool. The authors acknowledge the shortcomings of the pedagogical tool, but they stress its relevance in micro-media environments and highlight that when microcontent is well structured and prepared it is an effective tool to promote 21st century learning.

Chapter 14 *Multi-Perspective Teaching: Nurturing Analytical, Critical & Creative Thinkers* by Dr Niyati Chitkara, Dr Honey Chitkara, Ms Dolma Pathela, Ms Piyusha Sharma illustrates an innovative pedagogy based on the principle of individual differences. Multi-perspective teaching stresses on the varying learning paces and styles of students in contrast to traditional teaching methods that hindered the development of creative, critical, and analytical thinking skills in the classroom. This innovative pedagogical tool confronts students with the 'real' world, it allows them to learn skills useful not only for the workplace but also for being conscious citizens in 21st century societies. The authors explain thoroughly, step by step, how to use Multiple-perspective teaching in the classroom and they also provide the reader with supporting material and more importantly with students' feedback. This innovative pedagogy has also been tested in the remote learning environment, proving to be successful in delivering quality education in spite of the challenges that online learning presents.

Chapter 15 *Open Book Environment* by Ashutosh Biswal and Jaishree Das begins by outlining the benefits of the pedagogical tool in times of the 4th Industrial Revolution. The authors believe that the role of education systems is to lead a society in the positive direction, making children fit for the society they live in. They acknowledge the changing order in our world, that is why they believe that pedagogies should also evolve accordingly. Open Book Environment is a tool that provides flexibility in the teaching and learning techniques, it allows teachers to provide the students with a learning that links the classroom to their lives; and more importantly it puts aside rote learning by fostering conceptual understanding. The authors explain the differences between an open book environment and an open book examination in spite of their imminent connection. Their chapter guides the teacher thoroughly in the steps to take to create an Open Book Environment in the classroom. Lastly, this chapter written by Ashutosh and Jaishree reminds all education stakeholders about the importance of upgrading and making our discipline fit for the 21st century, Open Book Environment being an effective tool for this evolution.

Chapter 16 *Peer Facilitated Learning* by Nidhi Waldia starts by mentioning the old latin principle *Docendo discimus* - "the best way to learn is to teach". This proverb allows the reader to already understand what will be the foundation of Peer facilitated learning. Indeed, the pedagogical tool presented by Nidhi follows a similar principle: it engages students in class-wide and reciprocal peer tutoring to facilitate student learning. She meticulously explains to the reader how to use this pedagogy in his or her classroom, giving concrete examples and providing all necessary material and information. This innovative pedagogy reflects the reality students will face not only in the workplace but in their daily lives. Humans do not live in isolation, we are collective beings, and this can be seen by the amount of 'peers' we have: relatives, friends, colleagues… This tool bridges the gap between the traditional individualistic approach to education and the actual necessities of the 21st century. By fostering collaboration, collectiveness and partnership not only schools will be preparing students for the future of work, but the learning objectives will be met in an effective manner.

Chapter 17 *The product process analysis – A tool to develop critical, creative and systemic thinking skills* by Sören Schütt-Sayed and Andreas Zopff is a tool that takes into account the inherent need to foster critical thinking and consciousness in the 21st century classrooms. Initially, product process analysis (PPA) was a tool developed by the Project Group Ecological Economy (PÖW) to provide stakeholders with an information tool that can be used to view products and services holistically. By providing detailed and complete information, stakeholders were able to make conscious decisions and to weigh what their preferences were. Equally, this tool provides students with a complete picture of a product, a process, or a practice. The authors have included in the chapter a matrix that can be used to effectively implement PPA in the classroom. The matrix assesses the different components of the desired product or process and guides the students throughout the assessment process by allocating a score to each component. In a world where we are constantly consuming products, goods, services, and information it is important that the new generations have the right tools and knowledge to make conscious and well-founded decisions. In knowledge lies the power to build just and sustainable societies.

Chapter 18 *Reflective Cheat Sheet* by Sanjeev Sonawane and Nisha Valvi begins by underscoring the importance of self-discovery to enhance writing and reflective thinking skills. The authors acknowledge the difficulty behind reflective processes, as one is not always ready to learn the truth about themselves yet; anyone can develop effective reflective thinking skills with time and practice. Reflective Cheat Sheet is a pedagogical tool that will guide the student in the journey of self-reflection in what we understand as a 'high-impact experience'. The authors spell out the different components and the required instructions to

apply this innovative tool in the classroom - particularly in classes from 9th to 12th standard). The reader will understand that a key role responsibility for teachers is to foster reflective thinking amongst students. Reflective practitioners are to use their analytical and critical thinking skills to make mature and well-funded decisions.

Chapter 19 *TEAL (Technology Enhanced Active Learning) for STEAM, humanities and CLIL* by Letizia Cinganotto begins by tracing back the origins of the pedagogical tool. TEAL was firstly used in the USA to overcome some weaknesses identified in the Physics curriculum in order to attract more girls to study the discipline. The tool aimed to achieve its goals by combining traditional pedagogy with active learning, facilitating the co-construction of knowledge and the development of active learning. The author goes in depth in the practicalities of the tool and explains in detail the methodology of TEAL: a combination of lectures, simulations and workshops with digital tools and devices based on individual and collaborative tasks. TEAL is an innovative tool that caters for our highly technological societies. The tool understands the existing gap between tech-savvy students and teachers that might not have the adequate technological skills and it provides the latter with an innovative solution to this mismatch. In times when technology becomes more and more integrated in humans' daily lives, TEAL is proof that education systems have the potential and the capacity to keep up and lead this transformation.

Chapter 20 *Becoming an Innovation Coach* by Essi Silvennoinen and Graham Burns stress the importance for teachers to be real change makers. This acquires special relevance in times of the Fourth Industrial revolution where co-learning, co-cresting and reflection skills are at the core of professional and personal development. The authors explain that for teachers to be catalysts of change they need to have a shared vision and understanding which can be achieved with effective teacher training. The Teacher to Innovation Coach Programme is designed to develop teachers' professional skills from the idea of shared responsibility and peer learning. The authors explain the components of the programme and outline the innovative methods used: flipped learning, dialogical interaction, and peer-learning. By following the directions exposed by Graham and Essi, teachers are able to apply new knowledge and skills more effectively. In this chapter, the reader realises that when teachers learn as active participants by solving learning process challenges with other colleagues, they gain a multidisciplinary perspective beneficial to their teaching. In a multidisciplinary world, teachers need to embrace the world surrounding them and provide the best environment for the promotion of 21st century skills.

Chapter 21 *The Teaching Interplay for honing analytical, critical and creative thinking skills - Instructing to Learn with In-service and Pre-service Teachers* by Dr Niyati Chitkara, Dr Parul Sood, Dr Honey Chitkara, Ms Dolma Pathela, Ms Piyusha Sharma presents the relation between a beginner (pre-service) and an experienced teacher (in-service) and how this mutual partnership gives an opportunity to explore what is beyond the existing practices and methodologies of teaching. This collaborative effort, as outlined by the authors, allows novice and experienced teachers to be active learners and mutually learn from each other, and ultimately reform the learning experience of the students. However, this mutual sharing of learning is only possible when one of them is an experienced teacher/mentor or Teacher educator. This training framework for both in-service and pre-service teachers goes hand in hand with the Indian National Education Policy and with the UN SDGs, both placing a strong emphasis on the increasing need to qualify teachers for Education 4.0.

Chapter 22 *1 + 1 = 1. The path to the invisible* by Patrizia Fazzini, Marco Ghelardi and Francesco Maria Marelli outlines the value of creativity. In this chapter, the authors break the existing stigma that creativity is a skill that should only serve the 'artistic' professions and justify its necessity to become a horizontal and interdisciplinary competence. They go through the literature review to prove that creativity is a constant in every great mind, no matter its field of expertise. '1+1 =1' is a pedagogical tool that bridges the gap between the lack of creativity in schools and the importance this skill plays in personal and professional development. This innovative pedagogy presents students with the right scenario to find imaginative solutions to 21st century problems. Our societies have become interwoven, sophisticated, and complex and without developing creative minds, we will not be able to face the myriad of challenges our future lies ahead - environmental, technological, social. The authors outline the importance of teacher training and preparation to nurture creativity in the classroom and provide the reader with detailed guidelines to effectively use '1+1' in any learning setting.

Chapter 23 *Resilience and coping styles for transformative teaching and learning* by Patrizia Garista is the last chapter of our book which allows the reader to critically examine the current state of the teaching profession. One cannot ignore that teachers have had to overcome severe challenges in times of the COVID-19 pandemic, and most of these hindrances are still prevalent in their daily professional lives. Patrizia informs the reader that our social and educational systems are performance-centered. In times when individuals are looking for orientation and security in their lives, the cult for efficiency, productivity and top-performance is dehumanising and alienating. In this chapter, Patrizia calls for the need to refocus on education rather than on learning. The reason

behind this claim is that learning tends to be closely associated with performance, outcome, and outputs. The author argues that the current paradigm develops uncertainty in individuals, leading them to a negative capability that she describes as "reflective inaction". Nonetheless, the chapter ends by providing the reader with an alternative: the creation of an "educational zone", a mental and emotional space, where new learning can emerge from narratives. Our societies are characterised by the fast-pace social and technological progress, we have entered a dynamic of input-output dominated by the commoditisation of goods and services. Perhaps, as the author argues, it is the time for us to refocus on what we consider to be the necessary pillars for our societies.

ACKNOWLEDGEMENTS

This book is one of the outcomes of the EDUREFORM project funded by the European Union ERASMUS + Capacity Building Programme. We express our gratitude to EACEA for the financial support extended to us for this purpose.

We remain thankful to all the contributors for their hard-work and cooperation. Without their efforts the project and the book would not have come into being. We are confident that their knowledge and contributions, and the book as a whole, will be regarded as a reference in the field of education and pedagogy. We hope that our edited volume will stimulate the application of innovative pedagogical approaches and will nurture creativity, critical and analytical thinking skills amongst secondary school students. We could not have used our efforts in a better manner than for developing inquisitive and inquiring minds amongst students, the generation that will shape the future of our societies.

We, the editors of the book, thank Dr Sangeeta Pant, the Dean of Chitkara College of Education, and the present coordinator of the EDUREFORM project, for writing the foreword of this book and for always supporting our endeavours with her knowledge and passion for education. Without your coordination, encouragement, and furtherance, we could not have achieved the goals of EDUREFORM in a successful manner. Every teacher trained, every curious student, every knowledge shared, and every concept acquired is thanks to your constant guidance.

We thank Gruppo La Scuola SEI for finding value in our work and for supporting and working side by side with our team throughout the process. Your expertise has guided us in every step, and we relish the opportunity to count with a renowned publisher on our side.

We thank our eleven EDUREFORM partners and friends for making this journey possible, a difficult journey but a meaningful one. We could not ask for a better consortium to achieve our primary goal: improve the quality of education.

Our consortium would have never attained its goals without the help of our esteemed project managers: Alda and Celia. You have guided us in the right direction since you landed in India, and you have observed the growth of EDUREFORM with passion. You have put your energy and heart in this project, and we will always be grateful.

Last but not least, we extend our thanks to Stefano Greco - Founder and Director of Chitkara Spaak Centre for Multidisciplinary European Studies. With your intelligence and analytical capacity, you 'fathered' and built EDUREFORM from the ground up. We admire your capacity to understand the world and we hope to continue learning from you day by day. From the training sessions, the academic output, to even the friendships developed - you should take pride in being the architect of it.

Chapter 1

Brainwork

Dr Niyati Chitkara, Dr Honey Chitkara, Ms Dolma Pathela, Ms Piyusha Sharma

INTRODUCTION

The essence of education constitutes the development of thinking skills in students. In that, students become active participants in the teaching-learning process, where they are not merely the receivers of information but also the investigators and creators. A functional learning environment therefore requires the educators to perform all such tasks within their capacity that instill in learners an unfeigned inclination towards research.

The term **"brainwork"** refers to the **accomplishment of a task through focused mental effort**. In a 21st century context where the need of creating thinking classrooms appears bigger and more urgent, the term has definitely come to occupy a place of prominence.

The present chapter comprehensively deals with the various niceties of the pedagogical tool viz. "brainwork", which has been ideated, created & put into force by Chitkara International School, Chandigarh, India. Emanating from the need of encouraging learners to undertake in-depth analysis of information, the tool renders educators the opportunity to nurture critical and creative thinkers and simultaneously ensures their sound cognitive development.

THEORETICAL BACKGROUND

The gravest challenges of the former years in educational history include the unrestricted emphasis on rote-memorisation, where elevation of grades was ubiquitously sought, and enhancement of knowledge took a back seat. This is further indicative of the fact that the objectives of sound learning were unknown at large, and the processes that were designed to attain these unprofitable objectives varied greatly from the ideal ones.

Nonetheless, in the present world where mechanisms of doing the same things continue to change overnight, it becomes necessary to empower young

learners to adapt to these changes through sound learning and powerful research abilities. Correspondingly, the educator must actively communicate with children and help them undertake activities that necessitate them to "think".

In a general sense, rendering pupils with things to "figure out" and making sure that it adds to the process of learning by evaluating children's performances is the object of the classroom communication. An apparent behavioural change, irrespective of its extent, is invariably involved in the process of learning (Chitkara & Natarajan, 2015).

"Brainwork" serves as one of the most functional tools for instilling robust investigation skills in learners. While the modern-day schools strive to nurture successful professionals of Industry 4.0, the tool constitutes a sound mix of challenges and contexts that encourage children to enhance their investigational capabilities. The focus then lies on the augmentation of learners' critical and creative thinking skills, which prepare students to face challenges or solve problems, especially with unfamiliar contexts.

LITERATURE REVIEW

For individuals who value learning, research-based activities are undoubtedly nifty. Some researchers indicate a harmonizing relationship between teaching and research (Neumann 1992; Braxton 1996; Sullivan 1996). For instance, Neumann (1992) identified beliefs about three levels of relationship that entailed "concrete" benefits – where researchers provide students with latest and advanced information – and "abstract" benefits – where researchers foster in students a critical and inquiring approach towards the process of gaining knowledge. The recording of approaches to research-led education in the form of illustrations and case studies has made for the creation of comprehensive frameworks that elucidate the outcomes and objectives of education (Jenkins, Healey & Zetter 2007). Furthermore, Healey (2005a) adds to the work of Griffiths (2004) with the aim of formulating the framework of educational programme which showcases differences in (i) the stress on research from the content to the process, and (ii) the instructional methods that move from being teacher-centred to student-centred, wherein learners pose respectively as listeners or participants.

In today's world, the most important part of education is to educate learners of the ways of using thinking skills. These skills entail not just creativity ((Rhodes, 1961; Runco, 2014) but also problem-solving ability (Segal, Chipman & Glaser, 1985). Instructional programmes created for the educational sector, in fact, focus at one or the other type of thinking, or in the best scenario entail analogous educational activities that foster both types (critical and creative): no matter what, the instructional practice which fosters critical thinking is differentiated from the one that cultivates creativity (Hudgins & Edelman, 1986, Kagan,

1988, Nickerson, 1981, Yang & Lin, 2004). Having said that, through the past few years, it has become more and more perceptible that the differentiation between the different types of thinking viz. creative thinking and critical thinking is a systematically unnatural distinction (Marzano, 1998, Paul, 1993, Perkins, Jay & Tishman, 1993).

Correspondingly, integrated or comprehensive approaches of thinking have made for newer instructional programmes, which don't highlight the numerous functions of only one thinking type, but focus on learners' thinking holistically (Bleedorn, 1993, Perkins, Tishman, Ritchhart, Donis & Andrade, 2000, Sternberg, 1997).

Indeed, it remains one of the most prominent and crucial goals of the education sector to enhance the problem-solving skills and critical thinking of learners. As averred by Healey, learners are most likely to acquire the greatest depth of learning from research when they themselves undertake the research. Therefore, the need for research-based activities becomes significant, as these shall assist education in attaining its ideal objects, restore faith in public schools and in moral, democratic, and human values, help educators to teach for self-identity and individual realization and assist learners to adapt to cultural diversity. These would also help in the attainment of quality goals, cause alterations in racial attitudes, and would successfully meet the future world problems related to fast-paced technological and scientific advancements (Boykin, 1972).

EXPLANATION OF THE TOOL

Brainwork *per se* is a research-based approach to teaching and learning, under which a multi-disciplinary assignment is assigned to learners of primary to senior secondary classes (classes 1 to 12) on a bi-monthly basis. The assignment includes a mentally stimulating task, which aims at strengthening students' knowledge of various subjects and further encourages them to think creatively and critically.

This research work in turn assists the learner in comprehending a given concept or topic taught in the class. It entails activities that have less of paperwork and a lot of cognitive work, analysis, surveys, and employment of concept. (Kapoor, 2014)

Some of the definitions of brainwork include:

1. Brainwork is a research-based assignment which is prepared by the subject teachers to be assigned to the learners of the primary, secondary and senior secondary level, on a bi-monthly basis, with the object of ensuring multi-disciplinary and self-directed learning.
2. Brainwork is simply the key for unlocking the best way of learning through

research-based tasks and activities. It focuses on enhancing the critical thinking, creativity, and problem-solving skills of students; more than anything else, it teaches them how to learn.

The significance of research-based education has been well corroborated by educationists around the world. In this regard, *Brainwork* proves to be a functional tool through which the educator not only expands the horizon of his/ her learners but also of his/ her own.

A. Aims of the Tool

- To empower educators to help students become "successful thinkers"
- To enable teachers to expand their horizons and instill a positive affinity for critical analysis in students
- To assist teachers in undertaking a multidisciplinary and research-based approach to teaching
- To enable teachers to inculcate critical thinking, creativity, deductive reasoning, and problem-solving skills in students

B. Expected Outcomes

The learner will be able to

- carry an in-depth analysis of the given information and come up with practical, creative and comprehensive solutions for the assigned tasks;
- enhance his/her critical thinking, creativity, deductive reasoning, and problem-solving skills.

C. Role of Teachers

The effective implementation of *Brainwork* requires teachers to create and assign a fairly challenging research-based task to students, which is mapped to the curriculum of their respective subjects. For a functional *Brainwork* task, a teacher must ensure that it is multidisciplinary, relevant, age-appropriate, and has a fair deadline for submission (usually One-month).

D. Role of Students

The successful submission of a *Brainwork* assignment requires students to interpret the given information (task) carefully, carry out relevant research, and conceive plausible explanations or answers for the questions asked. A properly completed task should entail the meeting of all conditions as specified by the educator in the *Brainwork* assignment.

E. Steps to Use the Tool

The educator should follow the below-mentioned steps to ensure proper usage of the pedagogical tool:

1) Prepare a "Brainwork Assignment Preparation Checklist" before task creation: The checklist should be referred to by the educator during (and at the end of) the preparation of the brainwork task. A good brainwork task should ideally have all the boxes ticked by the task creator.

Table 1 – Sample of the Brainwork Assignment Preparation Checklist

Sr. No.	**Items**	**Yes/ No**
1	Topic Mapped to the Annual Blueprint (document containing the details about the syllabus to be covered in each month of the given academic year) of the Subject Taught	
2	Element of Research (The task should ensure that students will undertake research)	
3	Multidisciplinary Approach (integration of information from multiple fields like Science + Mathematics)	
4	Material Required (preferably, best out of the waste)	
5	Conditions to be Fulfilled (mention the requirements that learners need to meet to produce a successful brainwork)	
6	SMART Goals related to the Task	
7	Date of Submission and Other Important Details	
8	Rubrics of the Assessment (criteria for evaluating brainwork)	
9	Sample Answer	
10	Orientation Session on Brainwork (a preliminary training session)	

2) Select the chapter for *Brainwork* assignment: The chapter should be mapped to the annual blueprint (the layout showcasing the syllabus across different months of the academic year) of the subject chosen. For instance, if the topic of "Diary Entry" is to be taught to the students of Grade 7 in the months of October and November then, for the mentioned months (October-No-

vember), the English teacher will prepare the Brainwork assignment to be assigned to students on the topic of "Diary Entry".

3) Frame the *Brainwork* assignment: During the process of framing, the educator should keep the element of research at the centre and follow a multidisciplinary approach by adding elements relating to disciplines other than his/her own. The fusion of familiar and unfamiliar contexts would generally help teachers motivate their students in undertaking in-depth investigation of the topic. The various levels of complexity could then be added through the "Conditions to be fulfilled" section. For instance, the English teacher in the previous example may ask his/ her students to create the diary entries, thinking themselves to be a prominent historical figure (for research and multidisciplinary element) and he/ she may further list out subject-specific conditions to be fulfilled (such as, the students must use at least 4 kinds of adjectives in their diary entries).

   More than anything else, the educator should be certain of what he/she expects from his/her *Brainwork* and therefore establish SMART goals for the students. Correspondingly, a fair deadline (date of submission - usually One-month), rubrics and other important details should be mentioned at the end of the *Brainwork* document. The educator must additionally depict the achievability of the task completion by rendering a Sample Answer – one which ticks off all the conditions of the assignment.

4) Conduct an orientation session on the *Brainwork* assignment: The last step for the effective implementation of the tool should include an explanatory orientation session on the created *Brainwork* task that the educator expects his/ her students to complete. A proper orientation to the task shall allow students to perform the activity assigned in the most effective and productive manner.

F. Assessment

The assessment of a brainwork task depends on a predetermined set of rubrics, which incorporates the core aims of the brainwork. The rubrics entail the allocation of marks from 1 to 5, depending on the learner's performance, and are to be used for evaluation after the student has submitted his/ her brainwork assignment (at the end of the one-month deadline).

More or less, a general set of rubrics for brainwork would include levels of research, critical, analytical and creative thinking, and task-related proficiency achieved by students in increasing order.

Table 2 – Sample of the Brainwork Assessment Rubrics

Rubrics	Level	Marks Assigned
The learner understands the brainwork, carries out the basic task with considerable research along with analytical, critical, and creative thinking and meets all the conditions of the task.	Advanced	5
The learner understands the brainwork, carries out the basic task with considerable research along with analytical, critical, and creative thinking and meets most of the conditions of the task.	Upper Intermediate	4
The learner understands the brainwork, carries out the basic task with some research employing 2 of the 3 thinking skills (analytical, critical, and creative), and meets most of the conditions of the task.	Lower Intermediate	3
The learner understands the brainwork, carries out the basic task with some research employing 1 of the 3 thinking skills (analytical, critical, and creative), but does not meet most of the conditions of the task.	Beginner II	2
The learner understands the brainwork, carries out the basic task without research and does not meet most of the conditions of the task.	Beginner I	1

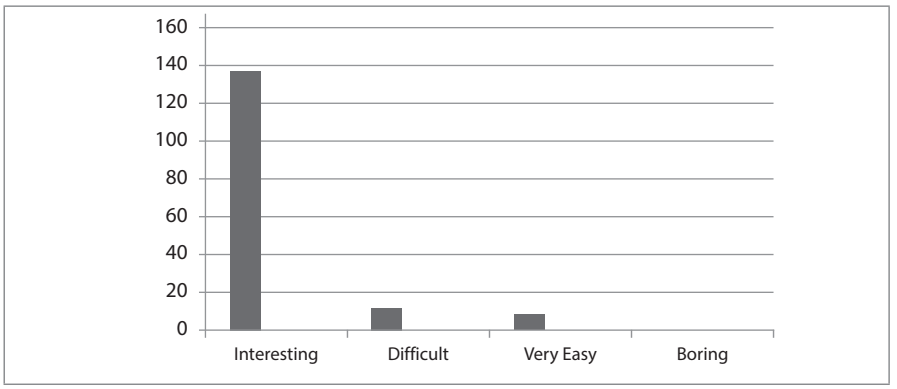
G. Students' Feedback

In the wake of Industry 4.0, which remains the impetus behind Education 4.0., the students' feedback is set to constitute the most beneficial tool for gauging teaching efficacy (Chitkara, 2021). Acknowledging the paramount significance of learners' feedback is therefore crucial for the educator, since students' feedback becomes the premise on which educationists promote the effectiveness of various pedagogical activities.

For the purpose of establishing the functionality of the *Brainwork* pedagogical tool, a sample of 160 students from Class 9 at Chitkara International School, Chandigarh, India was chosen and the following findings were made as per the students' feedback on the questions "How did you find the brainwork on Back to the (New) Future!?" and "How did the brainwork on Back to the (New) Future! help you increase your knowledge?"

Students' Feedback - Brainwork

How did you find the Brainwork on "Tour de Fun!"?

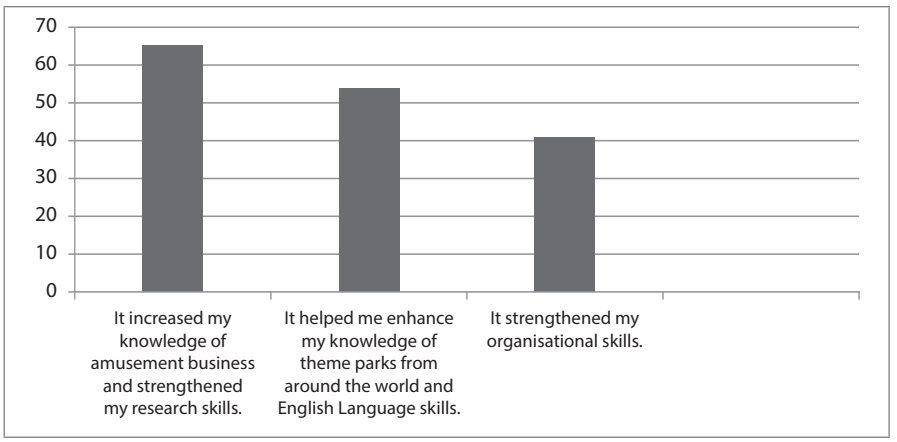


Source: Chitkara International School, Chandigarh, India

Graph 1 (Interpretation): Approximately 86% of students found the assigned Brainwork task to be "interesting", whereas about 8% and 6% found it to be "difficult" and "very easy", respectively.

Students' Feedback - Brainwork

How did the Brainwork "Tour de Fun!" help you increase your knowledge?



Source: Chitkara International School, Chandigarh, India

Graph 2 (Interpretation): As per the given data, a marked majority of students were able to elevate their knowledge of amusement business and research skills through the Brainwork (40.6%), whereas 33.8% and 25.6% were able to

elevate their knowledge of theme parks and English language skills and strengthen their organisational skills, respectively.

H. Visualized Examples

The students of class 6 at Chitkara International School, Chandigarh, India were assigned a Brainwork by their General Knowledge instructors, which was titled ***"Tour de Fun!"***

The following illustrations relate to the said assignment, which showcase the activity assigned, the conditions to be fulfilled and the sample answer respectively.

BRAINWORK
GENERAL KNOWLEDGE

Topic - Tour de Fun

Introduction - How exciting it is to plan for fun outings and holidays; especially, when one' s supposed to visit a fascinating theme park! In this brainwork, the students will get to experience just the same excitement as they design fact-based colourful brochures on any one of their favourite theme parks from around the world.

Task - Think of your favourite theme park and get researching. Prepare a creative brochure by including all the important details mentioned below:

a) About the Place
b) Tagline/ Slogan of theTheme Park (in your own words)
c) Suppliers of Tickets/Access to Facilities/ Ticket Rates
d) Park Timings/ Duration
e) Attractions
f) Food/ Cuisine
g) Social Media Handles

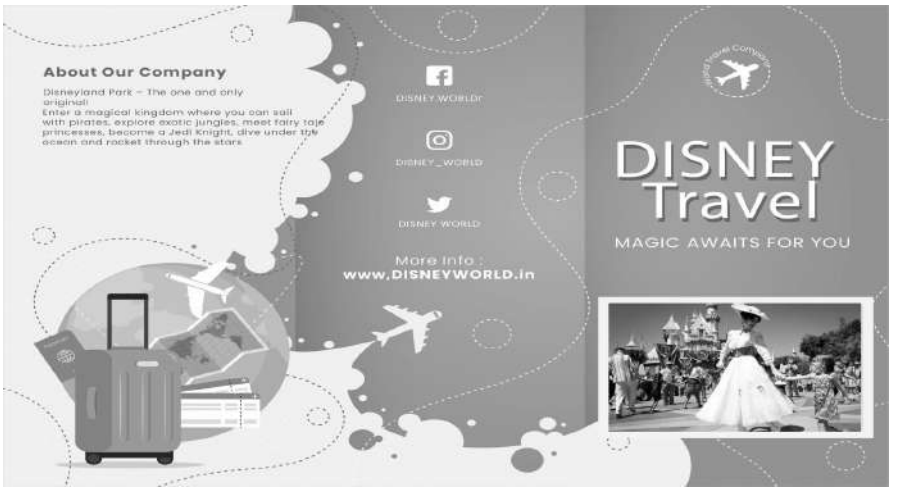
Conditions to be fulfilled

a) All information should be factual.
b) Students must create their own taglines and slogans for the park chosen.
c) Students must use at least 3 kinds of adjectives while creating their brochures.
d) Students must use at least 3 kinds of sentences in their brochures.

Other Important Instructions

a) Students must submit the hard copy (written) or soft copy (typed) of their Brainwork to their respective General Knowledge teachers through SchoolPad (if soft copy) or in school (if handwritten/ hard copy).
b) The last date for the submission of Brainwork is 20th December 2021.

Source: Chitkara International School, Chandigarh, India
Picture 1 - Brainwork Task on "Tour de Fun"



Source: Chitkara International School, Chandigarh, India
Picture 2 - Sample Answer for Brainwork on "Tour de Fun"

Source: Chitkara International School, Chandigarh, India
Picture 3 - Sample Answer for Brainwork on "Tour de Fun"

CONCLUSION

Not subject to the surrounding worlds and times, educators need implementable learning aids for their students that assist them to augment their various thinking abilities viz. analytical, critical, and creative. Such learning tools teach them not just about new things but the art of learning itself.

When students learn 'how to learn', they invariably become solution-oriented. The adoption of "brainwork" as a learning tool, hence, becomes a way for the educator to instill the zeal for learning and investigation in students.

REFERENCES

Bleedorn, B. D. (1993). *Toward an Integration of Creative and Critical Thinking.* American Behavioral Scientist, 37(1), 10-21.

Boykin, L. (1972). *Why Research in Education?* Retrieved December 20, 2017 from http://www.ascd.org/ASCD/pdf/journals/ed_lead/el_197204_boykin.pdf

Braxton, J. M. (1996). *Contrasting perspectives on the relationship between teaching and research, new directions for institutional research*. 90, 5-14.

Chitkara, H. (2021). *Using Students' Feedback to Improve Teaching Effectiveness Based on Kaizen Philosophy of Continuous Improvement.* V, 8-10.

Chitkara, N., & Natarajan, V. (2015). *Assessment Quotient: Efficient and Effective School Learning Paradigms for Generation Z and Generation Alpha Learners.* 71, 1-3.

Griffiths, R (2004). *Knowledge Production and the research-teaching nexus: the Case of the Built Environment Disciplines, Studies in Higher Education.* 29: 6, 709-726.

Healey, M. (2005a). *Linking research and teaching: exploring disciplinary spaces and the role of inquiry-based learning, in R. Barnett (Ed.) Reshaping the University: New Relationships between Research, Scholarship and Teaching.* Maidenhead: McGraw/Open University Press.

Hudgins, B., & Edelman, S. (1986). *Teaching Critical Thinking Skills to Fourth and Fifth Graders Through Teacher-Led Small-Group Discussions.* Journal of Educational Research, 79(6), 333-342.

Jenkins, A., Healey, M. & Zetter, R. (2007). *Linking teaching and research in disciplines and departments, Higher Education Academy.*

Kagan, D. M. (1988). *Evaluating a Language Arts Program Designed to Teach Higher Level Thinking Skills.* Reading Improvement, 25(1), 29-33.

Kapoor, N. (2014). *A Practical and Innovative Approach in Assessing Scholastic and Non Scholastic Aspects of Learning and Suggesting Improvement in Learning of 4th and 5th Graders in Mathematics, English and Science through Feedback.* 141, 2-5.

Marzano, R.J. (1998). *What are the General Skills of Thinking and Reasoning and How Do You Teach Them?* Clearing House, 71, 268-273.

Neumann, R. (1992). *Perceptions of the teaching-research nexus: a framework for analysis.* Higher Education, 23: 159-171.

Nickerson, R. (1981). *Thoughts on Teaching Thinking.* Educational Leadership, 39, 2:21.

Paul, R. (1993). *Critical Thinking: What Every Person Needs to Survive in a Rapidly Changing World.* (3rd Ed.). Robnert Park, CA*: The Center for Critical Thinking and Moral Critique, Sonoma State University.*

Paul, R. & Elder, L. (2012). *Critical thinking: Tools for taking charge of your learning and your life.* Upple Saddle River, NJ: Prentice Hall

Perkins, D. N., Jay, E., & Tishman, S. (1993). *Beyond Abilities: A Dispositional Theory of Thinking.* The Merrill-Palmer Quarterly, 39(1), 1-21.

Perkins, D. N., Tishman, S., Ritchhart, R., Donis, K., & Andrade, A. (2000). *Intelligence in the Wild: A Dispositional View of Intellectual Traits.* Educational Psychology Review, 12(3), 269-293.

Rhodes, M. (1961). *An Analysis of Creativity*. The Phi Delta Kappan, 42(7), 305-310.

Runco, M. A: (2014). *Creativity Theories and Themes: Research, Development and Practice.* (2nd ed.) USA: Elsevier Inc.

Segal, J. W., Chipman, S.F., & Glaser, R. (1985). *Thinking and Learning Skills: Relating Instruction to Research.* New York: Routledge.

Sternberg, R.J. (1997). *Successful Intelligence: How Practical and Creative Intelligence Determine Success in Life.* New York: Plume.

Sullivan, A. V. S. (1996). *Teaching Norms and Publication Productivity.* New Directions for Institutional Research, 90, 15-21.

Yang, S.C., & Lin, W.C. (2004). *The Relationship among Creative, Critical Thinking and Thinking Styles in Taiwan High School Students*. Journal of Instructional Psychology, 31(1), 33-46.

Chapter 2

Pedagogy of Case Study

Pratibha Patankar

INTRODUCTION

The 'case study' method of teaching has long been associated with Business, Medical and Law courses, but nowadays teaching and learning with cases has gained widespread interest in the education field also. This is a rich and powerful pedagogy used for the development of critical, analytical, and creative thinking skills among the students. This chapter serves as a guide for pre- and in-service teachers and for teacher educators to know more about theoretical background and implementation of case study as a pedagogy.

We are familiar with the word 'case' which is used in the medical field, in clinical psychology and in business education as a method of qualitative research.

In education we can use case study as an innovative pedagogy where cases are real facts, events, problems, dilemmas, or theoretical and conceptual issues related to education. In education, cases become stories with messages to educate. Cases are a narration of a phenomenon, a process, concepts or realistic facts and terms. In other words, case studies represent realistic, complex, and contextually rich situations that often involve a dilemma, conflict, or problem where one or more characters in the case must negotiate.

CASE STUDY PEDAGOGY

Case study is a task, which aims to teach the students how to analyse the causes and consequences of an event or activity by creating its role model**.** The pedagogy of Case Study stimulates the students about the real world and encourages them to bridge the gap between theory and practice.

"A case study is an intensive holistic description and analysis of a single instance, Phenomena and social unit." (Antony and Jack, 2009, Walshe 2011).

Thus, case study can be defined in terms of the case itself (the unit of study), the case study design (the process), and the case study (the product). These parts come together and make case studies become stories with an educational message.

A good case study, according to Professor Paul Lawrence is: "The vehicle by which a chunk of reality is brought into the classroom to be worked over by the class and the instructor. A good case keeps the class discussion grounded upon some of the stubborn facts that must be faced in real life situations." (Christensen, 1981). As an instructional strategy, case studies have numbered qualities. They bridge the gap between theory and practice and between the academy and the workplace (Barkley, Cross and Major, 2005). Case studies vary in length and detail and can be used in a number of ways, depending on the case itself and on the instructors' goals.

NATURE OF CASE STUDY METHOD

The case study method enables professionals to develop and refine problem-solving abilities through in-depth analysis of complex problems. Teaching based on cases using certain authentic situations, is a tried and tested method. This method is commonly used in the teaching of medicine, chemistry, mathematics, engineering science, language, economics, and political science. In this method of teaching the focus is on the learner, who studies, discovers the issue or the concern of the case and does in depth analysis of the case. During this analysis the learner thinks critically, discusses, discovers various aspects of the cases which have been used to solve the case problem. Here, learner can draw individually his/her inference and principles to handle a similar situation and thereby in the process he/she gains self-confidence. Automatically the whole teaching learning process becomes participatory and motivating.

One can use a case study to illustrate and enrich the lecture material or in a large class one can consider breaking the class into a small groups or pairs to discuss a relevant case.

A good case study can be identified by the teacher / instructor according to the classroom environment, enthusiasm of students; case study method requires certain process techniques, such as, listening, applying logic, following instructions, consciousness, and evidence. In a case study it is also important to frame questions which will help students to understand the concept clearly. Asking the right questions based on the content used for the case study is one of the key aspects of this pedagogy. The case study may be short or long with charts, financial statements, technical information, historical data etc.

CHARACTERISTICS OF CASE STUDY METHOD

- Reflects reality
- Prepares students for lifelong learning
- Inculcate process of inductive thinking

- Builds capacity for critical thinking
- Active engagement of students
- Motivates students
- Sharpens the understanding of the concepts

IMPORTANCE AND BENEFITS OF CASE STUDY METHOD

- The case studies are content rich and built around learning objectives. It helps students to understand the topic explained in a case study.
- Case studies enhance learning.
- Case study engages students in teaching-learning process.
- Case studies facilitates small group learning.
- Case studies help in achieving learning outcomes. (Bonney, 2015; Brslin, 2008; Herried, 2013; Krain, 2016)
- Students can construct new knowledge while solving case studies.
- Case studies increase the ease of learning and depth of learning.
- Use of case studies increase critical thinking skills of the students and promotes active learning.
- Case studies help in developing problem-solving skills.
- Case studies help in developing communication skills among students.
- Case studies develop self-study habits of the students.
- Case studies facilitate inter disciplinary learning.
- Case studies motivate students to take part in classroom activities which promotes learning.
- Case studies help students to improve their understanding of basic concepts.
- Case studies can be used to show the connections between specific academic topics and real-world issues and applications.

THEORETICAL BACKGROUND

Case study method has theoretical background of constructivist theory which is based around the idea of active learners participating in their learning process. A constructivist theory states that each person reflects on the new ideas with their prior knowledge. Therefore, individually, learners develop schemas to organize acquired knowledge. The foundation of case study stems from the learning theories of Dewey, Piaget, Vygotsky, Gagne, and Bruner.

Down below we present the two key elements that are crucial to the success of a constructivist classroom:

1. The instructor takes on the role of a facilitator instead of a director.
2. Learning occurs in small groups or individually.

By using the case study method, the teacher can ensure that the problems encountered in real life by the students are examined and resolved in the classroom environment. The case study method is appropriate for discovery learning (Cin, 2005), (Demirel,2009) and helpful in the development of analytical, critical, and creative thinking skills of the students.

To better understand the process and mechanism of case study it is important to review and outline the main tenets of constructivist theory.

Principles of constructivism:

- Knowledge is constructed. This is the basic principle, meaning that knowledge is built upon another knowledge.
- People learn to learn, as they learn.
- Learning is a social activity.
- Learning is contextual.
- Knowledge is personal and motivation is the key to learning.

All the above principles are used while implementing the case study.

LITERATURE REVIEW FOR CASE STUDY

Sharan Merriam (1988) in her first book focused on the end product of case study. The most important aspect of a case study is that it is a bounded unit. She writes, "The case is a thing, a single entity, a unit around which there are boundaries - I can 'fence in' what I am going to study." She describes three types of case studies: particularistic, descriptive, and heuristic. Particularistic case studies focus on a specific event or phenomenon. Descriptive case study focuses on thick description of whatever is being studied. Such studies may be longitudinal and study the ways in which many variables affect each other. Heuristic case study intents to increase understanding of the case. They can bring about the discovery of new meaning, extend reader's experience or confirm what is known. Ragin and Beckar (1992) add that the case may be a relatively bounded object or a process, it may be theoretical, empirical, or both. At a minimum, a case study is a phenomenon specific to time and space.

Shulman (1992) add to the literature review outlining what a well written case study should look like. Schulman adds that a well-used case study provides empathetic experience with important teaching dilemmas. Case studies help in illuminating human intentions, feelings, misinterpretations with case teaching

problems. Shulman advocated that case studies have the strength to increase students' repertoire of educational strategies showing them how teachers approach problems. Case studies also help students to learn about issues and think about practical problems. Lastly, Shulman highlights that case study methodology provides a connection between the student and their environment.

Richard Grant (1997) studied the case method in the teaching of geography. For him, the case method of teaching is an interactive learning approach which shifts the emphasis from a teacher centered to a students centered classroom teaching.

Dari, Y., R. Tal and M. Tsaushu (2003) studied the effect use of case studies in the teaching of Biotechnology. The aim of the study was to raise the level of student's scientific literacy and higher order thinking skills. The research population was about 200 students in eight classes of grades 10-20 from heterogeneous communities. The findings of the study were positive towards use of case studies. They found a significant improvement in students' knowledge and understanding and higher order thinking skills at all academic levels. In the higher order thinking skills-question posing, argumentation, and system thinking, a significant improvement was shown when using case studies. The result of the study proved that this approach is likely to contribute to developing scientific and technological literacy along with higher order thinking skills of Nano science majors.

Farhoomand Ali (2004) described how to write cases, what is involved in writing a good teaching case. The case method is a powerful approach to teaching and learning which allows students to participate in real-life decision-making processes by identifying the problem given in the case and then attributing to it appropriate solutions.

For Farhoomand, a case study typically consists of three main parts:

1. The opening paragraph which gives the idea about the topic of the case.
2. Body of the case which tells the main story of the case.
3. It should help students to think about solution of the problem. This is the main part of the case/case study which engages the reader and motivates to solve the problems given.

C. F. Herreid (2005) described the use of case studies in the article, "Using case studies to teach science." The author stated that stories set cultural norms, warn us from evils and give us reasons to hope for better things and better days. Great teachers are most often good storytellers who engage students in learning and motivates them, create interest about teaching learning process. Case study

teaching has gained a strong basis in science education. By using case studies students show improved learning.

Ozlem Sila Olgun, Belgin Adali (2008) described a case study approach in the article, "Teaching grade five science with a case study approach." They studied effect of a case study approach on student's achievement and attitudes towards viruses, bacteria, fungi, and Protista. Fifth grade students (N = 88) from different classes were selected as a sample. The control group achieved their instruction by traditional method of teaching while the experimental group students were instructed with a case study approach. Achievement and attitudes were measured before and after teaching the class. The finding of the study proved that by using case study methodology in the classroom, the achievement and attitude towards science of the students improved.

Yadav (2009) compared the lecture method with case teaching method in a mechanical engineering course. He explained that case-based teaching helps students to better succeed in the real world. Yadav selected 86 students for this study from mechanical engineering stream of Mid Western University. The authors developed two case studies based on actual events related to two topics. Instructor A taught one topic with case studies while instructor B taught by using traditional method of teaching. Findings of the study proved that case-based instruction has been found to increase student engagement and learning with motivation and participation. They outlined that the case study method proved to be successful in creating interest in the students' learning of any topic. To assess the learning of the students after using case studies, it is necessary to formulate proper questions to do appropriate measurement of learning.

From these reviews researcher got the idea about formation of question papers to test the effect of case study method on achievement of students in science subject.

Carom Kreber (2010) described learning through case studies in his article, "Learning experientially through case studies? A conceptual analysis." For Kreber, if appropriately applied the case study method is an effective way to involve students in active learning processes. It fosters students' self-learning ability and ability of critical thinking effectively.

Yildizay Ayyildiz and Leman Tarhan (2013) described the effects of case studies on science teaching in the article, 'Case study applications in chemistry lesson: gases, liquids and solids.' The study was conducted on 52 participants from the department of science teaching at universities in Turkey. Pre-test and post-test experimental design with a control group was used and the students were randomly assigned to these experimental control groups. A preparatory course was applied on both groups by the traditional method and after that the same educator taught gases, liquids, and solids with case study method to the experimental group. The achievement test results showed that the experimental group

significantly had higher scores. With regards to attitude towards chemistry, the results proved that chemistry education based on case studies significantly enhanced students'mpositive attitudes towards the topics.

Minniti, L.F.S., Melo Jr. J.S.M., Oliveira, R. D. & Salles, J.A.A. (2016) in their article 'The use of case studies as a teaching method in Brazil' explained the methodology of teaching case studies as a pedagogical alternative in the classroom. The Case Study is defined as an immersive exploration method of realities with an investigative nature. For them, the case study methodology, presents am educational purpose that serves mainly to illustrate concepts and develop skills in students, allowing them to reflect on situations given in the case study and making decisions about it. To clarify, the authors used the case study not as a research method but as a teaching strategy. In the case method, the real situations are presented to student for analysis and dispassion. Here, the teachers' role is to guide the students throughout the process. The teacher presents the description of the situation to the students and students solve the questions related to case study.

The Authors concluded in this paper that case studies are a didactic- pedagogic strategy using a constructivist approach. Furthermore, this pedagogy provides an immersive experience to the students as they do not act as passive elements in the learning process. Science Case Network supports science educators, learners, researchers who are interested in use of case studies and problem-based learning. The website provides various examples of case studies that can help teachers' implement these innovations in their classroom.

Katthy Galluci (2018) stated in her book "Science stories: using case studies to teach critical thinking," that case studies are one effective way to help students understand how science works and how science knowledge is constructed which proves difficult with the traditional method. Case studies help students to understand the scientific knowledge which is a powerful force in modern life and allows them to become critical and analytical thinkers.

Implementation of the Case Studies

The prerequisites to implement a case study in the classroom are the following:

- Willingness to break from traditional teaching
- Aligned with the overall objectives of the curriculum
- Identify the right content which has real facts in the textbook for preparing cases
- Efforts to search supportive material to enrich the case
- Prepare students for case method

THE ROLE OF TEACHERS IN IMPLEMENTING CASE STUDY

The table below outlines the roles attributed to teachers and learners when using the case study methodology in the classroom.

Role of Teacher	Role of Learner
• Facilitator • Mentor • Thinker • Collaborator • Coach • Knowledge navigator	• Knowledge navigator • Critical reflector • Researcher • Active learner

Components to create a successful Case Study

- Real facts given in the content
- Graphics
- Text
- Pictures / diagrams
- Audio / video clips
- Learning objectives
- Audio / video clips
- Learning objectives
- Activities
- Questions

Case study Development Method – steps to take and phases

1) Analysis of textbooks
2) Design of Case Studies
3) Development of Case Studies
4) Implementation of Case Studies
5) Evaluation of Case Studies

To better understand and more importantly, implement a case study in your classroom, teachers can follow the different phases or stages described below.

Phase I – This is the analytical part where the following analysis must be completed:

- Analysis of textbook
- Analysis of objectives
- Analysis of content
- Analysis of student's problems

Phase II – This is the design part where the teacher must compose and conceive the following tasks:

- List the activities
- Apply expected outcomes
- Select instructional strategies
- Validate the content
- Schedule the programme
- Design cases

Phase III – This is one of the key phases where the development of the process will occur and the following developmental activities ought to be performed:

- Develop Instructional strategies
- Development cases
- Development of lesson plans

Phase IV – Once the case is ready, we arrive to the implementation part where the two following tasks should be completed:

- Put into action the developed program (case study)
- Set Learning environment

Phase V – The last part is the evaluation part where the following needs to be performed by the teacher:

- Give the results achieved by implementing the case study

Case study Template

To guide the teachers to create a case study containing all the necessary parts, they can use the list below as a check to ensure all the elements have been integrated in their case study.

1. Title
2. Name of the topic
3. Introduction
4. Description of the topic
5. Situation Analysis
6. Conclusion
7. References
8. Notes

A GENERAL FRAMEWORK FOR HOW TO USE CASE STUDIES IN TEACHING

As we have seen in this chapter, there are many variations in how case studies can be used. To guide teachers, the steps below will give them a general framework for using case studies in their classroom.

- A teacher / instructor should give enough time to students to read and think about the case. If the case is long, it can be assigned as a homework with a set of questions for students.
- A teacher / instructor should introduce the case briefly and provide some guidelines to the students on how to approach it. Clear idea should be given to students about how they should think about the case. If it is necessary to focus or to disregard certain information, it should be clearly explained to students.
- A teacher / instructor should monitor the students to see that everyone is involved.
- If students ask doubts, these should be cleared by the teacher.
- Proper guidance should be given to the students so that they can solve the given questions.
- At the last, question and answers should be discussed to confirm learning through the case study.

CONCLUSION

This chapter gives a clear idea on the conceptual and theoretical background of case study pedagogy. It also reviews the literature supporting case studies and it outlines the procedures to apply this pedagogy in the classroom. The necessary information and the procedures to follow are listed in the chapter for teachers to implement this pedagogy without facing any obstacles. By going through this work, teachers can gain the necessary information and the required skills to start incorporating this pedagogical tool in their classroom.

As research has proven, the use of case studies motivates learners to self-study and to acquire additional subject knowledge. The implementation of case study in the classroom allows teachers to use their analytical, critical, and creative thinking skills to promote those same skills among their students. Therefore, case studies become a rich and a powerful pedagogy used for the development of critical analytical, and creative skills in children. Hence, this tool is helpful, for teachers as well as students equally, in developing various 21st century skills.

REFERENCES

Buccholz, R. and Rosenthal, S. (2001). 'A Philosophical Framework for Case studies', Journal of Business Ethics.

Bonney, K. M. (2019). 'Bonney case studies performance and Biology Education', Volume 16. Retrieved May26, from cop.adulet.eu/node/192?destination=/teaching-methods

Christensen, C. R., and Hansen, A. J. (1987) . 'Teaching and the case method', Boston: Harvard Business school,. Journal of Management Education, Vol. 39, 1 : pp. 36-55

Cheng, V. K. W. (1995). An environmental chemistry curriculum using case studies. Journal of Chemical Education, 72(6), 525–527.

Cliff, W. H., & Curtin, L. N. (2000). The directed case method: Teaching concept and process in a content-rich course.Journal of College Science Teaching, 30(1),

Davis, C., Wilcock E., Anderson, C., Wilcox J., Bramhall, M. (2014). Teaching Materials Using Case Studies.

Dr. Patil, S. R., Navalagi, R. R., Yaraddi, R. K., Dr. Kulkarni, R. R. (2018). 'Management case studies: A students handbook', Notion Press.

Encydopedia of Case Study research, Colorado state University, Mills, Albert J., Gabrielle Durepos, Eiden Wiebe, editors encyclopedia of Case Study research.

Farhoomand, A. (2004). 'Writing teaching cases: A quick reference guide', Communications of the association for information systems. Vol. 13, pp. 103-107.

Fischer, B. A. (2019). 'Fact of Fiction', Designing stories for active learning exercises, Journal of political science education.

Stake, R. E. (1995). The art of Case Study research. Thousand Oaks, CA: Sage.

May, S. (2017). Case Studies, The International Encyclopaedia of Organizational Communication First published: 08 March.

Minniti, L. F., Melo, J. S., Oliveira, R. D. & Salles, J. A. Invista, São Paulo (2017). The use of case studies as a teaching method in Brazil ,UNICEUMA, São Luis, Brazil Procedia - Social and Behavioral Sciences 237 373 – 377

Osborne, R. (1985). 'Theories of Learning', Some issues of theory in science Education. University of New Zealand.

Ozlem, S. O., Belgin, A. (2008). Teaching grade 5 life science with a Case Study approach, Education January, Volume 20, Issue 1, pp 29–44.

Ozlem, S. O., Belgin, A., Crowe, S., Cresswell, K., Robertson, A., Huby, G., Anthony, A. and Sheikh, A. (2011). Teaching grade 5 life science with a Case Study approach, Published online

Chapter 3

Computational Thinking: A Pedagogical approach for Constructive Classroom

Vidyanand Khandagale

INTRODUCTION

Computational thinking for solving problems is the advancement in thinking process and helps to enhance the thinking skills scientifically among an individual. Considering Computational Thinking as a pedagogical tool / technique led to a challenge and aroused interest and curiosity among the students and facilitators as it involves active participation.

The stages in the computational thinking process initiates from contextualization and decomposition, then patterns recognition and follows the abstraction and Algorithm. Every stage of the process in CT is linked meticulously and precisely to each other to arrive at the solution of the issue or a problem. CT pedagogy is student centric and gives an opportunity to the learners to apply various thinking skills to deal with a social issue or a problem with thorough analysis.

This chapter deals with the conceptual understanding of the CT and the guidelines to implement the CT in the classroom for effective learning in the fourth Industrial era.

The term 'Computational Thinking' can be defined as a study of the problem-solving skills and tactics involved in writing or debugging software programs and applications. It was first used in the year 1980 and later in 1996 by Seymour Papert in his article 'An exploration in the space of Mathematics Educations' which was published in the International Journal of Computers for Mathematical Learning. Computational thinking is very closely related to computer science. Jeannette Wing brought this term into limelight in an ACM Communications essay wherein she proposed that computational thinking is a basic skill. It is not limited just to computer scientists but can be learnt by everyone. This was when she suggested that it is very important to integrate computational ideas into other disciplines. Computational Thinking can be applied across a

large number of disciplines such as Maths, Science as well as Social Sciences, Languages and Arts. In the field of education, computational thinking refers to the set of means that are used to solve problems in a way that computers could solve.

The following elements are now widely accepted as comprising CT and form the basis of curricula that aim to support its learning as well as assess its development:

- Abstractions and pattern generalizations (including models and simulations)
- Systematic processing of information
- Symbol systems and representations
- Algorithmic notions of flow of control
- Structured problem decomposition (modularizing)
- Iterative, recursive, and parallel thinking
- Conditional logic
- Efficiency and performance constraints
- Debugging and systematic error detection.

THEORETICAL BACKGROUND BASED ON RESEARCH AND LITERATURE

Recently, Computational Thinking (CT) has been advocated as a twenty-first-century skill that students should possess in order to develop problem-solving skills using principles from computer science (Selby, 2015). Wing (2006) described computational thinking as "solving problems, designing systems, and understanding human behavior, by drawing on the concepts fundamental to computer science" (p. 33).

Since then, researchers have suggested that computational thinking involves a number of subskills, including breaking down complex problems into familiar ones (problem decomposition), developing algorithmic solutions to the problems (algorithms), and capturing the fundamental simplicity of a problem to develop quick heuristics that might lead to a solution (abstraction) (Barr & Stephenson, 2011; Grover & Pea, 2013; Wing, 2008; Yadav et al., 2014). Furthermore, given that computation is a crucial driver of innovation and productivity in today's technology-rich society (Selby, 2015), it is imperative that students engage in computing ideas at the K-12 level (CSTA & ISTE, 2011). For computational thinking to become part of the K-12 curriculum, there is a critical need to prepare teachers who are well trained to integrate computational thinking in their everyday pedagogical activities (Lye & Koh, 2014).

While computational thinking has been suggested as a problem-solving approach using principles from computer science, many of the existing efforts use

programming tools and environments to expose students to computational thinking. Fletcher and Lu (2009) argued that this approach might continue the misconceptions about computer science as being equivalent to "programming". Instead, they suggested, "just as proficiency in basic language arts helps us to effectively communicate and proficiency in basic math helps us to successfully quantitate, proficiency in computational thinking helps us systematically and efficiently process information and tasks" (Fletcher & Lu, p. 23).

This effort to lay foundations of CT needs to start early on in students' K-12 experience before they learn programming languages (Fletcher & Lu). Hence, we need to develop ways to embed computational thinking concepts and practices across disciplines both with and without the programming context to benefit students with varied interests.

Barr and Stephenson (2011) proposed nine core computational thinking concepts and abilities to integrate CT concepts in K-12 classrooms across core content areas. These core computational thinking ideas include data collection, data analysis, data representation, problem decomposition, abstraction, algorithms and procedures, automation, parallelization, and simulation. These computational thinking concepts can be implemented in K-12 classrooms through digital storytelling, data collection and analysis, and scientific investigations (Lee, Martin & Apone, 2014), creating games (Howland & Good, 2015; Lee et al., 2014; Nickerson, Brand, & Repenning, 2015), educational robotics (Atmatzidou &Demetriadis, 2014), physics (Dwyer, Boe, Hill, Franklin, & Harlow, 2013), visual programming languages like Scratch or other interactive media (Brennan & Resnick, 2012; Calao, Moreno-Leon, Correa, & Robles, 2015), and even through maker movements (Rode et al., 2015).

While computational thinking is relatively a new concept, Mannila et al. (2014) found that a majority of K-9 teachers from various disciplines were already practicing and implementing CT concepts and practices in their own teaching. These implementations ranged from using data collection, analysis, and representation to algorithm design and writing (i.e., programming). Additionally, in a review of 27 empirical studies about programming in K-12 and higher education settings, Lye & Koh (2014) reported that visual programming languages were most often used in K-12 to create digital stories and games. They found that constructionism was a common instructional strategy used by teachers, involving students to create artifacts displaying their understanding of CT concepts.

Moreover, research has also exhibited that exposing students to computational thinking ideas also improves their problem-solving abilities and critical thinking skills (Akcaoglu & Koehler, 2014; Calao et al., 2015; Lishinski, Yadav, Enbody, & Good, 2016).

For example, Akcaoglu & Koehler (2014) used a Scratch-based curriculum to examine the influence of CT on middle school students' problem-solving

skills as measured by a PISA problem-solving test. When compared to the control group, the results suggested that students who participated in Scratch activities significantly increased their problem-solving skills, including system analysis and design, decision-making, and troubleshooting skills.

In another study, Calao et al. (2015) embedded computational thinking in a sixth-grade mathematics classroom. Their results suggested that the intervention significantly improved students' understanding of mathematical processes when compared to a control group that did not learn about computational thinking ideas in their math class.

Taken together, these policy-related and practical initiatives strongly highlight the significance of introducing students to computational thinking in K-12 classrooms. However, preparing teachers to embed these concepts in their teaching or in their specific subject areas can be a daunting task.

Barr and Stephenson (2011) highlighted that a systematic change regarding CT implementation in school could not be accomplished without educational policies that include teacher preparation to help educators understand and implement CT in their teaching. Even though most of the computational thinking initiatives we describe in this chapter underline the necessity to train teachers in all subject areas to embed CT, little has been done to examine the instructional, curricular, and pedagogical implications for teacher preparation, particularly for preservice teachers (Lye & Koh, 2014). While preparing Teachers for Computational Thinking Instruction, there is an increasing need for teachers to be prepared to integrate CT into their classroom practices (Prieto-Rodriguez & Berretta, 2014). Recent efforts to expose teachers to computational thinking have focused on both preservice teachers through modules in existing teacher education courses (Yadav et al., 2014) as well as in-service teachers through professional development (Prieto-Rodriguez & Berretta, 2014). At the in-service level, a majority of the work has involved working with teachers through short professional development opportunities to embed computational thinking. Blum and Cortina (2007) examined how a weekend-long workshop to introduce teachers to computational thinking and the role of computer science in relation to other disciplines influenced their perceptions of computer science (CS). Results from the study suggested that teachers' perceptions of computer science significantly changed from being focused on CS as programming to viewing CS as being applicable to other disciplines. Teachers reported that they not only changed their ideas about computer science, but the workshop also allowed them to present CS in a way that would make it relevant to their students' day-to-day lives. Similarly, in another study Prieto-Rodriguez and Berretta (2014) focused on in-service teachers' thinking about the nature of computer science and whether teachers' perceptions about computer science change after a workshop. Findings suggested that connecting teachers to the skills and resources needed to teach computer science and computational thinking concepts can have a positive im-

pact on their perceptions of computer science. While there has been a considerable focus on professional development for in-service teachers, there is limited work on how to prepare preservice teachers to embed computational thinking in their future classrooms. In one study, Yadav et al. (2014) introduced preservice teachers to computational thinking and how to embed computational thinking in the K-12 classroom through a one-week module in an introductory educational psychology course. The authors used a quasi-experimental design to examine the effectiveness of the module on preservice teacher's definition of computational thinking and their ability to embed CT in their future classrooms. Results from the study suggested that preservice teachers who were exposed to the modules were significantly more likely to accurately define computational thinking and were also more likely to agree that computational thinking could be implemented in the classroom by allowing students to problem-solve (and not just by using computers). The results from this study are promising; however, while a one-week module might be enough to develop preservice teachers' understanding of computational thinking, it might not provide them with enough knowledge to embed computational thinking in meaningful ways. We need to consider how to expose preservice teachers to computational thinking constructs within the context of the subject area they will teach in their future classrooms. Barr & Stephenson (2011) recommended that in order for computational thinking to be part of every student's education, all preservice teacher preparation programs need to include a class on computational thinking across the disciplines. We would argue that teacher preparation programs should go beyond one class and teach computational thinking in the subject matter context of methods courses. The majority of teacher education programs offer an introductory educational technology course, which could serve as a core class to introduce preservice teachers to CT ideas. The teaching methods courses could then be used to expand on preservice teachers' understanding of computational thinking within the context of their subject area and build upon that knowledge to embed CT in their future classes. Given the calls to expand the pool of teachers who "teach" computational thinking (Cuny, 2012; Yadav et al., 2014; Yadav, Hong, & Stephenson, 2016; Gretter & Yadav, 2016), teacher preparation programs are critical and provide an opportune setting to introduce future teachers to CT. However, before being able to guide preservice teachers' implementation of CT in their future classrooms, we need to better understand how these student teachers think about CT. Specifically, we need to examine how teachers view computational thinking and its role in their classrooms given that teachers' conceptions can significantly influence and even stereotype students' views about what computer scientists do. Guzdial (2008) explained how the field of computing education research can start looking at what non-computing students - here, the training of future teachers - understand about computing for formal education to enhance their knowledge of computing.

Basu, et.al., (2012) in their research entitled 'A Science Learning Environment using a Computational Thinking Approach' developed a cross-domain, visual programming and agent-based learning environment named Computational Thinking in Simulation and Modelling. Class sixth students learnt distance-speed-time relations from physics and ecological processes in a fish tank system from biology. Remarkable learning was noted in both the science units. Students created their own computational models of scientific phenomena. Using these models and simulation tools, they performed experiments and compared the simulation behaviour produced by their models and the simulation behaviour produced by expert models.

Grover, S. and Pea, R. (2013) have given the following elements which are now widely accepted as comprising Computational Thinking and form the basis of curricula that aim to support its learning as well as assess its development: Abstractions and pattern, Generalizations (including models and simulations), Systematic processing of information, Symbol systems and representations, Algorithmic notions of flow of control, Structured problem decomposition (modularizing), Iterative, recursive and parallel thinking, Conditional logic, Efficiency and Performance constraints along with Debugging and Systematic error detection.

Weintrop, D. et.al., (2015) in their research entitled 'Computational Thinking in the Science Classroom: Preliminary Findings from a Blended Curriculum' found that in the case of science and computational thinking, there is a remarkable gap in the attitudes and confidence of male and female students. Very few students have access to preparing themselves for using advanced technological developments such as computation. Female and minority students especially lack behind in this case. Therefore, they recommend computational thinking content should be blended with high school science coursework.

Lockwood, J. and Mooney, A. (2017) in their systematic literary review entitled 'Computational Thinking in Education: Where does it fit?' found that many countries all over the world have yet not introduced computational thinking in the mainstream education process. Work related to computational thinking needs to grow and develop to a great extent. There is a huge scope for the teachers who wish to incorporate computational thinking in their classes as they have an abundance of tools, resources, programmes, hands-on exercises and more. However, more detailed lesson plans and curriculum structure would be more beneficial to the teachers who aim at using computational thinking in teaching and for curriculum development.

Wing, J. (2017) in her research entitled 'Computational Thinking's Influence on Research and Education for All' has concluded that apart from extremely useful hardware and software computer science provides for the system of computational thinking skills which can be used extensively in the field of ed-

ucation and research. Computational thinking should be treated as a basic skill like reading, writing or arithmetic.

Donna Kotsopoulos, & et.al (2017) proposed a Computational Thinking Pedagogical Framework (CTPF), developed from constructionism and social-constructivism theories. CTPF includes four pedagogical experiences: (1) unplugged, (2) tinkering, (3) making, and (4) remixing. Unplugged experiences focus on activities implemented without the use of computers. Tinkering experiences primarily involve activities that take things apart and engage in changes and/or modifications to existing objects. Making experiences involve activities where constructing new objects is the primary focus. Remixing refers to those experiences that involve the appropriation of objects or components of objects for use in other objects or for other purposes. Objects can be digital, tangible, or even conceptual. These experiences reflect distinct yet overlapping CT experiences which are all proposed to be necessary for students to fully experience CT. In some cases, particularly for novices and depending on the concepts under exploration, a sequential approach to these experiences may be helpful.

SUMMARY REVIEW

The review of literature helps to conclude and design the essential steps for the CT as a Pedagogic approach for constructive learning.

The review of literature may be summarized by taking into consideration the research and literature with reference to computational thinking. The initiation was traced in the work of Wing (2006) described computational thinking as "solving problems, designing systems, and understanding human behavior, by drawing on the concepts fundamental to computer science". Grover, S. and Pea, R. (2013) concluded the elements of Computational thinking as the Abstractions and pattern generalizations (including models and simulations) Systematic processing of information Symbol systems and representations Algorithmic notions of flow of control Structured problem decomposition (modularizing) Iterative, recursive, and parallel thinking Conditional logic Efficiency and performance constraints Debugging and systematic error detection.

Furthermore, given that computation is a crucial driver of innovation and productivity in today's technology-rich society (Selby, 2015), it is imperative that students engage in computing ideas at the K-12 level (CSTA & ISTE, 2011). For computational thinking to become part of the K-12 curriculum, there is a critical need to prepare teachers who are well trained to integrate computational thinking in their everyday pedagogical activities (Lye & Koh, 2014). Prieto-Rodriguez & Berretta, (2014) stated an increasing need for teachers to be prepared to integrate CT into their classroom practices. (Yadav et al., 2014) made an effort to expose teachers to computational thinking have focused on both preservice teachers through modules in existing teacher education courses as well as in-service teach-

ers through professional development. Akcaoglu & Koehler, 2014; Calao et al., 2015; Lishinski, Yadav, Enbody, & Good, 2016) research has exhibited that exposing students to computational thinking ideas also improves their problem-solving abilities and critical thinking skills.

Weintrop, D. et.al., (2015) in their research entitled 'Computational Thinking in the Science Classroom: Preliminary Findings from a Blended Curriculum' concluded that very few students have access to preparing themselves for using advanced technological developments such as computation. Female and minority students especially lack behind in this case. Therefore, they recommend computational thinking content should be blended with high school science coursework. Wing, J. (2017) Computational thinking should be treated as a basic skill like reading, writing or arithmetic. Donna Kotsopoulos, et al. (2017) proposed a Computational Thinking Pedagogical Framework (CTPF), based on constructionism and social-constructivism theories and it four pedagogical experiences: (1) unplugged, (2) tinkering, (3) making, and (4) remixing.The review of literature reveals that various effective attempts has been made by the researchers and teacher educators to conceptualize the concept of Computational Thinking and its implementation in teaching learning process. The RRL had broadened the comprehension OF Computational Thinking skills and gave insight to design the essential steps for the CT as a Pedagogic approach for constructive learning.

In the present chapter authors have attempted to propose the essential skills of Computational thinking as a pedagogical approach for Constructive learning.

EXPLANATION OF TOOL

The approach of Computational thinking for constructive learning is generic in nature. It may be applied as per the content of the subject. Each component along with the skills are equally important. The facilitator may adopt the skills as per the need of the content and learning outcomes.

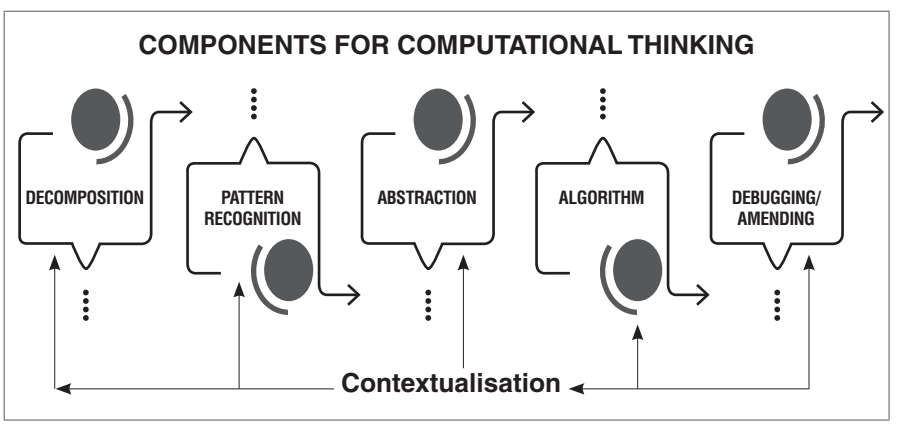


Figure 1 - Computational Thinking for Problem-solving

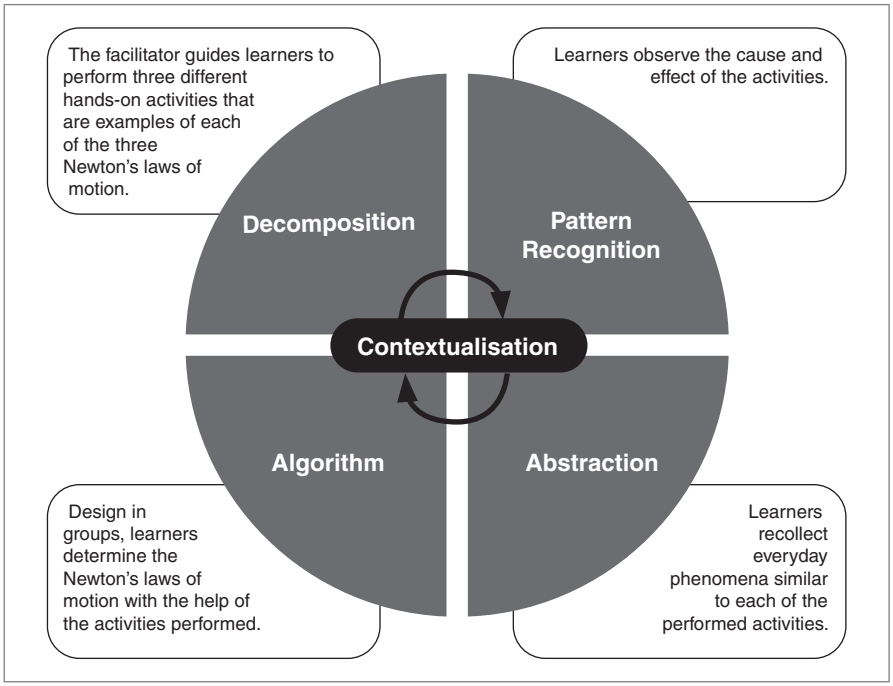


Figure 2 - Generic form of Computational Thinking

A. Aim of the Tool

- To equip the student teachers with the pedagogical approach for the computational thinking skills.

B. Expected Outcomes

The teacher will be able to

- Explain the computational thinking skills and their parameters.
- Create lesson plans/ sessions based on the parameters for computational thinking skills.
- Design evaluation stages/ procedure during the implementation of the computational thinking skills.

The learner will be able to

- analyze the topic / content / issue.
- Synthesis the topic / content / issue.
- Demonstrate analytical, critical thinking, and creative thinking to some extent.

C. Role of Teacher (Facilitator)

The role of teacher as a facilitator is to facilitate learning and hence has to be proactive to form and provide the in advance planning with resource and material need to make for the implementation. The computational thinking approach is analytical, creative, and critical in nature. The teacher has to work as catalysts where he/she finds that students are stuck up due cognitive dissonance and need to trigger the aspiration and motivation to complete the process of learning through a computational thinking approach.

D. Role of Students

The students have to work in collaboration hence need to understand the peers' strength and limitations. The group of students having different capacity and competency get involved and follow the instructions/ suggestions made by the teacher (facilitator).

They have to make a presentation at the end of the learning process. They have explained each stage clearly and their basis with references and substantial evidence (Objective or subjective).

E. Steps to Use the Tool (In few content /topics they are interchangeable).

The educator should follow the below-mentioned steps to ensure proper usage of the pedagogical tool:

1) Identify the topics based on content analysis for computational thinking.

For e.g., the topics can be from the subject Science, Social Science.

PILLARS OF COMPUTATIONAL THINKING:

Contextualization

It refers to the context as the teacher has to give an overarching view and need to educate about the topic / problem and concept as students would be acquainted with what has to be done in the process. Prior planning needs to be done by the teacher based on the topic / problem / concept.

Decomposition takes a complex problem and breaks it into more manageable sub-problems. By solving each potentially simpler sub-problem, we can put the solutions together to arrive at a solution to the original complex problem. You probably already do this in solving everyday problems like writing a paper by breaking it into sections that can be individually written and put together.

For instance, teachers have a topic / problem on online learning issues and resolution. How would you go about decomposing the problem to make it more manageable? First, you would need to get the information / knowledge. This would come from a variety of different sources. Teacher describes the concept of online learning and ask the students do the review and note the observation

with reference to the topic, students understand the problem / topic and initially first stage / pillar i.e. decomposition of the problem and subproblems with reference to student and teachers and identifies the problems and subproblems of the same.

A brief discussion is conducted by the teacher as a facilitator with students to understand their perception and understanding of the problems based on the same teacher asking to note subproblems. Students decompose the online learning issues and solutions into smaller or sub problems. How will you find a solution for effective online learning for the different strata of society like from villages, mountain areas or marginalized sections of society.

Teaching decomposition to young learners means that students are invited into problem-solving scenarios. Teachers share the complex, multi-step problem and facilitate conversations that help students to break it down. While students at their schooling ages are not always developmentally ready for multi-step directions or problems, they are ready to be exposed to models of adult thinking. In doing this, students begin to develop a framework of strategic, computational thinking.

Facilitators may try: Teachers might describe a scenario, such as planning a birthday party, that involves multiple steps. This type of task can quickly become overwhelming without an organized to-do list of smaller, more approachable challenges. Students can help to break down the larger task, and the teacher can help to draw or write a visual representation of their thinking, giving students a mental map of how to solve similar problems in the future.

PATTERN RECOGNITION

When the problem is decomposed, we frequently find patterns among the sub-problems, i.e., similarities or shared characteristics. Discovering these patterns make the complex problem easier to solve since we can use the same solution for each occurrence of the pattern recognition.

So, let's think about the problem related to network issues of village students. For example, students use to climb the tree to avail network while online teaching and learning. The sub problems were the network and data pack of the student's parents.

This entails finding similarities or shared characteristics within or between problems and allows us to use the same solution for each occurrence of the pattern.

Pattern recognition, as a cornerstone of computational thinking, begins with the basic ABAB pattern creation that is taught in the primary grades and extends to more complex layers of thinking. Pattern recognition invites students to analyze similar objects or experiences and identify commonalities. By finding what the objects or experiences have in common, young students can begin to develop an understanding of trends and are therefore able to make predictions.

Facilitators may try: To teach students to recognize patterns, you might begin by investigating trees. What do all trees have in common? They all have a trunk. They all have roots. They all have branches. While there are many differences between types of trees, these components are present in all trees.

ABSTRACTION

Data representation and abstraction involves determining what characteristics of the problem are important and filtering out those that are not. From this, we can create a representation of what we're trying to solve.

The important characteristic of the problem is the network issue of the student during the online teaching learning process. As it was found that most of the students are either from outskirt/village and mountains and network issues/ congestion. However, the only important characteristic for the purpose of online learning is to determine the network issue.

Abstraction is focusing on the information that is relevant and important. It involves separating core information from extraneous details.

Facilitator may try: In primary classrooms, teachers naturally teach kids the concept of abstraction with literature as they identify the main idea and key details. To take this one step further, teachers can encourage students to hunt for information, clues, or treasures by giving them a goal as they approach a book or even an experience.

As students listen to a speaker during a school presentation about dental hygiene, a kindergarten class might be hunting for details about brushing your teeth. By teaching abstraction to the students', they are able to sort through all of the information available to identify the specific information they need. This is an invaluable skill as students read larger texts and are presented with more and more complex information.

Information Literacy is the ability to think critically and make balanced judgements about any information we find and use.

Information Literacy skill is utmost important in today's context and needs to be trained to the students as most of the data and information is made available through the web resources hence the **Accuracy, Authority, Objectivity, Currency, and Coverage** are important to check the validation of the data and information.

ALGORITHM

An algorithm is a set of step-by-step instructions of how to solve a problem. It identifies what is to be done (the instructions), and the order in which they should be done.

For instance:

- Network issue for online learning

- At the first student will find the application with low band width
- Ask the student to download Jitsy app
- Orient the basic functions
- Apply and share

Algorithmic thinking involves developing solutions to a problem. Specifically, it creates sequential rules to follow in order to solve a problem. In the early grades, kids can learn that the order of how something is done can have an effect.

Facilitator may try: To present this idea to students, you might ask them to think about making a sandwich. What should we do first? Second? What if I put the cheese and lettuce on my sandwich before I add the mayonnaise? Conversations about sequence and order develop the foundations of algorithmic thinking.

To get students thinking in algorithms, invite them to design the path from their classroom to the gym by detailing a series of steps. Then, let them try it out! Additionally, invite students to think about their morning routine. What steps do they take to get ready for school each morning? How would the order impact the outcome? Asking students to consider how inputs change the outcome encourages them to be reflective in their thinking and to make changes to their plan to achieve the desired result.

DEBUGGING/ AMENDING

Refers to Detecting Errors by various methods and techniques. Reviewing the phases with reference to contextualization. The debugging / amending is an important component as it helps to review and detect the errors to find solutions through the algorithm. There is no perfect solution to the problem / issue as it may change as per the time and context hence detecting the errors is essential and after the detection relate to the contextualisation and find the right solution / answer.

F. Assessment

The assessment of a Computational thinking as a pedagogical approach depends on a predetermined set of rubrics, which incorporates the core aims of the technique. The rubrics entail the allocation of marks from 1 to 5, depending on the learner's performance.

- Allocated time: Overall 4 sessions in the classroom and home assignment (Subject to the content).
- Classroom Setting or place layout – A classroom can be set in groups of four to five students. The blended approach may be adopted based on the content selected for learning.
- Organization questions (if any).

- Necessary materials – the reference material of the resources to create contextualization and understanding of the problem and concepts.
- Number of participants – Four member for each group.

TABLE

Sample of the Rubrics

Rubrics	Excellent	Good	Satisfactory	Average	Need to motivate
The student engages in the contextualization process and exhibits analytical / critical thinking skills.					
Students display / exhibit analytical thinking skills during the decomposition of the topic / unit.					
Students display / exhibit analytical thinking skills during the pattern recognition of the topic / unit.					
Students display / exhibit analytical thinking skills / Critical thinking skills during the Abstraction of the topic / unit.					
Students display / exhibit analytical thinking skills during the Algorithm of the topic / unit.					
Students display / exhibit analytical thinking / Critical skills during the Debugging / Amending of the topic / unit.					
The learner understands Computational Thinking and was active during the entire process.					

CONCLUSION

The 4th Industrial Revolution is a fusion of advances in artificial intelligence, robotics, the Internet of Things, and more... We often are faced with a disjunctive differentiating technological thinking from human thinking. Nonetheless, this chapter teaches us the traits and applications of computational thinking and how it can be an adequate pedagogical tool to promote creativity, critical, and analytical thinking skills in secondary schools.

Computational thinking creates the adequate environment to solve a problem by thinking scientifically. Once the challenge is presented to the students, the teacher has to guide his pupils through the contextualisation of the problem, to later decompose its different parts in order to recognise a pattern. This organised thinking develops the analytical and critical thinking of the students as they are able not only to recognise common patterns in different scenarios and contexts, but they are also able to follow a set of instructions to reach a well-structured solution. In our current societies characterised by dynamism, interconnection, and promptness, being able to contextualise and recognise common trends and patterns is a required competence to thrive personally and professionally.

REFERENCES

Basu, Satabdi&Kinnebrew, John &Dickes, Amanda & Farris, Amy & Sengupta, Pratim&Winger, Jaymes& Biswas, Gautam. (2012). A Science Learning Environment using a Computational Thinking Approach. Proceedings of the 20th International Conference on Computers in Education, ICCE 2012. Retrieved from https://www.researchgate.net/publication/256065501_A_Science_Learning_ Environment_using_a_Computational_Thinking_Approach on 8th January, 2019

Grover, S. and Pea, R. (2013). Computational Thinking in K–12 : A Review of the State of the Field. Educational Researcher, 42 (1). 38-43. doi: 10.3102/0013189X12463051.

Donna Kotsopoulos& et.al. (2017) A Pedagogical Framework for Computational Thinking retrieved from https://link.springer.com/article/10.1007/s40751-017- 0031-2

Akcaoglu, M., & Koehler, M. J. (2014). Cognitive outcomes from the Game-Design and Learning (GDL) after-school program. Computers & Education, 75, 72–81.

Astrachan, O., Hambrusch, S., Peckham, J., & Settle, A. (2009). The present and future of computational thinking. ACM SIGCSE Bulletin, 41(1), 549–550.

Atmatzidou, S., &Demetriadis, S. (2014). How to support students' computational thinking skills in educational robotics activities. In Proceedings of 4th International Workshop Teaching Robotics, Teaching with Robotics & 5th International Conference Robotics in Education (pp. 43–50).

Barr, D., Conery, L., & Harrison, J. (2011). Computational thinking: A digital age skill for everyone. Learning & Leading with Technology, 38(6), 20–23.

Barr, V., & Stephenson, C. (2011). Bringing computational thinking to K-12: What is involved and what is the role of the computer science education community? ACM Inroads, 2(1), 48–54.

Blum, L., & Cortina, T. J. (2007). CS4HS: An outreach program for high school CS teachers. ACM SIGCSE Bulletin, 39(1), 19–23.

Brennan, K., & Resnick, M. (2012). New frameworks for studying and assessing the Development of computational thinking. In Proceedings of the 2012 annual meeting of the American Educational Research Association, Vancouver, Canada.

Brovelli, D., Bölsterli, K., Rehm, M., & Wilhelm, M. (2014). Using vignette testing to Measure student science teachers' professional competencies. American Journal of Educational Research, 2(7), 555–558.

Bundy, A. (2007). Computational thinking is pervasive. Journal of Scientific and Practical Computing, 1(2), 67–69.

Calao, L. A., Moreno-León, J., Correa, H. E., & Robles, G. (2015). Developing Mathematical thinking with scratch. In Design for Teaching and Learning in a Networked World (pp. 17–27). Cham: Springer.

College Board. (2014). AP Computer Science Principles Draft Curriculum Framework. Retrieved 26 June 2015 https://advancesinap.collegeboard.org/stem/computer- science-Principles Computer Science Teachers Association, & International Society for Technology in Education.

(2011). Computational Thinking: Leadership Toolkit (1st ed..) Retrieved from http://www.csta.acm.org/Curriculum/sub/CurrFiles/471.11CTLeadershiptToolk it-SP-vF.pdf.

Creswell, J. W. (2002). Educational Research: Planning, Conducting, and Evaluating Quantitative. New Jersey, Upper Saddle River: Pearson.

Csizmadia, A., Curzon, P., Dorling, M., Humphreys, S., Ng, T., Selby, C., &Woollard, J. (2015). Computational Thinking A Guide for Teachers. Cuny, J. (2012). Transforming high school computing: A call to action. ACM Inroads, 3(2), 32–36.

Denning, P. (2009). The profession of IT Beyond computational thinking. Communications of the ACM, 52, 28–30.

Dwyer, H., Boe, B., Hill, C., Franklin, D., & Harlow, D. (2013). Computational Thinking for Physics: Programming Models of Physics Phenomenon in Elementary School.

Fletcher, G. H., & Lu, J. J. (2009). Education human computing skills: rethinking the K- 12 experience. Communications of the ACM, 52(2), 23–25.

Good, J., Yadav, A., &Lishinski, A. (2016). Measuring computational thinking preconceptions: analysis of a survey for pre-service teacher's' conceptions of computational thinking. In Paper presented at Society for Information Technology and Teacher Education, Savannah, GA.

Gretter, S., & Yadav, A. (2016). Computational thinking and media & information literacy: An integrated approach to teaching twenty-first century skills. TechTrends, 60, 510–516. doi:10.1007/s11528-016-0098-4.

Grover, S., & Pea, R. (2013). Computational thinking in K–12: A review of the state of the field. Educational Researcher, 42(1), 38–43. doi: 10.3102/0013189X12463051.

Guzdial, M. (2008). Education paving the way for computational thinking. Communications of the ACM, 51(8), 25–27.

Howland, K., & Good, J. (2015). Learning to communicate computationally with Flip: A bi-modal programming language for game creation. Computers & Education, 80, 224–240.

Ingersoll, R., Merrill, L., & Stuckey, D. (2014). Seven Trends: The Transformation of the Teaching Force. Retrieved from: http://cpre.org/sites/default /files/workingpapers /1506_7trendsap ril2014.pdf

ISTE. (2011). Teacher Resources. Retrieved from https://www.iste.org/explore /articl detail ? articl eid=152

Lee, I., Martin, F., &Apone, K. (2014). Integrating computational thinking across the K-8 curriculum. ACM Inroads, 5(4), 64–71.

Lishinski, A., Yadav, A., Enbody, R., & Good, J. (2016). The influence of Problem-solving abilitieson students' Performance on Different Assessment Tasks in CS1. In Proceedings of the 47th ACM Technical Symposium on Computing Science Education (pp. 329–334). New York: ACM.

Lye, S. Y., & Koh, J. H. L. (2014). Review on teaching and learning of computational thinking through programming: What is next for K-12? Computers in Human Behavior, 41, 51–61.

Mannila, L., Dagiene, V., Demo, B., Grgurina, N., Mirolo, C., Rolandsson, L., & Settle, A. (2014). Computational thinking in k-9 education. In Proceedings of the Working Group Reports of the 2014 on Innovation & Technology in Computer Science Education Conference (pp. 1–29). New York: ACM.

Nickerson, H., Brand, C., &Repenning, A. (2015). Grounding computational thinking skill acquisition through contextualized instruction. In Proceedings of the Eleventh Annual International Conference on International Computing Education Research (pp. 207–216). New York.

Polly, D., Mims, C., Shepherd, C. E., &Inan, F. (2010). Evidence of impact: transforming teacher education with preparing tomorrow's teachers to teach with technology (PT3) grants. Teaching and Teacher Education, 26(4), 863–870.

Prieto-rodriguez, E., & Berretta, R. (2014). Digital technology teachers' perceptions of computer science: It is not all about programming. In IEEE Frontiers in Education Conference. doi:10.1109/FIE.2014.7044134.

Qualls, J. A., & Sherrell, L. B. (2010). Why computational thinking should be integrated into the curriculum. Journal of Computing Sciences in Colleges, 25(5), 66–71.

Rode, J. A., Weibert, A., Marshall, A., Aal, K., von Rekowski, T., el Mimoni, H., & Booker, J. (2015). From computational thinking to computational making. In Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing (pp. 239–250).New York: ACM.

Selby, C. C. (2015). Relationships: computational thinking, pedagogy of programming, and bloom's taxonomy. In Proceedings of the Workshop in Primary and Secondary Computing Education on ZZZ (pp. 80–87). New York: ACM.

Wing, J. M. (2006). Computational thinking. Communications of the ACM, 49(3), 33–35.

Wing, J. M. (2008). Computational thinking and thinking about computing. Philosophical Transactions of the Royal Society of London A: Mathematical, Physical and Engineering Sciences, 366(1881), 3717–3725.

Yadav, A., Hong, H., & Stephenson, C. (2016). Computational thinking for all: Pedagogical approaches to embedding a 21st century Problem-solving in K-12 classrooms. TechTrends, 60, 565–568. doi:10.1007/s11528-016-0087-7.

Yadav, A., Mayfield, C., Zhou, N., Hambrusch, S., &Korb, J. T. (2014). Computational thinking in elementary and secondary teacher education. ACM Transactions on Computing Education, 14(1), 1–16.

Yadav, A., Zhou, N., Mayfield, C., Hambrusch, S., &Korb, J. T. (2011). Introducing Computational Thinking in Education Courses, Proceedings of ACM Special Interest Group on Computer Science Education (pp. 465–470). Dallas, TX. doi:10.1145/1953163.1953297.

Web Resources

Aman Yadav, Sarah Gretter, Jon Good, and Tamika McLean Computational Thinking in Teacher Education Edited book by Peter J. Rich Charles B. Hodges (2017) Emerging Research, Practice, and Policy on Computational ThinkingSpringer International Publishing AG 2017 retrieved from:

https://link.springer.com/book/10.1007/978-3-319-52691-1

https://www.gettingsmart.com/2018/03/early-learning-strategies-for-developing-computational-thinking-skills/

Acknowledgement

https://www.coursera.org/learn/computational-thinking-problem-solving/lecture/qUro3/1-3-pattern-recognition

Chapter 4

Concept Formation for Enhancing Students' Analytical, Creative, and Critical Thinking Skills

Indra Odina & Anna Stavicka

INTRODUCTION

The Industrial Revolution 4.0 has resulted in the necessity to develop and implement new practices in all education cycles. It both poses the opportunities and challenges at both individual level and the society at large. Therefore, the emerging issues are related to the necessity to adjust to this new situation, which is one of the objectives for the educators, namely, equipping the teachers and students with the knowledge, skills, and attitudes relevant to successfully functioning under new circumstances. "The 21st century university student will not experience the kind of classroom that her instructors did" (Yacobucci 2012: x). The transversal skills – problem-solving, critical and creative, communication skills, analytical thinking, etc. – these are just some of the skills to be acquired within the study process. The "static body of knowledge" does not work anymore (Ibid.). Therefore, "a larger percentage of the course devoted to providing students with opportunities to work with concepts, practise skills, and develop their own understanding of course material" should be developed (Ibid.). Apparently enough, also the study environment will have to be transformed into the collaborative platforms being student-centered and promoting cooperation skills at the same time. Furthermore, it is obvious that the new technologies should be integrated into the designed courses (Yacobucci 2012; Lase 2019).

THEORETICAL BACKGROUND

The effectiveness of functioning in the new environment largely depends on the quality of teacher preparation to implement the new education practices incorporating digital literacy (Lase 2019) and transversal skills among the others. "Education 4.0 is a response to the need for the Industrial Revolution 4.0, where humans and technology are converging to create new opportunities creatively and innovatively" (Lase 2019: 49). Fisk (2017) proposed 9 trends related to Education 4.0:

- The physical environment is becoming less important within the education process. The learner is equipped with opportunities to learn anywhere and anytime provided the development and implementation of remote learning and other related practices, such as, e.g., flipped classroom.
- Learning is increasingly becoming student-centred providing the opportunities for personalized input.
- Students are having a choice to decide upon the study form appropriate to their individual needs.
- Project-based learning is becoming one of the central approaches to achieve the objectives.
- Students are increasingly engaged in gaining hands-on experience.
- New assessment types are being developed in response to the necessity to implement the new practices in the delivery of the study courses.
- Students' viewpoints and opinions are becoming of topicality in designing the new study courses.
- The teachers have to reconsider their roles within the education process (e.g., facilitators).
- Students are facing the necessity to critically assess the data they come across dealing with the diverse information (Fisk 2017).

Having taken into account the theoretical basis for the development of the study tools for the Education 4.0, the "concept formation" tool was chosen to promote the acquisition of 21st century skills.

Concept Formation is an inductive teaching strategy that helps students form a clear understanding of a concept (or idea) through studying a small set of examples of the concept (Parker 2016). Belonging to Information Processing Family Models, it increases students' ability to think divergently and flexibly, build concepts and organize information (Joyce et al. 2015). Concepts make up the "backbone" of minds. Concepts are defined as cognitive abstractions which represent classes of things, events, or ideas. In general, concepts are seen as natural semantic categories which help to unite things, qualities, and occurrences on the basis of a similarity of characteristics (Seel 2012). Acquiring a new concept account for knowing more and beyond the definition of a term acquiring the concept based on the examples. "This is deep conceptual learning rather than superficial knowledge of a vocabulary word" (Parker 2016: https://teachinghistory.org). In implementing this tool, it is crucial to keep in mind that "a concept is defined by critical characteristics shared by all examples of the concept". Therefore, examples should comprise all these critical characteristics (ibid.). Some concepts are concrete and straightforward, while other concepts are more abstract. Concrete concepts are learned more quickly and easily than abstract ones (Ormrod 2012).

Explanation of the tool

Concept Formation is a great way for students to understand the concept of something new. A concept is defined by the critical characteristics shared among all examples of it. Students discuss what makes these examples unique or important for themselves in relation to other things. They review sets of examples, and then make deductions about related concepts on their own through these studies without any help from others or resources outside themselves. The implementation process of the tool involves the following steps: enumerating and listing (mental operation: differentiation), grouping and exploring relationships (identifying and abstracting) and labelling and categorising (determining the order). It can be performed on three levels depending on mental functions the teacher wants to activate, or the students are able to perform and the nature of concepts chosen. See Table 1, 2 and 3 (based on Joyce et al. 2015).

Table 1. **Level 1 Concept formation**

Activity	**Mental operations**	**Eliciting**
Enumerating Listing	Differentiation	What did you see? Hear? Notice?
Grouping and exploring relationships	Identifying common properties, abstracting	What belongs together? What picture does it create in your mind
Labeling categorising	Determining the hierarchical order	What would you call these groups? What belongs to what?

Table 2. **Level 2 Interpretation of data**

Activity	**Mental operations**	**Eliciting**
Identifying critical relationships	Differentiating	What did you notice? See? Find?
Exploring relationships	Relating categories Determining cause-effect	Why did this happen?
Making inferences	Going beyond Finding implications	What does this mean? What picture does it create in your mind? What would you conclude?

Table 3. **Level 3 Application of data**

Activity	Mental operations	Eliciting
Predicting explaining Hypothesizing	Analysing retrieving	What would happen if?
Supporting	Causal links	Why do you think this would happen?
Verifying the prediction	Logical principles	What would it take for this to be generally true?

- Aims of the tool – 1) to form students' understanding; 2) to make deductions; 3) to help students understand the fundamental building blocks of something and allow to see connections between different things; 4) to foster students' creativity while giving students an opportunity to develop their own thinking and meaning-making.
- Expected outcome – generated data to be classified, grouped, and labeled or different open classifications of the provided data, there is no one correct answer. Good for vocabulary building and developing students' research skills.
- Allocated time – 30 to 40 minutes (depending on the choice of 7 or 10 steps, as well as concepts – how concrete or abstract they are and how familiar they are to students).
- Setting, place layout – students working in groups from 3 to 5; the group has got a specified working place – separate table per group.
- Necessary materials – one set of concepts per group (self-made cards, realia) with guidelines of task performance in case this is meant for self-directed learning.
- Number of participants – whole class in small groups of 3-5, not limited number of groups, but each group should have a set of materials and working place.
- Role of students – productive and creative, students enumerate and list samples, group them and label.
- Role of teacher – active observer, information elicitor. Teachers would choose for students to do a concept formation activity if it didn't matter very much if they came up with the same concept as scientists or not (if a teacher is mostly interested in students' thinking), or if the science concepts would almost certainly be formed. In other words, the teacher would use it when the particular concept didn't really matter, or when the results would be relatively unambiguous. This is a good tool to use to help students un-

derstand how much things are classified in regular life and how there are different rationales for different classifications.

- Steps to use the tool – depending on the starting point, there are 7 or 10 process steps, namely: listing, observing, examining, grouping, labelling, creating.

Concept formation (Version 1)

1. Divide the students into small groups (3-5 students per group)

   The group should have their own working space – face-to-face: preferably round table;

   online: breakout rooms and google document slide; use https://www.randomlists.com/team-generator

2. Provide the students with a number of items to classify. These items could be real objects, i.e., seeds, "thoughts", ideas, or words.

   e.g., No.1. How would you group these words and why?

   bukë kruh pa ogia leipä pain ħobż pão kenyér

   леб bara arán hlieb ψωμί maize леб Brot duona

3. Ask the students to organize the items into groups according to characteristics of their choice (10 to 15 minutes).

4. Ask students to discuss their grouping rationale.

5. Ask students to label and categorise groups (padlet.com can be used).

6. When classification is complete, have each group explain their grouping rationale to the class and show which groups contain which items (2 minutes per group).

   e.g., groups according to

   the number of letters

   the use of symbols

   the meaning of words

   the number of consonants

   the language trees

7. In order to have the students evaluate the general usefulness of their grouping rationale, provide them with other items to see if they can be fit into the established groups (10 minutes).

   brød brauð pan de molde хляб хліб chleb hljeb brood

Follow-up activities: As all the words mean "bread" in various languages, the students can be given the assignments to explore these languages, match with countries, find out what bread means to them, how bread is made, etc.

Concept formation (Version 2)

1. Students are asked to brainstorm for 3 minutes and put down on their notes, e.g., all possible countries / birds / fruit / values / geographical objects they can mention (choose only one).
2. Students are asked to count items and line up according to their numbers.
3. Divide the students into small groups of 4.
4. Assign roles: *question asker, presenter, timekeeper, moderator, note keeper.*

   If the roles are used for the first time, the students should be given role descriptions, e.g.,

   A QUESTION ASKER is the person who has rights to turn to the tutor with the question if there is something you cannot find out the answer in your group.

   PRESENTER does all kinds of presentations.

   TIMEKEEPER is the person with the watch / phone and who follows the time and instructions.

   MODERATOR leads the group work.

   NOTE KEEPER carries out all the written tasks of the group.
5. Each group is given 40 slips of paper, they have to compare the items in their notes and come up with 40 genuine ones, each item is to be written by the secretary on a separate slip of paper.
6. Ask the students to organize the items into groups according to characteristics of their choice.
7. Ask students to discuss their grouping rationale.
8. Ask students to label and categorise groups.
9. When classification is complete, have each group explain their grouping rationale to the class and show which groups contain which items.
10. In order to have the students evaluate the general usefulness of their grouping rationale, ask them to provide another 10 items to see if they can be fit into the established groups.

    - Assessment – to assess students' understanding of the concept, have them explore new examples and identify those that contain the critical characteristics of the concept and those that do not. Students' work can be assessed by analyzing how they perform the following concept formation steps: listing, observing, examining, grouping, labelling, creating, defending one's point of view.

- Students' feedback:

"This tool is structure oriented. It involves comparative thinking, symbolic representation and logical reasoning."

"Concept formation is not related to simple recall; it must be constructed."

"It encourages critical and creative thinking, communication, and independent learning. Inculcates personal and social values and skills amongst the students if they work in a positive way with their peers."

"Concept formation develops students' abilities to observe items thoroughly. It helps them discover the methods of classification."

"By concept formation tool, I learned the word bread in many different languages, because while working in groups we needed to figure out what was common between many given words - and as it turned out, they were all the same word "bread" but in different languages. This kind of task helps students to brainstorm their ideas about a topic that they probably have zero knowledge of. For example, the chosen languages were very specific and less known, so the task was challenging. Working in groups helped put the puzzle pieces together, each of us gave some ideas or information that we could work on til it made sense."

"First idea that inspired me was the task where me (and our group) had to match a list of words and try to find similarities. (One step concept formation – grouping different words in categories) with no wrong or right answers. In our group we matched them by number of letters and umlauts (Umlaut is a mark used over a vowel, to indicate a different vowel quality). It inspired me because I could essentially use this activity for teaching English, but also for different subjects."

Visualized examples (the works of students classifying the words of bread in several languages).

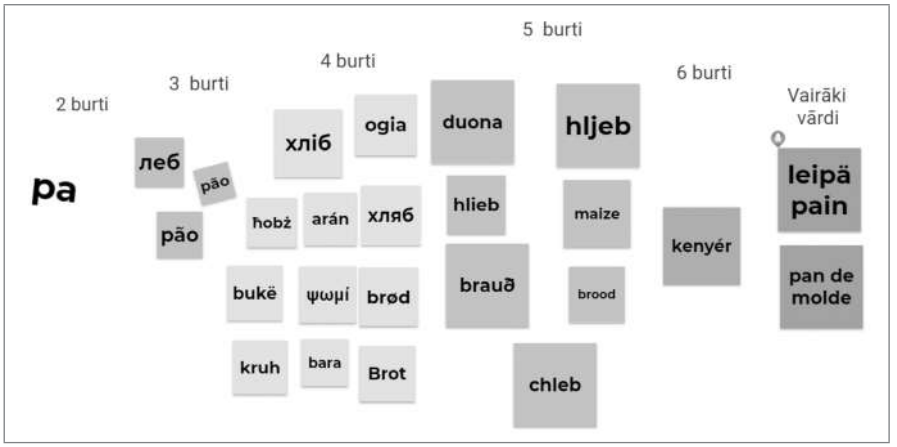


Figure 1 - Classification according to the number of letters (2 letters, 3 letters, 4 letters, 5 letters, 6 letters, many words)

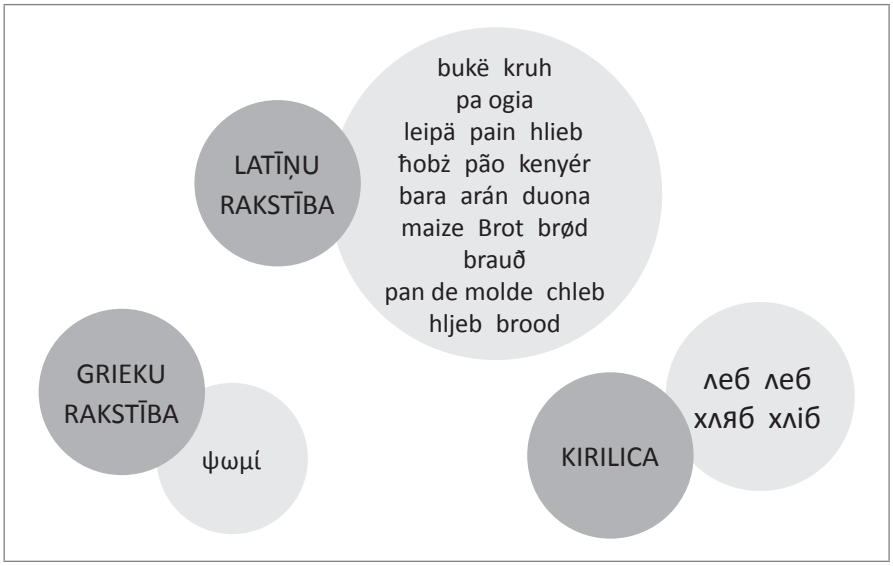


Figure 2 - Classification according to script (Latin script, Greek script, Cyrillic script)

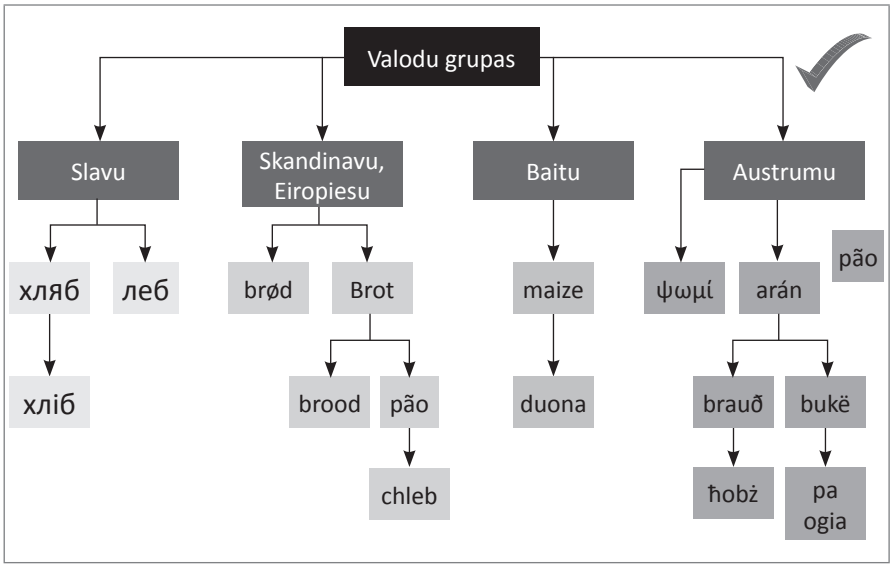


Figure 3 - Classification according to the language groups (Slavic, Scandinavian, Baltic, Oriental Language Group)

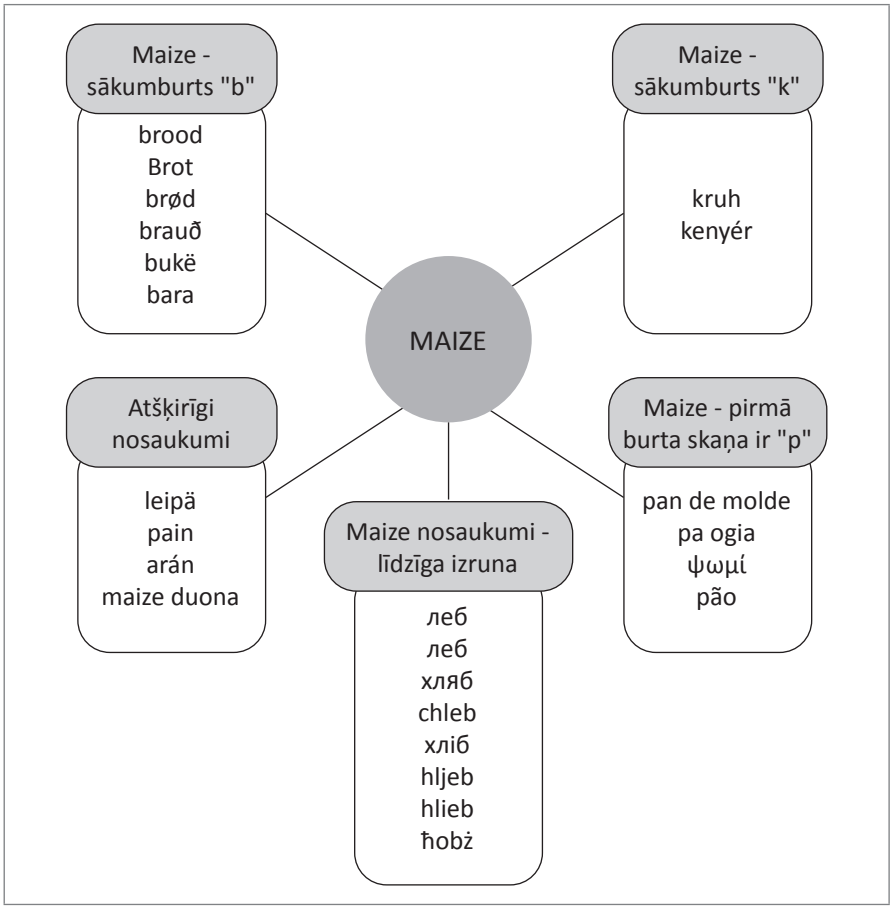


Figure 4 - Classification according to pronunciation (starts with letter "b", starts with letter "k", starts with letter "p", other names, similar pronounciation)

CONCLUSION

The above-stated examples accompanied by the brief theoretical background are aimed at shedding light upon the implementation of the "Concept Formation" tool for in-service and pre-service teachers. Based on the information provided in this chapter, the conclusion can be drawn that the "Concept formation" is crucial within the teaching and learning process provided that these are the building blocks for the students to understand the connections and distinguish among categories built within the inductive approach application. In addition, it is crucial to highlight that through categorizing objects, ideas and events people/ students make sense out of the world.

REFERENCES

Fisk, P. (2017). *Education 4.0 ... the future of learning will be dramatically different, in school and throughout life.* http://www.thegeniusworks.com/2017/ 01/future-education-young-everyone-taught-together/

Joyce, B. R., Weil, M., Calhoun, E. (2015). *Models of Teaching.* (9th ed.) Pearson

Lase, D. (2019). Education and Industrial Revolution 4.0. 10. 48-62. 10.24114/jh.v10i1.

Ormrod, J. E. (2012). Concept Learning. In: Seel, N. M. (eds) *Encyclopedia of the Sciences of Learning.* Springer, Boston, MA. https://doi.org/10.1007/978-1-4419-1428-6_793

Parker, W. (2016). Concept Formation. *Teachinghistory.org.* https://teachinghistory.org/teaching-materials/teaching-guides/25184

Seel, N.M. (2012). Concept Formation: Characteristics and Functions. In: Seel, N.M. (eds) *Encyclopedia of the Sciences of Learning.* Springer, Boston, MA. https://doi.org/10.1007/978-1-4419-1428-6_1866

Yacobucci, M. M. (2012). Introduction: A 21st Century Revolution in Science Education. *The Paleontological Society Special Publications, 12*, X-Xi. doi:10.1017/S2475262200009187

Chapter 5

Debate for Critical Thinking and Communication

Letizia Cinganotto

INTRODUCTION

"I was a very poor student and also had a discipline problem until the age of eleven. I was invited to be in a Debate. It changed my life" (Alfred C. Snider, in Cattani, 2011, p. 91).

The quotation is by Alfred Snider, considered the "father" of debate and it shows the potential of this strategy which can change one's life. In fact, discovering the power of communication, public speaking and oracy can make the difference in daily life and can change the way one interacts and behaves in any social context.

Debating is defined as an oral exchange which usually takes place between two teams, the proposition team, and the opposition team, defending their position in favour or against a motion or claim, launched by the teacher.

Therefore, the claim or motion is a sentence that can be debated both for and against, representing the starting point of the discussion. Supporting one's position with solid arguments referring to authoritative sources is one of the pillars of debate.

Debating leads students to reason, to develop critical thinking skills, to anchor their own considerations to data or sources that justify them, to listen to their companions in an attentive and active way, so that they can build their own arguments. In fact, active listening is crucial, as the students will build their own intervention starting from the rebuttal of the opponent's speech. A debate can help develop active citizenship and acquire the concept of democracy; moreover, it will help students develop elasticity and mental plasticity, allowing them to identify with others' ideas and then return to their own with greater critical awareness and with the inevitable enrichment that follows the exchange of ideas, opinions, and points of view.

Debating on political, economic, ethical issues or even on curricular disciplinary topics has a strong formative and cultural power, regardless of the specific subject matter.

Engaging in debates can help develop the students' critical skills, from the LOTS or Lower Order Thinking Skills, a less elaborate set of thinking skills, to the HOTS or Higher Order Thinking Skills, which are more complex and challenging, according to Bloom's taxonomy, facilitating both "slow" and "fast" thinking (both "system 1" and "system 2"), to quote Kahneman (2012).

THE VALUES OF DEBATING

Alfred Snider is the author of "The code of the debater", an important document, showing the pedagogical values of debating, which needs to be based on the respect of a wide range of values, highlighting the formative dimension of this strategy. In fact, persuasion and the power of argumentation using the appropriate style, register, tone of voice and non-verbal language should be chosen over coercion and verbal violence.

The code of the debater is as follows (Snider, 2008, p. 16):

I am a debater.

I attempt to be worthy of this title by striving to observe the code of the debater.

For myself

I will research my topic and know what I am talking about.

I will respect the subject matter of my debates.

I will choose persuasion over coercion and violence.

I will learn from victory and especially from defeat.

I will be a generous winner and a gracious loser.

I will remember and respect where I came from, even though I am now a citizen of the world.

I will apply my criticism of others to myself.

I will strive to see myself in others.

I will, in a debate, use the best arguments I can to support the side I am on.

I will, in life, use the best arguments I can to determine which side I am on.

For others

I will respect their rights to freedom of speech and expression, even though we may disagree.

I will respect my partners, opponents, judges, coaches, and tournament officials.

I will be honest about my arguments and evidence and those of others.

I will help those with less experience because I am both student and teacher.

I will be an advocate in life, siding with those in need and willing to speak truth to power.

According to Snider, these are the main features of debate:

- Debating is fun
- Debating is a sport
- You control debating
- Debating creates the skills you need for success wherever your life may lead you
- Debating can give you the power to change your world and yourself
- Debating is for everyone.

EXPLANATION OF THE TOOL: FORMATIVE AND COMPETITIVE DEBATE

Debates can help us rediscover the power of words and of face-to-face verbal interaction, in this society which is increasingly pervaded by the use of digital tool and social network for interaction and communication. We live in the era of Computer-Mediated Communication, in which most of our ideas, intentions, thoughts and desires are conveyed through a multimedia and digital channel. Therefore, it is crucial to rediscover "the power of talk in the digital age", as Sherry Turkle states in her beautiful best-seller "Reclaiming Conversation": "face-to-face conversation is the most human and humanizing thing we do" (Turkle, 2016, p. 3). Debates can be a way to enhance the power of language and dialogue.

There is a wide range of debate formats in the literature, many of which are based on the intrinsic competitive value and aim at local, regional, and national competitions.

The Competitive Debate category can have different formats and the majority of them get inspiration from the Parliamentary Debate, stemming from the Anglo-Saxon Parliamentary Debate, which imitates parliamentary debates ("This House believes that...").

The most common competitive format is the "World Schools Debate Championship", also adopted in the Italian Debate Olympiad, which is based on strict rules and roles. Specifically, the roles provided are as follows:

- two teams consisting of 3 debaters each (proposition team and opposition team);
- a chairman / chairwoman who gives the floor to the speakers;
- a timekeeper, who keeps the time of each round, generally 8 minutes, except for the final reply which is 4 minutes;
- the jury, whose task is to assign a score to each debater based on an evaluation rubric; the sum of the scores will decree the winning team;
- a coach for each team, who helps the debaters in the construction of the strategy and in the choice of arguments to be used for or against a particular motion;

- the audience, who generally attends the debate without taking the floor.

An important phase of the debate is the so-called "research laboratory", which consists of finding resources, data, facts and figures to be mentioned during the speech in order to strengthen and support it with evidence. The research usually takes place from a holistic perspective, before knowing which team the debaters are in. In this way they will be ready to defend both positions and overcome possible prejudices, stereotypes, or misconceptions. The use of technologies to find resources and information is crucial: information literacy and digital literacy play an important role in order to be able to distinguish authentic and valuable resources from fake news.

In the so-called "Formative Debate", in addition to the roles provided by the Competitive Debate (the two teams, whose number can be more than three, the timekeeper, the chairman / woman, the jury), it is usually recommended to assign other roles, in order to be as inclusive as possible. Each student can take the role he/she prefers, according to his/her own preferences and learning styles.

Riccardo Agostini (2018), coach of public speaking and debate in schools, suggests introducing some very interesting and useful roles, even in the training sessions of competitive debates:

- "the general evaluator", who evaluates in a comprehensive way all the interactions and actions of the various actors of the debate, offering suggestions for improvement, highlighting weaknesses and criticalities;
- "the director of improvised speeches", who supports the debaters in the organization of the impromptu or improvised speech, which is a particular type of debate also adopted in the National Debate Olympiad;
- "the person in charge of grammar", who notes down possible critical points from a linguistic point of view (possible mistakes in the performance), in order to discuss them in a dedicated session and reflect together on possible alternatives or improvements;
- "the person in charge of fluency", who is responsible for highlighting specific features which can impact fluency (for example, the use of "fillers", such as "um," "that is," "then," etc.), with the aim of helping improve the naturalness and fluency of the speech.

A very common role in the "Formative Debate" is the documenter: one or more students will be given the task of documenting the different steps of the debate using a wide range of media: notes, videos, audio, etc. This material will be fundamental during the final debriefing, aimed at activating students' reflection and meta-cognition, also referring to the collected documentation. It is a guided discussion that will lead to identify strengths and weaknesses of the different debating rounds and promote continuous improvement. The choral discussion will also foster peer feedback, allowing students to learn from each other.

Formative debates are extremely flexible and can be used to revise and reinforce concepts and content or as an alternative to a test, to be graded by the teacher.

A formative debate can also lead to negotiation, discussion and to new possible solutions, compared to the two opposing positions at the start: by listening to the other's position, a debater can even change his/her original position (Cinganotto, 2021).

THE WSD FORMAT

Over the years, the World Schools Debate Championship (WSD) has grown in popularity and has become one of the most popular competitive debating formats in high schools and universities throughout the world. The vehicular language is usually the national language and/or English. Internationally, the most common is English, however, there are international tournaments organized in Spanish, Arabic, Russian.

Each debate has two teams, which compete by defending the position for or against a particular claim or motion. The first team can be defined as "Proposition", "Affirmative", or "Government". The opposing team is generally referred to as the "Opposition." Each team has three debaters, who usually have one 8-minute speaking turn and alternate starting with the first debater from the pro team. Each team's closing argument is typically half the length of that of the regular speeches. The length of the speeches can be modified according to the specific rules.

Each team must convince the jury that their argument is the strongest, so they must make solid logical points and present them in an interesting and persuasive style.

The debate opens with the first speaker from the pro team, whose arguments are entirely new. As the debate progresses, more and more time is spent refuting the positions of the previous speakers, and less and less time is spent addressing new issues: rebuttal becomes crucial. The closing argument will be a summary of the arguments made by the team throughout the debate.

The pro team is the first to speak, generally beginning with the phrase "This House believes that..." (THBT).

Then speakers from the "pro" team and the "con" team will alternate, according to the scheme and the times indicated in the diagram below. The judges (adjudicators) will score the individual debaters according to a predefined rubric and determine the winning team and the best debater.

During the main speeches, the opposing team can ask questions, which are called "Points of Information" (PoI): the speaker can accept or reject it. The PoI brings about a major change in the role of the debaters: they are required to actively participate at all times, from beginning to end, not only during their speech.

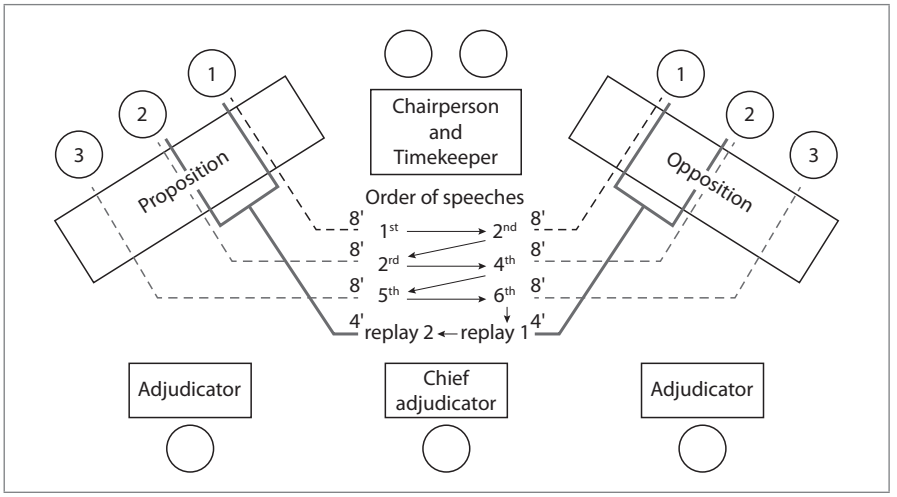


Figure 1 - The setting of the WSD

DEBATE IN ITALY

Debate[1] has been included among the Ideas of the Gallery of the "Educational Avant-Garde" movement, an Italian educational movement made up of different innovative ideas relating to methodologies, organization and learning environments. The movement was founded in 2014 by INDIRE (the Italian Institute for Documentation, Innovation, Educational Research), in collaboration with an ever-expanding network of schools, with the aim of creating a community of teachers and school leaders eager to experiment, disseminate and implement innovation from a holistic point of view: more than 1300 schools belong to the network nowadays.

Debate has the characteristic of being very flexible and dynamic, able to motivate and entertain students, from primary school to university, with the appropriate adaptations in terms of format, rules, timing, etc.

Unlike the Anglo-Saxon and American educational system, where debates are considered as a separate subject, in Italian schools debates are mainly adopted as cross-curricular methodology, which can be used across all subjects in the curriculum or in transversal projects. They can be used for revising and reinforcing content and knowledge, or as an alternative to testing, with evaluation expressed through grades or through descriptive qualitative judgments.

Debates can be adopted by a single teacher, by two or three teachers in collaboration, by a department or by the entire school.

National Debate Olympiad has been promoted in Italy by the Ministry of Education since 2017, with the first tournament in English in 2022 (Cinganotto et al. 2021).

DEBATE FOR LANGUAGE LEARNING AND CLIL

"Language specialists increasingly recognize the value of debate as a means of facilitating advanced-level foreign language uptake and overall discourse development" (Davidson, 2014, p.8).

Debate can represent a powerful tool for language learning and teaching, enhancing fluency and WTC (Willingness to communicate), as it can be considered an example of meaningful task to accomplish in order to persuade the jury or the audience.

According to the oracy framework by Voice21[2] in Fig. 2, debate has an impact on four dimensions:

- Physical dimension (body language and non-verbal communication)
- Linguistic dimension (vocabulary, style, register)
- Cognitive dimension (reasoning and thinking skills)
- Social and emotional dimension (cooperation, active listening, confidence).

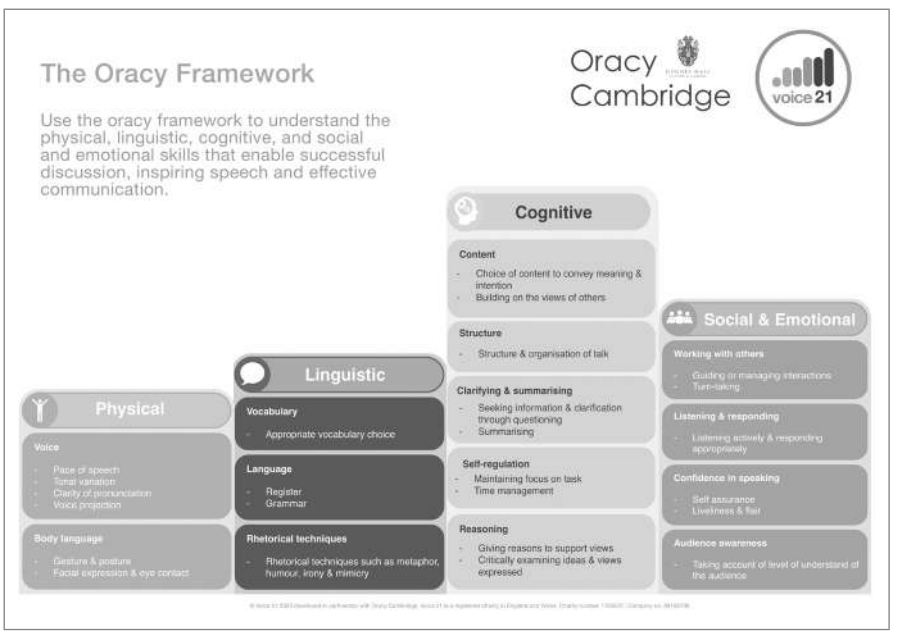


Figure 2 - Oracy framework

According to Rybold (2006), debating in a foreign language can help foster the linguistic skills in an integrated way, enhancing the four modes of communication defined by the Companion Volume of the Common European Framework for reference of languages (2020): production, reception, interaction, mediation.

In particular, Rybold suggests the impact of debate as follows:

- *Ice-breaking:* in the ice-breaking phase of the lesson, debating on controversial topics may help overcome anxiety and foster Willingness to communicate;
- *Listening:* active listening is crucial to understand the speech of the opposing team in order to plan the rebuttal or refutation;
- *Speaking:* regular practice of debate will improve fluency, pronunciation and vocabulary, enhancing the students' speaking skills;
- *Reading*: students have to prepare themselves for taking part in debates by searching for information, resources, facts and figures: reading literacy is therefore crucial to understand and apply knowledge and content to the debate strategy;
- *Writing*: debaters can develop writing skills as students will take notes, jot down a draft of their speech, use diagrams and graphs to summarize content etc. A useful exercise which is often assigned to foster writing debating skills is a position paper: like a debate, a position paper argues one side of an issue, addressing multiple aspects and presenting them in a way that is easy for the audience to understand and to perceive as valid, supported with persuasive evidence.

Written debates can also be practiced with the help of specific webtools such as *Kialo, Tricider* or *Parlay*, which have become popular during remote teaching and learning in Covid-19 times.

Debating will have a strong impact on literacy and on academic language (CALP, Cognitive Academic Language Proficiency), using the proper register, style, and vocabulary to express specific cognitive discourse functions (Dalton-Puffer 2013, 2016) linked to the topic of the debate. In fact, a debate can be integrated into a lesson plan aiming at developing a wide range of communicative functions such as reaching agreement in a team, supporting a point of view with evidence, expressing agreement, or disagreeing (Cinganotto, 2019).

Debates can also represent an effective way to implement CLIL methodology (Content and Language Integrated Learning) (Cinganotto, 2016; Cinganotto, 2021), as a claim about a curricular subject is explored, investigated, and discussed in a foreign language, co-constructing knowledge within the team of debaters. In fact, CLIL entails active learning of subject content in a foreign language through a wide range of student-centered teaching strategies and techniques and debate can be mentioned as an example of them. A CLIL debate is often organized by the so-called "CLIL team", made up by the sub-

ject teacher and the foreign language teacher, working together for the success of the initiative.

MUN

The "Model United Nations" (MUN[3]) is the international program that consists of the simulation of the UN parliamentary sessions, where the role of ambassadors is played by students. Each participant represents a different country and must faithfully respect its values and interests to be expressed in a position paper. The objective is to negotiate and obtain the approval of documents ("Resolutions") that favor the assigned country, while also considering the interests of the community.

It is a "cooperative competition" in which participants will learn about a country and focus on the major issues of international politics.

The potential of MUN is enormous:

- it is a very innovative teaching model, allowing students to acquire knowledge on issues of global interest in a foreign language, and guiding toward an effective and meaningful use of the language;
- it helps to improve the students' English language skills, as English is the official working language of the UN;
- it helps develop leadership and team working skills, thanks to the acquisition of negotiation techniques and strategies;
- it fosters the development of an overall vision of global phenomena that can guide future choices.

The following suggestions are usually given to delegates in training sessions:

- clearly state whether you are for or against a Resolution
- explain your reasons in one sentence or word
- select three operative clauses that support an opinion.

The simulations usually last three days, and on the last day the Resolutions adopted by the different committees will be voted on in a plenary session in the presence of all participants. During this plenary, the best delegates will be awarded with an honourable mention.

THE TED-ED FORMAT

Ted[4] (an acronym for Technology, Entertainment, Design) is a non-profit organization whose goal is to spread ideas of value (worth spreading), different points of view that can change people's lives. The TED program was founded in 1984 in California, with the format of a four-day conference.

Over the years, the initiative has expanded globally and is now held annually in Vancouver as a multidisciplinary conference, bringing together important speakers to share innovative ideas and projects, and building a global community of innovators.

The use of Ted Talks in education has been extensively experimented in various formal and non-formal contexts, from secondary to tertiary education. In particular, some studies (Romanelli et al., 2014) have highlighted the potential of this format in the academic field, as an excellent alternative to the traditional "lecture", which often takes on the characteristics of a transmissive and dispensational lecture, without effective student participation. The Ted Talk format could be used for reflection and critical analysis of videos already available on the repository. Ted-talks can also be recorded by the students themselves and uploaded on the school You-tube channel, representing effective examples of public speaking.

Ted-Ed offers not only authentic content, drawing-on-videos tools on the platform, but it is also possible to build a training path full of ideas and insights relating to the video itself, according to the following steps:

- *Watch*: the video of the Ted Talk can be manipulated and edited, inserting a title and additional texts;
- *Think*: the student is asked, after watching the lesson, to answer multiple-choice or open-ended questions; the answers are saved and can be monitored by the teacher;
- *Dig Deeper*: additional resources that the teacher can relate to the video to further explore the specific topic;
- *Discuss*: for each video, the teacher can open several discussions, eliciting reflections, opinions, ideas from students on the topic of the lesson.

Assessment

In a formative debate, assessment can be conceived as an alternative to an oral test to be graded by one or more teacher. This is similar to the CLIL debate, where both the subject teacher and the language teacher can be involved in the assessment process, taking into account both the content and the language, based on specifically designed rubrics, generally including the following criteria:

---

4. https://www.ted.com/

- Content: the arguments and examples used;
- Style: the language, the voice, the style and the register;
- Strategy: the level of engagement, the response to other people's arguments and structure, the coherence of the team.

The following linguistic components can also be taken into account in a rubric:

- Vocabulary
- Grammar
- Prosodic aspects (pronunciation, stress, intonation)
- Coherence of the speech and references to other arguments.

Debates for foreign languages can be assessed and self-assessed as suggested by a specific scale provided in the Companion Volume of the Common European Framework, reported below:

	Sustained monologue: putting a case (e.g. in a debate)
C2	No descriptors available; see C1
C1	Can argue a case on a complex issue, formulating points precisely and employing emphasis effectively. Can develop an argument systematically in well-structured language, taking into account the interlocutor's perspective, highlighting significant points with supporting examples and concluding appropriately.
B2	Can develop an argument systematically with appropriate highlighting of significant points, and relevant supporting detail.
	Can develop a clear argument, expanding and supporting their points of view at some length with subsidiary points and relevant examples. Can construct a chain of reasoned argument. Can explain a viewpoint on a topical issue giving the advantages and disadvantages of various options.
B1	Can develop an argument well enough to be followed without difficulty most of the time. Can give simple reasons to justify a viewpoint on a familiar topic.
	Can express opinions on subjects relating to everyday life, using simple expressions. Can briefly give reasons and explanations for opinions, plans and actions. Can explain whether or not they approve of what someone has done and give reasons to justify this opinion.
A2	Can explain what they like or dislike about something, why they prefer one thing to another, making simple, direct comparisons.
	Can present their opinion in simple terms, provided interlocutors are patient.
A1	No descriptors available
Pre-A1	No descriptors available

Figure 3 - Debate in the CEFRCV

The example of rubric reported below can be used to assess classroom discussion and formative debate.

Classroom Debate Rubric						
Criteria	**5 points**	**4 points**	**3 points**	**2 points**	**1 point**	**Total Points**
Respect for Other Team	All statements, body language, and responses were respectful and were inappropriate language	Statements and responses were respectful and used appropriate language, but once or twice body language was not	Most statements and responses were respectful and in appropriate language, but there was one sarcastic remark	Statements, responses and/ or body language were borderline appropriate. Some sarcastic remarks	Statements, responses and/ or body language were consistently not respectfu	
Information	All information presented in this debate was clear, accurate and thorough	Most information presented in this debate was clear, accurate and thorough	Most information presented in the debate was clear and accurate, but was not usually thorough	Some information was accurate, but there were some minor inaccuracies	Information had some major inaccuracies OR was usually not clear	
Rebuttal	All counter-arguments were accurate, relevant and strong	Most counter-arguments were accurate, relevant, and strong	Most counter-arguments were accurate and relevant, but several were weak	Some counter arguments were weak and irrelevant	Counter-arguments were not accurate and/ or relevant	
Use of Facts/Statistics	Every major point was well supported with several relevant facts, statistics and/or examples	Every major point was adequately supported with relevant facts, statistics and/or examples	Every major point was supported with facts, statistics and/or examples, but the relevance of some was questionable	Some points were supported well, others were not	All points were not supported	
Organization	All arguments were clearly tied to an idea (premise) and organized in a tight, logical fashion	Most arguments were clearly tied to an idea (premise) and organized in a tight, logical fashion	Most arguments were clearly tied to an idea (premise) and organized in a tight, logical fashion	Most arguments were clearly tied to an idea (premise) and organized in a tight, logical fashion	Most arguments were clearly tied to an idea (premise) and organized in a tight, logical fashion	
Understanding of Topic	The team clearly understood the topic in depth and presented their information forcefully and convincingly	The team clearly understood the topic in depth and presented their information with ease	The team seemed to understand the main points of the topic and presented those with ease	The team seemed to understand the main points of the topic, but didn't present with ease	The team did not show an adequate understanding of the topic	
					Total Points:	
Comments:						

Figure 4 - Example of classroom debate rubric[5]

In a competitive debate such as the Word School Debate, each substantive speaker can generally be awarded a maximum of 100 points: 40 points for con-

5. Source: https://web.stanford.edu/class/cs326/classroom_debate_rubric.pdf

tent, 40 for style and 20 for strategy. The reply speech is worth a maximum of 50 points, 20 for content, 20 for style and 10 for strategy. However, the actual World Schools speaker scale runs from 60 – 80 as depicted in the table below.

STANDARD	OVERALL (/100)	STYLE (/40)	CONTENT (/40)	STRATEGY (/20)
Exceptional	80	32	32	16
Excellent	76-79	31	31	15-16
Extremely Good	74-75	30	30	15
Very Good	71-73	29	29	14-15
Good	70	28	28	14
Satisfactory	67-69	27	27	13-14
Competent	65-66	26	26	13
Pass	61-64	25	25	12-13
Improvement Needed	60	24	24	12

Reply Speeches (out of 50)

STANDARD	OVERALL (/50)	STYLE (/20)	CONTENT (/20)	STRATEGY (/10)
Exceptional	40	16	16	8
Very Good to Excellent	36-39	15	15	7.5
Good	35	14	14	7
Pass to Satisfactory	31-34	13	13	6.5
Improvement Needed	30	12	12	6

Fig. 5 – Rubric in the WSD[6]

CONCLUSIONS

Debates are a very useful tool that can be implemented into the Indian curricula both at secondary and tertiary level, as it can foster the students' critical thinking skills and at the same time innovate teaching methodologies. Defending one's own position can develop the students' global and intercultural competences and can be useful in any subject, both humanities and STEAM (Science, Technology, Engineering, Arts, Math). Another added value is represented by the discussion of global issues or topics related to Agenda 2030 SDGs as transversal and cross-curricular motions.

6. Source: http://www.esu.org/wp-content/uploads/2019/01/Introduction-to-World-Schools-format-guide.pdf

Teacher training on debates can be the first step to gradually adopting it with the students, starting with easy exercises and games on public speaking, to help the students overcome anxiety and shyness when speaking in front of an audience.

Taking part in international initiatives on public speaking such as MUN or TED can offer an added value, as it develops socialization, internationalization, oracy, and transversal competences.

Apart from official competitions, debates can turn out to be a very flexible and powerful pedagogical tool to be adjusted and tailored to any educational target and context and to be easily integrated into any syllabus and teaching plan.

REFERENCES

Agostini R. (2018). Insegnare a dibattere. Debate e public speaking nelle scuole, pubblicazione indipendente.

Cattani A. (2011). Argomentare le proprie ragioni, Loffredo Editore, Napoli.

Cinganotto, L. (2016). CLIL in Italy: A general overview, in "Latin American Journal of Content and Language Integrated Learning", 9(2).

Cinganotto L. (2021). CLIL & Innovazione, Pearson.

Cinganotto L. (2019). Debate as a Teaching Strategy for Language Learning, in "Lingue Linguaggi", 30, pp. 107-25.

Cinganotto L. (2021). Handy Little Guide to Debate, Pearson.

Cinganotto L., Mosa E., Panzavolta S. (2021). Il Debate. Una metodologia per potenziare le competenze chiave, Carocci.

Dalton-Puffer C. (2013). A construct of cognitive discourse functions for conceptualizing content-language integration in CLIL and multilingual education, in "European Journal of Applied Linguistics" 1 [2], pp. 216-253.

Dalton-Puffer C. (2016). Cognitive Discourse Functions: specifying an integrative interdisciplinary construct, in Nikula T., Dafouz E., Moore P., Smit U. (Eds.), Conceptualizing Integration in CLIL and Multilingual Education, Multilingual Matters.

Davidson D.D. (2014). Foreword, "Mastering English through Global Debate", Georgetown University Press, Washington.

Kahneman D. (2012). Pensieri lenti e veloci, Arnoldo Mondadori Editore, Milano.

Rybold G. (2006). Speaking, Listening and Understanding. Debate for Non-Native-English Speakers. International Debate Education Association, New York.

Romanelli F., Cain J., McNamare J.P. (2014). Should TED Talks Be Teaching Us Something? In "American Journal of Pharmaceutical Education", Aug 2014, 78 (6) 113.

Snider A. C. (2008). The Code of the Debater, International Debate Education Association.

Turkle S. (2016). Reclaiming conversation, Penguin Books, New York.

Chapter 6

EduScrum in Teaching Lessons

Wilko Reichwein

INTRODUCTION

The world of work is undergoing fundamental change due to globalisation and digitalisation. Hardly any sector is spared: services and products as well as production and work processes are affected, as are the associated company structures.

It follows that teaching and learning must also change in order to meet the changing demands of the working world of present and future society. Students often lack personal competences and skills that are becoming increasingly important in the world of work against the background of the digital transformation: Cooperation skills, communication skills, planning and organisational skills and the ability to regulate learning processes independently (Gerholz & Dormann 2017). These skills, which are not only necessary for professional activities, are often only developed after leaving school.

A particularly interesting and promising didactic approach is based on the use of agile methods, which originally come from the IT industry and software development and are also already being applied in the school education context. For example, at the American School in Switzerland (Cosgrove, Magnuson, Tihen & Patton 2019) or at Ashram College in the Netherlands (Stolze & Wijnands 2019). Willy Wijnands teaches at Ashram College and is co-founder of the worldwide initiative "Agile in Education" as well as initiator and founder of eduScrum.

EduScrum is totally free and on the website "eduscrum.org", the eduScrum Guide is available for download in numerous languages. You can register for monthly eduScrum Newsletter and it is possible to join one of our monthly World Journey Sessions.

EduScrum is a very comprehensive method that draws its foundations from the Scrum process model. Scrum has been successfully used for years as an agile project management tool in software development, among other areas. It represents a process model for the development of multi-layered software products and has a high status within the IT industry. The Scrum framework combines principles of agile principles. These include transparency, recurring review, and

adaptation of the procedure. The approach of integrating Scrum in the education sector is relatively new and only little researched. This chapter presents eduScrum as a didactic concept which can be used both in the context of teacher training at universities and in schools within project-oriented lessons. Due to the fundamental process-open design combined with a firmly defined procedure, analytical, creative, and critical skills are particularly promoted among the students.

THEORETICAL BACKGROUND

EduScrum is based on the idea of the agile mindset. Agility is not a buzzword, but an attitude, an idea, and a guideline to be able to cope with the growing complexity in actions. Agile collaboration is understood as a countermovement to the "top-down" organisational processes that are seen as bureaucratic.

Behind the concept of agile education lies a value system whose essential contents are represented by the Agile in Education Compass (Delhij et. al. 2016) (Figure 1).

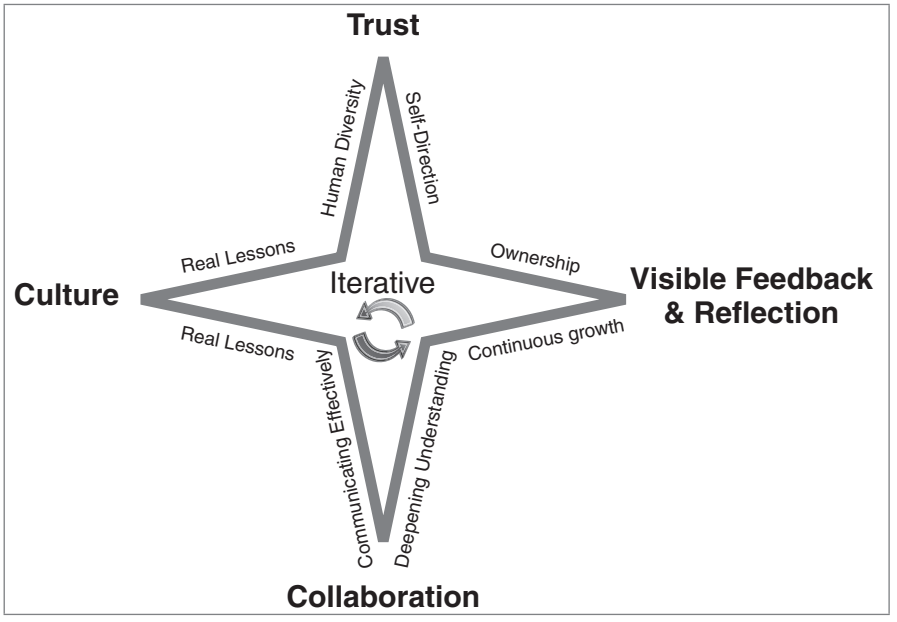


Figure 1 - Agile in Education Compass (Delhij et al. 2016)

The Agile in Education Compass represents a value system based on trust, feedback and reflection, education, and collaboration. These values are seen in an iterative process and in their totality reflect the understanding of the term 'Agile Education'.

Scrum is a process model. It is intended to break up the rigid, sequentially built-up procedure and redefine project work through iterative as well as incremental elements. The abbreviation "edu" stands for "education" and extends the Scrum framework to include integration in education. The essential components are taken from Scrum and adapted for use in education. Analogous to the Scrum Guide, in which processes, roles, artefacts and principles are defined, there is the eduScrum Guide (eduscrum Team 2020). The transparent processes make it possible to constantly review and adapt processes (e.g., learning successes, personal development). The focus is on the individual responsibility of each person and thus of the team. The approach and the underlying processes are determined to a large extent by the students. Teachers act as learning guides and determine the guidelines with regard to the topic and the assessment of the resulting products (successful implementation of the project). An advantage of (edu)Scrum is that there are only a few roles, rules and structural elements. This means that it can be learned and implemented quickly.

Working with eduScrum can also be justify in terms of educational theory with the help of Deci and Ryan's (2000) self-determination theory. The self-determination theory postulates three innate psychological needs that are equally relevant for intrinsic and extrinsic motivation and are particularly promoted in the implementation of eduScrum:

Need for competence or efficacy, autonomy or self-determination and social relatedness or affiliation.

LITERATURE REVIEW

The methodological concept of EduScrum originated in the Netherlands and is now being integrated by committed teachers into various educational sectors worldwide. On the website "eduscrum.org", the eduScrum Guide is available for download in numerous languages. The guide describes in detail the different steps in implementing eduScrum in educational programs (eduScrum Team 2020). Only in the last few years has eduScrum gained worldwide attention.

Most currently published articles on eduScrum deal with the didactic-methodical implementation of the concept in teaching situations. The special conditions of distance teaching during the pandemic are also frequently included (Reichwein & Stiehm 2022; Voštinár 2021). Some of the publications explicitly refer to the implementation of eduScrum in the field of higher education (e. g. Filho & Lima 2018; Ryazanova, Naumov & Kamennykh 2020; Kuz 2021). Other publications focus on primary and secondary education (e. g. Semenovskikh & Volkodav 2021; Voštinár 2021). However, it is noticeable that so far only a few articles explicitly deal with the effectiveness of eduScrum in learning processes. The results of the empirical research contributions apparently shows that the use of eduScrum improves competence development compared to other teaching concepts (Lazorenko & Krasnenko 2020; Sturm & Rundnagel 2021).

Positive results were particularly evident in the competence areas of communication, creativity, independence, and problem-solving. For the future, further studies on the effectiveness of eduScrum in teaching/learning processes are necessary to be able to comprehensively assess the quality of this new project management method when used in educational institutions.

EXPLANATION OF THE TOOL

- Aim of the tool

  The aim of the tool is to promote self-organised learning and action to improve critical, analytical, and creative skills of the students.

- Expected outcome

  EduScrum is a project-management method for education. It is very useful for project-based learning where the students have to solve complex task in a structure manner without a teacher give a direct information what they have to do. The outcome is the result of a problem-solving process which has to be solved in a autonomously working team of four to six students.

- Allocated time

  From two days up to two weeks and more.

- Setting, place layout

  This method can be implemented in a common classroom setting or in an online setting. It is necessary to have space for the scrum board unless the group is going to use an equivalent digital tool.

- Necessary materials

  If you are using a physically scrum board, you need some Moderation cards and pens. You can also use a digital board e. g. a KanBan board. The other materials depends of what kind of content your project has.

- Number of participants

  Each group of students consist of four to six students. The number of groups are not limited, but it is for the organization better not to have more groups than four or five.

- Role of students

  One role of students is to be a team member of the student-team. The team itself works autonomous, self-organized and interdisciplinary.

Another important position within the team is the eduScrum-Master or Team captain: The eduScrum Master (eSM) is the member of the student-team. The eSM ensures that the team can act in the best possible way. To do this, he moderates the individual phases and deadlines. The eduScrum-Master engages on the same level as the other team members.

In the starting period of an eduScrum learning circle it could be a good choice that the teacher works very closely with the eduScrum Master together or he is overtaken some task of his job.

- Role of teacher

  The role of the Product Owner (PO) is taken by the teacher, and he is not part of the student-team. The PO defines what is to be learned. For this purpose, details such as learning objectives, celebration criteria, learning materials, time, etc. are defined before the work starts. Celebration Criteria are requirements that the tasks or projects must meet for successful completion.

- Steps to use the tool

  In Figure 2 you see the entire learning and working cycle of eduScrum.

  On the left of the side, you could see the planning section. After the start it's turning a subject into a project. The teacher determines what and why to learn. To monitor the quality of what has been learned, the teacher uses a number of Celebration Criteria that are established in advance and shared with the student team. These Celebration Criteria consist of, for example, requirements for the tests, forms of presentation and their scope, rubrics, but also deadlines and other preconditions for the work to be delivered. The team is responsible for ensuring that the Celebration Criteria are met.

  Then it is necessary to form the Student Team with the Team captain. Friendships are not important. The next step is the planning section. On a board, we call it scrum board, the team develop an overview of all tasks of the project.

  In the middle you can see the working cycle. The student team are working self-organized and interdisciplinary on their project. During the working cycle stand ups were carried out. Stand ups are short reflection on the development steps to achieve the goal. It helps the student team to synchronize activities and plan for the next meeting.

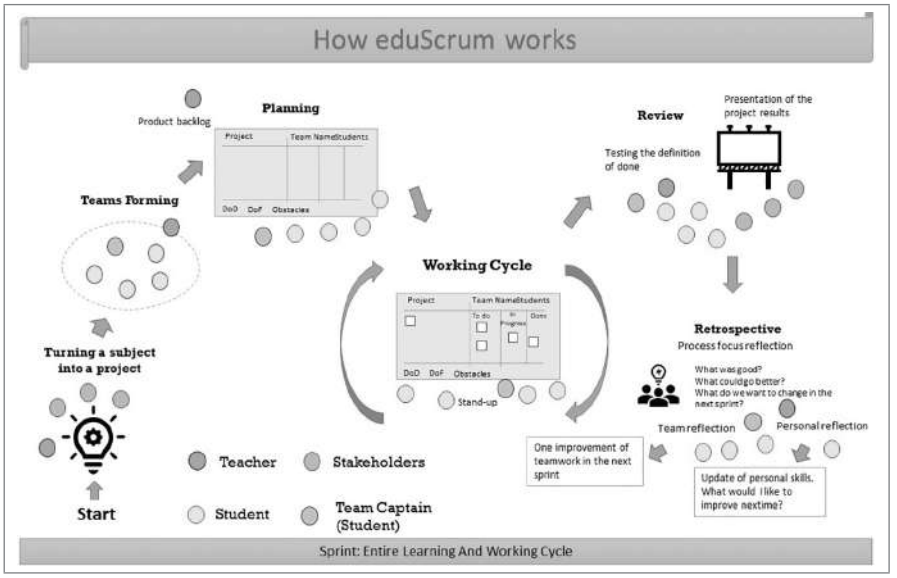


Figure 2 - How eduScrum works? (https://www.eduscrum.nl/resources)

After one working cycle the review-process will begin. The student Team demonstrates the project results, and the teacher compares this with the learning objectives. The form depends on the learning objective (s) and Celebration Criteria. During the entire sprint it is important to review and adjustment as often as possible, but not too often.

Finally, the retrospective is the moment for the student team where they look back on their delivered work and their personal and team development. The retrospective must be carried out with sufficient depth so that the team as well as the individual members can use it to draw up a plan to improve themselves during the next sprint.

Important elements, which will be described in more detail below:

Sprint: Main component of eduScrum. In a sprint, certain work steps are carried out in order for students to work on a project, subject, etc. independently.

Scrum-Board: An overview of all tasks that are required to achieve the learning goal.

Stand-Up: Short reflection on the development of work steps to achieve the goal.

Review: The teams show what they have implemented in the last sprint. The product owner compares this with the learning objectives.

Retrospective: Evaluation at the end of the sprint.

- Assessment

  In addition to determining what is being learned, the teacher will also have to monitor, test and improve the quality of the learning outcomes. For this he has Celebration Criteria at his disposal, which are the requirements or criteria the assignments or projects must meet. The Celebration Criteria that are established in advance and shared with the student team. They are clearly visible on the scrum-board. The team members set up tasks and activities themselves to ensure that the Celebration Criteria can be met. In addition, the students can also add their own Celebration Criteria to their own project and / or product in consultation with the teacher.

- Students' feedback

  Based on my experience by using this method this is a very new and challenging approach for many students, a longer introductory period is essential for a sustainable and successful implementation. The need to experience competence through the ability to act and positive effort is perceived as activating by the learners in the area of problem-solving in a team using their own skills. The students complete the self-imposed tasks on their own, can reflect on and optimise their approach in a goal-oriented way. It is noticeable that a lot of time is needed to understand the procedure and the individual phases in eduScrum. How to learn with eduSrum needs to be exercised. In the beginning, simulations such as the airplane game (Hermens 2016) or the ball point game could be carried out with the students.

EXAMPLE

This short example is intended to illustrate the use of eduScrum. The school class consists of 34 students between the ages of 16 and 22 who are undergoing vocational training to become IT specialists. The students first receive the eduScrum project goal and the acceptance criteria from the teacher. The project goal was: Create a **concept paper** for an educational video on the topic of electrical power and electrical work. The acceptance criteria were:

- Running time: 2 to 3 minutes, max. 5 minutes,
- Target group: IT specialists,
- Type of learning video: free (screencast, laying technique, interviews, ...),
- present a practical example in a way that is comprehensible to the target group,

- no in-depth physical formulas,
- Content and structure important, design and aesthetics secondary.

In the implementation, the teams were autonomous, individual, and self-directed. The learning goal was to be achieved in the form of a sprint divided into two sprintjes. Seven people from the class were chosen for the team formation, who were to put together an interdisciplinary team on the basis of the completed slips of paper ("What am I particularly good at?"). The students went through the planning, editing, stand-up, review, and retrospective phases twice and documented the process on their respective boards. Care was taken within the teams to ensure that tasks were distributed appropriately throughout the sprint and that time was kept to. Learning objective(s) and acceptance criteria defined the sprint goal.

After the sprint was completed, the teams were asked about the current status of the learning objective and the acceptance criteria. The Product Owner had to ensure that each team achieved the learning objective and the acceptance criteria. Finally, an outlook on the implementation of the learning videos was made. The creation of the videos took place in the following lessons. The teaching day ended with a detailed feedback session.

CONCLUSION

EduScrum is a framework model that gives the students orientation and a fixed structure. Within this structure, however, the students have a lot of freedom to work on their individual learning tasks. In this way, the students achieve a clear gain in competence in the areas of self-organization and problem-solving. Furthermore, eduScrum strengthens the ability of the students to take responsibility and guides them to plan the learning process by themselves. The teacher determines WHAT and WHY to learn, the students decide how to learn. During the sprint analytical thinking and problem-solving learning are particularly supported.

Based on the fixed and regulated processes and assignments, eduScrum offers an ideal setup in order not to lose contact with the class students even during the Lockdown, and to accompany and reflect on their "learning progress".

It is particularly important that the students are not completely left to their own devices and have a lively exchange with each other and with the teachers. Especially against the background of a heterogeneous learning group, central synergy effects of the individual learners are of enormous importance. These regular meetings are a clear advantage of eduScrum, as the respective team members are in close exchange with each other through the meetings and thus problem areas become visible more quickly. In "classic project work", these problems often only become apparent when it is too late (shortly before the project is handed in).

Many of the students found it difficult to identify needs (professional inputs) and to communicate them to the teachers. Furthermore, it has been noticed that some learners are still strongly bound to the "classical" role of teachers. This means that it is difficult for them to take responsibility for the learning process. At some points it became apparent that learners have internalised the attitude "I learn what the teacher tells me and how she tells me" and find it difficult to dissolve this. eduScrum offers some possibilities to support the necessary "change of mind".

Based on our experience by using this method this is a quite new and challenging approach for many students, a longer introductory period is essential for a sustainable and fruitful implementation.

REFERENCES

Cosgrove, N., Magnuson, P., Tihen, W. & Patton, D. (2019). Getting Agile at School. In. D. Parsons & K. MacCallum (eds.): *Agile and Lean Concepts for Teaching and Learning: Bringing Methodologies from Industry to the Classroom*. Singapore: Springer Singapore.

Deci, E. L. & Ryan R. M. (2000). Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being. *American Psychologist Vol. 55*, No. 1, 68-78

Delhij, A., van Dijk, G., French, M., Horn, E., Kodras, M., Miller, J. et al. (2016). *Agile in Education*. http://www.agileineducation.org

eduScrum Team (2020). *The eduScrum guide Version 2.0. The rules of the Game*. https://art2beagile.slab.com/public/posts/edu-scrum-guides-2-0-fk6r8ill

Filho, J. C. R. & Lima, R. M. (2018). Application of the eduScrum methodology to a higher education institution in the Amazon. *Proceedings of the PAEE/ALE'2018, 10th International Symposium on Project Approaches in Engineering Education (PAEE) and 15th Active Learning in Engineering Education Workshop (ALE)*. pp. 331-335

Gerholz, K.-H. & Dormann, M. (2017). Ausbildung 4.0: Didaktische Gestaltung der betrieblich-beruflichen Ausbildung in Zeiten der digitalen Transformation. *bwp@ Berufs- und Wirtschaftspädagogik – online, Ausgabe 32, 1-22.* http://www.bwpat.de/ausgabe32/gerholz_dormann_bwpat32.pdf

Hermens, E. (2016). *Airplane Game – Agile Games*. https://agile-games.de/airplane-game/

Kuz, A. (2021). Scrum: A new framework applied to education. *Eduweb, septiembre-diciembre, v.15*, n.3. pp. 10-17

Lazorenko, L. & Krasnenko, O. (2020). Applying Agile Learning to Teaching English for Specific Purposes. *International Journal of Learning, Teaching and Educational Research Vol. 19, No. 9*, pp. 238-258. https://doi.org/10.26803/ijlter.19.9.13

Reichwein, W. & Stiehm, D. (2022). Agile Lernprozesse - Das Potenzial von eduScrum als didaktisches Konzept für die berufliche Bildung. *lernen & lehren Heft 145*

Ryazanova, N.; Naumov, V. & Kamennykh, N. (2020). Implementation trajectories of environmental education for sustainable development in formal, non-formal and informal education based on eduScrum project management methodology. *E3S Web Conf. Volume 169.* https://doi.org/10.1051/e3sconf/202016905002

Semenovskikh, T. & Volkodav, T. (2021). EduScrum motivates younger school-age children to learn environmental science. *INTED2021 Proceedings*, pp. 4419-4423

Stolze, A. & Wijnands, W. (2019). Transforming Education with eduScrum. In. D. Parsons & K. MacCallum (eds.). *Agile and Lean Concepts for Teaching and Learning: Bringing Methodologies from Industry to the Classroom*. pp. 95–114. Singapore: Springer Singapore.

Sturm, N. & Rundnagel, H. (2021). Agiles Lernen digital gestützt: Die Methode eduScrum in der Hochschullehre. In. *Hochschulforum Digitalisierung (eds.). Digitalisierung in Studium und Lehre gemeinsam gestalten. pp. 577 – 599.* https://doi.org/10.1007/978-3-658-32849-8_32.

Voštinár, P. (2021). EduScrum method for teaching programming microcontroller Arduino. *44th International Convention on Information, Communication and Electronic Technology (MIPRO)*, pp. 749-753

Chapter 7

Elisir and Poison

Patrizia Fazzini, Marco Ghelardi & Francesco Maria Marelli

MISTAKES AS A SOURCE OF LEARNING

How to use the error in the educational process. "You learn by making mistakes" it's an old Italian proverb. "A new one could say that by making a mistake, you invent something new" Rodari writes in the Grammar of the Imagination. A mistake is a process that generates stories and knowledge. The error belongs to the human means of obtaining the knowledge of reality. When faced with the unexpected and the new, such means proceed by trial and, indeed, error and often this involves mistakes and deviations. Usually in school, an error is a source of frustration for students of all ages and this attitude often leads to a staggering drop in the levels of motivation to study, low self-esteem, and a negative relationship with educational institutions. The proposed tool offers a different and alternative way of considering the "error" turning it into a starting point for new creations and new narratives as well as a positive opportunity to recover the gaps in skills, setting up an educational dialogue supported by a relationship of trust between pupil and teacher. The teaching practice starts from the pedagogy proposed by Gianni Rodari both in the Grammar of the Imagination and in his famous Book of Mistakes.

ERROR AS A PEDAGOGICAL TOOL

The tradition, however, has distant origins and it has its roots not only in the history of science but also in the history of art. Artists such as Leonardo da Vinci and Andrea Mantegna understood how the 'stain', the error and the irregularity were an integral part of their research. We also remember one of the most famous projective tests used in psychological therapy for investigation and introspection, the Rorschach inkblots. The tool works well also with narrative and poetic texts. The experience we are proposing begins precisely with an error contextualized in William Shakespeare's famous stage story of Romeo and Juliet, where the error involves a change in the narrative structure and the final outcome. In the case of a straightforward acting of the piece, the concept of a mistake materializes in the interaction between the boys on stage who must improvise first and then write a new story and a new ending.

THEORETICAL BACKGROUND OF THE TOOL

"It is amazing to see how students can lose part of their fear of making mistakes, which is deeply rooted in them, when they find themselves with a teacher who does not ask them to be right, but just to join him in the search for error: of his as well as their own mistakes" (N. Postman, Teaching as a subversive activity, Delacorte Press, 1969). For the teacher it is important to be the object of this proposed practice. During her training, it is necessary for the teacher to come out of the habit of judgment and simply to act as an observer and tutor in the learning process. This tool asks not to go back to your work, to cancel or to restart the execution. Group work allows for an interaction between the students who decide their pictorial intervention in turn by interacting with their classmates and developing the image proposed by the previous classmate. The setting also plays a fundamental role: in an open and bright space, with large canvases available, each participant is asked to respect the rules of the 'game' which include silence (it is much better not to use words), stops cancellation and expect an interaction with the image of the other students without any overlap.

Only after the mid-Twentieth Century did a form of thought begin to emerge that laid the foundations of the Pedagogy of Error thanks to Karl Popper and Henry J. Perkinson's rereading of Popper's positions. Feuerstein dedicates a few pages of the Structural Enrichment Program to "errors" with the objective of emphasizing their function as source of conscious critical thinking. It is precisely by identifying the error and its cause that the student learns fundamental strategies of critical analysis. Knowing that you can make a mistake also helps the subject not to fear judgment because she is aware of the fact that knowledge increases through error. The identification of the mistakes, among other things, can be either individual or shared with the group, thus promoting soft skills of relationship, mutual support, and empathy. This tool distances itself from more rigid practices and it is based on creative dynamism, active cooperation, continuous research, on research by trial and error and it constitutes an experience aimed at finding satisfactory solutions to the problems that actual reality constantly presents.

LITERATURE REVIEW

It takes a great imagination to be a great scientist, to imagine things that do not yet exist, to imagine a better world that the one we live in and get to work to build it (Rodari, 1996). Rodari is convinced that imagination has its place in education, he claims the importance of developing creativity and imagination for education. Fantasy helps to uninhibit the mind, to get it out of preconceived patterns.

Nursery rhymes and stories in the name of error: distracted pupils, boring professors, athletes who are not up to date with their spelling ... Often "mistakes – said Gianni Rodari – are not in words, but in things; we must correct the dictates, but above all we must correct the world" (Rodari, 1994). Rodari in his writings takes us into a broken down and disordered linguistic universe, but it is not a text of boring grammatical exercises because the magical Gianni Rodari gives rise to laughter from every oversight, changes the rules of our grammar at stake, opens a dense and very rich dialogue with the readers.

Only after the middle of the twentieth century does a form of pedagogical thought emerge which founded the 'Pedagogy of error' thanks to the reinterpretation of Popper offered by Perkinson - consisting of identifying error as a basic element of teaching/learning (Perkinson, 1984). Perkison also challenges his theory with another one developed by Karl Popper entitled "evolutionary epistemology". This view holds that the teacher's job should not be to force predetermined knowledge (learning goals) into students' heads but to help them expand and correct their existing knowledge. This alternative view of teaching can be accomplished by using a 3-step model of teaching, consisting of: presentation, critique, and rebuttal (Perkinson, 1993).

The educational system has always been the instrument for the transmission of values, ideas, and cultural heritage. It therefore assumes a strategic function "teaching to become good thinkers", stimulating the development of thinking skills and awareness of one's mental processes. (Feuerstein, 2014). The goal is to create flexible minds, which do not get confused by the new and who know how to be critical and creative with respect to knowledge. The cornerstone of Feuerstein's work is his in-depth study of his models of "cognitive modifiability" and "instrumental enrichment".

In the early 21st century, Gaita published an essay that can be read as a novel. In the essay, a psychoanalyst and a musician accompany us with a simple language in evocative territories of our mental functioning: the way in which makes us think about something without being able to say it with words; the mechanisms by which a perfume irresistibly triggers a memory; or the profound patterns by which a fantasy, a landscape or a melody sets our minds in motion (Gaita, 2000).

Later in 2009, Pitruzella developed a survey on creativity born in the field of Arts Therapy, a discipline that was having a growing diffusion in Europe. After a general definition of creativity, the text analyses its importance in the healthy development of the person and its value as a resource in the educational, therapeutic, and social fields. Next, the author proposed a detailed description of

how the creative process works and the possibilities activating, governing, and evaluating it (Pitruzella, 2009). Munari, a great Italian artist known throughout the world for the whimsy and lightness of his creations, demolished the myth of the artist-star once and for all to replace it with the figure of the 'designer'. Through a compelling analysis of works and themes, conducted with clear and enjoyable drawings and images, Munari provides an extremely comprehensive presentation of design and mental strategies in the design phase. (Munari, 2008).

EXPLANATION OF THE TOOL

Preparing setting (Teacher):

- Open and quiet space
- Canvas, brushes and colours (for example black and yellow)
- Preparation of a starting point with words or images, images + words
- Rules of the activity (silence; change position, not to always draw over the same space of the canvas; Treat the other person's work as if it were your own)

Activity (Student):

1. Error as a cognitive possibility: group work starting from drawings, signs or words made by teacher
2. Free drawing by each student starting from the existing images, develops its own idea
3. The image continues to transform itself by playing with others signs and marks
4. Embrace / welcome the other person's idea
5. Add colour that increases the collective dimension of the artistic work
6. Realize the picture at the same time with other groups
7. A sheet becomes the backdrop for Romeo and Juliet
8. Changing the plot: what would happen if... deconstructing and rewriting the story

How to assess the experience: the goal is not to produce the 'best story' but to follow the consequences of change. Marks and assessment should be given according to:

- How the change has been chosen: how far and how much has changed the story?
- Have they respected the suggestion, or have they turned into something else?
- Was the group able to accept and follow the change to its consequences?

- Have they been able to close the story and reach a conclusion coherent with the new Turning Point?

The Teacher should monitor each group's work and assess how they work together. Are suggestions taken on board? Is there space for everybody to participate?

In general, in the evaluation of creative skills that also include critical thinking, we use these criteria that we believe to be transversal to all study subjects (macro-skills):

1. Understand and interpret verbal messages, written, iconic-visual texts, rules
2. Identify and summarize essential elements of communication
3. Recognize and interpret reference models
4. Correctly use the expressive tools in the disciplinary field
5. Correctly use artistic techniques for conception and communication
6. Use and be aware of the design methods alone or in a team
7. Qualify your work in a personal way
8. Operate for comparisons with a critical spirit and decision-making autonomy

Expected outcome
Students:

- Increased attention span
- Increase in self-esteem and self-awareness
- Increase of analytical skills
- Increase in problem-solving strategies
- Increased flexibility
- Greater control of behavior
- Knowledge and better management of emotions
- Reduction of impulsiveness
- Increase in vocabulary and verbal speech
- Increase of planning and organization skills

Teacher:

- Acquire new data in the assessment of skills by observing the process and the final assessment interview with the student
- Encourage collaboration with teachers from the team and other disciplines

CONCLUSION

Most of us would have heard and would agree with the sentence 'we learn by making errors'. Nonetheless, it seems that this is often disregarded in the teaching practice. Classrooms tend to be portrayed as spaces where mistakes are punished, and errors are equal to failure. In this environment, students develop a 'fear' of making mistakes which is detrimental to the learning process. 'Elisir and Poison' is a pedagogical tool that puts the error as the center of learning. It allows students to understand the importance of making mistakes and most importantly, they are capable of learning by navigating through errors. This innovative pedagogy requires the teacher to challenge his/her bias when it comes to attributing error to underachievement and he/she will have to reconsider the role of assessment. Once the conception of error and assessment are reconsidered by the teacher, Elisir and Poison become an optimal tool to promote creativity and collaborative thinking in the classroom.

REFERENCES

Gaita, D. (2000). Il pensiero del cuore. Bompiani.

Feuerstein, R., Felik, L.H., Feuerstein, R.F. (2014). Changing Minds and Brains—The Legacy of Reuven Feuerstein: Higher Thinking and Cognition Through Mediated Learning. Teachers College Press.

Munari, B. (2008). Design as art. Penguin Classic.

Perkinson, H.J. (1984). Learning From Our Mistakes: A Reinterpretation of Twentieth-Century Educational Theory. Greenwood Press.

Perkinson, H.J. (1993). Teachers Without Goals, Students Without Purposes. McGraw-Hill College.

Pitruzzella, S. (2009). The Mysterious Guest: An Enquiry on Creativity from Arts Therapy's Perspective**,** Iuniverse Inc.

Postman, N. (1969). Teaching as a subversive activity, Delacorte Press.

Propp, V. J. (1968). Morphology of the Folktale. The American Folklore Society and Indiana University.

Rodari, G. (1964). Il libro degli errori. Einaudi.

Rodari, G. (1996). The Grammar of Fantasy: An Introduction to the Art of Inventing Stories. Teachers & Writers Collaborative.

Rodari, G. (2020). Thelephone tales. Enchanted Lion Books.

Chapter 8

FIESI Model for Productive Thinking

Ashutosh Biswal & Kamakshi Raipure

INTRODUCTION

People today are faced with an increasingly fast changing world where the most important skills are flexibility, innovation, and creativity (NCF, 2005). Creative thinking and critical thinking are the two important thinking skills. These are the components of 21st century skills and life skills too. But somehow this part of human cognition is ignored in the classroom teaching learning process (Patel, 1988). The World Economic Forum (2018) described these thinking skills as important for the future in its report 'future of job'. National Education Policy (2020) also emphasized on creative and critical thinking along with problem-solving but unfortunately our students are not good at higher order thinking skill (Paily, 1999). One of the reasons may be teachers' questioning style that is initiated in a classroom by a fact-based question, then students give a response and then feedback or evaluation by the teacher (Newton, 2017). It will result in rote learning or reproductive thinking only (Newton, 2017). In the name of objectivity teachers sacrifice flexibility and creativity (NCF, 2005). To get rid of this situation teachers need to focus on retention as well as transfer skill both (Mayer, 2002).

If we want to equip our students with these demanding skills then we need a certain program, strategy or teaching model that can help teachers and learners to do in their respective direction. Productive thinking is an effort in this direction. Productive thinking is a cognitive ability that combines creative thinking and critical thinking. For the development of productive thinking among students, a productive thinking model (FIESI) is developed. This model is developed by keeping in mind the components of teaching model viz. focus, syntax, support system, social system, role of teacher/students and application. This model is verified by the experts and class VIII students of Kendriya Vidyalaya (Central Schools) also taught science through this model for one academic session and found effective in developing productive thinking, creative thinking, and critical thinking (Biswal & Raipure, 2020 and Biswal & Raipure, 2021).

THEORETICAL BACKGROUND

Productive thinking process has its foundation in psychological theories. Guilford's structure of intellect model (SOI) describes three-dimensional representation of human intellect. In which there are three components viz. operations, products, and contents. The operation component is the thinking part of our intellect, and it provides evaluation, convergent production, divergent production, memory and cognition to give different products after interaction with contents. It creates the foundation for higher order thinking skills in general and productive thinking in particular. Productive thinking is the cognitive ability which uses memory through cognition and applies higher order thinking operations.

Productive thinking has brought its essence from Bloom's Taxonomy. It provides learning objectives in hierarchical order. It divides thinking skills in two categories: lower and higher thinking skills. For higher order thinking processes lower order thinking creates a foundation. In productive thinking also creative and critical thinking are the higher order thinking skills for which knowledge, understanding and application creates foundation.

It is the process of generating new ideas, but generation of unique ideas may not be productive unless accompanied by an evaluative component which enables the individual to select the ones most appropriate for the particular problem (Hoffman and Hoffman, 1964). We can say that productive thinking includes problem-solving, analytical and logical dimensions, as well as creative thinking (Hoffman and Hoffman, 1964). In the process of productive thinking our past experience may become a hindrance and an obstacle which blocks productive thinking and reduces behavior to stereotyped and fruitless essays (Birch and Rabinowitz, 1951). So, to channelize thought processing we need a step by step guide that can help to think in a particular way. One of the models is the ThinkX model developed by Hurson (2011). According to him, productive thinking is a process of suspending judgment to generate long lists of ideas and then returning to those lists to make choices by judging the ideas against pre-established criteria. The ThinkX model for Productive thinking has six steps to solve a problem through productive thinking as displayed in below figure 1.

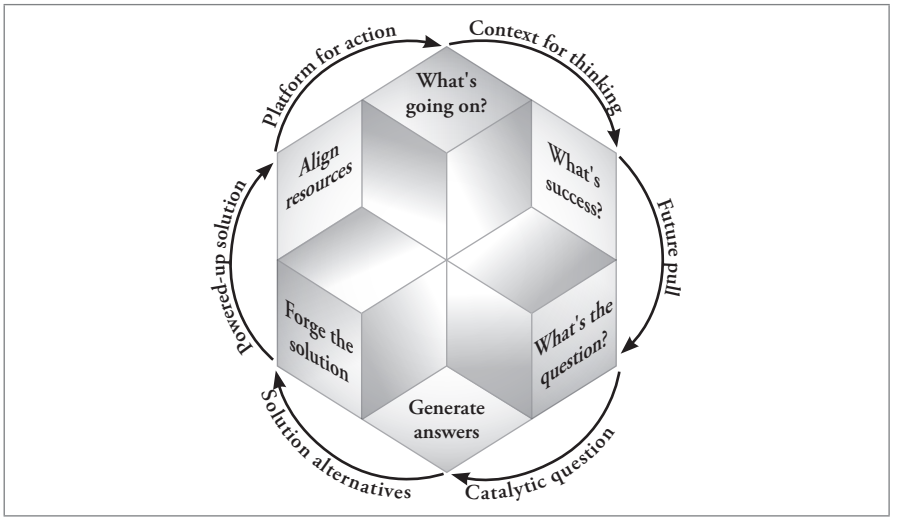


Figure 1 - ThinkX model

In this line, Newton (2007) also gave a model of Productive thought. She mentioned decision making, critical thinking, creative thinking, understanding and memory as the components of productive thought. In this model, memory is creating the foundation for higher order thinking abilities. It can be understood by the figure 2.

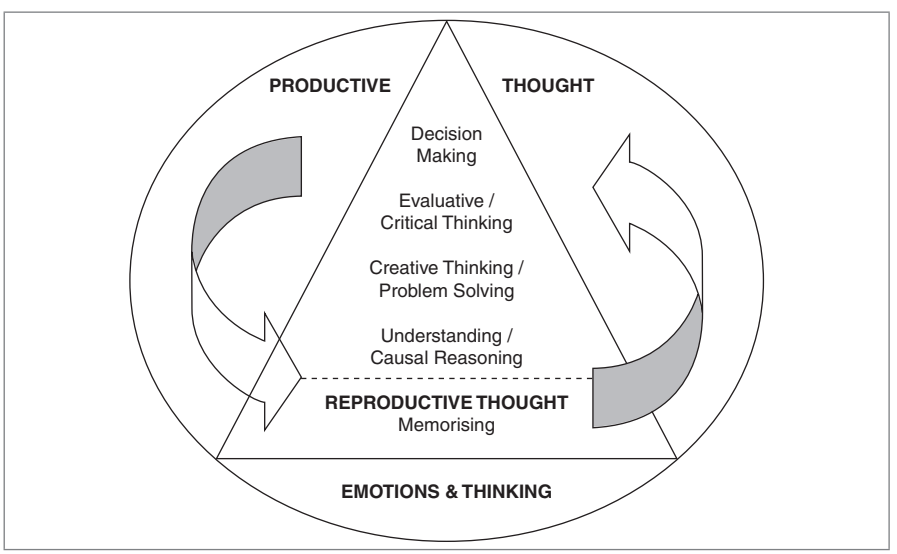


Figure 2 - Model of Productive Thought

Our memory and past experience are re-patterned and restructured to meet current demands in a productive thinking process (Birch and Rabinowitz, 1951). It is the combination of memory, motivation, creative thinking, and critical thinking (Rusbult, 1997). Patel (1988) described productive thinkers as who through their creation are able to make their lives more comfortable, meaningful and of healthy understanding. Davis and Scott (1971) (cited in Patel, 1988) define productive thinking as consisting in those divergent, convergent, and evaluating operations. It includes both creative and critical analysis dimensions of reasoning. According to Wertheimer (1945) reproductive thinking is associated with chained behavior or repetition and ultimately leads to rote learning whereas productive thinking is an insight based logical reasoning (Wertheimer, 2020). Gallagher and Aschner (1963) cited in (Aranda et al., 2020) considered productive thinking as the combination of creative and critical thinking skills where memory creates the base for higher cognitive activity. For this there are certain programs also to show the students how to proceed in an organized and systematic way when attacking a problem, and how to pay attention to relevant facts and conditions of the problem in evaluating one's ideas (Olton, 1969).

By keeping in mind, the available programs and models for productive thinking the present productive thinking model (FIESI) is developed to help the teachers, researchers and students to think in a particular way.

LITERATURE REVIEW

Review of related literature helps a researcher to develop an insight about the problem. Similarly, here also literature review helped the researcher to develop an insight about the teaching models and its components, productive thinking and its components, available models on creative thinking, critical thinking and productive thinking and strategy and techniques for the development of specific thinking processes.

We are living in the 21st century which is witnessing regular scientific advancements and challenges. As creative and critical thinking skills have a big contribution towards cognitive learning results therefore researchers and educators should have their focus over these skills (Siburian et al., 2019). As reported by Saido et al. (2015) students are not good at synthesis and evaluation skills which is one of the major concerns of education. Hence, teachers need to improve higher order thinking skills of students in the classroom by using appropriate teaching methods for active participation of students in the learning process. For the development of creative and critical thinking skills in students an opportunity should be given to exercise their own minds, to engage in critical appraisal, to risk opinions in a sympathetic atmosphere and then have the opinions challenged in a rational but respectful manner (Adey, 1999). Teachers can create a teaching and learning environment that is more conducive to foster creativity (Lee, 2001). We should provide the opportunity to the

learners to think like a scientist by engaging them in the process of thinking instead of merely ingesting the product of the scientists' disciplines (Saido et al., 2015). One of the ways can be collaborative learning as it provides room for negotiation of meaning, sharing of multiple views and changing the internal representation of the external reality (NCF, 2005). For the development of thinking skills among students it is required from the part of the teacher that the teacher should learn to listen to the students with empathy and without judgment, and to enable children to listen to each other (NCF, 2005). The obstacle of creativity is the passive unmotivated students with the tendency to rote learning, pressure to complete the syllabus and preparing students for examinations (Sarsani, 1999). We also need to change the atmosphere of objectivity and quizzing. Rather schools must provide opportunities to question, enquire, debate, reflect and arrive at concepts or create new ideas (NCF, 2005). In this direction, the Productive thinking program developed by Covington, Crutchfield and Davis (1966) (cited in Olton, 1969) teaches students how to generate many ideas, and how to look at them in different ways. Similarly, CoRT thinking program developed by Edward DeBono was also reported effective in developing thinking skills, Patel (1988) developed program for productive thinking to teach Geography was found effective. Brainstorming is an effective technique to develop creative thinking (Pandit, 2006 and George, 2016). Similarly, the Synectic model approach is an effective approach for creative thinking (Paltasingh, 1998). Use of open-ended questioning is evident for the training of problem-solving skills (Lee, 2001 and Chin, 2008). So, by having the review of literature researchers developed an understanding about productive thinking, its components, productive thinking model and techniques to be used in models for specific types of thinking.

EXPLANATION OF THE MODEL

Productive thinking model (FIESI) has a foundation in cognitive theories. It is based on other teaching models given for creative thinking, critical thinking, and productive thinking development. This model provides direction to the teachers to develop productive thinking skills among students. This model provides specific roles to the teacher as facilitator and student as creative problem solver. Productive thinking model creates space in the classroom where teachers can develop productive thinking skills among students through a subject content i.e., in an integrated way or it can also be done in a separate way. This model has its own focus, syntax, Social system, Support system, Setting/Place layout, Role of students/teacher and Assessment pattern. These components of the model are discussed here as follows:

- **Focus**

Productive thinking model (FIESI) is a teaching model which is developed with an aim to develop productive thinking among students. This model is designed to give enough space to creative thinking and critical thinking. Both thinking processes have opposite characteristics and therefore hinders the outcome of one another if applied at one place. To avoid this situation, the FIESI model provides a separate place to both types of thinking process such that they will support each other to refine the product.

- **Syntax**

The productive thinking model has its syntax with five phases FIESI i.e., Foundation, Ideation, Evaluation, Stabilization and Implication in the process of productive thinking. These phases are in one sequence starting from Foundation and ending at Implication. The Productive thinking process can be represented by figure 3.

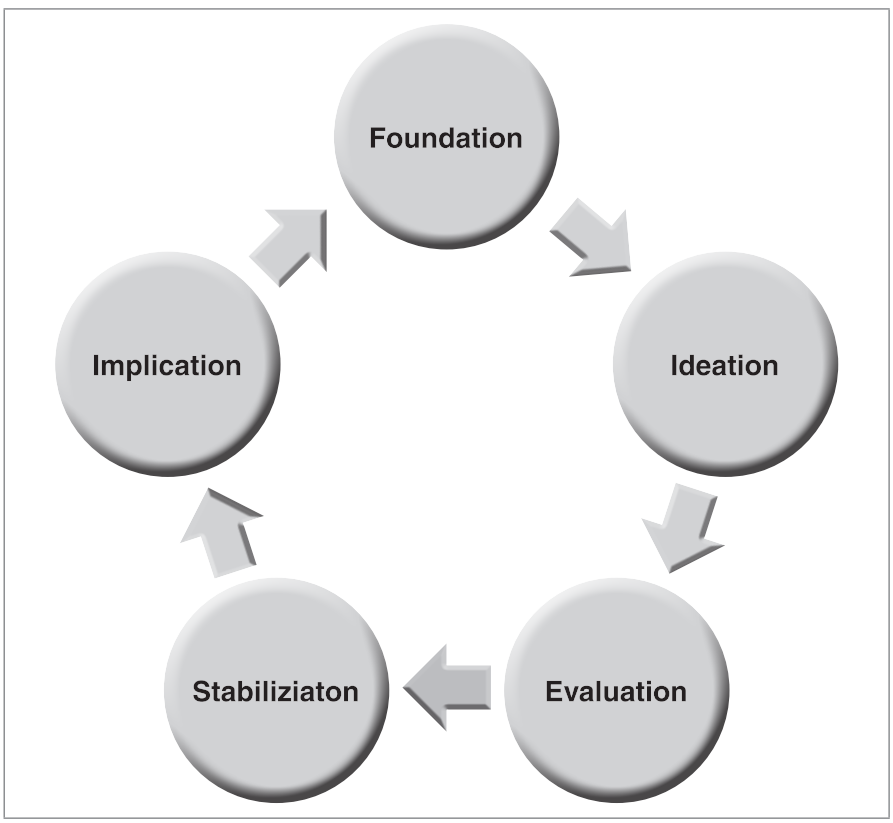


Fig 3 - Productive thinking process

a. **Foundation**

This is the first phase of this model. As its name indicates, it create a sound knowledge foundation among students with the help of learner centered techniques like using technology, activity, demonstration, discussion, and many more to engage learners in the teaching learning process. This step is based on the principle that creativity can never come in vacuum. For applying higher order thinking skills, a person must have a required level of knowledge to apply or transfer it in the new situation. After the explanation of the content, the teacher initiates the discussion also to clear the doubts among the students. The main objective of this phase is to create a knowledge foundation among the students for further proceedings.

b. **Ideation**

This is the second phase of the productive thinking model where students get a chance to draw their creative potential. Here, the teacher puts some situation in front of the students as the problem or question. Students analyze the problem carefully and think in an imaginative way to generate as many ideas as possible.

For this, teachers can use various creative thinking strategies like; creative writing, SCAMPER (Substitute, Combine, Adopt, Modify, Put to another use, Eliminate, Rearrange), cognitive question, brainstorming and many more... This is the phase where criticism by the teacher or by the peer group is not allowed. Because here the focus is on the quantity of ideas rather than quality. So, the students are allowed to think in many directions to generate the ideas without considering the quality of ideas.

c. **Evaluation**

This is the third phase where critical thinking has its role in refining creatively generated ideas of the ideation phase. Here, constructive criticism is allowed to increase the quality of ideas and add value to the budding ideas. This phase helps in selecting the best idea out of the generated list of ideas from phase 2. Teachers can use evaluation as one of the techniques to select the best possible idea. At this phase, ideas are evaluated on the basis of feasibility criteria and efficiency of ideas to solve the present problem. After this, students will have the best idea that can solve the problem.

d. **Stabilization**

This is the fourth phase of the productive thinking process. At this phase, teachers clear the doubts of the students if they have. Then students stabilize the concept by using techniques like concept map and summary. By doing this, students stabilize the concept in a systematic manner that will last for longer days.

e. **Implication**

This is the fifth phase of the productive thinking model which makes the difference between creative ideas and productive ideas. After evaluation the next phase is to imply the idea in some real-life situation to give a value to the idea. The idea that can be implied to the real-life situation is the productive idea or we can say the idea which is able to solve the problem in the present situation will be a productive idea.

After the five phases of the productive thinking process students will have a productive idea that can solve the problem.

- **Social system**

The model provides the central position to the students, or we can say the teacher used learner centric methods to teach the students. In the first phase, teachers focus on discussion and give equal importance to the child's experience to construct the knowledge. In this model, teachers set a collaborative learning atmosphere in the classroom where students feel free to share their new ideas with teachers and with their peers especially in ideation phase. Since criticism is not allowed, students share their ideas freely in the class.

- **Support system**

The productive thinking process requires a good mastery over the content and specific skills from the teachers' side. It can also be possible that the teachers can take specific training in this regard from the experts in this field.

SETTING/PLACE LAYOUT

This model creates a platform for cooperative learning. The process of this model can be done at individual student level, but it will be good if it is in a group. As the groups are formed by group dynamics principles so a variety of ideas can be the result of group process. For the activities in the group, classroom settings need to be changed according to the requirement.

ROLE OF STUDENTS AND TEACHERS

In the process of productive thinking, the role of a teacher is as a facilitator who facilitates the learning of the students. Teachers should act as a constant motivator who is always ready to accept students' responses without any personal comment of restrictive criticism. This type of behavior of the teacher stimulates students to think out of the box rather than sticking to the fixed answers. Here, the role of a student is as a creative thinker who can imagine in all the possible directions without considering the feasibility of the ideas. It can be said that students act as creative thinkers and teachers act as a constant motivator.

ASSESSMENT

Assessment of this teaching model can be done with the help of a Productive thinking scale which is developed by researchers (Biswal & Raipure, 2020 and Biswal & Raipure, 2021). This scale consists of 20 thinking situations and each thinking situation has 4 options. The 4 options represent the 4 types of thinking process viz. reproductive thinking, critical thinking, creative thinking, and productive thinking but not in the same order in the scale. Here the order of thinking starts from reproductive thinking and productive thinking is the highest order therefore 1 mark is allotted to option representing reproductive thinking and 4 for option representing productive thinking through critical thinking and creative thinking in the order.

The similar tool can be developed for different cognitive levels. This tool is generic in nature, it can be developed for a specific subject also.

Since, productive thinking is the combination of creative thinking and critical thinking, it can also be assessed through the standardized creative and critical thinking tools.

EXPECTED OUTCOME

After the completion of the training through the productive thinking model (FIESI) students will be equipped with productive thinking. As we know that productive thinking is the combination of creative thinking and critical thinking, so by the end of the training students will be able to think creatively and critically also. It can be said that this model will equip students with higher order thinking skills like analysis, synthesis and evaluation. This model helps students to become a creative problem solver.

CONCLUSION

Productive thinking model (FIESI) is a teaching model. It has its syntax, focus, social system, support system, role of students/teacher and place layout. It helps the teachers to train the students for productive thinking processes. It provides a platform to combine creative and critical thinking at one place. It can be generic as well as can be used in an integrated manner. It can be used for a wide range of age groups also i.e., for school education as well as higher education. It is a complete package for higher order thinking skills and can be used for creative thinking, critical thinking and other 21st century skills also.

REFERENCES

Adey, P. (1999). *The science of thinking, and science for thinking: A description of cognitive acceleration through science education (CASE).* UNESCO. International Bureau of Education.

Aranda, M. L., Lie, R. and Guzey, S.S. (2019). Productive thinking in middle school science students' design conversations in a design-based engineering challenge. *International Journal of Technology and Design Education.* doi: 10.1007/s10798-019-09498-5

Birch, H.G. & Rabinowitz H.S. (1951). The Negative Effect of Previous Experience on Productive Thinking. *Journal of Experimental Psychology*, *41*(2), 121–125. Retrieved from https://doi.org/10.1037/h0062635

Biswal, A. and Raipure, K. (2020). Fostering productive thinking among elementary school students through the FIESI model. *Issues and Ideas in education*. 8 (2), 77-85.

Biswal, A. and Raipure, K. (2021). Integrated strategy to foster productive thinking among elementary school students. *Education India,* 10 (5).

Chin, C. (2008). *Teacher questioning in science classroom: what approaches stimulate productive thinking?* Retrieved from http://hdl.handle.net/10497/4744

George, K. M. (2016). *Impact of play brainstorming and storyline on creativity among middle school Children* (Doctoral dissertation). Retrieved from https://shodhganga.inflibnet.ac.in/handle/10603/201002

Government of India, Ministry of Human Resource and Development (2020). *National Education Policy 2020*, New Delhi: MHRD.

Hoffman, J.M. & Hoffman M. L. (1964). *Review of Child Development Research (volume 1).* Russell Sage Foundation, New York. Retrieved from https://books.google.co.in/books?hl=en&lr=&id=0-u4BgAAQBAJ&oi=fnd&pg=PR5&dq=Hoffman+%26+Hoffman,+1964+on+productive+thinking&ots=2kh43Pia9M&sig=p-5WHPUnPe2z_n-2aZgis4PnScUY#v=onepage&q=Hoffman%20%26%20Hoffman%2C%201964%20on%20productive%20thinking&f=false

Hurson, T. (2011). *Think better*. Think Better - Business Book Summaries. DOI: 10.1017/CBO9781107415324.004.

Lee, L.K.W. (2001). Fostering creativity in science education. *REACT*, 2, 27-32. Retrieved from, https://repository.nie.edu.sg/bitstream/10497/3842/1/REACT-2001-2-27.pdf

Mayer, R.E. (2002). Rote versus Meaningful Learning. *Theory into Practice*, *41*(4), 226–232. Retrieved from https://doi.org/10.1207/s15430421tip4104_4

National Council of Educational Research and Training. (2005). *National Curriculum Framework 2005.* New Delhi: NCERT.

Newton, L. (2017). *Questioning: a window on productive thinking*. Ulm: International Centre for Innovation in Education (ICIE).

Olton, R.M. et al. (1969). A Self-Instructional Program for Developing Productive Thinking Skills In Fifth-And Sixth-Grade Children. *The Journal of Creative Behavior*, *3*(1), 16-25. doi:10.1002/j.2162-6057.1969.tb00040.x

Paily, M.U. (1999). *Development of critical thinking among secondary school students in relation to some psycho contextual variables* (Doctoral dissertation). Retrieved from https://shodhganga.inflibnet.ac.in/handle/10603/31912?mode=full

Paltasingh, S. (1998). *Effectiveness of training in creative thinking through different approaches in teaching biology at the secondary level in developing creative ability of students* (Doctoral dissertation). Retrieved from http://14.139.116.20:8080/jspui/handle/10603/281011

Pandit, D. (2006). *Development of an intervention programme in creative teaching for students of standard VII* (Doctoral dissertation). Retrieved from https://shodhganga.inflibnet.ac.in/handle/10603/110330

Patel, D. D. (1988). *A study of the effect of productive thinking programme in geography on creativity of students of class IX* (Doctoral dissertation). Retrieved from https://shodhganga.inflibnet.ac.in/handle/10603/75523

Raipure, K. (2020). Productive Thinking Model (FIESI): To Make Science Education More Scientific And Innovative. *Horizons of Holistic Education*, 7 (2), 96-103.

Rusbult, C. (1997). Productive Thinking in Science and In Life. Retrieved from https://www.asa3.org/ASA/education/think/prod.htm

Saido, G. M. et al. (2015). Higher Order Thinking Skills among Secondary School Students in Science Learning. *Malaysian online Journal of Educational Sciences*, 3 (3), 13-20.

Sarsani, M.R. (1999). *Exploring the promotion of creative thinking among secondary school students in India* (Doctoral Dissertation). Retrieved from https://discovery.ucl.ac.uk/id/eprint/10019235/

Schuler, G. & George (1974). The Effectiveness of Productive Thinking Programme. *Chicago, Illinois.*

Siburian, O. et al. (2019). The correlation between critical and creative thinking skills on cognitive learning results. *Eurasian Journal of Educational Research*, *19*(81), 1-16. doi:10.14689/ejer.2019.81.6

Wertheimer, M. (2020). *Productive Thinking (1945) (pp. 25–257)*. https://doi.org/10.1007/978-3-030-36063-4_2

World Economic Forum (2018). *The Future of Job Report*. Retrieved from http://www3.weforum.org/docs/WEF_Future_of_Jobs_2018.pdf

Chapter 9

Innovation pedagogy as a tool to solve challenges with teamwork

Essi Silvennoinen & Graham Burns

THE 4TH INDUSTRIAL REVOLUTION AND THE FUTURE OF WORK

Workforces across the world are being challenged by the changes brought about in the Fourth Industrial Revolution, as is widely acknowledged. For graduates to be successful as effective members of any workforce they need to be educated in entrepreneurship; they require skills to innovate, work collaboratively and think critically. Traditional teaching methods have been seen to be no longer appropriate to develop those skills. Governments around the world are beginning to task higher education to work more closely with employers to meet this demand. Using this tool will therefore enable teachers to learn how to guide students to become more effective and therefore more valuable resources (Sjöblom et. al. 2019; Mälkki 2010, 2019).

Feedback from work life often comments on a lack of skills in self leading, problem-solving and collaboration. The problems of the world and work life are extraordinarily complex and often compounded by the interconnectedness. This phenomenon has been termed wicked problems (Dunne & Martin 2006; Lackéus 2015; Leavy 2010). To solve them multidisciplinary expert teams are needed which must be capable of exploiting a fast and iterative development cycle (Katchenbach & Smith 2015; Sonalkar et. al 2016). It is widely believed to be too late to learn these skills in work life where they should focus on applying their substance skills and competences and therefore it must fall to education to prepare graduates to join the workforce with the appropriate skills.

The Innovation Pedagogy tool can be used in a single or multiple related courses to support the development of essential skills that can be utilised immediately by teachers. It includes introducing and developing student-centred learning, collaborative learning, and dialogical skills, which among others, are core skills in consolidating deep learning (Kolb 1984; Lackéus 2016; Lombardo 1996; Heikkinen et. al 2012; Ruhalahti et. al 2018). Guided reflection of one's

own and peers' performance used within this model therefore supports professional growth (Heikkinen et.al 2012, Mälkki 2011; 2019). *The Innovation Pedagogy Tool* can be used in Teacher Education programmes at bachelors, masters, and/or doctoral level when collaborative learning methods and student-centred approaches will clearly provide beneficial results.

INTRODUCTION

In this way of teaching, the workflow is divided to 3 parts: preparation, implementation, and reflection (Figure1). With these elements it is guaranteed that the process will meet the need of required course content or curriculum requirements. The preparation phase has two distinct tasks: the teacher will plan the whole learning process, create the knowledge baseline and learning goals, while simultaneously, the students will do any required pre-reading individually. Once the preparatory work has been completed, the implementation phase can begin. The students will now begin to learn how to solve authentic and contextual challenges in teams.

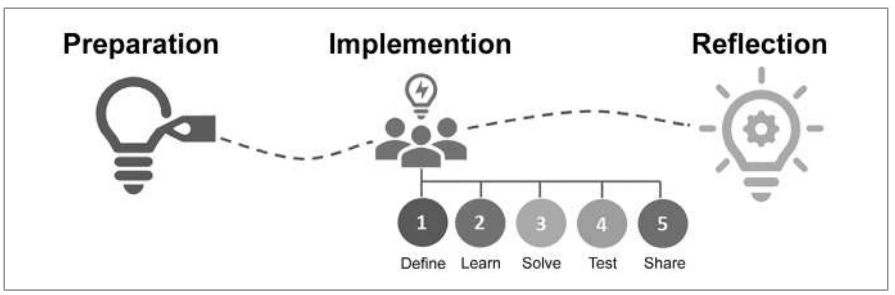


Figure 1 - Stages of learning process

Solving a so-called 'real problem' generates positive feedback reinforcing the learning cycle and can increase value creation by up to 70%. In this phase the teacher's job is to coach the students by using design thinking tools as the teams work through the problem to find one of any given number of solutions. To encourage the use of creative thinking skills, there should be no limit to the number of outcomes here. Finally, in the reflection phase the students will produce a report and reflect on their own learning but also that of their student colleagues in the teams, as well as their collective solution toward the content requirements (e.g., the content related learning goals that were set in the preparation phase).

THEORETICAL BACKGROUND OF THE TOOL

> *"Let students learn by applying their existing and future competencies to create something – preferably novel – of value to at least one external stakeholder outside their group, class, or school"*
>
> Lackéus, M. et. al. (2016)

The innovative pedagogy model consists of 3 components: innovative pedagogy, design thinking methods and teams as a learning platform. Combining these 3 components will create student-centred learning which produces the skills for self-leading, leadership, creativity, and critical thinking.

Design thinking brings the tools with which to solve modern and often wicked work life challenges because it involves enhancing creative and critical thinking skills. The tools and double diamond process model forces the team gently to focus and solve a problem from a user point of view. In the double diamond model, divergent and convergent thinking is part of solving process (Martin 2009, Osterwader & Pigneur 2010, Leavy 2010).

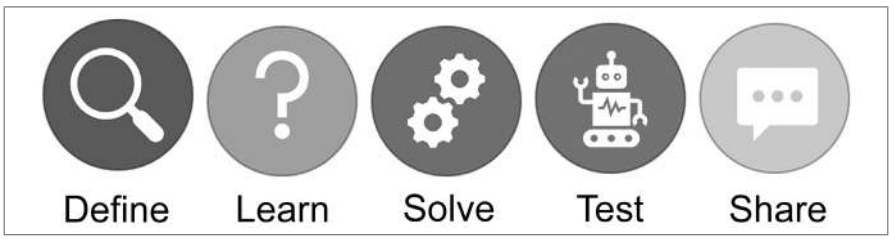


Figure 2 - Design Thinking phases during the implementation phase in learning process

In this model the double diamond is simplified into 5 stages: define, learn, solve, test, share (Figure 2). By guiding student teams in each phase using well select design thinking tools, the teams will be able to solve the original challenge. All the teams will have unique solutions and by sharing their teams' outcomes and thoughts during the process, peer-to-peer learning increases the learning outcomes.

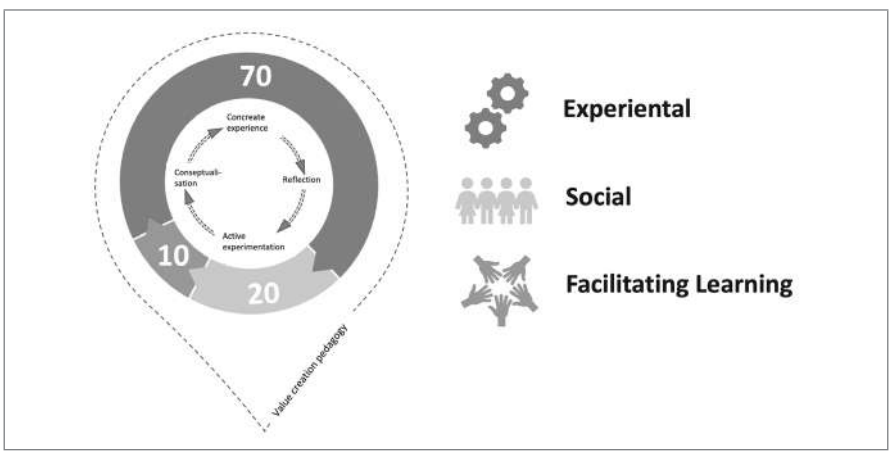


Figure 3 - Pedagogical model in Innovative Learning model

The core pedagogical theory in this experiential learning model is Kolb's cycle, applied at the individual and team level. According to Kolb (1984, 26), learning is best conceived as a process, not in terms of outcomes. The ideas and meanings in the learning process are not fixed, but in motion and change and construct through experience. The transformal learning process through experience includes, 1. concrete experience, 2. reflecting on experiences, 3. conceptualization and 4. active experimentation. All teachers should be aware of Kolb's learning cycle though their own education and training and be aware of how it affects education, but one could argue that they are mostly unaware of the value creation process required in certain learning situations. In experimental learning processes value creation pedagogy (Lackéus 2015; 2016) allows for a variety of values and meanings for all partners during the learning process. When the learning process and actions create value for others it helps students to see the importance of the ongoing process and its key contributing elements. Lackéus (2016) continues that this model has a direct effect on learning motivation and growth of entrepreneurial skills and community level to social climate. Both Kolb's cycle and value creation pedagogy state that real-life cases and active role of the student in learning process. Lombard et. al. (1996) reveals that individuals tend to learn 70% of their knowledge from challenging experiences and assignments, 20% from developmental relationships and 10% from formal education like lectures, coursework, and training.

In teachers' work, 70% of the work happens before the intensive student engagement part. Before coaching teams towards any learning goals, the case, a learning goals, assessment, reflection points and the coaching process need to be planned, agreed, and prepared. Twenty percent of a teacher's time is coaching and facilitating the learning process during intensive part and 10% formal instructions or lectures. While in students work 70% comes from interesting learning activities to solve the case with the team, 20% from reflection toward the learning goals and collaborative learning and 10% from writing reports or other formal educational tasks.

The third component of this innovative learning model are teams as learning platforms. The term, 'teamwork' is often applied synonymously with 'group work'. This is a mistake if a student-centred learning approach is desired. In group work, the teacher performs a central role and leads the work of students whereas in teamwork the teacher's role is to design the learning process and actively guide student teams to achieve the learning goals and to be active agents in their own learning (Katzenbach & Smith 2001, Kouzes et. al 2013). Effective teamwork requires self-leading skills, peer leading and collaborative working skills. The team needs to solve the problem – not the teacher. This requires that the leadership and action-oriented way of doing, and learning is encouraged and

supported by the teacher and the team is responsible for making its own decisions – for example, what ideas are worth presenting (criteria for what is a "good" idea must come from the teacher and the person or organisation who presents the initial challenge). Skills to negotiate, respect difference (in all respects) and sharing ideas and critically thinking are developed in teams when it is building part of the process, and the makeup of the team is multidisciplinary. For teachers this is central to gaining such awareness of understanding of the process of creating and managing effective teams (Katzenbach& Smith 2015; Kouzes et. al. 2013, 2; Wenger et. al 2002). When this is understood the focus on coaching teams and facilitating learning is a natural part of the process. The teacher is a key player by guiding the teams to focus on the right things and supports them to find solutions instead of simply giving answers. Developing a teacher's coaching skills is therefore based on meaningful learning tasks and, when suitable learning partnerships are utilised, learning is always value-driven according to the desired outcome.

Coaching as a method is a means of managing the learning process. It requires a large amount of work by teachers in planning and creating the learning tasks and identifying the milestones beforehand. This allows teachers to coach teams when the learning event starts. Teachers facilitate this learning by asking questions which help students with teamwork, and to solve the problem. This is a core element of the learning process which requires good presence and coaching skills from teachers. The challenges that teachers will face when using this model can appear rapidly but there will often be multiple solution that can be applied (Kouznes et. al 2013, Lackéus 2016). To reflect on a situation and create good learning process solutions, we strongly suggest employing the buddy teaching method.

Explanation of the tool

1. Preparation phase:
    a. Decide how long your process needs to be: from a few hours to a much longer processes, like a week.
    b. Create 3 to 5 learning goals for your student group (collaborative work, design thinking tools, problem-solving, critical thinking).
    c. Find/formulate a real-life problem and agree the boundaries for solving this. What outcomes are required from the challenge owner's (stakeholder's) point of view.
    d. Determine and agree what things the teams can decide for themselves.

e. How will the process learning be assessed? Often the outcomes are not important - the fact they have implemented the tools and collectively worked together and agreed the ideas, is more valuable. The criteria for assessment and outcomes are planned, agreed, and communicated at this stage.

Notes for consideration: Think the amount of work the tasks will demand from the students and plan and schedule the learning phase accordingly. With younger students it is advised that the process is very closely guided, and the instructions and tools are easy to implement. Guided reflection is also a key step in learning. Plan the steps for reflection: before, during, after each step. Collaboration, creating ideas and validating them will take more time than you might imagine.

2. Implementation phase – facilitating the learning process and coaching teams to solve challenges:
   - Define, learn, solve, test, share – make sure that teams are understanding what is required and the design thinking tools are available for them.
   - Start days or sessions with your student teams by telling the goals of the phase and introducing the tools they need to apply.
   - Coach teams to solve faced challenged and applying the tools. Give options instead of giving answers and help them to discuss and make decisions in a team.

3. Reflection phase:
   - Guide the reflection with the point of views and questions. For example, team working own participation and roles in team decision making and doing, design tool implementation.
   - Students write a reflective report of complete process, guided by teacher/tutor.
   - Peer and coach/mentor feedback in plenary.

The learning environment

In this active based learning approach, we cherish the time together with the team. This means that learning spaces need to be organised so that every team has its own space in which to work. Round tables are recommended because that helps communication when everyone sees each other's face and the leadership can be built in a democratic way. Helpful resources to help facilitate the process can be found from online platforms (like Moodle) and they can be adopted and adapted according to a teach-

ers plan of how the process should go. Prior preparation of any such resource is recommended as it saves valuable time for both teacher and students. Initially collaborative work in teams might seem extremely hard the students so consider how the learning environment can make the process easier for them. A simple remedy is pencil and paper. That is the fastest route to transfer thinking to a visual format. It also forces teams to interact with each other. There can be no hiding behind screens: computer or mobile. This stage can also be used as a physical learning phase. Sharing outcomes, ideas and thoughts during the process will boost peer-to-peer learning and is practising important work life skills at the same time.
If you use an E-learning platform, make sure it is suitable for collaborative work. Finally, any physical learning environment containing sufficient tables/chairs for the group and white/noticeboard for collaborative creation

Role of students and teachers

- Students: they are in the star role during such intensive learning events: actively participating in teams to create solutions.
- Coaches/teachers: they lead by example, designing the learning process, and coaching students towards individual and team-level learning goals.

Expected outcome:

- For students
  - To develop their creativity in problem-solving, collaborative work, and critical thinking skills.
- For teachers
  - To understand the definition of an effective coach in a pedagogical framework.
  - To define the self as a coach and understand how to act responsibly to be a successful role model.
  - Expand his/her own network within education and with work life partners and stakeholders.

CONCLUSION

Schools are for life – so education in all levels should give practical skills to manage one's own life. As the world evolves, teachers must develop their own skills through learning new and innovative methods that are suitable for the time to meet the demands of employers. This tool enables teachers to take one step in that direction. By leaving behind, even for a fleeting period, traditional teach-

ing methods, we can face new challenges and thus better prepare our young charges for their life ahead. After all, education's role is to create individuals to be valuable members of the society they grow up to become a part of.

A comprehensive approach is hard to implement as such. Also, this tool is best to apply in iterative rounds. That means that teachers can start to apply tools step by step and finding suitable solutions for their context. Buddy teaching is best way to support this implementation process. That is also a natural way to expand good pedagogical practises. Transferring the learning from student to others is a good motivator for students but also teachers and schools to take proactive step for community.

REFERENCES

Dunne, D., & Martin, R. (2006). Design thinking and how it will change management education: an interview and discussion. Academy of Management Learning & Education, 5(4), 512– 523.

Heikkinen, H. L. T.: Jokinen, H. & Tynjälä, P. (2012). Peer-Group Mentoring for Teacher Development. Taylor & Francis Group

Katzenbach, J.R.; Smith, D. K. (2001): The Discipline of Teams. John Wiley & Sons 2001. 0-87584-936-9

Katzenbach, J.R.; Smith, D. K. (2015): Wisdom of teams: Creating the High-Performance Organization.

Kolb, D. A. (1984). Experiential learning: experience as the source of learning and development. Englewood Cliffs, NJ: Prentice Hall.

Kouzes, J. M., & Posner, B. Z (2008). The student leadership challenge: Five practices for exemplary leaders. San Francisco, CA: Jossey-Bass.

Kouzes, J. M.; Posner, B. Z; High, B. & Morgan, M.M. (2013, 1). The student leadership challenge - Student workbook and Personal Leadership Journal. John Wiley & Sons, Incorporated.

Kouzes, J. M.; Posner, B. Z; High, B. & Morgan, M.M. (2013, 2). The student leadership challenge – Facilitator and activity guide. J-B Leadership Challenge: Kouzes/Posner Ser. Vol 278. John Wiley & Sons, Incorporated.

Lackéus, M. (2015). Entrepreneurship in Education. What, Why, When, How. Entrepreneurship360, Background Paper, European Commission: OECD.

Lackéus, M. (2016). Value creation as educational practice— - towards a new educational philosophy grounded in entrepreneurship? Doctoral dissertation.

Lackéus, M et al (2016): Bridging the traditional – progressive education rift through entrepreneurship. International Journal of Entrepreneurial Behaviour & Research, 22 (6), 777-803.

Leavy, B. (2010). Design thinking—a new mental model of value innovation. Strategy & Leadership, 38(3), 5–14.

Lombardo, Michael M; Eichinger, Robert W (1996). The Career Architect Development Planner (1st ed.). Minneapolis: Lominger. p. iv.

Mansoori, Y. & Lackéus, M. (2019). Comparing effectuation to discovery-driven planning, prescriptive entrepreneurship, business planning, lean startup, and design thinking. Small business economics 2019-02-28, Vol.54 (3), p.791-818

Martin, R. (2009). The design of business. Boston, MA: Harvard Business School Publishing.

Mälkki, K. (2010). Building on Mezirow's theory of transformative learning: Theorizing the challenges to reflection. Journal of Transformative Education, 8(1), 42–62.

Mälkki, K. (2011). Theorizing the nature of reflection. Studies in Educational Sciences 238. University of Helsinki, Institute of Behavioural Sciences.

Mälkki, K. (2019). Coming to grips with edge-emotions. The gateway to critical reflection and transformative learning. In: Fleming, T., Kokkos, A. & Finnegan, F. (Eds.): European Perspectives on Transformative Learning, 59- 73. London: Palgrave Macmillan

Ries, E. (2011). The lean start-up: how today's entrepreneurs use continuous innovation to create radically successful businesses. New York, NY: Random House Digital.

Ruhalahti, S., Aarnio,H. & Ruokamo, H. (2018) Deep learning evaluation vocational in teacher education: Conducted on the principles of authentic and dialogical collaborative knowledge construction. Nordic Journal of Vocational Education and Training, 8(2), 22-47.

Ruhalahti, S. (2019). Redesigning a Pedagogical Model for Scaffolding Dialogical, Digital and Deep Learning in Vocational Teacher Education. Acta electronica Universitatis Lapponiensis 257.

Sjöblom, K.; Lammassaari, H.; Hietajärvi, L. Mälkki, K. & Lonka. K (2019). Training in 21st Century Working Life Skills: How to support productivity and Well-Being in Multi-Locational Knowledge Work. Scientific Research Publishing. Creative education, 2019, 10, 2283-2310.

Sonalkar, N., Mabogunje, A., & Leifer, L. (2016). Developing a design thinking curriculum for venture creation in resource constrained environment. International Journal of Engineering Education, 32(3), 1372–1384.

Osterwalder, A., & Pigneur, Y. (2010). Business model generation: a handbook for visionaries, game changers, and challengers. Hoboken, NJ: John Wiley & Sons

Wenger, E. (2000). Communities of practice and social learning systems. Organization (London, England) 2000-05, Vol.7 (2), p.225-246

Wenger, E.; McDermott, R. & Snyder, W.M. (2002): Cultivating communities of Practise – A guide to managing knowledge. HBS Press. 1-57851-330-8

Chapter 10

Heads and Tails for Enhancing Students' Critical Thinking Skills

Indra Odina

INTRODUCTION

The outlook towards education has changed over the last few years. Furthermore, the variables and dynamics in education have also consistently demonstrated sustainable evolution. For this reason, the need to keep up with the latest changes in education and adaptation to those changes can be inevitably regarded as a must. One of the aspects that needs improvement is the students' critical thinking skills. Critical thinking is a key characteristic that every student is supposed to have, through which they conceptualize, analyse, synthesize, and evaluate the inputs they encounter during the classes. Therefore, the tools and activities have to address and develop the secondary school students` critical thinking skills. For that matter, "Heads and Tails" serves as a dynamic and functional tool for enhancing students' critical thinking skills.

THEORETICAL BACKGROUND

The tool "Heads and Tails" is based on reflection theory and experiential learning where experience is considered to be the main advantage. "Experience is a meaningful engagement with the environment in which we use our previous knowledge (itself built from experience) to bring new meaning to an interaction" (Beard and Wilson 2006: 21).

Experiential activities often start with specific narrow skills and then move on to broad skills such as teamwork, communication, time management, emotional intelligence, or leadership. Beard and Wilson (2006) consider this simple framework can be created both to classify outdoor and indoor experiential learning programmes and to show the sequencing of activities from play to intense self-development over the period of a programme.

"Narrow skills such as listening, or questioning can be focused on first. These might be built on later, as they are a subset of skills for teamwork or communication, which are very broad skills" (Beard and Wilson 2006: 120).

According to Beard and Wilson (2006), the following four-stage sequence or activity wave can be distinguished:

1. "Awaken participants' enthusiasm;
2. Start to focus attention with medium-sized activities and narrow skills;
3. Direct the personal experience with broader skills;
4. Share participants' enthusiasm using regular reviewing activities" (Beard and Wilson 2006: 121).

Using this tool, besides critical thinking skills, the students develop their reflection skills, support their arguments, and can give structured meaningful feedback evaluating the event that took place, learning process or what they like about school / activity / assignment and so on. In conclusion, this tool is designed to advance secondary school students` critical thinking skills through the idea that there is no completely positive or negative thing in any point.

EXPLANATION OF THE TOOL

"Heads and Tails" is based on reflection theory and experiential learning, where students internalize the fact that every strength has within it the potential for weakness, and likewise every weakness has within it the potential for strength along with improving debating skills and finding and supporting arguments.

- Aims of the tool – 1) to enhance secondary school students' critical thinking skills; 2) to develop students' reflection skills; 3) to prepare for debates, for finding and supporting arguments; 4) to give structured meaningful feedback evaluating the strength or weakness and find the other side.
- Expected outcome – to develop, present and support one's argument; to get meaningful feedback.
- Allocated time – 20 – 30 minutes
- Setting, place layout – students working stations/ separate tables for groups
- Necessary materials – one set per group (grid for notes, coin) with guidelines
- Number of participants – whole class in small groups of 3-5
- Role of students – critical reflectors
- Role of teacher – active observer
- Steps to use the tool
  1. Make the groups of 3-5 participants, one takes a coin of any nominal value.
  2. One keeps notes in the grid.

Name	Strength	Weakness in strength	Weakness	Strength in weakness

3. In your group agree which side will count as which.

A 10-rupee coin has the three lions' capital on one side, and the number 10 on the other side. The three lions' side is the obverse, so counts as heads.

If you need to toss a coin, it really does not matter – just agree before you toss which side will count as which.

4. The coin owner tosses the coin first. If the coin lands on the head (number) – tells about the strength, something he/she likes about the event that took place, or in the learning process or what they like about school.
5. And then describes "the other side of the coin" – what is the drawback still in the thing that he/she likes.

e.g., Strength: *I liked how I presented the group poster.*

Other side: *My teammates did not have a chance to speak*.

6. If the coin lands on the tail (picture) – tells about the weakness, something he/she dislikes in learning process or what is not satisfied with school and describes "the other side of the coin" – what is good about this negative side.

   Weakness: *My group mates were not ready for the lesson.*

   Other side: *It allowed room for creativity.*

7. Everyone tosses the coin in turns and at least twice.
8. Later the grid is summarised and presented, submitted for the teacher to make sure students have managed to find good arguments.

   It leads to the conclusion that there is no completely positive or negative thing – every coin has two sides.

   Every strength has within it the potential for weakness, and likewise every weakness has within it the potential for strength.

   - Assessment – "finding both sides"
   - Students' feedback

   The reflection of students during the classes of the study course Mentoring in Education (master students).

Reflection questions after the toll application	**Respondents' evaluations in groups**
Were there more talks about the strengths or weaknesses?	*We talked more about the weak sides.* *It was in balance.* *We spent more time on weaknesses.* *There were more discussions about the strengths.* *For both, but there was more to comment on weak sides – that which casts doubt.* *Our group had a balance between the two sides.* *Equal, others did not have to help find either the positive or the negative, because it was already determined individually.* *There were more discussions about weaknesses because it is relevant.* *It was important to discuss the issues with the group members.* *It was easy to talk about ourselves, because we had answered the questions of the questionnaire before.*

How did you succeed in talking about yourself and formulating the other side?	*Very good, because we have prepared a self-assessment at home and had the confidence to reveal ourselves.* *It was easy because the justification had already been partly written.* *Easy, open, acknowledging the situation "as is".* *Given that we had performed our self-evaluation before, it was quite easy to talk ...* *Very easy and successful because the self-assessment has been prepared in advance.* *There were no problems because the answers were already thought about. There was only necessary to find and formulate at the positive - and at the negative +.* *We did well! Sharing experiences makes it easier to formulate answers.* *We concluded that mentees are afraid to disturb and ask for help from colleagues.*
What was more difficult to formulate?	*It was difficult when talking about the positive to find flaws.* *It is a little harder to find the other side of the coin.* *Harder to talk about what works well.* *It was more difficult to formulate the "other side" in all cases.* *Finding weaknesses in strengths.* *To think of one answer from both sides at the same time – positive and negative for one question at a time.*
What is the purpose of this mentoring task?	*To develop active listening skills and respond meaningfully to what the narrator is saying.* *To see that there are two sides to every problem and two solutions.* *Listening skills, concentration, exchange of ideas, feedback, moving towards the goal.* *To listen and find solutions, insights, etc.* *The purpose of the tasks in mentoring is to be aware that each person has both "sides of the coin"; the conversation in the group creates an experience that we gain in negotiations about success, our anxiety. By throwing a coin in this way, we can understand the strengths and weaknesses of the mentee.* *Reflecting in a group we can share experience, thoughts, sometimes saying new ideas out aloud we can get to the result faster.* *The aim of this exercise in mentoring is to be able to look at the answers from different angles.* *To listen to others without interruption, share experience, insight into supervision.* *To share experience, encourage something new. To find commonalities and similarities. To encourage each other.* *Colleagues gain confidence.* *Self-assessment is a useful process for understanding potential risks that need more attention.* *Tossing a coin balances the pros and cons to talk about both sides.*

- Visualized examples

  The work of students during the teaching practice seminar (Bachelor students).

Name	Strength	Weakness in strength	Weakness	Strength in weakness
A	*I mostly performed practice tasks independently.*	*There is a lack of cooperation with the most experienced colleagues – deputy principal, field coordinator and other teachers.*	*Class lesson 5th grade. The language barrier.*	*Experience – how to work in a minority school.*
B	*I managed to observe the lessons of several colleagues, to get examples of good practice.*	*The notes made in the observation checklists are chaotic and difficult to analyse.*	*I was afraid to teach a class lesson, it is hard to reprimand and be strict.*	*Experience – not everyone will always be interested in the lesson, I must be morally prepared for it. The teacher is not an entertainer.*
C	*It was possible to learn many new and useful things.*	*The information provided was sometimes confusing, as it was sometimes difficult to understand what was being done.*	*Distance learning during the lockdown. It was difficult to get documents, communicate with teachers.*	*Observing online lessons, I have got to know more about the possibilities offered by technology and how diverse the remote lessons can be.*
D	*Teacher used Nearpod and the pupils liked it, as well as another site – to create avatars and answer questions about Christmas.*	*Initially, 2 minutes were lost for children to log in to Nearpod. At some point, it was necessary to attract attention.*	*It was hard to meet the mentor.*	*There was a possibility to work independently.*
E	*We did not manage to talk to the language coordinator.*	*However, we managed to interview the music and culture coordinator.*	*Lack of time.*	*Learn to plan your time so that you can manage everything.*

CONCLUSION

The tool introduced in this chapter may be used in all the education cycles and can be integrated in different subject areas. It is relatively easy to implement in any classroom provided it requires minimal preparation. The experiential learning approach encourages both active participation and reflections on the activities the participants are engaged in, while the reflection theory underlying this tool is crucial within the personal, academic, and professional development. In brief, "Heads and Tails" should be viewed as a dynamic and functional tool for enhancing students' critical thinking skills.

REFERENCES

Beard, C. M., Wilson, J. P. (2006). *Experiential Learning*. A Best Practice Handbook for Educators and Trainers. London and Philadelphia: Kogan Page.

The tool has been borrowed from

Malderez, A., Bodsczky, C. (1999). *Mentor Courses: A Resource Book for Trainer-Trainers*. Cambridge University Press.

Odiņa, I., Grigule, L., Kārkliņa, S., Skara-Mincāne, R. (2009). *ActivELP Mentoring Guidelines*. Riga.

Chapter 11

Integrated and Interactive Lesson Plan

Dr Niyati, Chitkara, Dr Parul Sood, Dr Sangeeta Pant,
Ms Dolma Pathela, Ms Piyusha Sharma

INTRODUCTION

Lesson planning is an essential component of effective content delivery. Effectual lesson planning is needed in order to make the lesson delivery more concise and structured. It helps the teacher to specifically list down the content to be covered along with the activities that are to be carried out by her during the lesson delivery. Lesson Plan can also be called as a step- by step guide for effective lesson delivery. The traditional lesson plan model consists of a sequence of 4 steps i.e., a) Specify Objectives, B) Select Learning activities, c) Organise Learning Activities, d) Identify Evaluation Procedure. The traditional format of lesson planning was cumbersome and detrimental in the willingness and effectiveness of teacher's lesson planning. The skill of creating a lesson plan involves the creative and critical skills of the teacher. Each lesson which is planned is very different. In fact, the lesson planned by two different teachers for the same class and for same sets of students is also different.

Based on the recent developments in the field of education, the need was felt to revamp the traditional format of the lesson plan and propose an "Integrated and Interactive Lesson Plan" which is based on Presentation, Controlled Practice, and Free Practice (3Ps) approach and emphasizes the integration of innovative pedagogies and ICT into the lesson plan. The Integrated and Interactive Lesson Plan follows the learner centred way and builds on the foundational concept of Multiple Intelligence Theory, inculcate analytical, critical, and creative learning for the students.

The present chapter deals with the pedagogical tool viz. **"Integrated and Interactive Lesson Plan"(IILP)**, which was conceived with an objective of enhancing critical, creative and analytical skills of the Pre-service and In-service teachers owing to the ongoing fourth industrial revolution. This tool promotes

constructivist approach to learning, provides a stage for the pre-service and in-service teachers to design different classroom experiences for students and above all shift the focus from regular teaching to student-centred teaching.

THEORETICAL BACKGROUND

With the altering requirements of classrooms arises a need for the change in lesson plans. The landscape of education has changed drastically. Consequently, it is imperative to move past the traditional practices and devise unique methodologies for edification.

Hence Integrated and Interactive Lesson Plan was formulated to give flexibility to the teacher to experiment with the content being delivered and engage the learners keeping 3Ps approach at the centre. The 3 P's approach in integrated and interactive lesson plan has been adapted from the 3 P approach of language Learning. The 3 Ps's approach of language learning are Presentation, Practice and Production.

Presentation stage: the content to be taught to the students are presented to the students to know their entry level of the content. This is done using various strategies like eliciting and cueing. This stage is dominated by high teacher talk time which may be as high as 65- 90% and consumes about 20-40% of the lesson time.

Practice stage: At this stage the activities are framed for the students so as to make the students practice the concept being taught. It focusses on high student talk time and less of written activities. The student talk time ranges from 60-80%. It takes about 30-50% of the lesson time.

Production stage: At this stage the students demonstrate the content acquired by performing some tasks. The student talk time at this stage is 90% and this stage takes about 20-30% of the lesson time.

The adoption of 3P approach from language learning to lesson plan was done in order to cater to 21st century skills and provide opportunities to the students to become independent and reflective learners who gain meaningful learning experiences through engaging activities designed for them.

This change in the format of the lesson plan was much needed keeping in mind the transformations happening in the field of education.

LITERATURE REVIEW

In order to prepare the students for the 21st century, it remains substantial to train in-service and pre-service teachers with respect to how they plan their lessons. Sias, (2017) in her study titled, "The Best Laid Plans: Educational Innovation in Elementary Teacher Generated Integrated STEM Lesson Plans" re-

ported that project based, and student centred learning should be a part of the lesson plan. In another study titled, "Finding the Balance between Process and Product through Perceptual Lesson Planning" conducted by Uhrmacher, Conrad & Moroye, (2013) concluded that the lesson plan should be such which helps in engaging the teachers and students. It should develop the creative side of the learner and make their learning journey joyful and meaningful. The environment that is created by the teacher in the class should have element of surprise and innovation and lesson planning should be given due attention while training pre-service and in-service teachers. Furthermore, the research on "Development of Lesson Plans by the Lesson Study Approach for the 6th Grade Students in Social Study Subject based on Open Approach Innovation"deals with the need of creating improved lesson plans for gaining optimal efficiency vis-à-vis teaching. Another study which was conducted by Panasuk, Regina, Stone, Walter, Todd & Jeffrey, (2002) titled, "Lesson Planning Strategy for Effective Mathematics Teaching"established the significance of planning meaningful experiences for the students to ensure successful teaching. Well planned lesson plans help in making better connections between various concepts and also play a major role in the way information is presented to the students and how the new knowledge is created by them, thus honing their critical, creative and analytical skills.

The works of Wiyanarti & Holilah (2020) titled, "The Innovation of Online-Based Social Studies Lesson Plan Models to Face the Industrial Revolution 4.0" brought about the online-based social studies lesson plan model as a part of the innovations in learning keeping in mind the industrial revolution 4.0. Through this lesson plan, they focussed on the needs of the future learning systems. Zhu, Chen, Du & Li, (2015) in their study titled, "Research on Model of Collaborative Lesson Planning for Primary Teachers Based on Online Environment" asserted that collaborative lesson planning can help widen the horizon of teachers' ideas and can aid in improving teaching by combining technology and resources.

From the studies quoted above the need was felt to design and develop a lesson plan which caters to all the essentials listed above related to a lesson plan. A lesson plan which focusses on student centred learning, engages the students and teachers, caters to the future learning system, is innovative and helps to foster analytical, critical, and creative side of the students. Thus, Chitkara College of Education developed a lesson plan which caters to the needs of Industry 4.0 and needs of the 21st century skills.

EXPLANATION OF THE TOOL

The IILP is broadly divided into 3 stages viz. Presentation, Controlled Practice and Free Practice, based on the 3 Ps approach, which is a soft approach to Communicative Language Teaching.

Each stage represents a stage of learning process and thus accordingly activities and aids are planned by the teacher. The first stage which is the Presentation Stage entails explanation of the topic by the teacher. The Controlled Practice stage is the stage for the teachers to allow students to practice new content / topic in a controlled environment. The Free Practice is the stage which gives the opportunity to the pre-service / in-service teachers to plan activities which enable students to freely practice the content taught.

A. Aims of the Tool

- To facilitate educators to help students think analytically, critically and creatively;
- To enable teachers to tap into the background knowledge of pupils and build new skills;
- To empower teachers to create a conducive environment which gives everyone a chance of interacting and asking questions.

B. Expected Outcomes

The teacher will be able to

- expand his/her horizon and that of his/her students;
- anchor learning in relevant and real-life ways;
- design suitable learning activities and devise strategies to assess and obtain feedback on student learning;
- inculcate critical thinking, creativity, and multifarious skills in his/her students.

The learner will be able to

- work effectively with his/her peers;
- joyfully learn through various activities;
- enhance his/her critical thinking, creativity, and various other skills.

C. Role of Teachers

The effective execution of IILP requires teachers to divide delivery of lesson in three stages. In the first stage which is Presentation stage, the teacher speaks up to 75% of the time, as they are presenting information and asks "concept check" questions to see if students have understood. The second stage i.e., Controlled Practice, requires teacher to use activities and group work to practice the concept. The teacher facilitates the activities of the class and corrects students when mistakes occur. In the last stage viz. Free

Practice, the teacher monitors but does not correct until the end. The focus in this stage is on fluency and rather than accuracy.

D. Role of Students

The role of the students also varies as per each stage. In the first stage which is Presentation stage, the student is predominantly the listener. The role of the student at Controlled Practice stage is being an active participant of the activities planned by the teacher. The Third stage, which is the Free Practice stage demands students to speak up to 90% of the time and describe/use the content taught in a natural, everyday context, with minimal input from the teacher.

E. Steps to use the Tool

The instructor should follow the steps mentioned hereunder to ensure appropriate usage of the pedagogical tool:

1) **Selection of the Pedagogy and Tools/Aids Required (Stage-wise):** Based on each stage, the Pre-service and In-service teacher is required to carefully formulate activities and use teaching aids. Since the first stage, which is called Presentation, forms the base of lesson reception, the teacher should clearly list out Medium of Instruction based on linguistic diversity of the class and catering to Multilingualism as proposed by NEP 2020, Instructional Aid to be used based on the type of content being catered to, Instructional Objectives catering to all the three domains of learning i.e. Cognitive, Affective and Psychomotor, Entry Behaviour - decided on the basis of the resources available, Pedagogy / Andragogy, Model of Teaching, Techniques of Teaching, ICT in Teaching, Activities to be Conducted in Class Catering to Different Types of Intelligence, Digital Media to be used. All the decisions related to this stage is based on the diversity of the students of the class, the demographic diversity, individual differences, and the entry level of the students. The learning theories selected by the pre-service teacher and in-service teacher depends on the difficulty level of the content and also depends on the learning outcomes to be achieved by the pre-service and in-Service Teacher. If the learning outcomes to be achieved belong to lower order thinking skills, then Pre-service and in-service teacher can use Behaviorism learning Theory which focuses on remembering and understanding levels of Bloom's Taxonomy. If the learning outcomes to be achieved belong to higher order thinking skills, then then pre-service and in-service teachers can use Cognitive or Constructivism Learning theory.

   The second stage, the Controlled Practice stage, is very closely associated with the Theories of Learning i.e., the activities which are conducted

for the learners focus on the different type of learning theory i.e. Behaviourism Learning Theory, Cognitive Learning Theory and Constructivism Learning Theory. In this stage, the activities are designed by the pre-service and in-service teachers to give practice to the students under the close supervision of the pre-service and in-service teachers. The activities are designed in such a manner that it ensures 60-80% of the student talk time through activities like cooperative learning, collaborative learning etc. Pre-service and In-service teachers ensures that Learning Spaces are used innovatively to enhance the teaching and learning experience of the learners.

For the third stage of the lesson plan, which is about free practice and focus is on enhancing the student talk time to 90%, the students are provided with free hand to come up with creative things by freely practicing the content taught. The teacher is required to make a suggestive list of free practice tasks for their perusal.

2) **Deciding the Assessment Type:** The second step for using the tool involves deciding the Assessment type like Peer Assessment, Formal Assessment, Assessment through Activity, Written/Oral Assessment etc. to ensure that the topic has been properly comprehended by the child.
3) **Listing the Method of Feedback:** Since feedback plays a major role in ensuring effective teaching, it is imperative for the pre-service and in-service teacher to decide the type of Feedback, he/she will be giving to the students towards the end of the lesson delivery. The feedbacks can range from Peer-feedback, Self-feedback, Just-in-time feedback etc. depending on the requirements of the topic.

F. Assessment

Assessment involves measuring and profiling of various aspects of learning. Owing to be more inclusive than gauging and measurement, assessment enables in chalking the fortes and weak points of a student (Kapoor & Natarajan, 2014). As the current tool intends to polish various skills of the pre-service, in-service teachers and students, it stresses on effective planning of content to result in its exceptional delivery. It is the formal demonstration of the topic by the pre-service, in-service teachers for making sure that learner comprehends and is able to recollect during the examination (Sood & Dutt, 2017).

In light of the foregoing, "Interactive and Integrated Lesson Plan"enables pre-service and in-service teachers to create a road map of what students need to learn and how it will be done effectively during the class time. The assessment of the tool involves Students' Assessment and Teachers' Assessment.

Teachers' Assessment

The assessment of pre-service and in-service teachers IILP is done on the basis of the pre-designed rubrics. The Assessment is done using a Mixed Method Approach. The pre-service teacher / in-service teacher is expected to prepare a lesson plan as per the format of the Integrated and Interactive Lesson Plan and then is expected to deliver the same in front of the peer group and an experienced teacher/coordinator. The experienced teacher/coordinator and peer group both provide feedback at the end of the lesson delivery.

Table 1:
Rubrics for the assessment of integrated and interactive lesson plan

CHITKARA UNIVERSITY

RUBRICS FOR THE ASSESMENT OF INTERGRATED AND INTERACTIVE LESSON PLAN					
	Disagree	**Somewhat Disagree**	**Neutral**	**Somewhat Agree**	**Strongly Agree**
Marks Alloted	**1**	**2**	**3**	**4**	**5**
The lesson was developed keeping in mind the multilingual approach					
The Lesson plan followed 3 Ps Approach					
The appropriate teaching aids were used in the lesson plan					
The instructional objectives were framed catering to all three domains of Learning i.e, Cognitive, Conative and Affective					
Entry Behavior was catered to while framing lesson plan					
Due weightage was given to the pedagogy being used in the lesson plan					
Appropriate use of ICT was made in the lesson plan					
Activities catering to different types of Intelligence were framed in the lesson plan					
Lesson plan focused on the activities that were framed keeping in mind the Constructivist Learning Theory					
Lesson plan focused on the activities that were framed keeping in mind the Cognitive Learning Theory					

Lesson plan focused on making use of infrastructure while content delivery					
Non-verbal communication was given due weightage in the lesson plan					
Due weightage was given to the types of Reinforcement in the class					
Lesson plan focused on providing opportunities to the learners for free practice					
The Integrated and Interactive lesson plan was able to develop the Critical thinking skills among the Pre-service/In-service teachers					
The Integrated and Interactive lesson plan was able to develop the Creative thinking skills among the Pre-service/In-service teachers					
The Integrated and Interactive lesson plan was able to develop the Analytical thinking skills among the Pre-service/In-service teachers					

Table 1 - SampleRubrics for the Assessment of Integrated and Interactive Lesson Plan
Source: Chitkara College of Education, Chitkara University, Punjab.

Detailed Quantitative Assessment of Lesson Delivery based on Integrated and Interactive Lesson Plan					
Rubrics	**1**	**2**	**3**	**4**	**5**
Description	**Below Average (BA)**	**Average (A)**	**Good (G)**	**Very Good (VG)**	**Excellent (E)**

LESSON DELIVERY	**Teaching Sub.**
	Social Studies
Topic Introduced	3
Smile & Expression	4
Pre-Knowledge Testing	4
Presentation Skills	4
Confidence	4
Methodology	4
Creativity	4
Innovativeness	4
Speech Clarity	3
Communication Skills	4
Blackboard Writing	N/A
Writing Skills	4
Motivation to Students	4
Teacher Talk Time (TTT)	4
Student Talk Time (STT)	4
Error Correction	4
Reinforcement	4
Repetition	5
Level of Interest	4
Questioning	4
Ability to Answer Questions	4
Level of Teaching Aids Prepared	5
Level of Teaching Aids Presented	4
Post-Knowledge Segment	5
Terminal Behaviour	4
Class Control	4

Eliciting	4
Feeding	4
Peer Work	5
Group Work	5
One-to-One Instruction	N/A
Eye contact with the students	N/A
Hand, Eye & Body Co-ordination & Movement	N/A
Computer Skills	5
Controlled Practice	4

Concise Qualitative Assessment of Lesson Delivery based on Integrated and Interactive Lesson Plan	
Name: Roll. No.:	
Teaching Subject- Social Studies	Remarks
Written Lesson Plan	
Presentation	
Teacher Traits	
Teaching Aids	
Overall Remarks	

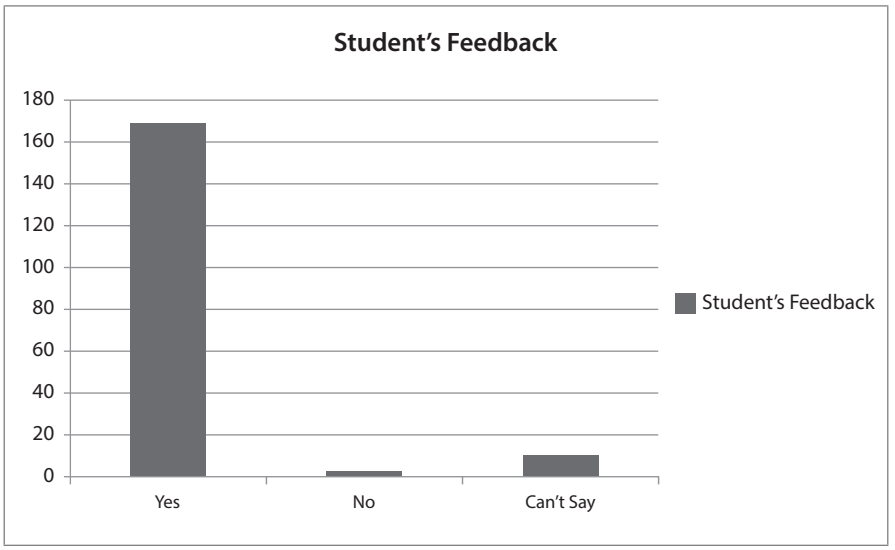
Table 2 - SampleRubrics (Detailed & Concise) for the Assessment of Teacher's Lesson Delivery based on Integrated and Interactive Lesson Plan

G. Students' Feedback

With the commencement of Industry 4.0, which remains the momentum behind Teaching 4.0., the students' feedback is set to comprise the most advantageous tool for gauging teaching efficiency (Chitkara, 2021). Keeping in view the supreme importance of students' feedback, it is thus vital for the instructor to obtain students' viewpoint to promote the effectiveness of diverse educational activities.

To establish the functionality of the IILP, a sample of 180 students from Class 6 at Chitkara International School, Chandigarh, India was chosen who were taught "Fibre to Fabric" topic through Integrated and Interactive Lesson Plan and the following findings were made as per the students' feedback on the question "Did you enjoy studying "Fibre to Fabric" topic?"

Students' Feedback - Integrated and Interactive Lesson Plan
"Did you enjoy studying "Fibre to Fabric" topic?"



Source: Chitkara International School, Chandigarh, India

Graph 1 (Interpretation): Approximately 94% of students enjoyed studying the topic "Fibre to Fabric", taught through IILP, whereas about 1% and 5% didn't enjoy or couldn't say about it, respectively.

H. Visualized Examples

The pedagogical tool of "Interactive and Integrated Lesson Plan" is extremely beneficial in teaching topics. At Chitkara College of Education, Chitkara University, Punjab, India and Chitkara International School, Chandigarh & Panchkula, India, lesson plans for each topic are created keeping in mind the prior knowledge of the students, along with the usage of ICT and related activities. The utilisation of the 3Ps cements the concept in students' minds and ensures a lifelong retention of the same.

DIARY FORM LESSON PLAN
FIRST SEMESTER

CHITKARA UNIVERSITY
COLLEGE OF EDUCATION

Date: 19/08/2020 Timings: 01.15 - 21:15 Period: 3rd

Grade: _____ Section: _____ Subject: _____ Topic: Open Bank Postion

PRESENTATION:

Medium of Instruction

Monolingual	☐	Bilingual	☑	Multilingual	☐

Languages Used

English	☑	Hindi	☑	Punjabi	☐

Any Other _____

INSTRUCTIONAL AIDS USED:

Audio Aids

Radio		Tape Recorder		Head Phone	

Visual Aids

					
Display Board		Print Material	✓	Comic Strip	
Flash Cards		Poster		Maps	
Cartoons		Newspaper		Graphic Aids	

Audio- Visual Aids

Television		Films		Digital Content	✓ 

3- Dimensional Aid

Objects/ Specimen		Exhibition	✓ 	Puppets	
Field Trip		Experiment		Muppets	

INSTRUCTIONAL OBJECTIVES: COGNITIVE DOMAIN

Remembering	☑	Understanding	☑
Applying	☑	Analyzing	☑
Evaluating	☑	Creating	☑

AFFECTIVE DOMAIN

Receiving Phenomenon	☐	Responds to Phenomenon	☑
Valuing	☐	Organization	☐
Internalizes Values	☑		

PSYCHOMOTOR DOMAIN

Imitation	☐	Manipulation	☐	Precision	☐
Articulation	☑	Naturalization	☐		

DIARY FORM LESSON PLAN
FIRST SEMESTER

CHITKARA UNIVERSITY
COLLEGE OF EDUCATION

ENTRY BEHAVIOUR

Use of Examples/ Analogies/ Similarities	☐	Questioning	☐
Lecturing/ Describing/Narrating/ Illustrating	☑	Story Telling	☑
Role Playing/ Dramatization	☐	Audio Visual Aids	☐
Experimentation/ Demonstration	☐		

PEDAGOGY / ANDRAGOGY / HEUTAGOGY USED

			☐
Open Ended Instruction	☑	Integrated Learning	☐
Inquiry Learning	☑	Differentiate Learning	☐
Experiential Learning	☐	Co-operative Learning	☐
Case- Studies	☐	Peer Teaching	☐
CLIL	☐	Dictogloss	☐
Flipped Learning	☐	Blended Learning	☑
Problem Based Learning	☑	Collaborative Learning	☐

MODEL OF TEACHING

Inquiry Based Model	☑	Concept Attainment Model	☐
Advance Organizer Model	☐		

TECHNIQUES OF TEACHING

Inductive – Deductive Technique	☐	Heuristic Method	☐
Analytic- Synthetic Method	☑		

ICT IN TEACHING

Tuxpaint	☐	Celestia-win	☐	Veyon	☐
Gcompris	☐	Lenmus	☐	iTest	☐
Typefaster	☐	Wordsworth	☐	Pearson	☐
Educom	☐	Extra Mark	☑		

Any Other _____

ACTIVITIES CONDUCTED IN CLASS CATERING TO DIFFERENT TYPES OF INTELLIGENCES

Linguistics	☐	Logical- Mathematical	☑	Spatial	☐
Bodily- Kinesthetic	☑	Interpersonal	☐	Intrapersonal	☐
Naturalistic Intelligence	☑				

DIARY FORM LESSON PLAN
FIRST SEMESTER

CHITKARA UNIVERSITY
COLLEGE OF EDUCATION

Black Board Usage	☑	Smart Board Usage	☐	Text	☐
Diagram	☑	Draw Picture Map	☐	Words	☐
Question Answer	☐	Notice Board Usage	☐	Pin Board Usage	☐

DIGITAL MEDIA

Facebook	☐	Instagram	☐	Twitter	☐
School ERP	☐	Any Other	☐		

CONTROLLED PRACTICE

THEORIES OF LEARNING

Activities conducted based on BEHAVIOURISM LEARNING THEORY

Drill Work	☐	Repetitive Practice	☐
Bonus Points (Providing an incentive to do more)	☐	Establishing Rules	☐
Participation Points (Providing an incentive to participate)	☑	Verbal Reinforcement (Saying ' Good Job')	☑

Activities conducted based on COGNITIVE LEARNING THEORIES

Classifying or Chunking Information	☐	Real World	☐
Linking Concepts (Associate New Content with Something Known)	☐	Providing Structure (Organizing your lecture in efficient and meaningful ways)	☐
Examples	☑	Discussions	☐
Problem Solving	☐	Analogies	☐
Imagery/ Providing Pictures	☐	Mnemonics	☑

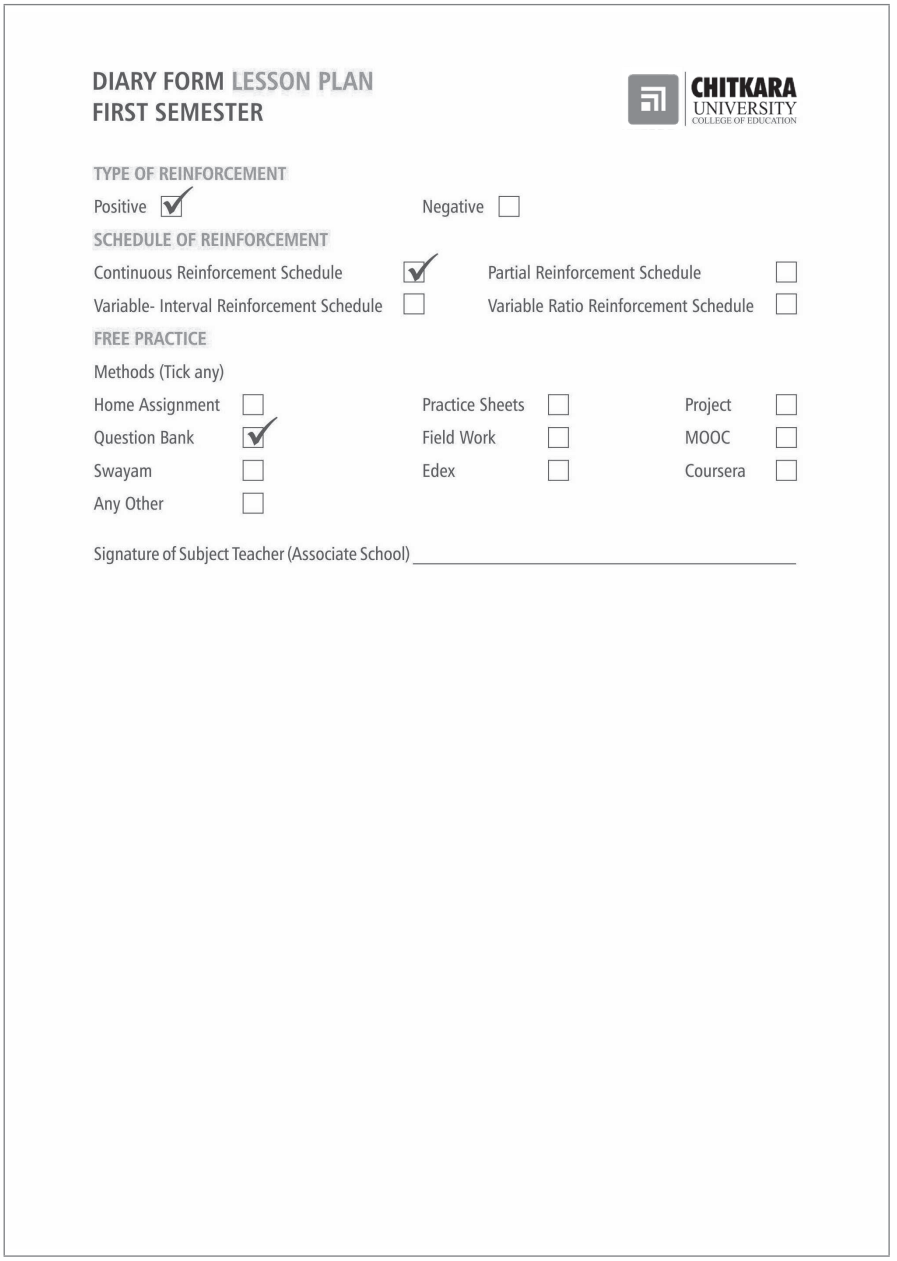
Activities Conducted based on CONSTRUCTIVISM LEARNING THEORY

Case Studies	☐	Research Projects	☑	Simulations	☐
Brain Storming	☐	Problem Based Learning	☑		
Collaborative Learning/ Group Work	☑	Discovery Learning	☑		

Infrastructure Usage

Phonetic Console	☐	Gaming Station	☐	Hello	☐
Bhasha Translation Zone	☐	Research Zone	☑	Play Ground	☐
	☐		☐		
Non Verbal Communication Sign Language		Musical Express Way			

Any Other _____



DIARY FORM LESSON PLAN
FIRST SEMESTER

CHITKARA UNIVERSITY
COLLEGE OF EDUCATION

TYPE OF REINFORCEMENT

Positive ☑ Negative ☐

SCHEDULE OF REINFORCEMENT

Continuous Reinforcement Schedule ☑ Partial Reinforcement Schedule ☐

Variable- Interval Reinforcement Schedule ☐ Variable Ratio Reinforcement Schedule ☐

FREE PRACTICE

Methods (Tick any)

Home Assignment	☐	Practice Sheets	☐	Project	☐
Question Bank	☑	Field Work	☐	MOOC	☐
Swayam	☐	Edex	☐	Coursera	☐
Any Other	☐				

Signature of Subject Teacher (Associate School) _____

Source: Lesson Plan Form in Reflections of Alpha Teachers', Chitkara College of Education, Chitkara University, Punjab, India

CONCLUSION

"Interactive and Integrated Lesson Plan" is a two-way roadmap for ensuring the subject-enrichment of the student along with allowing the teacher to understand what works best for each of their students. The 3Ps make way for each student to flourish in their respective fortes of learning, while giving the teacher a chance to broaden their pedagogical skill set to encompass a wide range of learning styles. This student-centred approach makes it easy for the teacher to simply give an outline of the topic, encouraging rigorous research and active participation by the students, instead. It is the best academic tool for bolstering the creative, critical, and analytical skills of the student, along with inculcating a lifelong hunger for learning.

REFERENCES

Chitkara, H. (2021). Using Students' Feedback to Improve TeachingEffectiveness Based on Kaizen Philosophy of Continuous Improvement. V, 8-10.

Kapoor, N. & Natarajan, V. (2014). Assessing Scholastic and Non-Scholastic Areas of Learning of Primary School 4th and 5th Graders in English, Mathematics & Science. 2 (1.1), 16-18

Nesusin, N., Intrarakhamhaeng, P., Supadol, P., Piengkes, N., &Poonpipathana, S. (2014). Development of lesson plans by the lesson study approach for the 6th grade students in social study subject based on open approach innovation. *Procedia-Social and Behavioral Sciences*, *116*, 1411-1415.

Panasuk, R., Stone, W., & Todd, J. (2002). Lesson Planning Strategy For Effective Mathematics Teaching. *Education*, *122*(4).

Sias, C. M., Nadelson, L. S., Juth, S. M., & Seifert, A. L. (2017). The best laid plans: Educational innovation in elementary teacher generated integrated STEM lesson plans. *The Journal of Educational Research*, *110*(3), 227-238.

Sood, P. &Dutt, S. (2017). Productive Pedagogies for Active Learning. Lambert Academic Publishing, 1(1.1), 18-19.

Uhrmacher, P. B., Conrad, B. M., &Moroye, C. M. (2013). Finding the balance between process and product through perceptual lesson planning. *Teachers College Record*, *115*(7), 1-27.

Wiyanarti, E., &Holilah, M. (2020, August). The Innovation of Online-Based Social Studies Lesson Plan Models to Face the Industrial Revolution 4.0. In *International Conference On Social Studies, Globalisation And Technology (ICSSGT 2019)* (pp. 16-23). Atlantis Press.

Zhu, X., Chen, M., Du, X., & Li, H. (2015, October). Research on model of collaborative lesson planning for primary teachers based on online environment. In *2015 International Conference of Educational Innovation through Technology (EITT)* (pp. 213-215). IEEE.

Doyle, M., & Holm, D. T. (1998). Instructional planning through stories: Rethinking the traditional lesson plan. *Teacher Education Quarterly*, 69-83.

Causton-Theoharis, J. N., Theoharis, G. T., & Trezek, B. J. (2008). Teaching pre-service teachers to design inclusive instruction: A lesson planning template. *International Journal of Inclusive Education*, *12*(4), 381-399.

Chapter 12

MAX for Enhancing Students' Analytical Skills

Indra Odina

INTRODUCTION

The Industrial Revolution 4.0 has transformed the way people live, work and study while Education 4.0 is the approach to learning that has to go hand in hand with the developments of Industrial Revolution 4.0. The top 10 skills necessary for students in 2020 stated in The World Economic Forum (2016) were complex problem-solving; critical thinking; creativity; people management; coordinating with others; emotional intelligence; judgement and decision making; service orientation; negotiation; cognitive flexibility (World Economic Forum 2016). Education 4.0 is becoming the primary approach to learning that aligns itself with the Industrial Revolution 4.0. Therefore, aligning teaching and learning methodologies, approaches, and strategies with the skills necessary in the future is of fundamental topicality in the preparation of both teachers and students The changes brought about are inevitable, therefore, it is high time to consider "education for the future" taking into account these transformations and acknowledging the transformations taking place at all levels. Within all these transformations, learners' autonomy, and the related phenomena (self-directed learning, etc.) are taking the central position within the new education 4.0 paradigm.

THEORETICAL BACKGROUND

The term learner autonomy implies conscious and deliberate efforts to develop individuals who have the ability to participate to some extent in all aspects of their studies. Learners' preparedness involves learners assessing motivation and confidence to make necessary decisions, whereas learners' capability involves learners possessing necessary skills to accomplish the choices which are made during the learning process. Learners are able to gain autonomy only when they possess necessary knowledge, skills, motivation, and confidence.

Moore (2010) emphasises that not only are learners obliged to have the capacity to take control over their learning, but the learning environment should

also provide them with an opportunity to gain autonomy. He mentions that to gain learner autonomy, not only are learners required to have or develop a set of personal qualities, such as confidence, enthusiasm, taking and accepting obligation, and ability to take initiative, but they should also possess a set of academic skills to identify learning goals and processes, understand how to evaluate learning, manage well-grounded conceptions of learning, apply a substantial number of learning approaches, organise learning and to be well-motivated to learn autonomously. Mackness (2011) explains that learner autonomy enables learners to become successful in learning; however, they should possess a certain set of abilities to gain autonomy, such as taking responsibility for own learning, monitoring, and evaluating own learning, flexibility in making decisions, reflectiveness with high-level of metacognition, being proactive, critical, analytical, and constructively critical, filtering and selecting the required information. However, possessing the aforementioned skills and abilities cannot be sufficient for learners to gain autonomy and achieve success in learning since it is a teacher who plays the leading role in promoting learner autonomy by creating the appropriate learning environment and developing the required skills. Enhancing the role of a teacher as a facilitator to promote learner autonomy, Sykes (2014) suggests the following four strategies be integrated into the course:

1. Teachers should establish a relationship with their future students and learn their needs and preferences before the course begins.
2. Teachers should encourage learners to monitor themselves while doing tasks.
3. Teachers should encourage learners to summarise the key points of the task.
4. Teachers should encourage learners to develop their own quizzes which are necessary to develop the ability to assess, combine and utilise what has been learnt.

EXPLANATION OF THE TOOL

MAX (Motivation – Acquisition – Extension) is a tool that enhances students` analytical skills based on autonomous learning theory, in which self-management approach is dominant and benefits from students` motivation, acquisition and extension. In this tool, after the determination of time and items to be taught, the aim is to elicit different opinions from the students about what they have learnt/found out (learners` motivation), what they want to try out (the evidence of acquisition) and what they would like to examine more in detail (learners` readiness to extend the acquired, to apply in practice).

- Aims of the tool – 1) to develop students' analytical and reflection skills; 2) to analyse, synthesize and evaluate the information obtained in accordance with particular teaching aims and objectives.

- Expected outcome – depending on the type of MAX – it can be to determine the level of students' motivation, acquisition, and readiness to apply the acquired in practice.
- Allocated time – from 15 to 30 minutes, depending on the depth of the question, could also take more time. If combined with follow-up see below, it can take additional 30 to 40 minutes.
- Setting, place layout – there are no special requirements concerning the setting, students can fill in the offered handout on their own after the activity (feedback or reflection MAX), or before the activity (opinion and learning check-up MAX), but it should be done alone.
- Organization questions – students should be explained the procedure of the use of the tool, the evaluation criteria if MAX is going to be assessed, and they should be given enough time for completing MAX on their own.
- Necessary materials – teacher's prepared handout or online assignment. Depending on the aim, the teacher can choose among several types of MAX.

Several types of MAX: for finding out students' opinion, for checking students' learning, for receiving the feedback on activity; for checking students' understanding.

Reflection MAX

(describe each mentioned thing clearly so as if one has not been present at the class would also benefit from this information or you yourself will be able to recall the situation from the description)

3 things I found out / ideas learned (Motivation)

V

V

V

2 things / ideas that inspired me professionally that I would like to try/use in teaching in near future. Please, describe why (Acquisition)

V

V

1 thing / idea that was attractive, but it still needs to be worked on (Extension)

V

Feedback MAX

(describe each mentioned thing clearly so as if one has not been present at the class would also benefit from this information or you yourself will be able to recall the situation from the description)

3 things I will remember about today

V
V
V
2 things I will try out
V
V
1 thing I want to ask, as it was not clear
V

Opinion MAX (describe each mentioned thing clearly and support by facts)
3 things you like about group work
V
V
V
2 things you consider significant to make group work effective
V
V
1 thing that bothers you about group work
V

Learning check-up MAX (describe each mentioned thing clearly and support by facts)
3 things you liked about the story
V
V
V
2 things you disliked about the story
V
V
1 thing you would like to ask / you would like to change if you were the author
V

- Number of participants – there are no restrictions concerning the number of participants, from one to hundreds.
- Role of students – active participants.
- Role of teacher – active analyser of information received.

- Steps to use the tool – students fill in the handout and submit / hand in; teacher analyses to see the students' motivation, acquisition, and extension.
- Assessment – the possible assessment for Learning or Check-up MAX could be based on the Taxonomy of cognitive field (Benjamin Bloom taxonomy`s updated version Anderson & Krathwohl, 1995-2000).

The entries of MAX can be assessed in the scale from average to outstanding and individual feedback provided to students.

1. Remembering – recognizing or recalling knowledge from memory to produce or retrieve definitions, facts, or lists, or to recite previously learned information – (average)
2. Understanding – constructing meaning from different types of functions be they written or graphic messages or activities like interpreting, exemplifying, classifying, summarizing, inferring, comparing, or explaining – (almost good)
3. Applying – carrying out or using a procedure through executing or implementing in situations where learned material is used through products like models, presentations, interviews, or simulations – (good)
4. Analysing – breaking materials or concepts into parts, determining how the parts relate to one another or how they interrelate, or how the parts relate to an overall structure or purpose. Mental actions included in this function are differentiating, organizing, and attributing, as well as being able to distinguish between the components or parts. When one is analysing, he/she can illustrate this mental function by creating spreadsheets, surveys, charts, or diagrams, or graphic representations – (very good)
5. Evaluating – making judgments based on criteria and standards through checking and critiquing. Critiques, recommendations, and reports are some of the products that can be created to demonstrate the processes of evaluation – (excellent)
6. Creating – putting elements together to form a coherent or functional whole, reorganizing elements into a new pattern or structure through generating, planning, or producing. Creating requires users to put parts together in a new way or synthesize parts into something new and different creating a new form or product – (outstanding)

■ Follow-up

The entries of Reflection and Feedback MAX should not be graded by mark, but the tutor could always facilitate the development of students' analytical skills providing the feedback using the descriptors of above-mentioned Taxonomy of cognitive field.

The entries received from students can also be cut in pieces: three things, two things and one thing, and students in groups could be asked to rate the responses according to the descriptors of Taxonomy of cognitive field.
Or students could be organized in three groups, the first group receives all the slips of three things; the second group receives all the slips of two things and the third group – the slips of one thing and groups are asked to classify them, label, and explain their reason (see concept formation steps).

- **Students' feedback** on MAX
  - ✓ "*Next, I consider success in this course by writing a MAX assignment. This enabled me to make self-analysis and look from another perspective to myself and motivated me for the further improvement of my professional competence*."
  - ✓ "*The other thing that I consider as a success of this course is the experience of writing MAXes. Initially, it was very hard to understand the idea of reflecting on each seminar. I thought it was lengthy and time-consuming. Still, the last lecture changed my mind. First of all, I finally understood the importance of writing MAXes. Second, through these three-previous works, I gradually realised how to write the appropriate feedback. Initially, I wrote my work as a reflection of what was done and what I have discovered and how I will use it. My first work was more like a retelling of the lecture. Then, having analysed the first work and made relevant conclusions, I understood what the primary purpose of the MAX work was, to reflect on your feelings and gain knowledge during the seminar. Thus, I elaborated the second MAX and tried to combine both my reflection of the conference and my feedback on what I have learned and how it will contribute to my personality and my profession. And lastly, in the last MAX, I already tried to reveal all my thoughts and my emotions when we were attending workshops, because I still consider that that was a valuable experience both for the development of my professional identity and methodologically for the development of my professional experience. Undoubtedly, someday I will use this approach on visiting the true representatives of their profession with my class because only true professionals can inspire to realise oneself in the profession. Finally, I consider the experience of writing MAXes as the success of this course because it gave me the idea how to use this approach in my future Master thesis. I assume that I will use MAX as a method of gathering empirical results in the context of my work. With the help of MAX, I will find what motivated my presumed research sample, what feelings they had at the time of the implementation of my research as well as their feedback and thoughts about the experience*."
  - ✓ "*In my opinion, MAX as an evaluation tool is useful for evaluating myself, my lessons, and for my students. Also, to use MAX as an evaluation tool for*

the course is useful, but I would recommend that given grades on MAX is contra-productive. I always thought about how much I should write and what I should write in order to get a good grade".

- **Visualized examples** (the works of students)

  Student No. 1

  3 things / ideas I learned **(Motivation)**

  - The seven levels of personal consciousness by Barrett were an interesting topic. This model is a framework for understanding how individuals and organisations develop and grow. I understood that I am at the level of transformation.
  - Evaluation of my professional competences was challenging to do. I think it is useful to look back and evaluate what things have you gained during these 2 years of studies. It helps to realize the skills that still need to be improved and reminds that there is always a place for development.
  - Making a whistle was really amazing because I like doing creative activities like this one. Working with clay again brought back some nice memories about some moments of my life when I have worked with it making little statues, candlesticks, and small bowls. The manager of the study and artist Helga Ingeborga Melbārde is a very interesting and charismatic person. Her positivism really encouraged and supported during this workshop. It was really great to see how happy and enthusiastic some course mates became when hearing their whistles' first sounds. I absolutely will try out making whistles at home too.

  2 things / ideas that inspired me professionally **(Acquisition)**

  - Aim activity I have already done several times, during *FranklinCovey* course "The Seven Habits of Highly Effective People", in my daily life and also with my grade 4 students at school. I have already used to setting aims and then setting tasks for reaching them. This skill is useful for children to gain awareness of how aims are formulated, how one can reach them, and also that aims should be measurable and tasks or a task should be concrete and measurable. We have done it already since February. They usually set their aims for a month, and they set 2-3 aims – personal and connected with their studies at school. At the end of month, they reflect back whether they have reached their aims or not.
  - Inner/outer circle discussions are great because they are person-centred. Everyone has a chance to speak up and also – to listen. I would like to use it in my work, but it won't be possible to do with primary grades from 1 to 3 but it could be used with grade 4 with a very easy discussion

topic or questions given for getting information from their group mates in a very limited period of time.

1 thing / idea that was attractive, but it still needs to be worked on **(Extension)**

- The evaluation of competences was difficult too, I think that I could have improved some points with more appropriate examples from my experience.

Student No. 2

3 things / ideas I found out/ I learned (Motivation)

- I found out that if I set clear goals, which can be measured, attended, time-phased and which are specific and realistic, then I am able to achieve them easier as if they are too broadly formulated, unmeasurable, unrealistic, and unspecific. Before this lecture, I set the goal that I want to have a better relationship with my mother. Therefore, I set the steps to phone her once a week and text her two times a week and to talk with her about her feelings, experiences, and life. I achieved my goal because I set these clear and specific steps. In the future, I want to set specific, realistic, and clear steps further to achieve my goals in daily life and within my profession.
- During talking about the three artefacts, I learned that people are developing their professional identity because of turning points in their life, for example, when they are changing schools, going abroad, or feeling unsatisfied with their situation. When I talked about my artefacts, I realized that my development of professional identity is based mostly on changing the schooling institution. My first professional development happened when I entered the vocational high school to be a kindergarten teacher and an after-school-care centre educator. In this stage, I was in the status 2 – Moratorium. I had a sense of who I am, but I was not sure who I wanted to be. Therefore, I wanted to get to know it. When I entered the university college for teachers, my next turning point happened. I was in status 3 – Foreclosure – in my professional development. I knew who I was, and I knew what I wanted. I wanted to be a teacher. Therefore, I created plans which I wanted to follow. Now, I am between status 3 and status 4 – achievement, because I am still establishing plans and developing myself, but I also want to finish my master degree, so I am working on my plans, but I have not achieved them yet.
- I learned that there are seven ways teachers learn. They are learning from institutions, research, ideas, analysing their own teaching, and inspirational examples. Besides, they are learning intuitively and as an adult

sharing their experiences. I found out that I learn theory from institutions, for example, about learning theories, teaching styles and methods, professional development, and subject-specific issues. My learning outcome depends on introductions and how professors give the knowledge further. In the bachelor's degree, I was like a blank paper, I had no experiences and ideas about being a teacher. Therefore, it was easier for me to learn. Whereas, now if I hear topics in lectures, which I already know, it will be more difficult for me to learn. In addition, I found out that I am not learning from research because I am not interested in it, but I think I should start reading scientific papers to learn from those and to develop my professional identity. I think, as a teacher, I always have to develop myself and be updated with new methods and theories. These methods and theories I only know through reading research papers. Moreover, I found out that I am learning through analysing my own teaching. After every German lesson, I talk with my colleague about the lesson and think about what I could improve.

2 things / ideas that inspired me professionally (Acquisition)

- The creative workshop, where we draw sketches, inspired me professionally because I learned that it is important to try out things, not always thinking about what other people might think about me, there is always space for improvements, and that everyone is an individual. In future, I want to try out more different teaching methods because I also learn from ideas and if I get doubts about what I am doing, I will ask my colleagues for honest feedback. Until now, I wanted to try out something, but then I stopped because I had doubts about it and felt uncertain if I had done the correct thing.
- The wheel of motivation tendencies inspired me professionally because I learned 14 motivation tendencies (acceptance of authority, orderliness, being demonstrative, autonomy, belonging to a group, introspection, accepting help, dominating, helping, tolerance to the new, persistence in reaching a goal, heterosexuality, aggression, feeling guilt, and motivation of achievements). I found out that I have a high tendency for orderliness, autonomy, belonging to a group, introspection, dominating, helping, tolerance to the new, persistence in reaching a goal, feeling guilt, and motivation of achievements. On average, I had the points: acceptance of authority, being demonstrative, accepting help, heterosexuality, and aggression. Therefore, I can conclude that I have high motivation tendencies. The motivation tendencies – tolerance for the new, motivation of achievements, persistence in reaching a goal, orderliness, helping, and introspection are helping me in my profession in daily life, but dominating and autonomy have in some situation's negative effects. I want to

be independent in making decisions and perform in my profession, but then sometimes I have problems being cooperative. Also dominating, to be the leader of a group and to make decisions instead of others, is not a positive aspect of working together with a colleague in one class. Therefore, in future, I can develop my professional identity when I give others as well the chance to say their point of view and to be the leader of the group.

1 thing / idea that was attractive, but it still needs to be worked on (Extension)

- The idea of going to a museum about the history of education and teachers was attractive to me, but it still needs to be worked on, because I heard and learned already a lot about the history of education and teachers, but in my teaching I am not aware of using teaching methods which came up in the past. Therefore, I want to read more about the history of education to gain more ideas which I could use in class.

Student No. 3

Three ideas I found out to be motivating

1. The first thing I really liked was the "My strengths" worksheet. There were some unfinished sentences like "I like about myself..."; "I am good at…"; "People can rely on me because…"; "One good thing about me…"; etc. Sometimes, I think we have to remind ourselves of our strengths. We are so busy in life's hustle and bustle that we forget about ourselves, what good qualities we possess and how to reflect them. On difficult days, remembering positive things can motivate us to cope up with stress and can help us to focus on our diligence. Some of the unfinished sentences, however, were difficult to answer. Those were like "This year better than last year I have dealt with..." or "One of the aims I am currently trying to achieve is...". I would say the former one I couldn't answer as I felt I haven't dealt with anything so difficult so far and the latter one was quite obvious as all of us are trying to complete our studies. Similarly, I can't answer on somebody's behalf like "they like me..." or "those who know me are happy that I am..." Different people have different opinions about the same person. So, I was not sure how to answer them. However, all these sentences made me feel that I have achieved a lot and I am capable of doing a lot of things other than studies.
2. I like the explanation about motivation tendencies. Some of the tendencies, however, I think help you become a better person. We have a very close society, so for me, belonging to a group is a necessary thing. Whenever we celebrate some functions or have some celebration together, we

try to appreciate each other's work and give regular compliments. That encourages us and we also try to help each other in difficult circumstances. I have seen that some of the people from our nationality who are married to the locals come in order to make their kids show the importance of our festivals so that they can adapt to both the local as well as the Indian culture. Besides this, I have found that 'Aggression' has motivated me to face some challenging situations. Like professor was telling about getting aggressive when your kids are being criticised for something, I have felt the same on many occasions and I have taken action against it not just to prove my point but also to show to my kids that they should not believe everything that others are saying about them, instead they should rely on their strengths, and they shouldn't let their morals down.

3. The third thing that inspired me was the workshop of making 'Clay whistles'. The task required a lot of patience and skilful hand movement. As I am not artistic by nature, the job was quite difficult for me. I was constantly asking for help from one of my colleagues or the professor. Accepting help was not a difficult element for me as I wanted to accomplish my job. I noticed that all of us were contemplating on the job very seriously and we were constantly examining our whistles after every few minutes. Everyone was putting their best to make it work. All this dedication made me think about what makes people try to accomplish something? Is it the competition to show I am the best or is it the real pleasure that you can get after achieving something. The other part of the activity I really enjoyed was the conversation. While the process was going on, we were chatting constantly to each other. In the end, I knew a lot about some of my fellow colleagues.

Two things that inspired me professionally

1. The first thing that inspired me was when the professor showed that priority between social skills and academic skills is important, and we should not ignore them. I agree that social competences play a major role for a person to be successful. Unlike India, where grades are given importance and every child is expected to excel in the academic field, my husband and I think that extracurricular activities like playing piano, singing, playing football, going out with friends, are as important as getting marks in various academic spheres. So, we don't press our children to be the best in the class, instead we pay attention to their moral and communal development. We have noticed that our children are flourishing both physically and intellectually. I think it is important for the parents to understand that modern day children can't thrive on traditional education, and they should have some additional awareness about the things around them.

2. The second thing that inspired me was the story by our fellow colleagues about accepting help. I agree that sometimes we don't have to force people to accept our help. Sometimes, it's best to let the students try themselves and let them see the outcome themselves. But in other cases, you have to reach yourself to offer them any help. I have seen some of my students in the class are very shy. They won't ask even if they haven't understood the task completely and they won't even come to me. In the beginning, I was unaware of this problem and their grades were going down. But now I know and whenever I offer help, they accept it and I have seen that they are not as weak as they seem to be.

One thing I would like to work upon

I was encouraged by motivation tendencies explanations, but I can say that some of the tendencies for me are fairly strong and they are "Tolerance about new things", "Persistence in reaching goal", "Achievement motivation" and "Working in a group" and those are the tendencies I would like to work upon. Although it's not bad to set a goal and work hard to achieve it, for the past few months, I have been ignoring my family to complete my home assignments and to manage my job. My family members don't complain, instead they provide me their full support. But somehow, I feel guilty being a mother and a housewife. It is also affecting my health and I can see that I get tired too soon and want to relax. Probably, spending time with my family and friends is what I'm looking forward to. But other tendencies like tolerance and belongingness to a group, I take it as an asset and admire my own culture as well as I am quite capable of adapting to a new culture.

Student No. 4

3 things that, as a result of the course, have changed in me as a person, as a professional, as a representative of a society

One thing that changed in me as a person is my attitude towards the concept of how other people see me. During the first lecture we were told that the answer to the question how others see me reveals the ability to analyse your personality as a whole. It was impossible for me to answer this question at the beginning. However, when we completed a task called "Johari windows" I had a chance to know that other people see several qualities in me which I thought I did not possess. This was a revelation and now I have a wider vision of myself.

The thing which changed in me as a professional is my attitude towards the students. I always knew that teachers have to study all their lives, but I forgot how it feels to be a student. While performing all the activities

in this course I tried to attach their meaning to my students' feelings and behaviour. This was done because of the lecturer's questions and suggestions to apply this or that aspect to the school context, which made me think in this perspective. Thus, completing a task about motivational strategies and analysing myself, I realized that my students might be different people and might think differently, therefore I have to be aware of such a possibility and be sensitive to them.

As a representative of a society, I have realized the importance of teachers in social life and community formation. Based on the experience of the first Latvian teachers of the 19th century who made the first steps in education development, I now realize that modern teachers are responsible for developing, enlightening, and educating this and future generations, forming society values, attitudes and moral beliefs. Therefore, after the words of Professor Krūze who stated that teachers have a very high position because they perform an important mission, deal with children raising and upbringing I realized that teacher's status should be raised in the society.

2 things to be considered as the success of this course

The first thing which I evaluate as the success of this course is the opportunity of developing new skills and overcoming challenges. I have tried out new skills and overcame a challenge of drawing and demonstrating my imperfect pictures to the spectators. Furthermore, what I value the most is the chance to develop creativity which every person has to have in everyday life. However, routine, and monotonous set of activities to be performed in an ordinary life deprive a person to spend much time on creative activities which turn into "flow", a process when one enjoys doing the thing and does not notice time. Surprisingly, my feedback about the art class was classified as "flow" during the feedback analysis activity. Therefore, I believe that the success of the course is the given chance to experience flow and satisfaction.

The second thing which I consider as the success is the multi-faceted approach, I have implemented to analyse my personality and teacher's identity from various perspectives. I would never do such a deep examination of myself without being given such an opportunity within the course. Firstly, I have discovered which stages of development I have gone through and which stage I occupy now. So far, I have gone through "diffusion" when I did not care much what was going to happen, and finally got to the "achievement", having a clear aim, understanding and a plan of what to do. Secondly, I have analysed seven ways I have been learning as a teacher during my professional life and which ways I have implemented in my professional practice, which now make me feel more

secure about the actions I perform. Thirdly, I have investigated which areas of teacher's development have been covered in my work and these are "skills" and "knowledge" and I have realized that at present I'm developing "attitude" and "awareness". Finally, having completed the checklist "you and your profession", "you and your school", etc., I have got a possibility to find out the areas which I have thoroughly developed, and which require more attention in the future. Therefore, the success in completing all these activities is the whole picture of me as a professional teacher and a plan of the steps to be taken in the future.

1 thing / recommendation for the improvement of this study course

I would recommend providing an opportunity to get acquainted with other teachers' identity stories. It could be an interesting experience to know how other people made their ways to become teachers, what the life stories were, how it happened that they had chosen this kind of profession and what their feelings about it are. I believe that any personal story is unique and when a person presents it in a written form, they have a chance to give minor details together with the important events that influenced their lives. In my life, I quite often ask my colleagues how they feel about being teachers and how it happened to them to become a teacher. However, I suppose that a written story might reveal deeper retrospection of personal life. Furthermore, any written work requires reading as all writers need a reader. Therefore, to write and present your teacher's identity story would be more stimulating and inspiring work if the writer knew that it would be read by a larger audience. It would also contribute to the development of belonging to a community of the teachers of this, previous and following courses, maybe even generations and would improve the well-being and positive stance of everyone connected with this profession.

CONCLUSION

The tool introduced in this chapter may be used in all the education cycles and can be integrated in different subject areas. It is relatively easy to implement in any classroom provided it requires minimal preparation. The autonomous learning approach encourages both active participation and reflections on the activities the participants are engaged in, while the reflection theory underlying this tool is crucial within the personal, academic, and professional development. The tool introduced in this chapter tackles the issue of the development of learner autonomy alongside the other skills, such as analytical, critical, and creative thinking skills among others.

REFERENCES

Mackness, J. (2011). *Characteristics of an Autonomous Learner*. [online] Available at: https://jennymackness.wordpress.com/2011/01/24/cck11-characteristics-of-an-autonomous-learner/

Moore, I. (2010). *What is Learner Autonomy?* [online] Available at: http://extra.shu.ac.uk/cetl/cpla/whatislearnerautonomy.html

Sykes, A. H. (2014). *Four Strategies for Promoting and Developing Learner Autonomy in Blended Learning Contexts*. [online] Available at: http://tlc.unisim.edu.sg/blog/sharing/? p=88

World Economic Forum (2016). *Annual Report 2015-2016.* www.weforum.org

Additional reading about MAX as a data collection method in research

1. Mikelsone, I., Odina, I. (2016). Future Teachers' Reflection to Understand Their Professional Identity. // In: *Proceedings of 1st International Conference on Lifelong Learning and Leadership for All.* Vol.1. ICLEL conference, Olomouc, 2015. Published in 2016 by Sakarya University, Faculty of Education. - pp. 239-244. Available at: http://media.wix.com/ugd/d546b1_a7b3edd54a2e41718bb5a79c754b7dc0.pdf.
2. Mikelsone, I., Odina, I. (2017). How Novice Teachers of Different Education Backgrounds Perceive Their Professional Identity.// In: *Proceedings of 3rd International Conference on Lifelong Learning and Leadership for All.* Politechnical University of Porto, Portugal. www.ijlel.com/conferance17/65.pdf
3. Mikelsone, I., Odiņa I. (2018). Goal Setting Skills in Teachers' Professional Development.// In: *4th International Conference on Lifelong Education and Leadership for All.* (ICLEL 2018), University of Lower Silesia, Wroclaw, Poland, 3-5 July 2018: *Conference Proceeding Book* / ed.: Osman Titrek, Agniezska Zembrzuska, Gozde Sezen-Gultekin Sakarya, 2018 p.310-322.

Chapter 13

Micro-Learning Planer (MLP)

Sanjeev Sonawane & Vaibhav Jadhav

INTRODUCTION

In this digital age, continuous technological changes are inspiring new ideas and strategies that improve learning. As our lifestyles change, so do our learning requirements. Many studies have shown that teaching with small chunks of information improves information retention (Luminita, 2017). Micro learning dictates that the content should be small and interconnected with a focus on individual learning objectives (Singh, 2014).

Many studies have found that online learning information is usually made up of tiny bits. The essential goal of those small portions is to achieve the goal. These little portions are crucial and beneficial for learning in this regard. The research separated the online information into 16 chapters and three student groups. Group one answered all of the questions on the test, group two answered four questions, and group three answered eight questions. Students supported the same test in the second stage after the first. Small bits of knowledge helped students retain information in the first and second stages of the study. Small chunks boost working memory capacity and provide a better learning environment for students. Therefore, Micro learning allows students to learn quickly and recall information through shorter learning modules (Luminita, 2017).

Microlearning may not be the finest educational strategy, but, it is indeed an excellent way to bring together micro-media environments. Microcontent is more holistic than mere data in a sense that data does not always provide complete information, but microcontent does (Hodgins, 2001). The present age of the IOT and consistent web presence makes it pertinent that available learning materials are converted into relevant chunks of microlearning content. This is the reason why Google has become the most effective e-learning tool. This informal microlearning is the e-learning design of the future. Some of these can still be macro-structured content in courses but in future the e-learning content developer must make these learning materials into micro-structured digital form. Some of these will continue to be macro-structured content in the courses, but in the future, e-learning content developers will need to create micro-structured learning materials in digital form.

BACKGROUND OF THE TOOL

Micro-learning is the process of learning through short, digestible, well-organized units. Micro-learning caters to the needs of students while also achieving the goals set by instructors. Microlearning is beneficial in catering the dwindling attention spans of Gen z and Alpha generation learners in the most efficient and effective manner possible. The background of micro-learning tool is as follows:

1. Micro-learning helps teacher educators achieve single learning objective at a time.

   A learning objective is a statement which defines what the learners will be able to do or know after completing the study module. Micro-learning lessons are beneficial as one micro-learning lesson deals with only one performance objective per module. This ensures that the learner takes one step at a time so that he/she clearly understands it, before moving to the next one.

2. Micro-learning provides specific and targeted information to the learners.

   Micro-learning mostly offers only important information. This saves a lot of time and makes micro-learning highly concise and to-the-point with targeted knowledge. It removes the ambiguity of what is significant and what isn't, and just provides the information required to complete the task.

3. Micro-learning is relevant for short attention spans of new age learners.

   Micro-learning is so well-structured that it takes no more than 8-10 minutes to complete. This feature of micro-learning makes it ideal for today's learners with short attention spans and tight schedules.

4. Micro-learning strategies comes in variety of formats.

   Micro-learning strategies won't always take the form of traditional learning forms. They can be self-contained learning modules in the form of a short movie, an infographic, a podcast, a quiz, scenarios, whiteboard animations, interactive PDFs, or games, among other formats. This will help to pique learners' interest and appeal to a variety of learning styles.

5. Micro-learning can be utilised at various points of the learning lifecycle.

   The beauty of micro-learning is that it can be used for any kind of learner at any point of the learning cycle. It can be used in school teaching, teacher training delivery, and for continuous learning for professionals. It is also easy to blend with other teaching strategies.

THE THEORETICAL BACKGROUND OF THE TOOL

Microlearning Theories

Theories	Description
Cognitive Flexibility (Jean Piaget)	The ability to spontaneously restructure one's knowledge in a variety of ways in adaptive response to radically changing situational demands, allowing knowledge and abilities to be transferred to new learning situations.
Adaptive learning (Charles Darwin)	According to the Adaptation theory, also known as survival theory or survival of the fittest, adaptive learning refers to an organism's ability to adapt to changes in its environment and make adjustments over time is referred to as adaptive learning.
Situated Learning (Lave and Wenger)	According to Lave and Wenger, learning is unintentional and situated within authentic activity, context, and culture. Cognitive apprenticeship (Brown, Collins, & Duguid) is a related idea.
Discovery Learning (Bruner)	Discovery learning is an inquiry-based teaching technique that argues it is ideal for students to discover facts and correlations on their own.
Social Development (Vygotsky)	According to Vygotsky, social interaction precedes development. He further asserts that the consciousness and cognition are the end product of socialization and social behaviour.

- **Cognitive Learning Theory (Jean Piaget):**

  The Cognitive Learning theory, developed by Jean Piaget in 1936, suggests that knowledge is actively constructed by learners based on previously learned knowledge. The theory is concerned with how information is processed by the brain and how learning occurs through that internal processing of information. According to the theory, there is a set amount of information that can be remembered at a time and therefore, the theory suggests ways to maximize the mind's productivity by minimizing distracting information. In the Cognitive theory of Multimedia learning, the overarching principle is that we learn more effectively from words and pictures than form words alone. Drawing from this theory, Microlearning focuses on human ability to spontaneously restructure knowledge in many ways in adaptive response to radically changing situational demands, to facilitate the transfer of knowledge and skills to new learning situations. Moreover, microlearning utilizes a wide variety of multimedia tools to make the learning modules interactive to make learning more effective.

- **Adaptive learning Theory (Charles Darwin):**

  According to Charles Darwin's Adaptation theory, also known as survival theory or survival of the fittest, adaptive learning refers to an organism's ability to adapt to changes in its environment and adjust accordingly over time. Microlearning helps create customized content for learners based on their proficiency levels. It is associated with extensive testing to determine where a learner is and what they need to complete. Results from this testing are used to create custom learning paths for each user based on their goals.

- **Situated Learning (Lave and Wenger):**

  This theory argues that learning is necessarily situated, i.e., learning occurs in the process of participation in communities of practice. According to the theory, newcomers join communities of practice and learn through immersion in the new community by absorbing its modes of action and meaning as a part of the process of becoming a community member. Learning viewed as a situated activity has as its central defining characteristic called the legitimate peripheral participation which defines how newcomers eventually become experienced members and later older members in the community of practice. Based on that Microlearning gives opportunity to deal with unintentional and situated learning within authentic activity, context, and culture. Cognitive apprenticeship (Brown, Collins, & Duguid) is a related idea.

- **Discovery Learning Theory (Bruner):**

  Discovery learning theory was introduced by Jerome Bruner. Discovery learning is a method of inquiry-based instruction. This theory encourages learners to build on past experiences and knowledge, use their intuition, imagination and creativity, and search for new information to discover facts, correlations, and new truths. Learning more than absorbing what was said or read, leaning means to actively seeking for answers and solutions. The discovery learning educational sessions should be well-designed, highly experiential, and interactive. Instructors should use stories, games, visual aids, and other attention-grabbing techniques that will build curiosity and interest, and lead learners in new ways of thinking, acting and reflecting. The techniques utilized in Discovery Learning can vary, but the goal is always the same, and that is the learners to reach the end result on their own. In alignment with this theory, Microlearning helps discover facts and relationships on their own.

- **Social Development Theory (Vygotsky):**

  In this theory, Leo Vygotsky explains that socialization affects the learning process in an individual. According to him, learning occurs in social interactions. This means that when we talk to our peers or adults, we talk to

them for the sake of communication. After we interact with other people, we tend to internalize what we say. A traditional classroom model where the teacher transmits knowledge to students is still widely prevalent, although it is now being accepted that a group learning context can make the learning faster and efficient. Because of social development theory, many schools are now encouraging recitation so as to reciprocate the learning experience inside the classroom. This means that the teacher also learns from the students as the students learn from the teacher. Microlearning gives opportunity to learn through social interactions wherein the consciousness and cognition are the end product of socialization and social behaviour.

- **Spaced Learning Theory (Hermann Ebbinghaus):**

  Microlearning can help commit information to memory with better ease. Because microlearning follows the concept of spaced learning, i.e., learning is more effective, and information is more readily retained if it is spaced out over time. Ex. If a traditional eLearning course of 2 hours is spaced out into 6 modules of 20 minutes each, a microlearning course of 2 hours will be spaced out into 24 modules of 5 minutes each. Spaced learning, according to Ebbinghaus, is more likely to end up in the long-term memory, and thus can be retained and recalled more easily.

LITERATURE REVIEW

In the 21st century the web has evolved from a producer-consumer oriented information source to a social web filled with used generated content. Loss of quality in the learning is a major concern, therefore, the numerous developers are continuously coming up with solutions to ensure content quality on the web (Goschlberger, 2011). Researchers propose to use interaction patterns of successful social networking sites to create a platform that motivates students to create and share learning activities for quality content. Engagement of learners is also significant for better producer-consumer orientation. The success of Microlearning as a pedagogical approach stems from the evaluation of learners' engagement. It is also observed that learner participation is increased through the evolution of microlearning (Bannister, Neve & Kolanko, 2020). The development of regular activities for successful learning experiences in higher education is the most remarkable requirement. As implied by many studies during the COVID 19 period, often, learners are unable to pay continuous attention in the e-learning systems. Thus, it is vital for the teachers and mentors to maintain the engagement or participation of learners during learning through microlearning. Moreover, the micro learning environment is developed with the help of technology which helps enhance learning. Microlearning environments encompass various motivational factors that peak learners' interest and engagement. Basically, it helps in repetitive learning through embedding the learning

process into the daily routine by use of communication devices. Through this method a new learning space emerges and becomes available for lifelong learning (Gerhard, Theo & Christian 2004).

The most stunning factor is that micro learning is able to improve student's learning ability. The problem with traditional learning methods is that the learner's mind is glued in its state, and it does not motivate them to get new knowledge and improve their skills. Microlearning provides a new teaching paradigm which can allow knowledge and information to be divided into small chunks and deliver it to the learners. Microlearning can make the learning subjects easy to understand and retain for a longer period (Gona, Karzan & Sarkhell, 2018). On the other hand, according to a study on various interactive education materials, microlearning was found to be successful in improving the learning of students and to increase learner's enthusiasm (Eser, Ozan & Hilal 2021). These research show that the class using microlearning methods was more useful compared with traditional methods. The results emphasized that the microlearning group showed better learning than the traditional group. Thus, using microlearning techniques, the effectiveness, and efficiency of learning can be improved. Also, the information can be retained for longer periods.

Microlearning is also helpful for continuous professional development, and it provides learners with the flexibility to engage in a number of different learning modalities such as short articles, bite-sized videos or audios, podcasts, blended instructional designs that extend the reach of live educational activities into a succinct video or audio, and illustrative case studies for model clinical decision-making (Dahiya, S. & Bernard, A. 2021). Micro-learning, aligned with formal learning and embedded in online communities, has the potential to support professional development (Ilona, & Hamelmann, 2010). Microlearning is designed to help learners acquire a skill or solve a problem within a short time period. It should be digitally based, skill based, and personalized. Since microlearning is in its early development, a broad range of studies can make significant contributions to this field. Future research can focus on generating quantitative and qualitative evidence to examine the effectiveness of microlearning for professional development in various industries (Zhang & West, 2020).

Microlearning is compatible with mobile learning as both are trying to provide bite-sized content at anytime and anywhere with easy access to the end users to facilitate learning with real engagement. Researchers describe an application for mobile phones and personal computers designed to help users learn via "micro-learning" events (Beaudin, Intille & Morris, 2012). The various devices like mobiles or tablets are helpful for microlearning system and studies have shown that mobile micro learning could not only increase students' performance, achieve-

ment, learning motivation, engagement, professional skills, and knowledge retention but also contribute to the field of just-in-time learning in the workplace so that employees can fit microlearning into their busy work routines anytime using their smartphones (Lee, 2021). Technological innovation and ICT has made our society a well-informed hub through the school education and teacher education (Jadhav, 2011). In such a hub, learners can acquire and utilize the available information quickly for defining their daily problems. Mobile Micro-learning is aimed at discovering new ways of responding to the growing need of lifelong learning or learning on demand for members of our society in the present techno-society. The education industry is regularly updating curriculum to cope with the changing demand of industry and business to meet the challenges in the internal and external environment of businesses (Job & Ogalo, 2012). Subsequently, the exploration of micro-learning is used to organize and order a set of pedagogical and technological phenomena and concepts in new and interesting ways (Luminita Giurgiu, 2017). The micro-learning should not be thought one approach among many, but instead as a perspective that applies to many aspects of education, as something that goes on continuously, since micro-learning have a generalized applicability to the studies of media and technology in education in the broadest possible sense (Theo Hug, 2007).

Hence, microlearning is the demand of the education industry and it will promote quality education at school level and teacher education. The impact of the Fourth Industrial Revolution on education in India is highly noticeable and the principle of connection among the learners in the society due to technology is remarkable for making a knowledgeable society. This has been implied for higher education institutions in terms of planning and preparing learners to not just be prepared in terms of traditional disciplinary requirements but also be able to adapt to the needs of the job market. This is nothing but increasing interconnection among the people and it is an essential element of the fourth industrial revolution (Schwab, 2015).

MICRO LEARNING PLANNER

Creating a Microlearning Planner is a systematic task that includes proper analysis of content, designing of delivery mechanisms, confirming the principles of creation, and planning of execution. Microlearning must meet the specific requirement of the target users. For example, in teacher training, the focus could be the development of the teacher's professional skills.

1. Elements of the Micro Learning

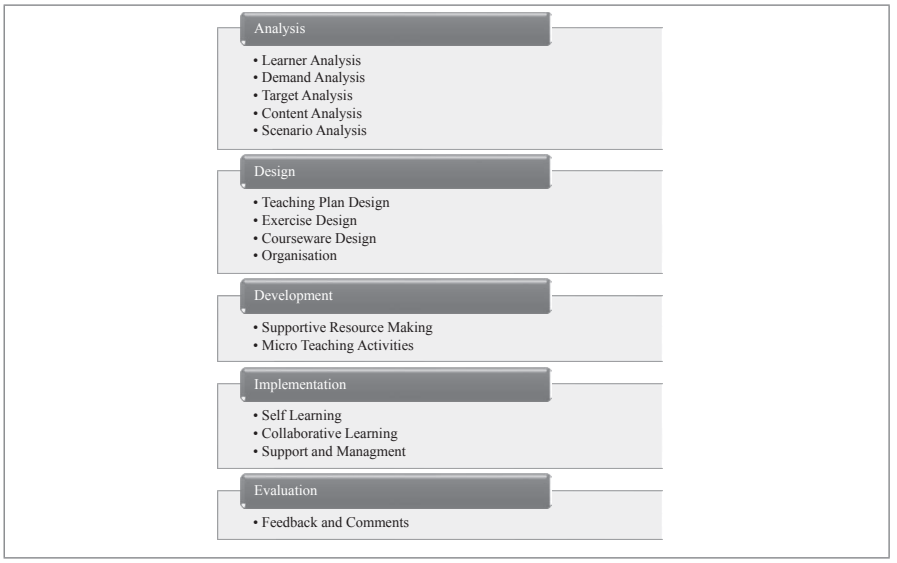
Since each microlearning asset serves a specific objective, the forms they take are diverse and dependent on the intended learning outcome. Common exam-

ples of microlearning objects that can be used across multiple devices such as desktops, laptops, computers, tablets, and mobiles etc. are as follows:

1. Interactive / non- interactive Videos - Using multimedia and developing video is easier to transfer information and create more engaging content for learners. And learners can engage with two cognitive subsystems: the visual channel and the auditory channel. Therefore, the visual and verbal form of the information is enhanced recall and recognition "…people learn more deeply from words and pictures than from words alone" (Mayer, 1994). According to Cognitive psychology, after three days we retain only 10% of the information we hear, but we have a recall rate of 65% when visuals are added. So, the principle of Micro learning is that small bits of content are retained and internalized better than the longer learning content.
2. Interactive / non-interactive infographics / PDF - Infographics are a combination of visuals and text that simplify complex ideas. They are great for learning material/training material that involves facts, statistics, and trends. Infographics can also act as quick reference tools as they give a general overview of a topic. Using infographics can help make textual content interesting and engaging for the learners. Interactive or non-interactive infographics and PDFs are gaining use as quick and handy resources that are ideal as microlearning elements. Nowadays, PDFs of contents are very easily available and mobile friendly. It can be supported across multiple digital devices for easy circulation.
3. Gamification - Gamification based techniques can be applied across all teacher training needs. A well-crafted Gamification for serious learning will help you achieve the objectives of the teacher training or classroom teaching. Learning through Gamification can help achieve fast completion of a task and it makes learning not feel like learning. Learners are drawn to Gamification as it makes learning fun and features rewards and recognition -that all of us love! Combined with microlearning, this approach offers learners a "bite-sized" Gamification experience.
4. Mobile – Microlearning on a mobile device means micro lessons can be completed anywhere, anytime, and importantly at a learners' own pace. The combination of Mobile learning and microlearning provides a deeper understanding of the content and the most beautiful thing is that it can be consumed anytime and anywhere. Learners prefer these formats, and this leads to higher completion cycles. Mobile learning makes great companions, and you can use them to multiply the impact of your training delivery. Short nuggets (Microlearning) can be taken on the go (on smartphones or tablets that are an integral part of Mobile learning).

5. Peer Learning or collaborative learning - It can be helpful when a learner needs to master a competence or new skills. Through the principles of micro learning, a learner can achieve a goal with the help of peers in a short time or with short content. Watching how a peer completes a task while hearing that co-learner explain their process is a form of highly relevant context-based learning.
6. Keeping it Short - Breaking complex content into multiple courses or in lessons so they can address one chunk at a time. This kind of chunk content defines how to deliver a quantity of knowledge and information, structured in several short chapters, fine-grained, well-defined, and interconnected. Micro-content refers to information whose length is determined by a single topic, content that covers a single idea or concept and is accessible via a single URL, being suitable for presentation in handheld devices, emails, web-browsers. Thus, micro-content is the part that integrates into micro-learning (Giurgiu, 2017).
7. Reinforcement / Rewards - Rewarding can be implemented by offering rewards to those who complete the course as quickest. This kind of reward gives motivation for further learning.
8. Graphical User Interface - The GUI is the point of interaction between learners and the content that you have created. Its facilities interaction and enables navigation through the learning resource using items such as icons, menus, and controls. It is therefore crucial to pay attention to the design of the GUI, as it will have a major impact in determining the success or failure of the microlearning content. Common features of a GUI will often include next and back navigation buttons, menu-based navigation, audio controls, closed captioning controls for accessibility, contextualised help button, and exit/close buttons.
9. Rapid Authoring - Teacher can distribute the content at a fast pace while managing the logical sequence among the learners.
10. Competition and Leaderboards - Add a competitive element to training with leaderboards showing the best performance.
11. Cloud Based Translation - Translating eLearning courses into multiple languages are time consuming and expensive. With microlearning, it can be easily translated and will be available to all the learners. Because of cloud systems, any device is connected anywhere and anytime and learners can learn content in the languages of their choice.
12. Moodle Quiz / Google Forms - In micro learning, the assessment of learners also takes place. Moreover, formative assessment is most important in microlearning. At that time, teachers can use Moodle quiz or Google form for assessing their learning.

2. Model for Creating Micro Learning Planner



Source: Introduction to Microlearning, CoL, 2021

2.1 Analysis: Before starting to create the microlearning planner, as a teacher, we need to conduct detailed analysis of some important element i.e., learner, their demand, content and content learning objectives, their scenario etc.

- Learner Analysis: Due to individual differences, learners possess unique learning preferences. It is imperative to understand who they are, including aspects such as age, gender, socioeconomic status, experience, and education level.
- Demand Analysis: Adult learning is demand-centred. It is crucial to understand the learners' learning requirements in order to ensure that the micro-lesson will stimulate motivation and meet their learning needs.
- Goal Analysis: This is to determine the goal(s) that teachers should achieve at the conclusion of the learning activity. The goal(s) should be communicated to everyone who is involved in the creation of the particular microlearning lesson. These goals must be SMART [Specific, Measurable, Achievable, Relevant, and Time-Bound].
- Content Analysis: The teacher or mentors should align the course content to the learning goals and devise ways of chunking the content into reasonably small units. The available learning materials should be aligned with decided content.

- Scenario Analysis: This involves assessing the learning environment in order to consider the tools to use, platforms to avoid and potential challenges that the teachers may encounter in application/demonstration of knowledge, as well as other physical and organizational constraints that may impact learning. Some questions that teachers can ask themselves while designing microlearning modules are: In what setting will the learning take place, and would it influence the efficacy of microlearning? What are the technical requirements of the course?

2.2 Design: This stage is focused on the microlearning objectives, assessment instruments, exercise design, lesson plan design, content, and media selection. The teacher or mentor should fully understand the curriculum objectives in order to create informed documentation. Documentation in this case refers to microlearning teaching plans, storyboards, scripts, and the selection of appropriate media for microlearning objects.

2.3 Development: At this point, the content outlined in the design phases is assembled and/or created. For example, videos are produced (shot, recorded and edited) or animations and infographics are created, depending on the type of microlearning object being developed.

2.4. Implementation: At this stage, microlearning lessons are packaged to be uploaded to the relevant platforms, such as USB, DLMS and social media platforms, etc.). The decisions made in the design phase will largely influence this implementation phase. It is important to ensure that the content works and displays correctly before teachers commence learning. So, conducting a pilot course is a useful exercise. Once the microlearning lesson is uploaded, teachers can access the microlearning resources and take part in the course activities and also provide feedback to the trainer.

2.5 Evaluation: Evaluation of the individual microlearning lesson consists of both formative and summative evaluation. Formative evaluation is present as reflection in each stage of the process while summative evaluation consists of specific design features to get feedback from the users. Teachers who are part of the microlearning lesson should be able to evaluate the content, its design, and process against their own experiences in order to review whether the lesson has achieved set goals.

3. Steps of Implementation

The implementation is a very crucial phase, and it is important to ensure that the content works and displays correctly before teachers commence learning. The steps in the implementation as follows...

- Step1– Selection of the Content

  In the Micro Learning Planner, the teacher (mentors) should align the course content to the learning objectives. The learning materials are available in different forms, but the teacher or mentors should identify it properly and make the final selection for micro learning i.e. all content is not always useful for microlearning.

- Setp2 – Classify of the Content

  Content is playing a vital role in the microlearning planner. Therefore, selection of the content is basic then the content should be classified into different parts. Actually, the arrangement of content or classification of content is also important in microlearning. It has been organised as follows:

  – Principles: A teacher or mentor can identify the principles of the selected content; this will be one chunk of the whole content. All the principles of the content should be elaborated analogy or local contextual practices or examples.
  – Procedure: Some content carries their importance with their procedures so a teacher should be able to find out the decided procedure or need to modify or develop the particular procedure of the content. So, this kind of selected content will be easily delivered to the learner through any Digital Learning Management System (DLMS).
  – Facts: The selected content in micro learning definitely carries some facts, a teacher can be drawn out the facts of content. This is a very tedious job of identifying the facts of particular content, because teachers should be using all the learning materials.
  – Concepts: The contents are always free to be separated and can form any new pattern (Sánchez-Alonso et al., 2006). Sometimes the content includes many more concepts, therefore a teacher or mentor can identify all kinds of concepts from the selected content. All concepts are very attractive because they are also individually addressed and referred to by sets of formal metadata.

- Step3 – Chunking of the Content

  Micro-learning is often referred to as "bite-sized" because the content is defined in small chunks that usually last no longer than a few minutes (30 seconds to 10 min). The way micro-learning addresses short size of learning content that is made up of fine-grained, interconnected and loosely coupled short learning activities, determines the focus on the individual learning needs. The design maxim "less is more" is applicable in the chunking process. Instead of cluttered information, the teacher chunking the content, and this will increase the efficacy of a microle-

arning lesson. Keep supporting materials such as sounds, graphics and effects to a minimum, and only use them when they serve to reinforce learning.

- Step4 – Compute the Content

  In this step, a teacher organises the chunked content into logical flow. Main/critical information has to be in front and centre in micro learning flow, while additional information should be made discrepancy as per the needs of learners. Each chunk or learning block should be consumable with main/critical information and additional information.

4. Framework of Microlearning Planner

Below is a framework on how to structure each microlearning lesson and example microlearning objects for each structural element:

Framework of Micro-Learning			
Sr. No.	**What-structural element**	**How-instructional method**	**Medium-microlearning object**
1.	Welcome to the Lesson	Structured overview	Video
2.	Tap on the prior knowledge	Inquiry Drill and Practice	Survey on Moodle Quiz
3.	Review key points	Mental modelling Discovery learning	Infographic
4.	Content	Direct instruction Lecture Drill and Practice	Video Infographic Interactive PDF
5.	Discussion	Reflective Discussions Group Discussions Debate	Discussion forum in DLMS Social Media Post
6.	Review Key Points	Questions and Answer Inquiry	Video Infographic
7.	Assessment	Quiz	Moodle Quiz Google Forms

Source: Introduction to Microlearning, CoL, 2021

The above framework is useful for a teacher or mentor for making lesson plans. There are several examples given regarding the instructional method and micro learning objects. When implementing microlearning, there are many risks/challenges that should be considered i.e., the casual attitude of learners, technology barriers, content fragmentation etc. These can be some challenges, but the teacher can minimize such barriers with their experience and available resources.

CONCLUSION

The major benefit of the Micro Learning Planner is to enhance the learning among learners of any level and it can help in developing a learning environment, which would improve the learner' level of self-concept as well as learners' interactions. Micro learning planner increases the level of knowledge and understanding and its moves towards application. In fast moving learning areas, information sources and information units are available in large scale, therefore, the microlearning planner is trying to apply for rapid development and a constantly high degree of changes among learners in the field. The main characteristics of the Micro Learning planner is that it is flexible for delivery of content and pointing to the speedy development process. As a teacher, it is a meaningful input opportunity for developing your own content with the help of mobile or low-cost gadgets. It is also showing clear advantage when designing a comprehensive instructional design strategy to address identified needs. Teachers as well as learners have busy schedules and heavy learning loads that include teaching and curriculum-related activities. In that situation, a micro learning planner will definitely be helpful to teachers for maintaining the learning interest of the learner in the respective subjects or courses. In addition, today, teachers have social responsibilities, which may take up most of their spare time. Thus, the traditional long format of lesson plan is not up to the mark and effective so that a micro learning planner is able to achieve the expected results and outcomes with better ease in a short time.

APPENDICES

Template for developing a microlearning planner

Micro Learning Planner

Subject: **Date:**

Chapter name: **Time:**

Learning outcome of the chapter

Sub-division of the chapters:	Sr. No.	Section of the chapter	Learning outcome
	1		
	2		
	3		
	4		
	5		
	6		
	7		

Section 1	Principles [what]	Procedures [how to]	Facts [what is]	Concepts [why]
Section 2	Principles [what]	Procedures [how to]	Facts [what is]	Concepts [why]
Section 3	Principles [what]	Procedures [how to]	Facts [what is]	Concepts [why]
Section 4	Principles [what]	Procedures [how to]	Facts [what is]	Concepts [why]
Section 5	Principles [what]	Procedures [how to]	Facts [what is]	Concepts [why]
Section 6	Principles [what]	Procedures [how to]	Facts [what is]	Concepts [why]
Section 7	Principles [what]	Procedures [how to]	Facts [what is]	Concepts [why]

Selection of delivery mode:

Sr. No.	Section	Mode
1		
2		
3		
4		
5		
6		
7		

Compute the content [what will the logical flow in which you will teach]:

1.
2.
3.
4.
5.
6.
7.

REFERENCES

Bernhard Goschlberger, (2011). A Platform for Social Microlearning. Reserch

Studios Austria FG, Linz, Austria.

Borko Hilda, (2004). Professional Development and Teacher Learning: Mapping the Terrain. Educational Researcher, Vol.33, No. 3-15, 2014, American Educational Research Association.

Dahiya, S. & Bernard, A. (2021) Microlearning: The Future of CPD/CME, Journal of European CME, 10:1, DOI: 10.1080/21614083.2021.2014048

Eser Yıldırım Sözmen, Ozan Karaca & A. Hilal Batı (2021) The effectiveness of interactive training and microlearning approaches on motivation and independent learning of medical students during the COVID-19 pandemic, Innovations in Education and Teaching International, DOI: 10.1080/14703297.2021.1966488

Glahn, C. (2004). Integrated Micro Learning An outline of the basic method and first results. International Conference.

Gona S.M., Karzan W., Sarkhell S.N., (2018). The Effectiveness of Microlearning to Improve Studnets' Learning Ability. International Journal of Educational Research Review, 3 (3), 32-38

Guskey Thomas R., (2002). Professional Development and Teacher Change. Teachers and Teachning: Theory and Practice, Vol. 8, No. 3/4 , 2002, Carfax Publishing.

Goschlberger B. (2016). A Platform for Social Micro-learning, Johannes Kepler University, Linz, Austria

Ilona Buchem, Henrike Hamelmann, (2010). Micro-learning: a strategy for ongoing professional development. University of Applied Sciences, Berlin.

James Bannister, Mia Neve & Celeste Kolanko (2020) Increased Educational Reach through a Microlearning Approach: Can Higher Participation Translate to Improved Outcomes?, Journal of European CME, 9:1, DOI: 10.1080/21614083.2020.1834761

Jennifer S. Beaudin, Stephen S. Intille & Margaret E. Morris, (2012). Micro-Learning on a Mobile Device. Massachusetts Institute of Technology, Massachusetts Avenue, Cambridge.

Job M.A. & Ogale H.S., (2012). Micro learning as innovative process of knowledge strategy, Faculty of IT, Arab Open University, Kingdom of Bahrain.

Luminita Giurgiu., (2017). Microlearning an Evolving eLearning Trend, DE Gruyter Open Scientific Bulletin, Vol. XXII No. 1 (43).

Mali M., Sonawane S. & Jadhav. V. (2021). Micro-learning(ML): An effective way of learning in teacher education, Zeichen Journal, ISSN: 0932-4747, Vol. XII, Issue. 7, Page No. 101-108

Mali M., Sonawane S. & Jadhav V. (2021). Micro Learning Strategies for Professional Development of Teachers in Higher Education Institute, Education India Journal: A Quarterly Refereed Journal of Dialogues on Education, ISSN 2278-2435, Vol. 10, Issue- 1.

Theo Hug, (2007). Outline of a Micro-learning Agenda, University of Innsbruck, Austria.

Yen-Mei Lee (2021) Mobile microlearning: a systematic literature review and its implications, Interactive Learning Environments, DOI: 10.1080/10494820.2021.1977964

Zhang, J., West, R.E. (2020) Designing Microlearning Instruction for Professional Development Through a Competency Based Approach. TechTrends, 64, 310–318. https://doi.org/10.1007/s11528-019-00449-4

Haipinge, Erkkie & Olivier, Jako. (2019). Paving the way towards success in terms of the 4th Industrial Revolution: The affordances of multimodal multiliteracies.

Jadhav, V.(2011)."ICT and Teacher Education" International Educational E-Journal, vol 1, no 1, pp. 64-69

Weblinks:

https://www.edapp.com/blog/cognitive-learning-theory/

https://learningsolutionsmag.com/articles/darwin-would-approve-levels-of-learning-adaptation

https://newlearningonline.com/new-learning/chapter-6/supporting-material/lave-and-wenger-on-situated-learning

https://elearningindustry.com/discovery-learning-model

https://esteemjourney.com/wp-content/uploads/2018/07/Social-Development-Theory.pdf

Chapter 14

Multi-Perspective Teaching: Nurturing Analytical, Critical & Creative Thinkers

Dr Niyati Chitkara, Dr Honey Chitkara, Ms Dolma Pathela, Ms Piyusha Sharma

INTRODUCTION

Over the past few decades, there has been a marked shift from the traditional lecture-based method to highly innovative pedagogies. This continual refinement is premised on the magnitude of diversity that is found among learners within a single classroom. Irrespective of the region or state, a learning ecosystem invariably presents a dynamic convergence of varied perspectives in which learners deem education through their own individual lenses.

'Multi-Perspective Teaching' therefore can prove to be a valuable tool in the hands of the teacher. It constitutes **an overarching educational approach that considers the different perspectives of learners** towards education. An in-house practice of Chitkara International School, Chandigarh, India, Multi-Perspective Teaching enables the learners to learn a given concept or subject in their most preferred styles and manners.

The present chapter elucidates the functional teaching method of *Multi-Perspective Teaching (MPT)* and clarifies how the teacher can undertake relevant activities to suit the diverse interests of learners. The method holds good especially for the learners of classes 3 to 12, who can undertake independent projects effectively. Under the Multi-Perspective Teaching, each student is allowed to understand (analyse), conclude (criticize), and present (create) a given topic, in their own manner and style, which enhances the pupils' ability to think analytically, critically, and creatively, and the aforementioned skills, in turn, prove to be crucial for ensuring the success of learners, especially in the wake of Industry 4.0.

THEORETICAL BACKGROUND

The heavy focus on traditional teaching practices that demand students to memorise or recite and not understand the content of learning has long hampered the full development of learners. Such practices usually bring about an environment, wherein few students stand the chance to thrive and pupils with different abilities and inclinations become sidelined. Apropos of the foregoing, the learners' needs in the wake of Covid-19 have seen a tremendous increase, with children nowadays facing not just the dearth of activities that suit their inclinations, but also the dearth of resources that can render them access to quality education.

In this context, one of the priorities for the in-service teachers is to undertake a more inclusive approach towards teaching which comprehensively meets the diverse needs of learners. Here, the teacher takes into account the likings of his/her learners and devises relevant activities which he/she thinks would help the learners learn.

The core of Multi-Perspective Teaching constitutes and upholds the principle of individual differences, which emphasizes the varying learning paces and styles of students. In today's world where children enjoy considerable access to information and exposure to the world of work from a very young age, Multi-Perspective Teaching can prove to be an extremely beneficial tool in the hands of the teachers who stay in the pursuit of nurturing dynamic and successful professionals. The said mode of teaching remains highly relevant, across all platforms of lesson delivery viz. Hybrid, Online, and Offline. Especially in the post COVID era, MPT can serve as a powerful tool in the hands of teachers through which remote learning may be turned into high-quality education.

LITERATURE REVIEW

At a universal level, teachers deal with mixed-ability classrooms, which themselves pose as great challenges to the teaching-learning process. In general terms, these classes comprise students with varying interests, inclinations, and abilities (Chapman and King, 2003).

Ansari (2013) for example, depicts mixed-ability classes as those that entail not only pupils with different capacities but also learners that have divergent preferences and learning styles. Consequently, teachers in normal classrooms remain under serious pressure to meet the requirements of their diverse learners (Meyer, 2008). In this context, the diversity within classrooms remains the most significant threat to effective lesson planning, and so, considering the distinct perspectives of learners in the process of planning a class or a lesson is a crucial

move for ensuring teaching efficacy. Correspondingly, research workers and policy formulators encourage teachers to accept and support diversity and adapt their teaching to the varying learning needs of learners in their classrooms (Schleicher, 2016; UNESCO, 2017).

However, teachers today face a dearth of training programs that equip them with the knowledge and skills to deal with such situations in their workplaces. At the end of the day, most teachers lack the necessary training, planning time, or the proficiency to continually undertake and implement distinction (Loiacono & Allen, 2008). In this regard, when the teacher fails to meet the requirements of each learner, it leads to a scenario wherein the active students or high-ability students maintain their "active" status, while the passive learners stay passive, with no considerable progress or development (Hedge, 2000).

Therefore, the teacher needs to implement various approaches or strategies in mixed-ability classrooms that may help him/her elevate the teaching-learning process. Chiefly, the suggested approach to address the problems of teaching in a diverse classroom is "differentiation". The strategy of "differentiation" has in fact grown in prominence as the same has become a reappearing theme in the classroom teaching strategies (Tomlinson & McTighe, 2006; Winebrenner, 2001). In that, the teacher may segregate his/her pupils into different groups and entail distinct learner-centred teaching strategies to enhance students' learning and encourage them to participate actively in their most-liked learning styles. Some of these strategies include character enactment, additional homework, in-class activities, and game-based challenges (Pedersen & Kronborg 2014). Corroborating the effectiveness of such strategies, Tomlinson (2001) further maintains that teachers merely need to diversify teaching types in mixed-ability classrooms to adjust and augment the fruitfulness of the learning process.

Premised on the significance of differentiation, Multi-Perspective Teaching (MPT) thus helps instructors to leverage the different perspectives of learners and devise functional lesson plans, which help the pupils with varying abilities enhance their analytical, critical, and creative thinking along with their interest-specific skills.

EXPLANATION OF THE TOOL

Multi-Perspective Teaching (MPT) posits the effectiveness of multidisciplinary teaching, which builds on the vocational inclinations or interests of students. Herein, the teacher considers the likings of his/her learners, prepares seating plans and puts the students into separate groups according to their interests. He/she then designs such learning activities and tasks that cater to the interests of the learners.

Correspondingly, under Multi-Perspective Teaching, a musically-inclined student is given the opportunity to learn a concept of any subject through the medium of music, whereas an artistically-inclined learner gets the chance to learn through the medium of art. While the idea stays constant behind each such activity, the process varies according to the learner's inclination.

Multi-Perspective Teaching can hence be defined as:

1. a wholly inclusive pedagogical approach that helps learners learn in a pleasurable, natural, and unhindered manner.
2. a comprehensive take on multidisciplinary education that helps pupils augment their concept-related knowledge through the undertaking of activities in their respective areas of interest and simultaneously develops their skills in these areas.

From the given definitions, it may be established that through Multi-Perspective Teaching (MPT), the teacher allows a level playing field for learners, wherein each student gets the chance to grow optimally and succeed convincingly.

A. Aims of the Tool

- To ensure the fulfillment of the diverse needs of learners through multidisciplinary tasks and activities.
- To assist teachers in augmenting the analytical, critical, and creative thinking skills of students.
- To empower teachers to help students enhance skills in their respective areas of interest.
- To enable teachers to promote "out-of-the-box" thinking among the learners.
- To ensure a joyful learning experience for the students.
- To boost students' confidence and nurture well-rounded individuals.

B. Expected Outcomes

The teacher will be able to:

- impart multidisciplinary and interest-based education to his/her students;
- instill critical thinking, creativity, and vocation or interest-specific skills in his/her students.

The learner will be able to:

- learn a given concept on the basis of his/her own perspective

- undertake analysis of the given information and come up with creative and out-of-the-box solutions for the assigned tasks;
- enhance his/her critical thinking, creativity, and vocation or interest-specific skills.

C. Role of Teachers

The teacher's role in Multi-Perspective Teaching is primarily that of a facilitator. In that, he/she first assesses the needs of different learners on the basis of the responses registered in the "Squad Selection Form" by the parents after due discussions with the children, and thereafter, assigns them separate co-curricular clubs or 'vocational squads' related to AI, music, coding, dance, photography, acting, sports, etc. to them. This assignment is premised on the learners' inclination. Subsequently, the teacher along with the Club Mentor or the Squadron Leader comes up with club-related activities that help children gain knowledge in various subjects viz. English, Mathematics, Science, Social Science, Hindi, French, Technology, etc. through their most preferred mediums.

D. Role of Students

The learners remain active participants in the said form of teaching. In that context, their role encompasses chiefly, the selection of the most-liked co-curricular squad (after due discussion with and guidance of parents) along with the completion of the assigned task through the employment of their critical thinking and creativity skills. Essentially, in a co-curricular squad setup, pupils leverage the opportunity of gaining substantial knowledge of a given concept through their respective interests or hobbies, and they further hone their vocation or interest-specific skills in the process.

E. Materials Required

- **Squad Selection Form –** The school shall collect data regarding students' interests through this form, and the allocation of squads (co-curricular clubs) shall be premised on the findings of the same.

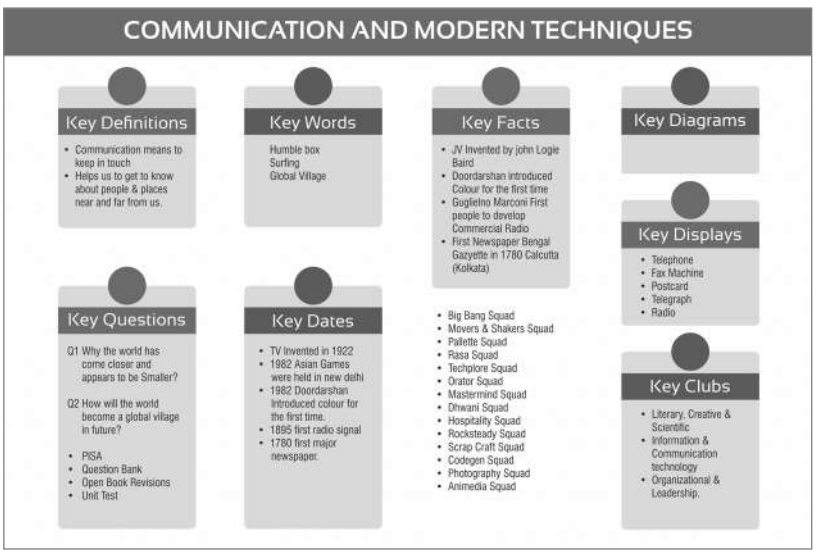
- **Rubrics –** Rubrics comprise the parameters of evaluating a task assigned under Multi-Perspective Teaching (MPT).

F. Steps to Use the Tool

The successful implementation of Multi-Perspective Teaching requires extensive thinking on the part of the teacher. In this regard, the steps that he/she must undertake to utilise the pedagogical tool effectively include:

1) *Selection of the Topic:* The teacher first chooses the topic from the syllabus of his/her subject that he/she wishes to teach through the Multi-perspective approach. For instance, a Social Science instructor may choose to teach the chapter "Communication and Modern Techniques" through MPT in his/her lesson.

2) *General Reading and Explanation of the Topic*: Like all times, the content delivery begins in a traditional manner, wherein the teacher asks students to read through the chapter and explains them the concept simultaneously. In this regard, the teacher sectionalizes the significant sub-concepts of the chapter under a comprehensive "Concept Map". Illustratively, the Social Science instructor in the example mentioned above would prepare and discuss an explanatory Concept Map on "Communication and Modern Techniques" (Picture 1) to help children break down and assimilate important information.



Source: Chitkara International School, Chandigarh &Panchkula, India
Picture 1 - Concept Map on "Communication and Modern Techniques"

3) *Assignment of Co-curricular Clubs to Students and Implementation of Seating Plan in the Classroom*: After the general explanation, the teacher shall commence the process of assigning co-curricular clubs to students with the collection of data regarding students' choices of co-curricular squads or clubs. Generally, at the beginning of the academic session, the class teacher collects the said data and shares it with all the subject teachers.

The list of clubs in this regard may include a theatre club, a music club, an orator club, a sports club, etc.

For instance, at Chitkara International School, India, students across different levels of learning get the opportunity to choose from the following co-curricular squads, on the basis of which, the teachers at the institution implement Multi-Perspective Teaching for their respective classes.

Source: Chitkara International School, Chandigarh & Panchkula, India
Picture 2 - Co-curricular Squads at Chitkara International School

Once the list of students' choices is made, the teacher then devises and implements a complementary seating plan, where children with similar club choices are allocated the same "rows" or "classroom areas" or are put together into groups.

4) *Creation of Tasks for Different Clubs:* This step entails creation of separate activities that essentially teach the similar concept. In that, the teachers must collaboratively design interesting tasks mapped to their subjects for each group of students alongside the various leaders or mentors of the co-curricular squads.

   At this stage, the Social Science instructor in the example mentioned above would collaborate with the different co-curricular club leaders to devise relevant activities for his/her diverse learners on the topic "Communication and Modern Techniques". Illustratively, he/she may ask the student members of the music club to create a Rap Song on "Means of Communication" or ask the members of the art club to prepare a comprehensive collage depicting the "Evolution of Communication Techniques". Likewise, the teacher in association with the mentors of different co-curricular clubs attempts to cover the various aspects of the chapter for addressing the needs of each learner in the most effective manner.

5) *Demonstration of the Assigned Tasks:* Under Multi-Perspective Teaching (MPT), the task assignment is ideally followed by a clear demonstration of the method of performing the activity or task. The step is deemed singularly crucial for it enables the teacher to render his/her students enhanced clarity.

G. Assessment

The pedagogical approach of Multi-Perspective Teaching (MPT) allows learners with diverse needs to think out-of-the-box and augment their knowledge in the process. In this regard, the assessment of students' learning is conducted with two aims – one, to assess the subject knowledge of students and the other, to assess what students have learnt under their respective squads.

In the general run of things, a teacher would first assess the knowledge of the students vis-à-vis a given topic through asking "key questions" in the class tests. Thereafter, while assigning different tasks or activities to his/her learners, the teacher would give a one-week deadline to the students to prepare for their performances / activities. The evaluation of these performances shall subsequently take place in the week following the "task assignment" week, wherein children belonging to different co-curricular squads or groups would present their respective performances to their teacher.

Importantly, the assessment of activities assigned under Multi-Perspective Teaching (MPT) constitutes both the "assessment of learning" and "assessment for learning".

The "assessment of learning" refers to a process wherein somebody tries to express and measure the quantity of the knowledge, skills, or attitudes that are possessed by the other. In this case, directions from the teacher are imperative and the learner has little participation in the designing or employment of the assessment procedure. On the other hand, the "assessment for learning" entails elevated levels of autonomy, which the learner enjoys under the supervision and with the collaboration of the teacher. Herein, the focus primarily lies on rendering effective suggestions to the learner rather than allotting marks or grades to him/her (Kapoor & Natarajan, 2014).

The evaluation of these performances is thereafter undertaken on the basis of a set of predetermined rubrics, which the teacher along with squad leaders utilizes to present a comprehensive picture of learners' growth. The aforementioned rubrics include five major aspects viz. Creativity, Relevance,

Confidence, Knowledge of the Subject, and Tools / Aids Used, and each parameter is ascribed marks ranging from 1 to 5, depending on the effectiveness of the learner's performance. As per the findings, the teacher also provides verbal feedback to the students to help them work on their areas of improvement and encourage them to enhance their performances.

Rubrics for Task Assigned under Multi-Perspective Teaching (MPT) *5 = Exceptional, 4= Good, 3= Above Average, 2= Average, 1= Needs Practice*						
Name of the Student	**Creativity**	**Relevance**	**Confidence**	**Knowledge of the Subject**	**Tools/ Aids Used**	**Total Marks**

Table 1 – Sample of the Activity Assessment Rubrics under Multi-Perspective Teaching (MPT)

H. Students' Feedback

Irrespective of the sector, profession or area of expertise, the practice that motivates individuals to perform better and aim for excellence is that of providing feedback. In this regard, since students remain the foremost stakeholders of the educational institution, establishing a routine for collecting learners' feedback stands as a markedly fruitful deal (Chitkara, 2021).

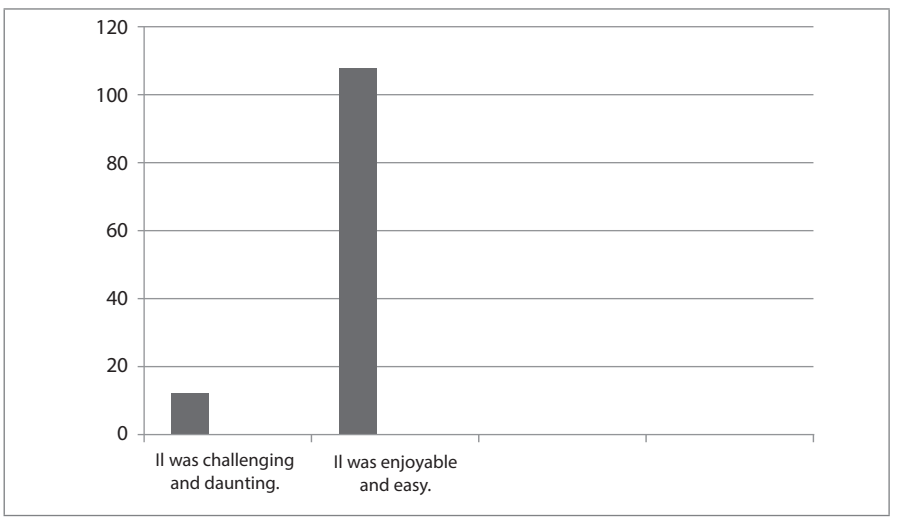
Upholding the relevance of feedback is yet again a crucial step for the teacher who wishes to impart effectual knowledge to his/her learners through the multi-perspective approach. Correspondingly, for the purpose of establishing the efficacy of Multi-Perspective Teaching (MPT), Rapid Feedback Method was undertaken by Chitkara International School, Chandigarh, India. The method involves collection of anonymous responses from students (O'Donovan, den Outer, Price, & Lloyd 2019a, 2019b). The answers are generally sought for a set of three questions (Mulliner and Tucker, 2017; Nicol, 2020). Under the mentioned kind of feedback, the responses are collected at the end of the lesson, where pupils are asked to share their opinions on a lesson delivery in a brief manner (Karim et al., 2006; Burke, 2009) within five minutes, after the conclusion of the class.

In this context, a sample of 120 students from Class 5 at Chitkara International School, Chandigarh, India was selected with the aim of assessing the learners' understanding of the topic "Communication and Modern Techniques".

After the tasks were attempted by the students in their respective co-curricular groups, the following findings were made as per the students' feedback on one of the 3 questions asked - "How did you find the squad-based activity on Communication and Modern Techniques?"

STUDENTS' FEEDBACK – MULTI-PERSPECTIVE TEACHING

How did you find the squad-based activity on Communication and Modern Techniques?



Source: Chitkara International School, Chandigarh, India

Graph 1 (Interpretation): About 90% of students found the squad-based activity on "Communication and Modern Techniques" to be "enjoyable and easy", whereas 10% of learners thought that the activity was "challenging and daunting" to perform. The data credibly exhibits the effectiveness of Multi-Perspective Teaching, wherein each learner learns various academic concepts in a comfortable and pleasurable manner.

FIRST-HAND ACCOUNTS

"I loved drawing mobile phones and television. I got to know that John Baird invented coloured T.V. and also about Doordarshan. When I was creating the drawing on internet, I found out about different types of connections such as LAN, WAN, etc."

- Grade 5 Student, CIS, India

"I had a lot of fun while doing my project. As I was writing my Rap Song on Communication, I learnt many new words and also read interesting articles on how the internet was invented and the history of Apple Computer Company."

- Grade 5 Student, CIS, India

I. Visualized Examples

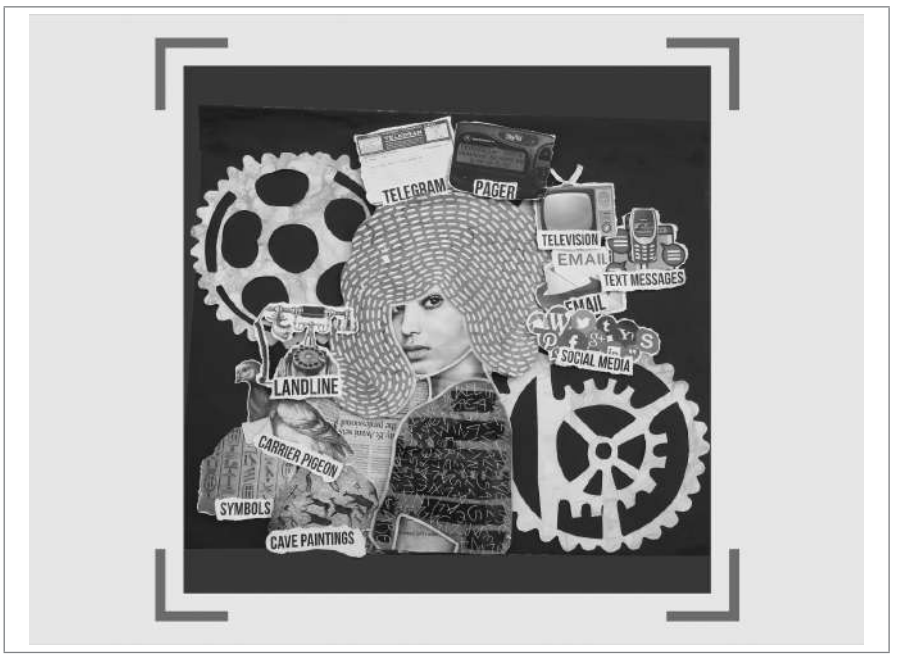
The pedagogical tool of Multi-Perspective Teaching (MPT) was implemented to teach the Social Science Chapter of "Communication and Modern Techniques" to the students of class 5 at Chitkara International School, Chandigarh, India. In that, various activities were devised by the concerned teachers, which aimed to comprehensively meet the requirements of the diverse learners.

The illustrations given *hereunder* represent the interest-specific activities that were assigned to different student groups along with the activity demonstrations that were presented by the teachers undertaking MPT:

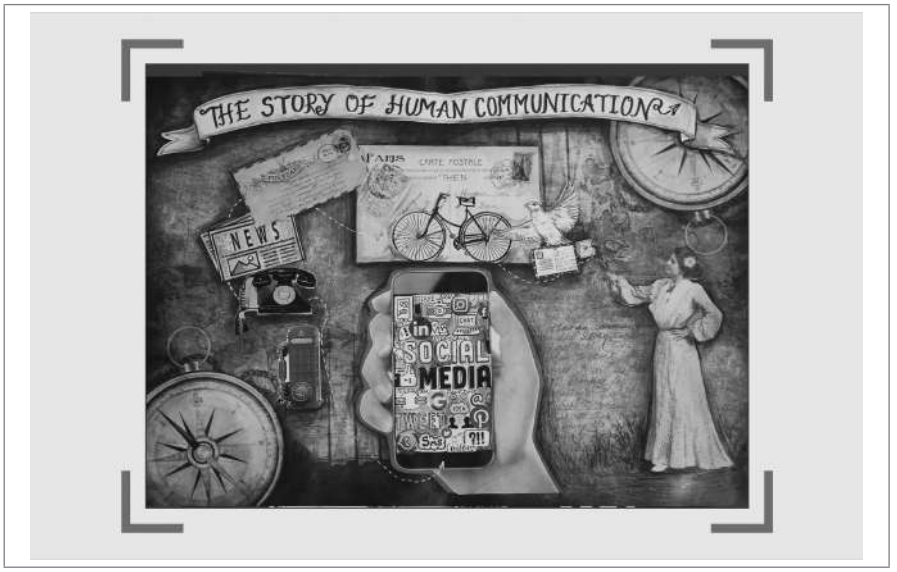
SQUAD	ACTIVITIES
Palette Squad & Scrap Craft Squad	Collage of different pictures depicting pre and post independence communication and communication techniques
Dhwani Squad & Mastermind Squad	Rap song on "Means of Communication" and Quiz on Communication Techniques
Movers & Shakers Squad	Dance on a tuneful medley depicting the evolution of communication techniques
Rasa Squad	Mime act of different methods of communication / Quiz on non-verbal communication
Animedia Squad	Creating videos/reels on Means of Communication
Techplore Squad & Codegen Squad	Webpage Design, App Development, Bot/ Voice Assistant Development
Hospitality & Grooming Squad and Techplore Squad	Touchless & Innovative Menu via QR Code
Orator Squad	Create a podcast on Modern and Old Ways of Communication/ Debate
Photography Squad	Click a picture of any communication device - pictures on the theme of Radio Day
Techplore Squad/ Animedia Squad	Digital Art on Radio Day
Rocksteady & Orator Squad	Game of Cricket and Evolution of Commentary Mediums

Source: Chitkara International School, Chandigarh & Panchkula, India
Picture 3 - Club-based Activities for Teaching "Communication and Modern Techniques"

Source: Chitkara International School, Chandigarh &Panchkula, India
Picture 4 - Demonstrative Slide for Activity under "Techplore Squad" (technology club) for Teaching "Communication and Modern Techniques"



Source: Chitkara International School, Chandigarh &Panchkula, India
Picture 5a - Demonstrative Slide for Collage Making Activity under "Palette & Scrap Craft Squad" (arts & crafts club) for Teaching "Communication and Modern Techniques"



Source: Chitkara International School, Chandigarh &Panchkula, India
Picture 5b - Demonstrative Slide for Collage Making Activity under "Palette & Scrap Craft Squad" (arts & crafts club) for Teaching "Communication and Modern Techniques"

CONCLUSION

The functionality of education is best manifested where learners of diverse abilities, interests or inclinations succeed in attaining varying excellences through active, analytical, critical, and creative thinking. Not unexpectedly, this requires the teachers to work toward designing and implementing serviceable teaching strategies, under which, each student is able to find his/her "zone of comfort learning".

Multi-Perspective Teaching (MPT) *therefore* serves as a weighty tool for teachers by way of which the teachers can render the aforementioned zone of comfort learning to students in their mixed-ability classrooms and thereby ensure development of the learners in an optimal manner.

REFERENCES

Ansari, M. S. (2013). *Coping with the Problems of Mixed Ability Classes: A Study in the Context of Teaching English as SL/FL*. International Journal of English: Literature, Language & Skills.

Burke, D. (2009). *Strategies for Using Feedback Students Bring to Higher Education.* 34(1), 41– 50.

Chapman, C., & King, R. (2003). *Differentiated Instructional Strategies for Reading in the Content Areas.*

Chitkara, H. (2021). *Using Students' Feedback to Improve Teaching Effectiveness Based on Kaizen Philosophy of Continuous Improvement*. V, 3-7.

Hedge, T. (2000). *Teaching and learning in the language classroom. Oxford, UK: Oxford University Press.*

Kapoor, N. and Natarajan, V. (2014). *Assessing Scholastic and Non-Scholastic Areas of Learning of Primary School 4th and 5th Graders in English, Mathematics & Science.* 2 (1.2) 9-12.

Karim, N. S. A., Darus, S. H., & Hussin, R. (2006). *Mobile Phone Applications in Academic Library Services: A Students' Feedback Survey*.

Loiacono, V., & Allen, B. (2008). *Are Special Education Teachers Prepared to Teach the Increasing Number of Students Diagnosed with Autism?* International Journal of Special Education, 23(2), 120-127.

Meyer, E. J. (2008). Gendered Harassment in Secondary Schools: Understanding Teachers' (non) Interventions.

Mulliner, E., & Tucker, M. (2017). *Feedback on Feedback Practice: Perceptions of Students and Academics.* 42(2), 266–288.

Nicol, D. (2020). The Power of Internal Feedback: Exploiting Natural Comparison Processes. 1–23.

O'Donovan, B. M., den Outer, B., Price, M., & Lloyd, A. (2019a). What makes good feedback good? 1–12.

O'Donovan, B. M., den Outer, B., Price, M., & Lloyd, A. (2019b). What makes good feedback good? 1–12.

Schleicher, A. (2016). *Teaching Excellence Through Professional Learning and Policy Reform: Lessons from Around the World.* Paris: International Summit on the Teaching Profession; OECD Publishing. doi: 10.1787/9789264252059-en

Tomlinson, C. A. (2001). *How to Differentiate Instruction in Mixed-ability Classrooms.* Alexandria, VA: ASCD.

Tomlinson, C. A., &McTighe, J. (2006). *Integrating Differentiated Instruction & Understanding By Design: Connecting Content and Kids.* Alexandria, VA: ASCD.

UNESCO (2017). *A Guide for Ensuring Inclusion and Equity in Education. Paris: United Nations Educational, Scientific and Cultural Organization*. Available online at: https://unesdoc.unesco.org/ark:/48223/pf0000248254

Winebrenner, S. (2001). *Teaching Gifted Kids in the Regular Classroom: Strategies and Techniques Every Teacher Can Use to Meet the Academic Needs of the Gifted and Talented. Revised, Expanded*. Free Spirit Publishing Inc., 217 Fifth Ave., North, Suite 200, Minneapolis.

Chapter 15

OPEN BOOK ENVIRONMENT (OBEnv): A Tool for Developing Critical and Creative Thinking

Ashutosh Biswal & Jaishree Das

INTRODUCTION

A good education system leads a society in the positive direction making children fit for the society and prepares them for the betterment of the society. In the context of the present time, curriculum design is based on the changing pattern of society. Due to the changing global order in the context of liberalization, privatization and globalization, there is a drastic change in the education curriculum and it is a continuous process of change. National Curriculum Framework (2005) of NCERT tried to highlight a few concerns that may be related to the present system. "There is a deep disquiet about several aspects of our educational practice: (a) the school system is characterized by a inflexibility that makes it resistant to change; (b) learning has become an isolated activity, which does not encourage children to link knowledge with their lives in any organic or vital way; (c)schools promote a regime of thought that discourages creative thinking and insights; (d) what is presented and transmitted in the name of learning in schools bypasses vital dimensions of human capacity to create new knowledge; (e) the 'future' of the child has taken center stage to the near exclusion of the child's 'present', which is detrimental to the wellbeing of child as well as the society and the nation.' In the other words it can be said that instead of having a child centered education we are moving towards an examination centered education system where the child uses its mind to a minimum extent by giving more emphasis on rote memorization. Examination is considered vital in the process of education and all other aspects of education are manipulated to have a good examination score. The consequence is very much seen in the system having a teacher centered method of teaching and rote memory centered method of evaluation. Further, the scenario is becoming more challenging due

to the Industrial Revolution 4.0 which is evolving at an exponential rather than a linear pace and changing the way people live, work and study. It is affecting almost every industry in every country in terms of production, management, and governance. It needs the learning approach of Education 4.0 to go hand in hand with the Industrial Revolution 4.0. It needs specialized skills for the youth as The World Economic Forum (2018) urged for the skills like, complex problem-solving, critical thinking, creativity, people management, coordinating with others, emotional intelligence, judgement, and decision making, service orientation, negotiation and cognitive flexibility. Hence the new Education 4.0 paradigm demands new approaches for learning and evaluation at all the levels of education. The new National Education Policy (2020) also tried to deemphasize the rote learning nature of present practice of teaching learning and examination stating that 'emphasis on conceptual understanding rather than rote learning and learning for exams'. There is a felt need to improve both the instructional process and evaluation of the education process. In this changing scenario and need, there is a necessity to have some sort of tool to influence the process of teaching, learning and evaluation in Indian schools. Open Book Environment (OBEnv) is one such tool which can help in bringing the said desired outputs in the system of education. Though an open book environment is a tool necessity for the open book examination, it also can be used as a process intervention tool independently to eliminate memorization among students and for the development of mental faculties using critical thinking, creative thinking and problem-solving.

OBEnv as a pedagogical tool was conceived and developed by Biswal and Das in 2004. Since then, the system has been in use for teaching, experimentation, and projects in elementary, secondary and higher education levels. It was a part of a major Indian Council for Social Science Research (ICSSR) project of Biswal (2014), a major University Grants Commission (UGC) project of Das (2014), a major ICSSR project of Das (2018), an Institute of Advanced Studies in Education (IASE) project of Das and Biswal (2015), Ph.D. work by Maity (2016) and Jana (2019). OBEnv has also been experimented in the Faculty of Management Studies, The Maharaja Sayajirao University of Baroda during (2004-2018) as an intervention at higher education. Year-Long implementations of OBEnv in Schools like University Experimental School, Vadodara, and Satya Sai Vidyavihar, Navsari proved its effectiveness in the school education.

THEORETICAL BACKGROUND

The theoretical background of the present tool is derived from the learning theories and principles like Discovery Learning of Jerome Bruner (1961), Multistore Model of Atkinson & Shiffrin (1968), Working Memory Model of Baddeley and Hitch (1974) and Bloom's Revised Taxonomy (2000).

Discovery Learning of Jerome Bruner (1961) is an approach to instruction through which students interact with their environment by exploring and manipulating objects, wrestling with questions and controversies, or performing experiments, while drawing on their own experience and prior knowledge. Environment has bigger role in learning development. Bruner argued that social factors particularly language were important for cognitive growth of learners. It is an Inquiry based learning. Discovery learning can occur whenever the student is not provided with an exact answer but rather the materials in order to find the answer themselves. The steps like collaborative learning and inter group discussion of the OBEnv are added from the assumptions of discovery learning model of Bruner like, pose a question and let students try to find the answer and encourage students to make intuitive guesses.

Some of the procedure of OBEnv is taken from the Multi-Store Model of Memory of Atkinson and Shiffrin (1968) that talks about the memory which is made up of separate structures like sensory stores, the short-term store, and the long-term store with the help of control processes like, attention, rehearsal, coding, search and retrieval. Even after more than 50 years, this memory model is still relevant today and found useful in OBEnv. Attempt is made in the present tool to send the sensory information to long term store through sensory store and short-term store with the help of social and group attention, activities and meaningful rehearsals to make the memory permanent and long lasting. The control processes of searching for and retrieval of information in the short-term and long-term stores is strengthened in the OBEnv with the help of active sensory stimuli and concept mapping. One can retrieve information from our long-term memory by using active search processes using spatial relations with very less memorization.

In OBEnv, the components of content flowchart and concept mapping were added with the help of Working Memory Model (WMM) of Baddeley and Hitch (1974). This model consisted of three main sections with a fourth section added in 2000 by Baddeley like Supervisory System called Central Executive and Slave Systems called The Phonological Loop (e.g., language), The Visuo-Spatial Sketchpad (visual semantics) and Episodic Buffer (added in 2000) (short term episodic memory). In WMM short term memory of the Multi store model has been replaced with Visual Spatial working memory, information we hold and manipulate in our conscious attention. The central executive has the ability to store information, but its capacity is limited. The articulatory control system of the Phonological Loop revives memory traces with all auditory information believed to directly enter the phonological store. The Visuo-Spatial Sketchpad is believed to hold visual information. The added Episodic Buffer is to link together every piece of information from all other elements of working memory with

further information relating to time and order. This process enables memories to be prepared for episodic long term memory storage. This working memory model seems perfectly realistic because it ties in with the manipulation of information when problems are encountered and solved. This model shows short term memory to be a dynamic process.

OBEnv brought its essence of higher order thinking from Bloom's Revised Taxonomy (2000). It provides learning objectives in hierarchical order. It divides thinking skills in two categories: lower order and higher order thinking skills. For higher order thinking processes, lower order thinking creates a foundation. In OBEnv much emphasis is given for the development of higher order thinking skills like Applying, Analyzing, Evaluating & Creating on the basis of a strong foundation of knowing and understanding.

LITERATURE REVIEW

Few research literatures were found that either supported the OBEnv or argued and suggested the need of a tool like OBEnv. The study of Gharib and Phillips (2013) on tests of anxiety, student preferences and performance on different types of examination found students slightly better on open book examinations and had lower levels of anxiety than on cheat sheet examinations. Karagiannopoulou and Milienos (2013) found students who preferred the open-book examination scored lower on 'time management', 'achievement', and 'unrelated memorizing' which suggested an environment for OBE. Chatterjee (2014) develops a strategy like OBE including the steps like content presentation through power-point, collaborative learning activities with cognitive questions, cross group sharing and deliberations, putting knowledge into action and concept mapping etc. to teach economics to standard XI students for open book examination with a control group following the traditional approach of teaching. The major findings revealed that students taught economics through the developed strategy for open book examination scored significantly more than the control group. Jalal, Fadhil, and Hasini (2014) found that students only did well in the open book assessment; those were well prepared and had a deep understanding of the current and prerequisite subjects. Das (2015) studied the effectiveness of an open book examination system having two components viz. open book environment and open book testing for standard VIII students in terms of the content knowledge, logic, divergent thinking, comprehension, achievement of students and reaction of students and teachers. The findings of the study revealed that (a) open book examination system was found significantly effective in comparison to traditional examination system in enhancing scores in most of the subjects and most of the components; (b) and both teachers and students showed positive reaction towards both open book environment and open book testing separately and as a whole. Biswal and Das (2016) conducted a study to see the

effectiveness of the open book examination in terms of the achievement of standard VIII students in English, Gujarati, Hindi, Mathematics, Science and Social Sciences subjects along with the examination anxiety with a sample of randomly selected 670 students. Open book examination was found to be effective in enhancing the achievement of students in English, Gujarati, Hindi, Science Social, Science and Mathematics. It also helped to reduce examination anxiety. Maity (2016) conducted a study on the effectiveness of open book examination in English in different environments (OBEnv and traditional environment) in terms of content knowledge, logic, divergent thinking, comprehension, and overall achievement. The findings revealed similar achievement in all the components between Close Book Testing (CBT) and Open Book Testing (OBT) in a traditional environment, whereas the achievement in open book testing was found significantly better in comparison to the same in close book testing in an open book environment. Students taught through OBEnv showed their positively agreed response in most of the components related to OBEnv and OBT separately and as a whole. Biswal (2015) investigated an open book examination system for secondary school students in different teaching learning environments with the objectives to design an open book environment for standard VIII students for all subjects and to study the effectiveness of the open book environment. Major findings of the study revealed that (a) in a traditional environment the result of close book testing and open book testing were found similar in most of the subjects; (b) in an open book environment the result of close book testing and open book testing were found similar in most of the subjects; (c) in an open book testing, open book environment was found significantly better than traditional environment in all the subjects; (d) in a closed book testing, open book environment was found significantly better than traditional environment in enhancing scores of all the subjects; (e) both open book environment and open book testing were found effective in terms of the reaction of students; (f) open book environment helped students to write answers in a better way in both open book testing and close book testing with divergent ideas, content knowledge and sound logic along with the comprehension of the subjects. It also helped students to score better in their overall achievement. A study conducted by Das and Delawala (2019) to know the impact of the open book examination on standard VIII students in terms of the academic achievement and examination anxiety found no significant difference in the mean achievement score of English, Social Science, Mathematics, Hindi, Gujarati and in overall subjects appeared examination through traditional close book examination and open book examination, whereas, the achievement in science subject was found to be significantly greater in case of open book examination. Even no significant difference was noticed between the mean examination anxiety level of students who appeared in the close book examination and open book examination. The study suggested the need for an open book environment for the students to do better

in open book examinations and to develop their thinking abilities. Jana (2019) conducted a study with the objectives to design and develop an Open Book Environment (OBEnv) for standard VIII students in teaching Social science and to study the effectiveness of the developed open book environment in terms of the achievement of standard VIII students in Social science and the reaction of student towards developed open book environment. The major findings revealed that in an open book examination (OBE), an open book environment was found significantly better than a traditional close book environment in terms of enhancing scores in content knowledge in social science, logic, and divergent thinking. Open book examination including open book environment (OBEnv) and open book testing (OBT) was found effective in terms of the reaction of students.

From the studies reviewed, the studies of Das (2015), Biswal and Das (2016), Maity (2016), Biswal (2015), Jana (2019) proved the superiority of an open book environment in terms of better achievement, better thinking, and decreased examination anxiety. Studies conducted by Chatterjee (2014) and Das and Delawala (2019) also suggested the open book environment for the success in open book testing. One the basis of this review of studies, it can be said that OBEnv is a good tool for enhancing achievement, developing thinking, and reducing examination anxiety and hence suggested here for developing thinking abilities of present and future teachers.

EXPLANATION OF THE TOOL

OBEnv is a pedagogical tool to help students for better achievement, reducing examination anxiety along with developing thinking skills. An OBEnv helps students to acquire new knowledge, to modify existing knowledge on the basis of new experience, to build new knowledge to solve problems and make intelligent decisions. It is more processing of information, rather information content itself. It helps students to think and rethink the gained knowledge to make it more practical and application oriented. This is done by activating learning through questions, giving different examples, doing exercises, projects, assignments, and so on. In this process, the focus shifts from rote learning to the development of certain mental faculties.

Open book examination system consists of two components: (i) Open Book Examination (OBE) and (ii) Open Book Environment (OBEnv). Open book examination also called as open book testing is a commonly used pattern of examination where students are allowed to refer and copy from a list of approved material or books during the examination. It is related to the product aspect of the teaching learning system, whereas open book environment (OBEnv) is related to the process aspect of the teaching learning system. OBEnv prepares students for open book examination along with the development of thinking skills

particularly critical and creative thinking. Open book examination requires an open book environment without which there is no meaning in this system. OBEnv is the spine of open book examination. It helps to reduce anxiety and promote learning (Biswal & Das, 2016; Green, S. G., Ferrante, C. J.& Heppard, K. A. 2016; Das & Delawala, 2017). Open Book Environment improves academic achievement in open book examination (Das and Delawala, 2019; Das, 2014; Jana, 2019; Maity, 2016). One of the most important components of the open book environment is the transaction of the content in the class by the teachers in such a way that it would help the students to think and to develop higher order thinking skills without compromising on the achievement in different subjects. Hence, an attempt is made in this tool to have a balance between these two components.

AIMS OF THE TOOL

- To bring a change in the current practice of teacher centered teaching learning process and the rote memory centred examination.
- To bring lots of activities inside the class making it more live and dynamic. To make the classes happy and joyful.
- To develop a better understanding of the content among students.
- To develop skills like critical thinking, creative thinking and problem-solving among students.
- To develop social skills among students.

EXPECTED OUTCOME

From the results found from the experiments on the OBEnv, the following outcomes could be expected from the successful implementation of this tool following the prescribed steps.

- It could increase the achievement of students in all subjects.
- It would help to develop critical thinking, creative thinking and problem-solving among students.
- Attendance of the students would be increased when it is not compulsory.
- It would ensure maximum participation of students in classroom discussion and activities.
- It would motivate students to use a variety of reference materials.
- Students would be satisfied with their answers.
- Answers of students would be based on logic and there would be varieties of answers and examples from students.
- It would help students to develop social and life skills like discipline, cooperation, leadership, respecting each other, communication etc.

ALLOCATED TIME

The present tool can be used in the general school timetable. It can be used in the allotted time of 35 minutes to 60 minutes of class. While using this tool, teachers would be more vigilant in time management, as a little more time needs to be spent in intra group discussion and inter group sharing, whereas time could be saved for these activities through the use of available technology. These activities could be integrated in the timetable in such a way that different steps could be performed in different periods if the time slot is less than 35 minutes. It is experienced that the courses of different subjects would be completed within the allotted time.

SETTING

The present tool is quite generic in nature and can be used for any type of theoretical subjects. No special setting is needed to use this tool. It can be best managed in general classrooms with 30-40 students. In case of overcrowded classrooms, teachers need to take care and manage while arranging the intra-group discussion so that students can sit comfortably in groups for 10-15 minutes so that they can come out with the answer of the given cognitive questions.

ROLE OF TEACHERS AND STUDENTS

Before using this tool, it is very essential for the teachers to motivate students to participate maximally in the classroom activities. To some extent, it should be ensured to avoid the strict classroom discipline and silence to allow students to express themselves. A student friendly teacher is a better option in comparison to a strict teacher. It is observed from the previous experiences that students used to be self-disciplined while working in the OBEnv process. Here, the teachers need to develop the skills of attending students' responses and to listen to them maximally. Punishment in any form has no role while using this tool that desires specific behavior of teachers and students. Teachers need to be more of a mentor and co-worker with the students giving guidance from time to time.

STEPS TO USE THE TOOL

For this purpose, following nine step procedure is followed to make this tool effective and practical while teaching a subject content in the class.

1. **Content Flow Chart / Content to be Covered:** It includes the points of discussion in the classroom for a specific topic including the units and subunits of the content to be covered in a class through a line flow chart.
2. **Learning Objectives:** It refers to the expected outcome of a content of teaching in terms of change in students' behavior both in a short period of

time and a long span of time. Hence, a combination of both general as well as specific educational objectives will be kept to be achieved after completion of a specific topic in terms of knowledge, understanding, reflections and skills. For example, after Completion of the content students will,

- develop understanding about the animal and plant cell (subject - Science and topic - Cell),
- understand basic pattern of crop production in India (subject - SS and topic - Crops in India,
- imagine the social pattern, the poet wants to depict (subject - English and topic - The Geography Lesson - poem),
- develop critical and creative thinking,
- develop social skills.

3. **Content Presentation in Brief by the use of Technology:** It is one of the very important aspects of the OBEnv tool where attempt would be made to prepare certain teaching learning materials like, powerpoint presentation, collection of video clips and audio clips etc. as per the availability of the materials in the open and free source from internet. Major purpose behind the development of such material is to make students thoroughly understand the topic and to have good achievement in their examinations. Apart from this, the developed material will help teachers to present and explain the content briefly by saving some time for doing other activities related to thinking.
4. **Questions of Cognitive Conflict / Cognition / Cognitive Reflection:** At this stage, teachers need to prepare five to ten questions of very higher order thinking like analyzing, evaluating, and Creating on every content unit of teaching. These are the questions to make the whole class think in small groups after completion of each unit through brainstorming using the acquired content knowledge. Questions of Cognitive conflict type are the questions to create a conflicting situation in the mind of the students related to the learned content and to find the possible answers to these questions. These are the best type of questions at the creating levels to develop critical and creative thinking among students. In the contents where questions of cognitive conflicts are not possible, the questions of simple cognition or cognitive reflection would be prepared. These are mostly analyzing and evaluating level questions. These are a few examples of questions of Cognition/Cognitive Conflict/Cognitive Reflection from Indian school subjects.
    - What could happen to human beings if their cells could have chlorophyll? (Science, Cell).
    - What would happen if water were only in liquid form? (Language, Water Dance).

- What would be the scenario if there were no combustible substances on the earth? (Science, Combustion).
- Imagine the situation if East India Company would not establish their territory in India? (Social Science, East India Company).
- How would our life be, if there would be no friendly microorganisms? (Science, Micro Organs).

5. Collaborative Learning Activities/Intra-group Discussion

Small groups working with different cognitive questions are called collaborative learning activities. This activity is designed to make the students work collaboratively in small groups. The class can be divided into small groups consisting of four to five members and one question of cognitive conflict/cognitive reflection would be given to each group. The groups would be given 10 to 15 minutes of time to come out with the answers to the cognitive questions having brainstorming, discussion and making a consensus about the answers of the cognitive questions. The purpose of this activity is to have more thinking when working with a group using more brains, a habit of working in a group, to have a consensus in case of divergent answers, and to allow the group to think in a social norm. After the brainstorming and discussion among the groups they would prepare a write up or activity which would be presented by group member/s in the whole class.

6. Inter-group Sharing

It is the stage to develop critical and creative thinking among students through **c**onfirming and expanding their thinking. After completion of the discussion among themselves and having an answer/solution of the cognitive question, one or more members of each group would present their answers to the cognitive question and discussion points that they had done in the group in the inter group discussion or sharing. A maximum 4-5 minutes would be provided to each group for this purpose. The purpose of this activity is to let the whole class know the answer to different cognitive questions and to have learning sessions through their answers. In this activity, the role of the teacher is not to evaluate the answers of the groups, rather to support, encourage and appreciate the groups for thinking in different ways. As there is no right or wrong answer for any cognitive question and the degree of rightness of an answer depends on the use of proper content knowledge and the suitable logic, teachers are advised not to evaluate the answers to the cognitive questions, rather the teachers would steer the direction of thinking of the groups, if it is found that any group is going with wrong idea or thinking. During the presentation, members of other groups are allowed to add some new ideas in their line of thinking. At the end of this session, after all the groups presented their answers, the teachers will be

advised to conclude the session by taking the main concepts of the whole presentations in brief.

7. Question-Answer Session

It is the stage for the students to clarify the concepts, clear the doubts, solidify the existing understanding and to prepare themselves for mainstream examination as well. Apart from developing critical and creative thinking through OBEnv, students will also be prepared for their examinations and to have better academic achievements. So, it is planned to have a question answer session to discuss the exercises of the textbook. Hence, at the end of each and every chapter/unit of the content, teachers are asked to discuss each and every probable question of the content that could be asked in the examinations with the possible answers. During the content presentation teachers will also ask the probable questions from the chapters. Here maximum care would be taken not to change the traditional practice of the class considering the traditional examination-oriented practice of students along with the development of critical and creative thinking.

8. Concept Mapping

In the present tool, students are supposed to do well in their examination and to have good marks in their achievement tests along with the development of critical and creative thinking. Though maximum emphasis would be given on developing higher order thinking skills, the lower order thinking skills like knowledge and understanding would not be ignored. As more questions in the examination are of knowledge level and students need to memorize a lot of their content, concept mapping is added in the process that would help to sharpen their memory, replace memorization and to enhance their space relation and visual literacy which indirectly will help them in their mainstream examinations. Hence, at the end of each chapter, students would be asked to prepare a concept-map on their own on the basis of their understanding of different components they were taught and to keep those in mind. Through the concept map, teachers whatever taught in the class and students whatever understood about the taught content, need to prepare a pictorial or line diagram of important points related to the whole content in a compact way which could be kept in the mind in such a way that it could be visualized by the students at any point of time and they can get the information from it. As very less emphasis is given to memorization in the OBEnv, the concept mapping would be used to make the process of memorization easier.

9. Questions for Open Book Examination

OBEnv is designed to prepare each and every student to perform well in the Open Book Examination at the end of a session. This is the stage for

students to get questions for open book examination from different chapters easily and to make students aware about different types of questions. Hence, 5 to 10 questions for open book examination in each and every subject would be asked by the teachers and those would be discussed during the regular teaching learning process. Following are some questions for the open book examination.

- Why are all bacteria not pathogens? (Science, Micro Organs).
- Suggest some preventive measures to avoid pathogens. (Science, Micro Organs).
- How can we do irrigation in dry land? (Social Science, Irrigation).
- Which is the most suitable traditional method of irrigation? Why? (Social Science, Irrigation).
- What animal cells should learn from plant cells? (Science, Cell).
- If mean=median=mode, whether the group is normal? Justify your answer. (Mathematics, Measures of central tendencies).

These questions can also be asked to the students in the form of an open book examination to test their achievement and thinking style as a part of the evaluation of the tool.

ASSIGNMENTS

At the end of every chapter, individual application-oriented assignments would be given to students related to the surrounding environment including society, newspapers, TV, internet etc. This component is designed to have a higher order thinking among students which could have some relevance in the society and the surroundings. Like homework, teachers would be asked to check the assignments of each and every student and to provide feedback accordingly.

STUDENTS' FEEDBACK

Regarding OBEnv students said that it was a realistic teaching-learning environment, and it was a less stressed environment. It helped them to be more extroverted and logical in giving responses either oral or written. It helped them to think critically and creatively during the stages like intra group discussion and inter group sharing. Students find it fun while working in the groups. Cognitive questions compelled them to think out of the box. They learned social skills like respecting others' views, cooperating, and helping each other from the group work. Regarding the open book examination, they observed that they got a different test of examination. It helped them to apply the knowledge learned during the course, it helped them to take the examination easy and found it a part of the teaching learning process. They opined that though it was difficult

for them to answer the questions asked in the open book examination, they liked the questions.

CONCLUSION

The tool OBEnv is one of the alternatives of traditional teaching learning and evaluation having the potential to enhance achievement, to reduce memorization, to reduce examination anxiety and to develop critical and creative thinking among learners of all ages. It is a tool which can be used with or without an open book examination. It is a generic tool which can be used by any teacher at any level for any subject. It has the potential to transform and revamp the present practices in a more meaningful way which is the need of the hour. This tool has the potential to mitigate the impact of the industrial revolution 4.0 and to prepare the future workforce with 21st century skills like critical thinking, creative thinking, problem-solving and effective communication. More and more teachers need to be trained to use this tool in their regular classroom. Following the given nine steps, the tool can be used by the teachers to make their classes more interesting and skill oriented. The steps like preparing cognitive questions, intra group discussion with the help of brainstorming and discussion, inter group sharing and concept mapping are very important aspects of this tool and need lots of initiatives and practices. It also needs continuous practice and improvement. It can be done through regular training and peer help. It needs more research and a proactive approach to implement at different levels of school education for different subjects.

REFERENCES

Agarwal P. K. (2007). Examining the Testing Effect with Open- and Closed-Book Tests. *Wiley Inter Science.* https://www.interscience.wiley.com

Atkinson, R. C., & Shiffrin, R. M. (1968). Human memory: A proposed system and its control processes. In K. W. Spence & J. T. Spence, *The psychology of learning and motivation: II*. Academic Press. *https://doi.org/10.1016/S0079-7421(08)60422-3*

Biswal, A. & Das, J. (2011, December 20-21). *Open Book Instructional System (OBIS) at Higher Education: An Experiment*. Seminar on Higher Education for Knowledge Based Society: Global Reforms, Faculty of Education & Psychology, The M.S. University of Baroda, Vadodora, India.

Biswal, A. (2015). *A Study on Open Book Examination System for Secondary School Students in Different Teaching Learning Environments*, A Major Research Project, Indian Council of Social Science Research, New Delhi.

Biswal, A. & Das, J. (2016). *Open Book Examination in a Different Teaching Learning Environment*. Lambert Academic Publishing.

Bloom, Benjamin S. (1956). *Taxonomy of Educational Objectives: Cognitive Domain.* New York: David McKay Company, Inc.

Brightwell, Daniel & Stewart (2004). Evaluation: is an open book examination easier? *BEE-j* Volume 3: http://bio.ltsn.ac.uk/journal/ voln/beej-3.3.htm.

Bruner, J. S. (1961). "The act of discovery". *Harvard Educational Review,* 31 (1): 21–32.

Das, J. (2015). *A Study of Open Book Examination System at Secondary School*, A Major Research Project, University Grand Commission, New Delhi.

Das, J. (2017). A Study on the Open Book Examination in Terms of Achievement in Language Subjects and Examination Anxiety of Standard VIII students. *International Journal of Research and Review*, 3 (5), 46-54.

Das, J. and Zulfia, D. (2019). Effectiveness of Open book examination system in terms of the Students' achievement and anxiety at Upper Primary Level. *Edusearch*, 8 (1), 42-52.

Feller, M. (1994). Open-book testing and education for the future. *Studies in Educational Evaluation*, 20(2), 235-238.

Gharib, A., Phillips, W. & Dominican, N.M. (2012). Cheat Sheet or Open-Book? A Comparison of the Effects of Exam Types on Performance, Retention, and Anxiety. *Psychology Research,* 2, 8, 469-478.

Government of India, Ministry of Human Resource and Development (2020). *National Education Policy 2020*, New Delhi: MHRD.

Gupta, S. (2011). *A Comparative study of Achievement of B.Ed. Students examined through OBE and CBE with reference to certain objectives*. (Report of Major Research Project) ICSSR, New Delhi.

Jalal, M. F. A., Fadhil, S. S. A. & Hasini, H. (2014). Students, Assessment through Open-Book Concept for Final Exam. *International Journal of Asian Social Science*, 4(2): 217-225. http://www.aessweb.com

Jana, M. (2019). *Development and Implementation of an Open Book Environment in Teaching Social Science among Standard VIII students*. Unpublished Ph.D. Thesis, The Maharaja Sayajirao University of Baroda, Vadodara.

Karagiannopoulou, E. & Milienos, F. S. (2013). Exploring the relationship between experienced students' preference for open- and closed-book examinations, approaches to learning and achievement. Educational Research and Evaluation. *An International Journal on Theory and Practice*, 19, 4, 271–296. http://dx.doi.org/10.1080/13803611.2013.765691.

Loannidou, M. K. (1997). Testing and life-long learning: Open-book and closed-book examination in a university course. *Studies in Educational Evaluation* 23(2), 131 – 139.

Maity, S. (2018). *Effectiveness of Open Book Examination in English for Standard VIII in Different Environments*, Unpublished Ph.D. Thesis, Vadodara, The M.S. University of Baroda, Vadodara.

Malmberg, K.J., Raaijmakers, J.G.W. & Shiffrin, R.M. (2019) 50 years of research sparked by Atkinson and Shiffrin (1968). *Mem Cogn,* 47, 561–574. https://doi.org/10.3758/s13421-019-00896-7

Government of India, Ministry of Human Resource and Development (1986). *National Policy of Education- 1086*. New Delhi.

Mekala, S. (2011). Open Book Examination a Paradigm Shift. Vol. III. 5-6 Jan-Dec, 2011.

Mohanan, K.P. (1997). 'Open Book Examination-A Report and a Response to some Recurrent Concerns Examination', *Centre for Development of Teaching & Learning*, July, 1997, Vol.1, No.2. www.cdtl.nus.edu.sg

N.C.E.R.T. (2005). *National Curriculum Framework for School Education: NCF-2005*. New Delhi: N.C.E.R.T.

Pauker, J. D. (1974). Effect of open book examinations on test performance in an undergraduate child psychology course**.** *Teaching of Psychology*, 1(2), 71-73.

Theophilides, C. & Dionysiou, O. (1996). The major functions of the open-book examination at the university level: A factor analytic study. *Studies in Educational Evaluation*, 22(2), 157 – 170.

World Economic Forum (2018). *The Future of Job Report*. http://www3.weforum.org/docs/WEF_Future_of_Jobs_2018.pdf

Chapter 16

Peer facilitated learning

Sanjeev Sonawane & Nidhi Waldia

Docendo discimus – "the best way to learn is to teach"

INTRODUCTION OF THE TOOL AND LINKING TO THE RELEVANT SKILL

Frank Oppenheimer emphasized the old Latin principle "Docendo discimus" – "the best way to learn is to teach". Following a similar principle, "Peer facilitated learning" engages students in class-wide and reciprocal peer tutoring to facilitate student learning. Co-operation between peers, according to Piaget (1971), is likely to foster the exchange of thought and discussion. He emphasised that cognitive conflict caused by the multiple perspectives during the peer interaction and the deemed cooperation is necessary for the formation of a critical mindset, objectivity, and discursive reflection. Furthermore, Vygotsky (1962) suggested that the variety of skills and learning gained by collaboration with peers is richer than anything that can be attained alone. The tool "Peer facilitated learning" is a structured peer tutoring pedagogical approach based on social constructivism that mixes reciprocal peer tutoring and class wide peer tutoring. Using PFL technique of peer tutoring can enhance students' experience of collaborative learning and knowledge co-creation. The PFL model of peer tutoring doesn't involve a 'deficit' model for 'fixing' the needs of one child but rather seeks to be a tool for thinking collectively and engaging in co-reasoning. **The tool can help foster analytical and critical thinking skills, articulation and rational argumentation skills, research, and team-work skills among the pupils.**

Nancy Falchikov (2002) in her review of several research on peer tutoring found that peer tutoring can have positive outcomes in the following domains:

- Academic outcomes.
- Metacognitive outcomes like learning how to learn and transfer of learning.
- Study skills outcomes.
- Non-academic outcomes like motivation, attendance, retention, and attrition.

These benefits of peer tutoring have motivated several academic institutions to adopt one or more type of peer tutoring methods into their curricula. However, there are two sets of problems that occur.

- First, although teachers in almost all educational institutions are seen as assigning group work to students, the peer learning activities usually are unstructured.
- Besides, even when students are assigned collaborative assignments, the end result is frequently patched-together individual efforts delivered just before the due date (Dunn, 1996).

According to a study conducted by Gillies in an Australian school setting, it was found that in a sample of 223, 13–14-year-old students, adding structure to peer learning activities resulted in more effective group learning situations and enhanced academic attainment (2004).

Therefore, structuring peer tutoring and peer learning activities is imperative to ensure that the envisaged benefits of peer tutoring are achieved. "Peer facilitated learning" offers an opportunity to structure peer tutoring activities by using artifacts like group process form, group conduct form, and designated roles. Moreover, the teacher remains informed about the group process by obtaining regular minutes of meetings from the groups and by monitoring the group process. Such structuring of peer tutoring activity ensures that students engage in true collaborative learning.

THEORETICAL BACKGROUND

The tool "Peer facilitated learning" is rooted in social constructivism, as explained by Thurston et al. (2007).

Cognitive developmental theory: the work of Piaget

Piaget (1932) emphasized that 'the very nature of relationship between the child and adult that places the child apart, so that his thought is isolated.' In contrast to adult-peer relationships, power in peer-peer interactions is distributed more symmetrically and is more likely to be shared (Blatchford et al, 2003). Piaget's theories of collaborative learning stems from the concept of equilibration. According to Piaget, when a child encounters new information, they try to modify it to fit it into their existing schema [assimilation]. If the new information is not in accordance with the existing schema, the child tries to modify the existing schema to fit the new information. Learning is characterized by the adaptation of schemas. The adaptation of schema occurs when assimilation and accommodation are in balance. When a child encounters a new idea that is incongruent to their own, they experience cognitive conflict. Cognitive conflict can be defined as a conflict between existing schemas (i.e., an organized knowledge structure in the brain) and environment (i.e., concepts in a book, peer's opinion, teacher's

instructions, etc.), or a conflict between conceptions in cognitive structure (Kwon, 1989, as cited in Kwon & Lee, 2003). This state of disequilibrium motivates the child to keep seeking for a solution through assimilation and accommodation, and thus adapting to the new schema to make sense of the new information (Woolfolk, Winne, & Perry, 2003) and achieve equilibration. Equilibration is more easily established between peers than between child/teacher as in the case of peer-peer interaction, cognitive structures are more open to adaptation and less prone to conservation (De Lisi & Golbeck,1999). Peer learning, according to Piaget's theory of cognitive development, has a higher likelihood of cognitive structuring because peer learning environments can provide the correct balance between disequilibrium induced by cognitive difficulty and social interactions between peers, allowing for effective learning (Palinscar, 1998).

Vygotsky's zone of proximal development

Cognitive abilities, according to Vygotsky's theory of cognitive development, are socially constructed, with children learning their cultural values, beliefs, and problem-solving strategies through collaborative conversations with more informed members of society. The Zone of Proximal Development (ZPD) defined as "the distance between the actual development level as achieved by engaging in independent problem-solving and the level of potential development as achieved by engaging in problem-solving under adult guidance or in collaboration with more capable peers" in the Vygotskian framework, highlights the importance of peer learning. The principles of intersubjectivity, which lead to more effective intra-psychological functioning, are central to operating within the ZPD. The degree to which two individuals can participate in communication and dialogue that transcends their respective worlds/minds is known as intersubjectivity. Adults may struggle to transcend to the child's world (Donaldson, 1978). Peers may thus provide a more conducive environment for intersubjectivity and cognition. Vygotsky's psychological model emphasised the importance of discourse in mediating cognitive growth, claiming that learners can "perform... in collaboration with one another what they have not acquired alone." In order to allow internalization and long-term cognitive progress, Vygotsky determined that peer interaction in the learning process was necessary.

LITERATURE REVIEW

According to the World Economic Forum report of January 2016, human civilization is standing on the precipice of the 4th industrial revolution that will radically transform the way we live, work and interact with each other. The technological advancement accelerated by the fourth Industrial revolution will change the core competencies required in the workplace and life. The disruption in the skill set requirement caused by the fourth industrial revolution will increase the

demand of social skills (like persuasion, emotional intelligence, and teaching others), content skills (like ICT literacy and active learning), cognitive abilities (like creativity and mathematical reasoning) and process skills (like active listening and critical thinking) across industries (World Economic Forum, 2016, pp. 20-21). Furthermore, according to the systematic review conducted by Chowdhury and Murzi (2020), teamwork was one of the most important core competencies that will be needed in the workplace as we enter 4IR. To mitigate the impacts of the fourth Industrial Revolution on the workforce and employability, the educational institutions should be prepared to promote core competencies including persuasion, emotional intelligence, teamwork, ICT literacy, active learning and creative and critical thinking among the students. Peer teaching has been recognized as a teaching strategy that benefits students in all of the above domains.

In their study "Peer tutoring as instructional method: a systematic approach," Kapil and Malini (2018) define peer tutoring as a teaching style that employs students as tutors. In this instructional strategy, student pairs may concentrate on academic, social, behavioural, functional, or social skills. Depending on the three key variables, viz. the status of participants; the location of the activity; and the roles undertaken, peer tutoring can be of different types [Falchikov, 2002, p. 8). "Peer facilitated learning" is a technique that combines the "Reciprocal Peer Tutoring" and "Classwide Peer Tutoring" approaches. According to Falchikov (2002), "Reciprocal peer tutoring" [RPT] is a type of peer tutoring that allows each student to play the role of both tutor and tutee, reaping the benefits of both teaching and being taught by. Meanwhile, "Classwide Peer Tutoring" takes place at the same time for all tutor-tutee pairings, encompassing the entire class. Teachers break down the academic information to be tutored into daily and weekly units and prepare these resources for use in a peer teaching setting. During sessions, the teacher can watch and monitor the pupils and their reactions while using CWPT.

There have been several studies on the benefits of Peer tutoring. According to Nancy Falchikov (2002), peer tutoring can benefit students in four main domains namely: academic, non-academic, metacognitive and study skills. Several researchers agree that peer tutoring is the one of the most cost-effective interventions to improve academic, social, behavioral, functional, or social skills (Kapil and Malini, 2018; Goldschmid and Goldschmid, 1976).

Academically, peer tutoring has been found to increase literacy scores, promote development of reasoning and critical thinking (Kapil and Malini 2018). Moreover, Reciprocal peer tutoring was effective in lowering exam anxiety and increasing higher examination scores among students (Fantuzzo et al., 1989; Griffin and Griffin 1998). Besides, cross-age peer tutoring, according to Lindsey and Watts (1979) leads to improvements in students' academic performance and interest towards academic endeavours, preventing students from dropping out. Furthermore, Millis and Cottell (1998) affirm that reciprocal peer tutoring

focuses on "integrating knowledge, active learning, student–student interactions and immediate feedback" allowing students to commit information to memory and promoting deep learning. Peer tutoring has been found to benefit both tutor and tutee. Witherby asserts that his Peer Assisted Study Scheme (PASS) boosted the ability of mentees to adapt acquired skills and competences to other courses, as well as the mentor's academic performance and confidence (1997).

In terms of socio-psychological learning, peer tutoring has been found to benefit students in improving social skills and resolving bevioural issues (Kapil and Malini, 2018). Cross-age peer tutoring helps improve students' self-confidence, self-image, social behaviour, attitude and encourages them to clarify and prioritize their values (Lindsey and Watts, 1979). Besides, when students learn to practice judgement during peer evaluation tasks, there is an improvement in their self-esteem, and value clarification (Bruffee; 1978).

Toppings (1996) through meta-analysis of several studies affirm that peer tutoring very often benefits students with special needs in socioemotional domains of functioning. Peer tutoring improves students' attitudes toward the academic areas being tutored and towards the school. Moreover, it has been found that peer tutoring improves attitudes toward authority, development of cooperative behavior, reduction in antisocial acts, engagement in friendlier play, and neater dressing.

Grasha (1972) found that the "teacher-of-the-day" scheme which gives student teachers an opportunity to contribute to lesson delivery activities like giving lectures, leading discussion, performing demonstrations, running experiments, and so on helped the author address the problem of student absenteeism.

"Peer facilitated learning" engages students in the process of critically evaluating each other's work. Bruffee (1978) found that including students in the task of evaluating each other's academic writing improved students' writing skills. and lowering of failure rates to approximately zero.

Overall, peer tutoring benefits students in promoting their cognitive and social skills that are some of the core-competencies required for the jobs of the future. Peer tutoring also gives students an opportunity to engage in democratic processes within their groups where they hold accountable roles; thus, it helps them practice the spirit of participatory democratic citizenship.

EXPLANATION OF THE TOOL

The tool "Peer facilitated learning" enables teachers to engage students in a meaningful peer learning experience. The tool can be used in any subject and requires some amount of planning on part of the teacher before the semester starts. The tool is a combination of reciprocal peer teaching and classwide peer teaching.

Reciprocal peer teaching allows each student to take on the roles of tutor and tutee, reaping the benefits of both teaching and being taught. Classwide peer tutoring refers to the strategy in which the student acquiring the role of the tutor

teaches the whole class. The PFL tool engages students in brainstorming, research, discussion, self and peer assessment, peer monitoring, and presentation.

Peer assessments entail students making broad judgments about their peers' work based on clear and explicit criteria. In PFL, peer assessment entails constructive discussion and the offering and receiving of rich feedback to help students improve their learning outcomes.

EXPECTED OUTCOME

1. Students' engagement in group assignments will enhance their writing and reasoning skills.
2. Students' engagement in reciprocal teaching will enhance their articulation and presentation skills.
3. Students' involvement in the group process will enhance student belonging and social inclusion.
4. The learning outcome of the topic assigned to the PFL task will be achieved.

NUMBER OF PARTICIPANTS

The number of members in each PFL group should not exceed 6 and should not be less than 4.

ROLE OF STUDENTS

Students in the PFL activity take different roles to structure the group process. The student can be designated one of the following roles based on activity (Johnson, et al., 1991; Millis and Cottell, 1998; Smith, 1996).

- Facilitator: Leads group discussion, keeps everyone on track, and distributes tasks.
- Record Keeper: Takes notes on team meetings and decisions and maintains all essential records.
- Reporter: Represents the group to the class or instructor, outlining its activities and/or conclusions.
- Timekeeper: Reminds the group of time limitations and deadlines, as well as ensuring that meetings begin on schedule.
- Devil's Advocate: Presents counterarguments and (constructive) objections, as well as alternate explanations and solutions during group meetings.
- Harmonizer: While allowing a full expression of ideas, the harmonizer attempts to achieve consensus and build a harmonic and positive team environment.
- Prioritizer: Ensures that the group concentrates on the most critical topics and is not distracted by minor details.

- Explorer: Looks for new opportunities in situations and individuals (teammates and the whole class], as well as new areas of inquiry.
- Innovator: Promotes creativity and brings new and different viewpoints and ideas.
- Checker: Ensures that everyone in the group understands the concepts and the group's findings.
- Runner: Gathers necessary materials and serves as a link between the group and the teacher.
- Wildcard: Assumes the job of any absent team member and fills in the gaps.

Apart from playing the aforementioned roles in the PFL meetings, the students need to participate in group writing assignments at the end of each unit.

ROLE OF TEACHER

The teacher has the following role in using the PFL tool.

1. **Structuring course content to accommodate PFL tasks**: The teacher needs to structure the course content in such a manner that one Unit of the course is divided into subtopics that can be designated to PFL groups as their tasks. The topic designated to PFL groups should not be: too short, too detailed, too easy or too advanced. Moreover, teachers should ensure that the units that are not assigned as PFL tasks should also entail one group writing assignment to be done in the PFL groups.

2. **Making peer groups**: Teachers can form groups in one of the following two ways. One, she can randomly form groups using chit picking. Second, teachers can use sociometric grouping for creating a socially diverse group of pupils to work together. For this, each group should have both high performing and low performing students.

3. **Briefing of the groups**: Teacher is required to brief the students about the objective of the activity and how it will be conducted. She should acquaint the students with their role in self-assessment, peer-assessment, group writing assignments, PFL groups, and PFL presentations.

4. **Facilitate students in creating their group conduct form and group process form**: Teacher should provide students with guidelines to form group conduct form and group process form.

5. **Design rubric for cross group evaluation**: According to the objective of the topic assigned to the groups, the teacher should independently or in collaboration with students create rubrics for cross-group evaluation.

STEPS TO USE THE TOOL

The PFL activity has the following three stages:

1. **Activation**:

   PFL involves randomly dividing the class into groups in the beginning of the academic year such that each group has an equal number of students. Each group is thereafter assigned a topic and each member of the group is assigned a role. The PFL groups come up with a contract about the roles, responsibilities, and ethics of the group. A contract can state a group's ethics, policies & procedures about group goals, participation, communication, conflict resolution, consequences if policies are violated, responsibility towards one's own group, responsibility towards the classmates, & deadlines. Then, each member of the team can be designated a role. The roles you assign will depend on the goals of the assignment, the size of the team, etc. The roles can be fixed or rotating.

   Group assessment: Each member of a PFL group evaluates all the members of his/her own group, his/her own group, one member of every group, and every PFL group. The evaluation rubric to evaluate other groups can be collaboratively designed by the students or can be designed by the teacher on the basis of what she/he deems as the objective of the activity. The possible areas of evaluation of one's own team may include clarity of goals, extent of participation, seriousness about the group process, adherence to timeline, etc. The individual members from one's own team can be evaluated on the basis of how well they perform the designated role and how fairly they align with the group contract. The members of other teams can be evaluated on how fluently they presented the topic and how well they answered the questions raised regarding the topic.

2. **Group process**:

   The group meets regularly to discuss the work they have completed and work they need to complete. In these meetings each group member performs the function assigned to him/her during the group contract making. Moreover, the teacher structures each unit of the course such that each unit has an assignment that requires group work. The teacher has regular meetings with the groups to evaluate their group processes and work timeline.

3. **Presentation**:

   The group presents their topic to the class, where each member receives qualitative feedback [feedback from members of their own team, one member from each team, feedback from teacher, feedback on team performance from other teams] about their performance and ability to articulate the as-

signed topic. – Such feedback helps the individual identify intrapersonal, interpersonal, and content related areas of improvement.

ASSESSMENT

The assessment of the group process is done using the group process assessment form attached in the appendix. Moreover, the recorder and the reporter submit the information about the meeting after each meeting to the teacher. This helps the teacher monitor the process. The teacher evaluates the group process at the end of each month where she sits with the group and cross-checks them on the basis of prior reports.

Furthermore, the PFL activity has a component of collaborative writing, wherein students are given a group assignment each week or once in two weeks on which they have to write together. The student's participation in group assignments is also recorded and reported to the teacher. The teacher pitches all the responses to the students and asks them to evaluate the best responses and provide the argumentation for the same.

Moreover, each group also evaluates other groups based on the curricular objective of the concept they taught and their presentation skills.

The teacher can show the specimen attached in the appendices to the students to help them understand the significance of each document. Thereafter, the teacher can encourage the students to create their own contracts, group process documents, and group process assessment forms.

CONCLUSION

We are steadily moving towards a future where machines are becoming an indispensable part of our lives and the surplus of information available at a click of a finger is overwhelming. To handle this information overload and technology interdependence, there is a need to foster democratic citizens who are critical, creative, and analytical. The tool will help students experience democratic decision making in early years of their lives giving them a head start into tomorrow. The tool can help students learn the skills including enquiry, collaboration, communication, empathy, respect and tolerance. The tool will encourage the students to learn the importance of active listening in collaboration and the role of collaboration in innovation. In the coming technologically advanced age of tomorrow, such skills will enable the students to become lifelong learners who are able to learn, unlearn and relearn so that they remain relevant to the job marketplace.

APPENDICES

Appendix I

PFL - Group Conduct Document

Group Name: .....

These are the ground rules for group behaviour and collaboration that we have agreed to as a group.

Participation: We agree to...

- Respect ourselves and others.
- Come prepared with the part assigned to us.
- Stay focused on the task.
- Support others when I can.

Communication: We agree to...

- Be an active listener.
- Ensure that everyone gets a chance to speak.
- Offer and accept constructive feedback gracefully.
- Critique ideas rather than people.
- Not to interrupt people while they are speaking.
- Actively ask for help when I am confused.

Meetings: We agree to...

- Beginning every meeting on time.
- Meet biweekly/weekly/…
- Perform the assigned roles actively throughout the meeting.
- Maintain decorum during the meetings.
- Maintain meeting records.

Conduct: We agree to...

- We agree to respect ourselves and others.
- We agree to convey our disagreement.

- Keep open mind.
- Attend and arrive on time for all group meetings.
- Allocate fair share of work to every member of the group.

Conflict: We agree to...

- We agree to convey our disagreement with each other with respect.
- Be open to compromise and collaborate on ideas.
- Confront the group member who is not able to fulfil his/her role to understand their problem.

Deadlines: We agree to...

- Schedule a deadline for each task that we allocate within the group.
- Respect each deadline and do not seek extension till extremely necessary.
- Complete and review all the tasks assigned by the teacher one/two days before the deadline set by the teacher.
- Submit our work before the deadline set by the teacher.

Name of Team Member	Signature

Appendix II

PFL Group Process Format

Group Namer: .....

Date: .....

GOALS: What are our team goals for this assignment?

How do we hope to achieve? What abilities do we want to develop or improve?

- We want to understand the concept of ..... and/or acquire the skill .....

To achieve this, we will .....

EXPECTATIONS: What do we expect of one another in terms of meeting attendance, engagement, communication frequency, work quality, and so on?

- We expect every member of the team to complete the work allocated to them before the deadline so that we can review and revise the final submission for the course. We will ensure that our assignment will not be a patched together work but a well-drafted document which will help understand the ..... [concept on which the group has elucidated]. The timekeeper will daily follow up with the group on their progress in the task.

POLICIES & PROCEDURES: What norms can we agree on to assist us achieve our objectives?

- We will explore the concept with integrity and will ensure that all the members of the group have fully participated in the task. We will ensure that each member of the group understands the task and agrees with the timeline and role allocation.

CONSEQUENCES: How will we deal with non-compliance with these objectives, expectations, rules, and procedures?

- If anyone in the group is not able to comply with group rules, we will try to understand the reason behind their non-compliance rather than being judgmental. We will encourage each other to comply with the rules. We will not shy away to seek teacher's support if we are not able to smoothen the group process.

We agree to these policies, procedures, and punishments because we share these goals and expectations.

Team member's name

Team member's name

Team member's name

Team member's name

Appendix III

PFL- Group Process Assessment

Name of the group: .....

Assessment date: .....

Attendees: .....

Number of assessments: .....

Please select the box that best represents the degree to which each statement applies to your group.

		To a very little extent	To a little extent	To a great extent	To a very great extent
1.	The team members are clear about the team goals and are fully committed to achieving them.				
2.	We collaborate and cooperate with each other.				
3.	The group is concerned about the quality of the work.				
4.	We have high performance expectations.				
5.	Some members are too casual with our group's task.				
6.	Some team members who have good ideas don't speak up.				

		To a very little extent	To a little extent	To a great extent	To a very great extent
7.	For fear of offending others, some members of the group would not disagree.				
8.	Some members of the team act as though they know everything.				
9.	The group discussions are often dominated by one or two members.				
10.	We pay attention to what each person has to say.				
11.	Members of the team are encouraged to express both positive and critical comments.				
12.	An atmosphere of trust exists in our group.				
13.	We are comfortable in the roles we play in the group.				
14.	Members are hesitant to ask for or provide assistance.				
15.	Individuals' abilities, knowledge and experience is not well utilized.				

What is the group's assessment of its own process? What areas does the group need to work on? What is your strategy for dealing with this?

Appendix IV

Feedback on the individual presenter:

1. Subject. Was the presentation informative? Did it have a clear focus? Was it well researched?

1 . . . 2 . . . 3 . . . 4 . . . 5 . . . 6 . . . 7

Needs improvement ..... Excellent

2. Organization/Clarity. Was it easy to follow? Were key ideas and concepts discussed in a manner that allowed you to engage with them easily?

1 . . . 2 . . . 3 . . . 4 . . . 5 . . . 6 . . . 7

Needs improvement ..... Excellent

3. Sensitivity to audience. Did the speaker maintain eye contact with all members of the class? Did s/he give you time to take notes as needed? Did s/he repeat the main ideas more than once? Did s/he make effective use of pauses, gestures, change in pace and pitch?

1 . . . 2 . . . 3 . . . 4 . . . 5 . . . 6 . . . 7

Needs improvement ..... Excellent

4. Visual aids. Did the speaker make effective use of handouts, overheads and/or the blackboard? Were overheads or board writing large enough to see easily?

1 . . . 2 . . . 3 . . . 4 . . . 5 . . . 6 . . . 7

Needs improvement ..... Excellent

5. Activities and classroom engagement: Did the speaker involve the class in activities or discussions? Were these linked to the topics and concepts being discussed?

1 . . . 2 . . . 3 . . . 4 . . . 5 . . . 6 . . . 7

Needs improvement ..... Excellent

Overall grade of the individual presenter [Tick anyone]

O	A	B	C	D	E	F

One area of strength of the presenter:

One area that needs improvement:

Appendix V

Feedback on the group

1. Did all the members of the group participate in the facilitation of the session?

1 . . . 2 . . . 3 . . . 4 . . . 5 . . . 6 . . . 7

Needs improvement ..... Excellent

2. Was preparation and practice apparent in the group? Did each member seem equally prepared?

1 . . . 2 . . . 3 . . . 4 . . . 5 . . . 6 . . . 7

Needs improvement ..... Excellent

3. Was the session well organized? Was it easy to follow and did the overall presentation have a stated objective and a definite conclusion?

1 . . . 2 . . . 3 . . . 4 . . . 5 . . . 6 . . . 7

Needs improvement ..... Excellent

4. Did the group show creative thinking in the organization of the classroom session? Did they get the audience involved in the classroom session?

1 . . . 2 . . . 3 . . . 4 . . . 5 . . . 6 . . . 7

Needs improvement ..... Excellent

5. Was there evidence of the group collaborating with each other during the presentation? Did they consult each other, take notes, and contribute during the Q & A session?

1 . . . 2 . . . 3 . . . 4 . . . 5 . . . 6 . . . 7

Needs improvement ..... Excellent

6. Did the session incorporate effective TLM and did the facilitators give clear and concrete explanations and examples?

1 . . . 2 . . . 3 . . . 4 . . . 5 . . . 6 . . . 7

Needs improvement ..... Excellent

10. Overall, did the team connect with each other? Were other team members of the team attentive when individual members presented?

1 . . . 2 . . . 3 . . . 4 . . . 5 . . . 6 . . . 7

Needs improvement ..... Excellent

Overall grade for the group [Tick anyone]

O	A	B	C	D	E	F

One key strength of the group:

One area for improvement:

REFERENCES

Barkley, E.F., Cross, K.P., & Major, C.H. (2005). Collaborative learning techniques. San Francisco: Jossey-Bass.

Blatchford, P., Kutnick, P., Baines, E. & Galton, M. (2003). Changes in grouping practices over primary and secondary school, International Journal of Educational Research, 39(1), 9-34.

Bormanaki, H.R., & Khoshhal, Y. (2017). The Role of Equilibration in Piaget's Theory of Cognitive Development and Its Implication for Receptive Skills: A Theoretical Study. *Journal of Language Teaching and Research, 8*, 996-1005. 10.17507/jltr.0805.22.

Bruffee, K.A. (1978). The Brooklyn Plan: Attaining Intellectual Growth through Peer-Group Tutoring. *Liberal Education, 64*.

Chowdhury, T. M., & Murzi, H. (2020, June), *The Evolution of Teamwork in the Engineering Workplace from the First Industrial Revolution to Industry 4.0: A Literature Review* Paper presented at 2020 ASEE Virtual Annual Conference Content Access, Virtual On line . 10.18260/1-2—35318

De Lisi, R. & Golbeck, S. L(1999). Implication of Piaget's theory for peer-learning. In O'Donnell, A. M. & King, A. (Eds.) Cognitive perspectives on peer-learning. Lawrence Erlbaum Associates: Mahwah, New Jersey.

Donaldson, M. (1978) Children's minds, Glasgow: Fontana/ Collins.

Dunn, D. S. (1996) 'Collaborative writing in a statistics and research methods course', Teaching of Psychology, February, 23, 1: 38–40.

Falchikov, N. (2001). Learning Together: Peer Tutoring in Higher Education (1st ed.). Routledge. https://doi.org/10.4324/9780203451496

Fantuzzo, J. W., Dimeff, L. A., & Fox, S. L. (1989). Reciprocal Peer Tutoring: A Multimodal Assessment of Effectiveness with College Students. Teaching of Psychology, 16(3), 133–135. https://doi.org/10.1207/s15328023top1603_8

Gillies, R. M. (2004). The effects of cooperative learning on junior high school students during small group learning. Learning and Instruction, 14(2), 197–213. https://doi.org/10.1016/S0959-4752(03)00068-9

Goldschmid, B., & Goldschmid, M. L. (1976). Peer Teaching in Higher Education: A Review. *Higher Education*, *5*(1), 9–33. http://www.jstor.org/stable/3445550

Grasha, A. F. (1972). Observations on relating teaching goals to student response styles and classroom methods. *American Psychologist, 27*(2), 144–147. https://doi.org/10.1037/h0032741

Griffin, M. M., & Griffin, B. W. (1998). An Investigation of the Effects of Reciprocal Peer Tutoring on Achievement, Self-Efficacy, and Test Anxiety. *Contemporary educational psychology*, *23*(3), 298–311. https://doi.org/10.1006/ceps.1998.0971

Johnson, D. W., Johnson, R. T., and Smith, K. (1991). Cooperative learning: Increasing college faculty instructional productivity (ASHE-ERIC Higher Education Report No. 4). Washington, DC: The George Washington University, School of Education and Human Development.

Kapil, Y., & Malini, J. S. (2017). Peer tutoring an instructional strategy: A systematic approach. *Scholarly Research Journal for Humanity, Science and English Language*, *6*(22), 7792-7798.

Kwon J. (1989). A cognitive model of conceptual change in science learning. In Kwon, J. and Lee, G. (2003). Towards an Understanding and Use of cognitive conflict in Science Instruction (I): Definition and Model. Vol 23 (4). pp 360-374. Journal of Korean Association for Research in Science Education.

Lindsey, J. D., & Watts, E. H. (1979). Cross-Age (Exceptionality) Peer Tutoring Programs: Have You Tried One? *The Clearing House*, *52*(8), 366–368. http://www.jstor.org/stable/30185193

Millis, B.J., and Cottell, P. G., Jr. (1998). Cooperative learning for higher education faculty, American Council on Education, Series on Higher Education. The Oryx Press, Phoenix, AZ. 67.

Millis, B.J., & Rhem, J.L. (2010). Cooperative learning in higher education: across the disciplines, across the academy. Stylus Publishing.

Piaget, J. (1971) Science of education and the psychology of the child, trans. D. Coltman, London: Longman.

Piaget, J. (1932).The moral judgement of the child. London: Routledge & Keegan Paul.

Pallinscar, A.S.(1998).Social constructivist perspectives on teaching and learning, Annual Review of Psychology, 49, 345-375.

Smith, K. A. (1996). "Cooperative Learning: Making 'Group work' Work" In Sutherland, T. E., and Bonwell, C. C. (Eds.), Using active learning in college classes: A range of options for faculty, New Directions for Teaching and Learning No. 67.

Thurston, A., Keere, K.V., Topping, K.J., Kosack, W., Gatt, S., Marchal, J., Mestdagh, N., Schmeinck, D., Sidor, W., & Donnert, K. (2017). Peer learning in primary school science:Theoretical perspectives and implications for classroom practice. *Electronic Journal of Research in Educational Psychology*, 5, 477-496.

Topping, K. J. (1988) The peer tutoring handbook, Cambridge, Massachusetts: Brookline Books.

Topping, K. J. (1996). The Effectiveness of Peer Tutoring in Further and Higher Education: A Typology and Review of the Literature. *Higher Education*, *32*(3), 321–345. http://www.jstor.org/stable/3448075

Vygotsky, L. S. (1962) Thought and language, Cambridge, MA: MIT Press.

Witherby, A. (1997). *Peer mentoring through peer-assisted study sessions*. London: Routledge.

Woolfolk, A. E., Winne, P. H., & Perry, N. E. (2003). Educational psychology (2th ed.). Pearson Education Canada Inc: Allyn & Bacon, Inc Needham Height, MA.

World Economic Forum. (2016). (rep.). *The Future of Jobs: Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution*. Retrieved April 7, 2022, from https://www3.weforum.org/docs/WEF_Future_of_Jobs.pdf.

Chapter 17

The product process analysis – A tool to develop critical, creative and systemic thinking skills

Sören Schütt-Sayed & Andreas Zopff

INTRODUCTION

Globally, the proportion of the population with sustainable consumption awareness is increasing. According to market research firm NielsenIQ, the majority (73%) of global consumers say they "definitely or probably [would] change their consumption behavior to reduce their impact on the environment" (NielsonIQ, 2019). In many countries around the world, quality and health but above all environments are considered the main drivers of sustainable purchasing decisions (Statista 2021). The adoption of the 17 UN Sustainable Development Goals supports this trend. Subgoal 12, "sustainable consumption and production," accordingly formulate the claim that the satisfaction of the needs of current and future generations must not be at the expense of the ecological carrying capacity of the earth, nor lead to the violation of human rights (cf. UBA & BMU). Against this background, the product process analysis offers a suitable teaching method to answer the question: how, what, for what and with which [ecological, social, and economic] consequences are produced and consumed?" (PÖW, 1987, p. 19).

The product process analysis (PPA) was developed by the Project Group Ecological Economy (PÖW) to provide various stakeholders (such as employees, trade unions, citizens' initiatives, politicians, consumers, consumer groups as well as companies) with an information tool that can be used to view products and services holistically. In this way, well-founded sustainable decisions can be made. Thus, PPA has not been developed as a teaching method. However, in this article, we show the possibility of designing learning processes with PPA.

PPA is suitable for all learners in secondary and post-secondary education (ages from about 12 to 99). Learners do not need any specific prior knowledge. The great advantage of PPA is that learners use their own experiences as consumers to systematically gather information and evaluate it.

Our own experience often shows how difficult it is when shopping in the supermarket to decide whether foodstuffs such as coffee or bananas have been produced sustainably or what social and ecological impacts are associated with purchasing these products. The assessments are even more difficult for more complex products, such as a cell phone, a washing machine, or even an electric car. Even if the product line analysis of consumers cannot be used directly at the point of sale, it is a suitable method in school education to deal with one's own needs and characteristics of sustainable products and services.

To reduce the amount of work required to collect and process all relevant information, the method of PPA was didactically and methodically prepared for implementation in schools (Retzmann, 2000, p. 14). The aim of the use in school lessons is not to be able to apply the technical analysis procedure methodically flawlessly, but above all to develop creativity, communication, criticism, and problem-solving skills. Of course, knowledge and skills for carrying out the method and knowledge about its limitations are also necessary. Learners are thus enabled to reflect on their consumption, and they are then able to make more informed product decisions at the point of sale.

In the following, the theoretical basis for the application of PPA will be presented. Then it is shown how the method is received in science and practice. The concrete implementation of the method is illustrated with an example and some practical tips.

THEORETICAL BACKGROUND

The theoretical starting point for developing the product line analysis lies in the criticism of traditional economics (Waldmann, 1992, p. 167). The instruments of classical economic theory were insufficient to make differentiated statements about the ecological and social impacts of economic production processes. Against this background, the "Project Group Ecological Economics" (PÖW) developed a method that took into account the following aspects (PÖW, 1987, pp. 15-17):

- Human consumption needs
- Natural resource consumption included in value creation processes
- Social and environmental costs in value creation processes
- Various economic areas
- Production and consumption as a whole
- Openess to other scientific disciplines, such as social sciences

The concept of PPA was then used in the 1970s in Germany in environmental education. It was didactically-methodologically prepared for the school sector to teach responsible use of the earth's natural resources. The pedagogical aim was to develop a sense of ecological responsibility in young people (Retzmann,

2000, pp. 8-10). The focus of ecologically and economically oriented learning was to convey an individual's "readiness to act in the face of complex and collective [environmental] problems." Ecological judgment and action formed the basis (Retzmann, 2000, p. 9).

The adoption of Agenda 21, in which a globally significant political commitment to "sustainable development" was declared, expanded the predominantly ecologically oriented ideas of the economy. The sustainability triangle symbolized the equal consideration of ecological, economic, and social aspects as a future strategy of human activities. The PPA refers to this theoretical view. The PPA (see Figure 1) expresses this threefold perspective. At the same time, the three sustainability dimensions are linked to the theoretical model of the product life cycle derived from economics.

Agenda 21 expanded the strongly ecologically oriented environmental education by teaching sustainable development (ESD). Education should now change people's corresponding ways of thinking and acting in the guiding idea of sustainability. All people should acquire the necessary competencies "to be actively and responsibly involved in shaping a sustainable future for humanity" (Pelegri, 2018, p. 20). Specifically, learners should develop a so-called "Gestaltungskompetenz" (design competence). This implies that individuals learn

- global interdependencies (competence in systemic thinking),
- to think ahead (competence to anticipate),
- to act empathically and in solidarity (normative competence),
- to include uncertainties and future forecasts (strategic competence) and
- wanting to participate in collective decision-making processes (interpersonal competence) (cf. Wiek et al., 2011; De Haan, 2008).

The learning process is based on the concept of action-oriented teaching (Jank & Meyer, 1994). The independent work of the learners is at the center of the organization of the lessons. During their PPA, the teachers support the learners by advising them in their research and helping them to evaluate the results of their research. However, the action is clearly in the hands of the learners. They have the responsibility for their learning process. PPA provides an opportunity to address these youth skills and develop them if done several times.

LITERATURE REVIEW

Using a PPA in secondary and post-secondary education is a very new idea that the authors are pursuing. It is to be expected that there is hardly any literature on the use of PPA in the classroom. The translation of "Produktlinienanalyse" into English "production process analysis" did not lead to any hits. It is exclusively received in German in scientific discourses and practical application. The literature evidence used, which is almost solely limited to the German-speak-

ing area, clarifies that the method has not yet been able to spread in the international educational context.

It is striking that the method is mainly implemented in economic education contexts (Retzmann, 2000; Pelegri, 2018). Sustainable economics must address problems such as climate change, energy and resource scarcity, waste disposal, and social inequalities. Sustainability-oriented methods in economic education demonstrate the necessary social change towards more sustainability. In particular, economic, living, and consumption styles need to be more responsible and equitable.

EXPLANATION OF THE TOOL

PPA is a method that allows learners to compare different products. It provides essential information about a product (or service) regarding its need satisfaction, environmental impact, social impact, and economic efficiency over the entire life cycle.

This information is compiled by considering four perspectives (PÖW, 1987, p. 18):

- The need orientation: At the beginning of the investigation, it is asked which need is to be satisfied by consuming a product or service. The environment of the product / service is also taken into account.
- The vertical view: A product is considered from raw material extraction and processing, transport, production, trade and distribution, consumption, to disposal. These phases form a product line.
- The horizontal view: The phases of a product process analyzed in the vertical view are examined concerning their effects on the three dimensions of nature, society, and economy. For each product process analysis, a criteria grid is developed for each size, with the help of which the effects of the product line variant can be determined.
- Comparison of variants: Since the product process analysis is intended to be an instrument on the way to a socially and ecologically oriented economy, the comparison between different variants of products, services, production processes can be an indication of the most environmentally and socially compatible form. One of the alternatives can also be the zero variant, in which the product is not produced or sold at all.

  The product process matrix is at the heart of the PPA (see. Figure 1).

Dimension/ Criteria		Production Prozess					
		Raw Materials	Transport	Manufacturing	Trade	Consumption	Recycling
Nature	Energy and Cost of materials						
	Pollutants in air, water and soil						
Society	Health compatibility						
	Job satisfaction						
Economy	Company position						
	Cost and Quality						

Figure 1 - Template of a product process analysis

It determines the information acquisition process. Vertical and horizontal views are related to each other in the matrix. Thus, the interactions between the natural environment and the human economy become apparent.

AIM OF THE TOOL

Conducting a product line analysis in educational processes has four objectives (Österreich, 2011, p. 5):

- Learners identify what needs they want to satisfy and discuss the need to meet that very need.
- Learners analyze different alternatives or variants of a product or service to fulfill this need.
- Learners recognize the consequences of these alternatives for the individual and society, for nature and the economy.
- On this basis, learners can weigh the ecological, social, and economic consequences.

In conducting the analysis, learners are empowered to,

- assess various sources of information about a product holistically (analytical thinking),
- assess the impact of the production process of a given product on themselves, others, the environment, and the economy (systemic thinking),

- to deal critically with the sources of information (critical thinking),
- be able to discuss their values with other learners (critical thinking),
- being creative in the production of new products (creative thinking).

PROCEDURE

The implementation of the PPA is not clearly defined. The authors present here an ideal-typical course planning, which must be adapted with regard to the learners, the teachers, the products and the spatial situation. Here, a sequence in four phases is presented, which refers to the theories described and, at the same time, is based on a didactic- methodical trial (Schütt-Sayed, 2020, p. 334).

1. Introductory phase: First, a product or service must be selected for a PPA that plays a prominent role in the learners' lifeworld. Depending on the age group or previous education, these can be very different products or services. The central task of a PPA is to compare different variants of a product or service. Here, for example, one could compare an iphone7 and a fairphone3. To illustrate the procedure, a PPA on smartphones is presented here. After this fundamental decision by the teacher, the learners must now be activated and motivated. Ideally, a needs analysis is carried out first. To do this, the learners are asked who owns a smartphone and what is important to them when buying a smartphone. These questions should activate and motivate the learners for the subsequent analysis by making them aware of why they use a particular product. Subsequently, it is essential to clarify what needs are behind a product. One needs to have a smartphone, for example, to communicate with friends. Another is the smartphone as a status symbol. After identifying the needs, the next step would be to get the learners to think about hidden components in their smartphones. Following this, they need to consider what impact the smartphones they produce, and use have on themselves, others, the environment, and the economy. Here it would be helpful to start an initial discussion in the learning group about their opinions. The conversation should be kept short. At the end of the discussion, the learners should agree on two smartphones to be analyzed in more detail. Likewise, the essential investigation criteria must be determined in the introductory phase.
2. Implementation phase: The second phase is the most extensive in terms of time, in which the learner's research and evaluate the relevant information. The implementation phase begins with the learners being divided into groups of four to five. The different groups can now decide which products they want to analyze. The number of groups per product should be approximately equal. After the learners have been divided up, they should research relevant information. The teacher can provide prepared literature for this: a report about the smartphone from an IT magazine or product information from the manufacturer's website. However, learners can also research the

necessary information themselves on the Internet. While learners research the information, they fill in the so-called production process matrix. The matrix is the core of the analysis. Any information that can be found is then recorded in the matrix. Figure 2 shows an example of a completed production process matrix for the Fairphone: The columns show the product life cycle. The rows show the test criteria, each in the form of a given question. The groups should check all requirements for each production process step of a product. An example might look like this: In the column 'Raw materials' and the row 'How employees are treated, one is entered 2 by the learners. Behind this number is an inquiry by the learners. Their evaluation is based on the information that only raw materials from conflict-free mines in the Congo are used for the Fairphone. Therefore, the evaluation of this information with the school grade 2 (in Germany, one is the best grade and six the worst) is based on the learners' assessments. This jointly developed assessment is very important for the learning process so that the students have to enter into discussion among themselves. This makes their attitudes and values regarding this information visible. The teacher should also point out that the learners should always pay attention to the given information source when evaluating it. This is because the author's perspective (e.g., the manufacturer) may be different from the perspective of an independent IT magazine.

Dimension/ Criteria		Production Prozess						Average Total
		Raw Materials	Transport	Manufacturing	Trade	Consumption	Recycling	
Nature	Energy and Cost of materials	0	0	4	0	0	0	4
	Pollutants in air, water and soil	2	0	2	0	0	0	2
Society	Health compatibility	2	0	0	0	0	0	2
	Job satisfaction	0	0	0	3	0	0	3
Economy	Company position	0	0	2	0	0	0	2
	Cost and Quality	0	0	0	0	1	0	1
Assessment school grades (Germany): Overall score = 2,33								

Dimension/ Criteria	Raw Materials	Grade
How employees are treated	Use conflict-free materials from Congo	2

Figure 2 - Example of a filled production process matrix (fairphone)

1. Reflection phase: In the third step, the students are asked to reflect on the analysis results. After that, it is essential that the learners reflect on their results again. After the matrix has been completed as far as possible, the last step is for the groups to present their results to each other. Each group should then answer the following questions (Östereicher, 2011, p. 110):
   - How would you evaluate the results?
   - What consequences do I draw for myself from these results?
   - What actions should be taken to improve the situation?
   - What actions can I personally take as a consumer or producer to improve the situation?
   - What actions should companies and politicians take to improve the situation?
   - Which actions should already be taken for granted?
   - Which criteria are still insufficiently investigated and should therefore be better researched?
   - Which ecological and social innovations can be derived from the results?

   Answering these questions is the central basis for assessing the consequences of consumption and thus identifying the need for action to develop a product or service further. The learners are therefore able to weigh up the consequences and the need for action.
4. Reporting phase: The last step is summarizing all the results in a report and formulating a personal conclusion. The form of the information can be freely chosen: a video, a presentation, a classic report. The report should contain at least four bullet points:
   - The completed production process matrix
   - A summary of all relevant information
   - An evaluation of the individual information
   - A reflection on the consequences and possible alternative actions

The following table gives an overview of the process:

Learning phase	**Time**	**Teaching-/Learning activity**	**Method/ Social Form Media**
Introduction	20 min.	- The teacher gives a presentation introducing the learners to the problem of cell phone production and the theory of PPA. - The following questions lead to the problem of the cell phone issue: "Who of you has a smartphone?", "What is important to you when buying a smartphone?" "What do you need a smartphone for?", "What needs does your smartphone satisfy?", "What is hidden in your smartphone?", "What impact does the smartphone have on me, others, the environment, and the economy?" - The learners reflect on their needs. They recognize the relevance of the "cell phone problem." They work out the effects of their satisfaction of needs on local and global contexts. - They scrutinize a product or service for the underlying need, taking into account the environment. - They will learn the definition, objectives, and process of PPA.	Teaching/learning conversation, plenum, ppt slides

Learning phase	Time	Teaching-/Learning activity	Method/ Social Form Media
Execution	approx. 180 min.	Participants conduct their product process analysis for two comparable products. - The teacher introduces the work assignment and divides the learning group into groups of 4. (recommended minimum number of learners: 8) - The teacher distributes selected articles or gives access to the articles. - Learners read through the given articles and filter out the relevant information and content. - They arrange the information into a given product process matrix. - The learners present product-related data over the entire life cycle of a product (iPhone/ Fairphone) and recognize which effects and consequences are associated with this in ecological, social, and economic terms.	Group work, Work order, shared document with product process matrix
Reflection	60 min.	- Comparison of the different results in plenary, e.g., on the Smartboard.	Plenum, Worksheet "Reflection Questions"
Report	60 min.	- Learners prepare a report (production process matrix, summary of all information, evaluation of each information, reflection of consequences, possible alternative actions). - Learners formulate personal conclusions from the PPA.	Group work, Report Template

EXPECTED OUTCOME

The PPA enables the learners to reflect on their satisfaction of needs and assess the ecological, social, and economic consequences of their actions. They develop recommendations for action for the future. The most important outcome, however, is to guide learners in practicing critical thinking!

ALLOCATED TIME

Depending on the learners' previous education, 5 to 6 hours are needed to run through a complete PPA. In particular, the time required for the execution phase is quite variable. Learners who develop a great deal of ambition need significantly longer to research and complete the product process matrix than groups who use many of the teacher's prepared texts.

SETTING, PLACE LAYOUT

The PPA method can be carried out in average classrooms. Internet access is helpful, and it is also advantageous if the groups do not hinder each other during the work phase.

NECESSARY MATERIALS

The teacher has to decide in which form the information material should be provided with the learners in mind. In a learning group that is used to working independently, the main research work can be transferred to the learners. Less experienced groups need more precise guidelines and more information about the products or services. This is especially important because otherwise, the motivation suffers significantly if the research results are unsuccessful.

NUMBER OF PARTICIPANTS

Since at least two product process matrices are to be compared at the end of the implementation phase, four learners must work in each of two learning groups: i.e., at least eight learners.

ROLE OF STUDENTS

The learners become - depending on the preparation and support by the teachers - experts of the PPA. They have to be very active in shaping their learning process. This must be learned gradually. The more PPA the learners do, the more practiced they become in actually taking responsibility for their learning process. The learners must be very well accompanied by the teachers in this process.

ROLE OF TEACHER

Teachers need to find a good balance between guidance and counseling. They must have the courage to gradually reduce the stringent control of the lessons in order to offer the learners ever greater opportunities to control their own learning process. Nevertheless, the teachers must be ready to support the learners at any time. This applies both to the information about the products studied and to the methodological course of the PPA. In the phases 'introduction' and 'reflection' the role is rather 'guidance'. In the phases 'excecution' and 'report' the role is rather 'councelling'.

STEPS TO USE THE TOOL

From the teacher's point of view, excellent preparation of the content of the chosen product or service is an essential basis for a successful PPA. In addition, the teacher must be taught in accompanying learning processes. The learners have sufficient freedom but are also sufficiently guided in the decisive phase to achieve the goals.

ASSESSMENT

The success of a PPA can be measured very well by the results. The teacher can evaluate the completed product process matrix and the elaborated report, preferably with the learners.

STUDENTS' FEEDBACK

In evaluating our implementations, the learners expressed their great interest in the PPA. The information research was especially popular among the learners. All learners described the discussion of the different product process matrices as a crucial and stimulating phase of the method.

CONCLUSION

The method of product process analysis is not an 'original' didactic method, yet teachers can use it very well in learning situations. It ensures an intensive insight into assessing the ecological, social, and economic interrelationships of products and services. Working with the PPA places high demands on the learners' independence. They must be able, or be enabled by the teachers, to take responsibility for their learning process. To be able to assume this responsibility, the PPA is relatively clearly structured so that the learners can concentrate well on the content-related assessment of the products and services. The teacher's excellent content preparation ensures the learners' learning success.

REFERENCES

Deutsche UNESCO-Kommission e.V. *Bildung für nachhaltige Entwicklung.* Zugriff am 01.10. 2015, verfügbar unter http://www.bne-portal.de/.

De Haan, G. (2008). *Gestaltungskompetenz als Kompetenzkonzept der Bildung für nachhaltige Entwicklung.* In I. Bormann & G. de Haan (Hrsg.), *Kompetenzen der Bildung für nachhaltige Entwicklung: Operationalisierung, Messung, Rahmenbedingungen, Befunde* (1. Aufl., S. 23–43). VS, Verl. für Sozialwiss.

NielsenIQ. (2019). *A Naturel rise in sustainabilty around the world.* URL: https://nielseniq.com/

Östereicher, C. (2011). *Fallbeispiel: Die Produktlinienanalyse am Beispielprodukt, Handy* Diplomarbeit. https://docplayer.org/5300864-Fallbeispiel-die-produktlinienanalyse-am-beispielprodukt-handy.html

Pelegri, A. (2018). *Die Produktlinienanalyse als Methode zur Verknüpfung von ökonomischer Bildung und Bildung für nachhaltige Entwicklung anhand des Fallbeispiels ‚Pommes frites'*: Bachelorarbeit. GRIN Verlag. https://www.grin.com/document/492429

PÖW. (1987). *Produktlinienanalyse: Bedürfnisse, Produkte und ihre Folgen.* Projektgruppe Ökologische Wirtschaft. *Wege aus der Krise: Bd. 4*. Kölner Volksblatt Verl.

Retzmann, T. (2000). *Förderung des ökologischen Verantwortungsbewusstseins mit der Produktlinienanalyse.* In E. Jung & T. Retzmann (Hrsg.), *Berufsbildung zwischen innovativer Programmatik und offener Umsetzung: 2. Politische Bildung an berufsbildenden Schulen: Globale Herausforderung, neue Medien und individuelle Benachteiligung* (S. 63–83). wbv Bertelsmann.

Schütt-Sayed, S. (2020). *Nachhaltigkeit im Unterricht berufsbildender Schulen: Analyse, Modellierung und Evaluation eines Fortund Weiterbildungskonzepts für Lehrkräfte* [Dissertation, wbv; W. Bertelsmann Verlag, Bielefeld

Statista. (2021). *Sustainable Consumption in India 2021* Report. URL: https://www.statista.com/study/89748/sustainable-consumption-in-india-report/ (Stand: 04.02.2022)

UBA – Umweltbundesamt und BMU - Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit. *Sustainable Developement Goals.* URL: https://sdg12.de/ (Stand: 04.02.2022)

Waldmann, K. (1992). *Umweltbewusstsein und ökologische Bildung: Eine explorative Studie zum Umweltbewusstsein Jugendlicher und Beiträge zu Konzeption und Praxis ökologischer Bildung.* Leske und Budrich.

Wiek, A., Withycombe, L. & Redman, C. L. (2011). Key competencies in sustainability: A reference framework for academic program development. *Sustainability Science*, 6(2), 203–218. https://doi.org/10.1007/s11625-011-0132-6

Chapter 18

Reflective Cheat Sheet

Sanjeev Sonawane & Nisha Valvi

> *"It is not sufficient simply to have an experience in order to learn. Without reflecting upon this experience, it may quickly be forgotten, or its learning potential lost. It is from the feelings and thoughts emerging from this reflection that generalizations or concepts can be generated. And it is generalizations that allow new situations to be tackled effectively."*
>
> - Gibbs (1988) in *Learning by doing: a guide to teaching and learning methods.*

INTRODUCTION

The world is becoming complex; with the Internet of Things, AI, and social media, a vast amount of information is becoming available at the tip of our fingers. New knowledge is being created and information is rapidly changing. What was relevant yesterday, might not be relevant today. To match pace with this rapidly changing world, we need to constantly rethink, switch directions, and change problem-solving strategies. Thus, it is becoming increasingly imperative for us to develop reflective thinking among students from early on. This will help learners become critical of the events around them and the information they receive and develop strategies to apply new knowledge to the complex situations in their everyday life. Reflective thinking, also known as reflection, is a critical thinking process that refers to the processes of analyzing and making judgments about an event that the learner has witnessed and experienced. Dewey (1933) suggests that "reflective thinking is an active, persistent, and careful consideration of a belief or supposed form of knowledge, of the grounds that support that knowledge, and the further conclusions to which that knowledge leads." During learning scenarios, learners are aware of and in charge of their learning by actively participating in reflective thinking - examining what they know, what they need to know, and how they bridge that gap. It is a meaning-making process that leads a student from one experience to the next with a better grasp of how it relates to and connects to other concepts and experiences.

Reflection is the instrument by which experiences are translated into dynamic knowledge. Including reflection in the learning process has many benefits in terms of the development of an individual's dispositions towards situation analysis, problem segmentation, solution analysis, and conclusions.

ADVANTAGES OF REFLECTION IN THE LEARNING PROCESS

1. **Analysis capacity**: Reflective individuals can define & analyze their experiences more clearly. They find it easy to interpret situations in a profound way to reach a clearer conclusion.
2. **Active listening**: A reflective person is an active listener as he or she is aware that through the discourse of others, valuable information is obtained from which an analysis can be made.
3. **Observation skills**: Reflective individuals are more observant of their surroundings and see all the experiences as meaningful experiences.
4. **They are patients**: Reflective people are patient and know that acting impulsively would be counterproductive to their interests. Reflective people do not usually act at the first sign of change but take the time to obtain as much information on the subject as possible to allow for reflection or analysis.
5. **Managing emotions**: A reflective person has good handling of his/her emotions since he/she can reflect on them. They are self-aware, practice self-regulation, and show a high level of emotional intelligence.
6. **Evaluate pros and cons**: Reflective individuals know how to discriminate between the pros and cons of the situations that occupy our analysis. Therefore, reflective people are rational decision-makers and reach a better conclusion.
7. **Planning skills**: Reflective people know how to structure and organize their experience in a way where every detail counts. Reflective people plan based on the information they have to see how their reflection can be shaped, or whether new information on the subject of analysis is needed.
8. **Objectivity**: Reflective individuals practice introspection and are aware of their biases. Furthermore, they are capable of viewing a situation independently of their biases and thinking objectively.
9. **Internalize learning**: Reflective individuals internalize experiences significantly. This gives them adequate learning about the event they have experienced.

Reflective thinking offers a multitude of benefits as illustrated above, however, too often, students do not know how to reflect on experiences, critically or otherwise. Nielsen et al. (2007) stress the importance of having a structure that allows students to write more in-depth accounts of their experiences and their thoughts about them.

The reflective cheat sheet tool enables the teacher to structure students' reflection process by dividing the reflective practice into three parts namely, tactile, strategic, and takeaways. This kind of scaffolding in reflective thinking gives students' thoughts a direction on what to consider while engaging in reflection. In short term, the tool will help learners engage with the experience in the following ways:

- Rethink about the experienced event/activity objectively,
- Rethink about their responses during the activity,
- Understand their own thinking and learning strategies,
- Identify new knowledge from the experience and link it to the prior understanding,
- Develop novel strategies that they can employ in similar situations.

In long term, using a reflective cheat sheet will help learners become critical and reflective thinkers who are capable of lifelong learning as they constantly analyze, question, and critique established assumptions.

Reflective Cheat Sheet: What is it?

Self-discovery is a big part of reflective thinking and writing. The reflective process, according to Cottrell (2010), is difficult because we don't always prefer to learn the truth about ourselves, and the things we most need to know are often the most difficult to hear. Anyone can develop effective reflective thinking skills with time and practice. Furthermore, as Fischer and Pruyne point out, reflective thinking is not a preordained ability that arises at a specific age or stage of development; rather, it is a skill that must be methodically developed like any other skill, in this case, via enhancing abstract systems thinking capacity. According to a study conducted by Stel (2011), the age of 15 years is a critical point in the development of metacognitive skills. The author further emphasizes that growth dominates the development of metacognitive abilities in kids aged 12 to 14, increasing both the frequency and quality of metacognitive skills. Post 14 years of age, the development of metacognitive skills can be fostered by the generalized application of these skills. As a result, students around the age of 15 will be able to transfer metacognitive skills learned in one task or domain to new tasks or domains with growing ease. Therefore, it is essential to guide students through reflective cues. A reflective cheat sheet is a pedagogical tool that consists of questions that encourage reflection among students after a high-impact experience. It can be used for secondary school students (classes- 9th to 12th) so that they can become reflective practitioners. **The pedagogical tool aims to foster secondary school students' analytical and critical thinking skills.**

As a guide to belief and behavior, critical thinking is an intellectually disciplined process of deliberately and skilfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, ob-

servation, experience, reflection, reasoning, or communication (Scriven and Paul, 1987). Halpern (1996) describes critical thinking as the use of those cognitive skills to increase the likelihood of the desired outcome. The author suggests that critical thinking that is purposeful, reasoned, and goal-directed - the type of thinking involved in solving problems, formulating inferences, calculating likelihoods, and making decisions - occurs when the thinker employs skills that are thoughtful and effective for the context and type of task at hand.

Besides, analytical thinking is defined as the capacity to recognize and characterize problems, extract crucial information from data, and build practical solutions for the problems discovered to test and verify the origin of the problem and develop solutions to resolve the problems identified (Chicago State University). Analytical thinking skills allow a person to make sense of new information by connecting it to previously acquired knowledge, as well as anticipate correlation and develop new knowledge.

Developing reflective thinking skills is important to promote critical and analytical thinking skills as it encourages the student to be a reflective partitioner who is highly aware of their experiences, their thought process, and strategies in a complex problem-solving situation. Reflective thinking allows students to take a step back and consider how they solved the problem in the past and how a certain set of problem-solving tactics might be used to achieve their goal in the future. Reflective thinking fosters self-awareness and self-confidence, which prompts students to take informed actions. Practicing reflection in the classroom will empower the students to self-regulate themselves during complicated situations because their brains will be trained to pause in the midst of chaos, disentangle and sort through observations and experiences, consider numerous possible interpretations, and generate meaning. Deliberately engaging students in the reflective process encourage them to practice objective, multi-perspective analysis that helps them make rational decisions. Reflective questions guide students in identifying various components of the experiences, organizing their thoughts and feelings, and therefore, it helps students make sense of their situation and extract relevant information from it. This way reflection can promote critical and analytical thinking in the students.

The theoretical background of the tool: On which theories is the tool based?

The reflective Cheat Sheet tool is based on the following theories and models.

Donald Schon's reflective practices theory (1983)

The notions of reflection-in-action and reflection-on-action were introduced by Donald Schon. Reflection-in-action, according to Schon (1983), allows for continuous interpretation, analysis, and reflective conversation with oneself about the situation while using information obtained from previous experienc-

es to inform and lead new actions. Reflection-on-action refers to reflection that takes place after an experience and encourages the learners to think about what they did, what they felt, what they could have done better, and what did they learn. The reflective cheat sheet comprises questions that motivate students to engage in reflection-on-action. Moreover, continuous use of reflective cheat sheets in the classrooms will develop students into reflective practitioners who are capable of reflection-in-action as well.

Gibbs Reflective cycle

The tool also has the components of Gibbs' Reflective Cycle. In 1988, Graham Gibbs developed the Gibbs' Reflective Cycle to help people learn from their experiences. The cycle offers a framework for understanding, analyzing, and examining the experiences. Gibb's reflective cycle contains six stages description, feelings, evaluation, analysis, conclusion, and action plan described briefly as follows:

1. Description of the experience.
2. Description of feelings and thoughts about the experience.
3. Evaluation of the experience, both good and bad.
4. Analysis to make sense of the situation.
5. Conclusion about what you learned and what you could have done differently.
6. Action plan for how you would deal with similar situations in the future, or general changes you might find appropriate.

The reflective cheat sheet tool accommodates the 6 stages of Gibbs Reflective cycle into three simple steps namely: Tactical [that entails a description of the experience and analysis of feeling and thoughts about it], Strategic [that encourages the learners to undertake an evaluation of their responses and actions during the activity], and takeaways [conclusion about what was learned about self and what can be done differently in the future].

Borton's Learning Cycle (1970)

According to Borton (1970), reflection has three elements that ask the practitioner: What, So what, and Now what. "What" is the element that describes the event, what you and others have been doing. The second component "So what" helps the learner make sense of what has happened in the situation you described and to consider what the learner learned from the experience. The "Now what" element prompts the learner to think about how they can improve their strategies in the future. The reflective cheat sheet caters to all the components of Borton's Learning Cycle.

Kolb's reflective model (1984)

Learning theorist David A. Kolb proposed a reflective model that emphasizes the concept of experimental learning and is focused on the transformation of data into knowledge. This entails four phases namely, Concrete Experience, Reflective Observation, Abstract Conceptualization, and Active Experimentation. The tool "Reflective Cheat Sheet" can be administered after a High-impact experience. The high-impact experience should be a concrete experience that the teacher should engage the students in. The teacher can use reflective cheat-sheet regularly in her classrooms so that students remain vigilant of their actions, thoughts, and feeling during all the learning experiences, and this will enable them to make reflective observations during and after the activity. The tool has the element of "Takeaways" that can be equated with the "Abstract Conceptualization" phase of Kolb's model. The teacher can engage students in the last stage of the model, i.e., "Active Experimentation" by consistently exposing them to high-impact experiences.

LITERATURE REVIEW

According to Colley, Bilics, and Lerch (2012), with today's multinational, multicultural, complex concerns, citizens must be able to filter through large amounts of various data to make educated and informed decisions. Therefore, higher education must focus on critical thinking skills a priority to give students the intellectual training they need to engage in this fast-paced environment. Moreover, according to the study conducted by the McKinsey Global Institute on the Indian labor market, soft skills - critical, analytical, and creative skills - will soon become a must in the Indian productive sectors (2018). Critical thinking as theorized by Scriven (1985) is "the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action." Colley, Bilics, and Lerch (2012) argue that critical thinking skills enable citizens to thrive and participate in this dynamic world. Nuraini, Cholifah, Mahanani, and Meidina (2020) claim that doing in-depth studies of scientific knowledge and conducting scientific studies to be able to adapt them to new scenarios will help train critical thinking skills and improve creative thinking skills.

Mälkki (2011) while exploring the challenges and prerequisites of reflection suggests that social influence and environment provide support to question one's assumptions and produce challenging viewpoints. The author further points out that in conditions where reflection is encouraged, the emotional risks of reflection are mitigated by a supportive social context that eliminates social dangers and gives emotional support for dealing with incompleteness. (as cited in Malkki, 2011). Malkki (2011) concludes that reflection teaches the learner to accept

their unpleasant feelings and detect in one's own thinking their tendency to orient interpretations in favor of maintaining the comfort zone.

Dewey (1933) proposed that practical occurrences that cause feelings of unease or bewilderment, as well as a sense of wonder and awe, might trigger reflective thinking. He asserted that reflective thinking was different from everyday routine thinking, and especially from impulsive thinking. He proposed that routine thinking (and any subsequent actions) resulted from an individual's automatic conformity to rules originating from authority or tradition (Dewey, 1933). In contrast, reflective thinking resulted in an 'intelligent action' (Calderhead, 1989), because in reflective thinking, the practitioner has engaged in rationally analyzing the issue and gone through stages of doubt and uncertainty while working toward a solution. Dewey (1933) defined reflection as persistent, reasoned thinking that was guided by the goal in mind. Additionally, Nuraini, Cholifah, Mahanani, and Meidina (2020) assert that reflective thinking allows the thinker to take a step back and consider the best technique for reaching a goal, which stimulates the thinker in problem-solving situations. The authors while citing Sabandar (2013) state that the ability to think reflective includes the ability to think critically and think creatively as well as other thinking skills. The authors propose that the ability to think reflectively accounts for half of the problem-solving process.

Rüütmann (2019) described "reflection as a universal mechanism for self-development and self-changing as a part of students' learning process and development." The author emphasized that the teacher should create conditions for the development of student reflection. Collaborative group work, muddy cards, peer instruction, reflection quizzes, visual diagrams, student-led recitations, project-based learning, simulations, case studies, journals and portfolios, problem-based learning, a compilation of test questions, and the INSERT Method are among the activities that teachers can do with their students to foster their reflective and creative thinking skills. To assist students to become significantly better at creative and critical thinking than they were at the beginning of the course, teachers should convey to them the examples of the kind of thinking teachers have in mind; assign students tasks and assignments that require that kind of thinking; give them feedback; and repeat (Brent and Felder, 2014). Teachers can promote reflection in students in both online and offline contexts. Through their research, Yilmaz and Kesar (2016) prove that reflective thinking activities can also be carried out during e-learning. They discovered that using podcasts in conjunction with reflecting activities was more effective in assuring post-test success and motivation than other ways. Xiao, Clark, Rosson, Carroll, and John (2008) claims that promoting reflexivity or helping students think about how they approach challenges and how they seek and find solutions, is critical. Their study reveals that engaging learners in the process of documenting decision rationales helped them clarify and articulate their thoughts and

ideas, effectively explore the course concepts, and participate in higher-order thinking.

Jha and Shah (2018) describe the main components of reflective thinking as 1. Experiencing something, 2. Thinking about what happened, and 3. Learning from our experience. The authors emphasize that reflective thinking aids in identifying the areas for change and improvement, developing a questioning mindset and fresh views, effectively responding to new difficulties, applying knowledge of what they have learned, and generalizing and thinking in new ways.

Overall, reflection can be seen as a process of looking back at an experience and learning from it. Reflective thinking is a very important skill that helps individuals make rational decisions about their choices and actions in this dynamic and chaotic world. Encouraging students to think reflectively enhances their critical, creative, and analytical thinking skills. An emotionally safe, non-judgmental learning environment that provides meaningful experiences is a prerequisite to engaging students in the process of reflection.

EXPLANATION OF THE TOOL: HOW IS THE TOOL?

A reflective cheat sheet is a pedagogical tool that will scaffold the learning of reflective thinking skills for students. The tool can be administered after a high-impact activity to help the learners consolidate their learnings from the activity.

The tool has three components namely:

1. **Tactical**: This is the first element of the reflective cheat sheet. The questions under this category encourage the learner to identify a moment in the High-impact activity that created feelings of disquiet or confusion or by a sense of wonder and awe in them. The questions that can be asked under this component are:
   - Identify something you experienced or observed during the activity that surprised/shocked/baffled you?
   - What happened [respondent's observations about the event]?
   - What did this incident result in?
   - Why did it happen?
2. **Strategic**: This component of the reflective cheat sheet prompts the learners to analyze the causes of the incident that they identified in the tactical component of the tool. The questions that can be asked in this part are:
   - What actions [of the learner and other participants] explain the causes and effects of the incident?
   - What change in the actions [of the learner and other participants] would have prevented the incident from happening?

3. **Takeaways**: This element of the reflective cheat sheet encourages the learner to identify their learning from the experience. This also prompts them to think about ways in which they can apply their learning to the new experience. The questions that can be asked in this part are:
   - What kind of improvement do you see in yourself after the activity?
   - Have any of your previous beliefs about this issue changed?
   - What did you learn from the incident?
   - How will you apply your learning to other such situations?

Note: These questions are listed only for suggestive purposes and the teacher can change the questions in each category depending on the experience they expose their students to.

Expected outcome of the tool: Students engage in introspection & reflection on their behavior, attitude & action during High Impact Activity.

Allocated time: Two Sessions (First for High impact activity and Second for Reflection).

Setting, place layout: The teacher can select two different places for the tool administration. The first place can be selected based on its appropriacy to carry out a high-impact activity. The second place can be any space that is peaceful and where students will feel safe to introspect.

Necessary materials: High impact activity, Reflective cheat sheet, Student and Teacher.

Number of Participants: The teacher can independently conduct and observe a high-impact activity of 20 teens and thereafter administer the reflective cheat sheet. The teacher can also include a supporting teacher and extend the number of students in a high-impact activity to 40 teens.

Steps of the implementation:

The tool can be administered in three steps namely: 1. Orienting the students about the goal of the activity, 2. Exposing students to the high-impact activity and 3. Encouraging students in the process of reflection using the reflective cheat sheet.

1. **Orienting the students about the goal of the activity**:

   In this step the teacher can talk to students about:
   - What activity are the students going to participate in?
   - Why are they participating in the said activity?
   - What does the teacher expect from the students during and after the activity?
   - What points should the students consider while engaging in the activity?

- What is reflection?
- Give examples of reflective thinking by demonstrating it?
- Explain the tool reflective cheat sheet?

2. **Exposing the students to a high-impact activity:**

   A high-impact learning activity is a hands-on experience in which students are encouraged to apply their higher-order thinking skills. A high-impact activity should encourage the student to brainstorm, strategize and execute their plan. Some of the high impact activities that the teacher can organize for the students are:

   a. **Classroom Discussions**

      Classroom Discussions help students understand, articulate, and inspect their understanding of various concepts and think about how they can apply those concepts in solving the problems of the day-to-day life. Discussions help the students to broaden their thinking abilities and engaged them in reasoned argumentation and rebuttal. Through discussion, many skills, and qualities like assertiveness, listening skills, and interpersonal skills can be improved.

   b. **Role Plays**

      Role plays expose students to situations that they might not experience in daily life and hence engages them in multi-perspective and abstract thinking. Roleplay also facilitates the practicing the skills and provides a better understanding for handling real-life problems.

   c. **Group tasks**

      When the number of students is high and time is limited, groups are helpful for better results. It facilitates the interpersonal skills of the students and learns how to work as a team through effective communication and understanding. It is also helpful for developing empathy.

   d. **Games and Simulation**

      Games are the favorite learning activities of most students irrespective of age. Games demands skills like interpersonal communication, teamwork, planning, etc. It provides a safe and stress-free classroom atmosphere and facilitates the practicing of many skills.

   e. **Situation analysis tasks and Case studies**

      Situation analyzing and case studies give students an opportunity of indulging in problem identification, segmentation, analysis, and solution generation. Engaging in such activities helps develop students' interpersonal skills, communication skills, analytical and critical thinking skills, and problem-solving skills.

f. **Story Telling**

Storytelling helps children to develop creative and critical thinking. It allows them to draw analogies with real-life situations. It also enhances the skills such as listening skills, attention, and endurance.

g. **Debates**

Debates can be organized in class to encourage students to pursue a thorough engagement with the topic. Debates help foster skills such as assertiveness, communication skills, listening skills, critical thinking, empathy, and tolerance.

During these activities, the teacher can act as a moderator and facilitator while making student observations to analyze their strategies and activity as a whole.

3. **Engaging students in the reflection process: How are the students engaged in the reflective process?**

The teacher can administer the reflective cheat sheet immediately after the activity or can decide to give students time to process their experience by giving them an incubation time of at most 2 days. Before, administering the tool, the teacher can orient students about why the tool is being used and that their responses will not be judged as right or wrong. The teacher can then distribute the reflective cheat sheet to the students and give them 30-50 mins to fill it out. The time allocated for filling the reflective cheat sheet will correlate to the intensity of the high-impact activity.

While the students are filling out the reflective cheat sheet, the teacher can observe the class and see if any students seem to have a problem. The teacher can then help students understand the questions asked better.

A specimen of the reflective cheat sheet is illustrated below. The teacher can pick questions from the specimen to include in their reflective cheat sheet or draft a completely different reflective cheat sheet.

	Question	**Your response**
1	1. Identify something you experienced or observed that *surprised you* during the experience. 2. What about the process or the completed product was particularly fulfilling/satisfying to you? 3. What was/is frustrating about it for you?	

2	1. What happened? What did you observe? Be specific. 2. What did you learn about yourself as you worked on this piece? 3. What difficulties did you face while working on this piece? What method did you use to solve them?	
3	1. What were the results? 2. What were your expectations for this project/activity? 3. Did you live up to your expectations? 4. If you were the teacher, what comments would you make about your performance/piece?	
4	1. What conclusions did you reach? 2. One thing/area I would like to improve is ..... 3. What's the one aspect in your classmates' work or process that you would like to try in your next piece?	
5	1. Why did the results work out this way? 2. What are things you might want more help with?	
6	1. What are the strategic elements (principles or theoretical framework) that explain your results? 2. What process did you go through to produce this piece?	
7	1. What is the lesson(s) learned from your reflection? How will these transfer into new situations or real-life challenges? 2. How much did you know about the subject before we started? 3. What kind of improvement do you see in yourself? 4. Have you changed any ideas you used to have on this subject?	

Adapted from "Reflect on a High-Impact Experience: Moving from Specific to General" by Cindy Raisor. Retrived from https://docs.google.com/document/d/1Wxbjp_hEfUCyiUy2QKqLY25gy4ps-9DtbrLTvCnW2TeY/edit

ROLE OF STUDENTS & TEACHERS

Role of Teachers:

In the reflection process teachers' and students' role is most important. During classroom transactions, for better learning, the teacher has the role of:

1. Orienting students about the aim of activity being conducted.
2. Designing high-impact experiences that engage students in brainstorming, production of ideas, articulation of ideas, argumentation, refutation & consolidation. These high-impact experiences can be anyone out of the ones described above.
3. Moreover, as part of pre-instruction planning, teachers should prepare and provide a rubric to the students. The rubric should be framed according to the learning objective of the high-impact activity and reflection. This will enable teachers to facilitate the learning of the students in the way they want.
4. During the high-impact activity, teachers' role is facilitation and continuous monitoring.
5. During reflection activity, the teacher's role is to encourage students to express views and ideas clearly. The teacher also should provide clarification to the students if any question of the reflective cheat sheet is unclear.
6. After the reflection activity teacher's role is to provide qualitative feedback to students on their performance on the high-impact activity and how can they make their reflection better.

Role of Students:

The pedagogical tool "Reflective cheat sheet" allows students to see the importance of their own learning process. Students can learn about how they react to situations, what they did well, where they failed, where they need improvement, what they want to learn more, what they would change if given another opportunity, and what change do they see in themselves after the activity. Students' role in this tool is of an objective observer, a rational critique, and an active participant. Before the activity, students should go through the rubric for the activity provided by the teacher to give higher selective attention to some aspects of the high-impact activity over others. During the activity, students need to be self-aware of their feelings, emotions, responses, and actions. This will help them reflect after the high-impact activity. During the reflective process, students should try to articulate their thoughts coherently and clearly. Students can and should seek the support of the teacher whenever they are doubtful about any aspect of the activity.

CONCLUSION

Reflection is a meaning-making process that allows a student to move from one experience to the next with a better knowledge of how it connects to and interacts with other concepts and experiences. Reflective thinking skills are one of the most important skills in the present world. With information overload, misinformation, disinformation, and new information being generated every day, it is essential for all individuals to make rational choices. Reflective Cheat Sheet is used as a pedagogical tool that helps the learners become self-aware and fosters their analytical, creative, and critical thinking skills. The tool can be used in any context – online or offline – and can be modified as per the level of the learner. The tool helps the students become life-long learners who imbibe best from each experience.

REFERENCES

Baron, J. (1981). Reflective thinking as a goal of education. *Intelligence, 5*(4), 291–309. https://doi.org/10.1016/0160-2896(81)90021-0

Borton, T. (1970). Reach, touch, and teach: Student concerns and process education. McGraw-Hill.

Chicago State University, URL: https://www.csu.edu/humanresources/empdev/documents/AnalyticalThinking.pdf

Colley, B. M., Bilics, A. R., & Lerch, C. M. (2012). Reflection: A Key Component to Thinking Critically. The Canadian Journal for the Scholarship of Teaching and Learning, 3(1). https://doi.org/10.5206/cjsotl-rcacea.2012.1.2

Dewey, J. (1933). How We Think: A Restatement of the Relation of Reflective Thinking to the Educative Process. Boston, MA: D.C. Heath & Co Publishers.

Fischer, K. W., & Pruyne, E. (2003). Reflective thinking in adulthood: Emergence, development, and variation. In J. Demick & C. Andreoletti (Eds.), *Handbook of adult development* (pp. 169–198). Kluwer Academic/Plenum Publishers. https://doi.org/10.1007/978-1-4615-0617-1_10

Gibbs, G. (1998) Learning by Doing: A Guide to Teaching and Learning Methods. Oxford Brooks University, Oxford.

Halpern, D. F. (2014). *Thought and knowledge: An introduction to critical thinking* (5th ed.). Psychology Press.

Jha, N. & Shahm M. (2018). Reflective Thinking: An Insight. International Journal of Research and Analytical Reviews, 5 (2). http://ijrar.com/upload_issue/ijrar_issue_956.pdf

Karaoğlan Yılmaz, Fatma Gizem & Keser, Hafize. (2016). The Impact of Reflective Thinking Activities in E-Learning: A Critical Review of the Empirical Research. Computers & Education. 95. 10.1016/j.compedu.2016.01.006.

Kolb, D. A. (1984). Experiential learning: Experience as the source of learning and development. Englewood Cliffs, N.J: Prentice-Hall.

Nielsen, A., Stragnell, S., & Jester, P. (2007). Guide for reflection using the clinical judgment model. The Journal of nursing education, 46(11), 513–516. https://doi.org/10.3928/01484834-20071101-06.

Nuraini, Ni & Cholifah, Puri & Mahanani, Putri & Meidina, Andini. (2020). Critical Thinking and Reflective Thinking Skills in Elementary School Learning. 10.2991/assehr.k.201112.001.

Raisor C. (2020). Reflect on a High-Impact Experience: Moving from Specific to General.Retrived from https://docs.google.com/document/d/1Wxbjp_hEfUCyiUy-2QKqLY25gy4ps9DtbrLTvCnW2TeY/edit

Ruutmann, Tiia. (2019). Development of Critical Thinking and Reflection. 10.1007/978-3-030-11935-5_85.

Schon, D. (1983) The Reflective Practitioner: How Professionals Think in Action. New York: Basic Books.

Scriven, M. (1987). Critical for survival. National Forum, 55, 9-12. doi:10.22329/il.v9i2.2665

Sellars M. (2017). Reflective Practice for Teachers (2nd Ed.). SAGE Publications Ltd.

Stel, M. van der. (2011, October 6). Development of metacognitive skills in young adolescents : a bumpy ride to the high road. Retrieved from https://hdl.handle.net/1887/17910

Weil, L. G., Fleming, S. M., Dumontheil, I., Kilford, E. J., Weil, R. S., Rees, G., Dolan, R. J., & Blakemore, S. J. (2013). The development of metacognitive ability in adolescence. Consciousness and cognition, 22(1), 264–271. https://doi.org/10.1016/j.concog.2013.01.004

Xiao, Lu & Clark, Shawn & Rosson, Mary Beth & Carroll, John. (2008). Promoting Reflective Thinking in Collaborative Learning Activities. 709-711. 10.1109/ICALT.2008.280.

https://libguides.hull.ac.uk/reflectivewriting

https://www.franklin.edu/institute/blog/critical-reflection-more-just-looking-mirror

https://ritchiediopita.wordpress.com/2016/03/16/journal-3-critical-reflection/#:~:text=Critical%20reflection%20occurs%20when%20we%20analyze%20and%20challenge,and%20beliefs%20given%20our%20present%20contexts%20%28Mezirow%2C%201990%29.

https://web.iitd.ac.in/~nkurur/2015-16/IIsem/cml522/CriticalThinking.pdf

Chapter 19

TEAL (Technology Enhanced Active Learning) for STEAM, humanities and CLIL

Letizia Cinganotto

INTRODUCTION: ORIGINS OF TEAL

TEAL was born in the USA, related to Physics teaching, and first developed by North Caroline State University. Soon after, it was adopted and implemented by the Massachusetts Institute of Technology (MIT), in particular by prof. Peter Dourmashkin and his colleagues. This model was created with the aim of overcoming some of the weaknesses identified in the Physics curriculum, improving student academic achievement, and attracting the girls to the STEAM. In fact, the students attending Physics courses were mainly male.

The innovation managed to combine and integrate traditional pedagogy with active learning at MIT, facilitating the co-construction of knowledge and the development of active learning. Learning test results from recent years have shown that students learn and perform better in Physics thanks to the TEAL methodology (Dori & Belcher, 2005; Dori et al., 2007). The drop-out rate decreased from 20% to 5%. The effectiveness of the TEAL methodology was reported by the students with reference to the following dimensions: collaborative learning, peer and teacher support, organizational renewal, innovative learning environment, use of the "clicker" technology.

Teaching has become more interactive and focused on helping students learn concepts rather than on the delivery of content; teachers and students have acquired a higher level of awareness in the use of classroom technologies such as "clickers" and the associated methodology of peer instruction (Cinganotto et al. 2016).

EXPLANATION OF THE TOOL

TEAL methodology combines lectures, simulations and workshops with digital tools and different devices for an active learning experience, based on both individual and collaborative tasks. The methodology calls for ICT and physical

spaces to be closely interlinked: in fact, it requires basic technological equipment to be used in spaces with specific characteristics and equipped with flexible, versatile, easily arranged furniture. The furniture layout includes a teacher's desk usually located in the middle of the classroom, round tables as work-islands, IWBs, and as many projection points (or whiteboards) as the number of work-islands. Students are divided into groups usually consisting of 3 or 5 students: the odd number is important to avoid situations where decisions are difficult to make, and the members are required to vote.

The picture below shows the TEAL room at MIT.

Figure 1 - The TEAL room at MIT

The teacher introduces the topic to be studied through a "concept question", which is a problem or situation to be solved or discussed with the aim of finding possible solutions in groups.

The TEAL cycle starts with a poll or quiz launched by the teacher through the so-called "clicker" technology, a webapp such as Mentimeter, Kahoot, Quizlet, Socrative or similar, allowing students to respond immediately, just by following their intuition. The results of the poll will be shown on the IWB and will be displayed until the end of the cycle.

Each group will then work on the theme given in a collaborative and active way with the help of devices to select and gather information and data, and also carrying out experiments and tests, if needed. Finally, the results from the work assigned will be shown by each group to the rest of the class in order to

get peer feedback from classmates and the teacher's feedback. The final product, to be presented together with the storytelling of the process and the dynamics of the group during the work, can take the shape of an artifact (paper or digital), a ppt presentation or even more advanced technological solutions, such as a blog, a website, etc.

The main pillars of TEAL can be summarized as follows:

- Problem posing/solving to develop critical thinking skills,
- Cooperative learning and discovery learning in small groups or in pairs,
- Peer tutoring and Peer learning,
- Learning by hands-on experiments to develop active involvement in the learning process,
- Inductive methods: from the observation and the practice to the conceptual frame,
- Concept questions with individual reflection, peer discussion, corrective feedback from the teacher,
- Challenge-based learning: launching challenges to the students through a gamification process,
- Project-based learning: working with the aim to produce a project through artifacts (video, tutorial etc.),
- Experimentations, visualizations, simulations,
- Task-based learning: activities assigned according to specific tasks,
- Interactive presentations and OER (Open Educational Resources).

The TEAL cycle is made up of four steps:

1. *Activation*: this step consists of providing students with a theme, an issue that captures their curiosity, directs their interest, and motivates them to undertake an activity (this means activating student engagement). This is the "problem-posing" phase.
2. *Production*: the activity carried out in class, which allows students to respond to the challenge and teachers to implement active teaching according to the different subject areas: presenting and analyzing a case, carrying out a project, conducting an investigation, solving a problem. These activities prompt students to activate their thinking processes. In this phase, the teacher will take the role of a coach or tutor, observing the students in action, taking notes, using grids, and supporting each student according to their specific needs.
3. *Elaboration*: the phase of elaboration, or rather, re-elaboration, is a collective process of reflection and comparison of what has been learned. The

objective is to clarify, make explicit, and consolidate learning. In this phase, evaluation seems to be less important, but on the contrary, it is a transversal dimension as a continuous and formative practice. Therefore, assessment will involve observation and annotation of the students' activities in context, focusing on individual and group evaluation, self, and peer evaluation, as well as more traditional assessment learning tools.

4. *Closure:* an important phase of the lesson where the teacher will collect feedback, comment on it, and provide a brief explanation which will build a bridge to the next TEAL lesson.

   During this step, the teacher will go back to the initial poll and ask the students to compare their answers with the ones they would provide at the end of the cycle, after investigating, discussing, and acquiring new skills and knowledge. This step is crucial to activate reflection and meta-cognition, and to reach deeper learning.

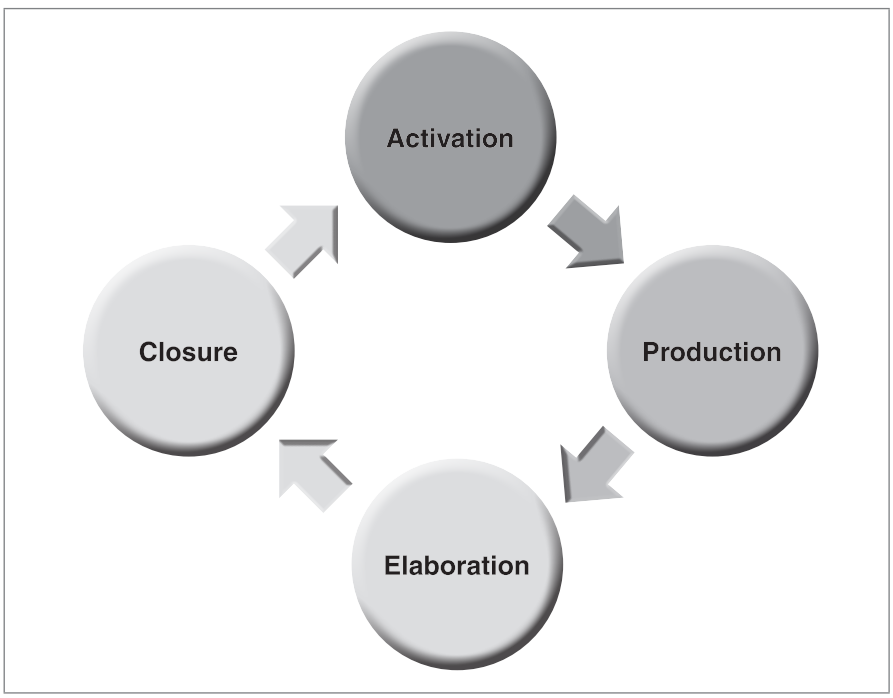


Figure 2 - The TEAL cycle

As already mentioned, the TEAL methodology employs a wide variety of organizational and instructional techniques and solutions, including interactive group work, the setting of work- islands with round tables and tablets for each group member, and the use of projection points for each work-island, etc. A

fundamental pillar of the TEAL methodology is the use of two-or-three-dimensional visualizations and simulations in digital and virtual environments, with the aim of facilitating the understanding of complex concepts, diagrams and graphs, and the study of phenomena, reactions, and events in real time and in a natural dimension. Therefore, in a TEAL STEAM class, the use of websites such as Phet Simulations or Labster is particularly effective, as the students are guided to work in a virtual laboratory, where they can interact, change chemical elements and observe what happens, comment and report on experiments, reactions, etc. This is particularly powerful in terms of deeper learning, as students are led to look at the world from the eyes of a scientist.

Group learning and individual learning are intertwined in the TEAL model based on the principles of peer tutoring, peer instruction, and reciprocal teaching. In particular, with regard to tutoring and peer learning, some elements are crucial, such as positive interdependence (Deutsch, 1968) (in cooperation) and negative interdependence (in competition); cognitive conflict (Piaget, 1926), allowing to re-organize one's own knowledge and view, and taking on someone else's perspective; the zone of proximal development and scaffolding (Vygotsky, 1978), which allows students to be individually helped and supported by the teacher, if necessary.

ASSESSMENT

As already mentioned, assessment is a transversal dimension in TEAL, especially formative assessment, and self-assessment, based on the use of learning journals, diaries, observation grids. These tools are important both for students and teachers, aiming at continuous and progressive improvement and at developing meta-cognition and meta-reflection.

An important dimension of TEAL is feedback, which, according to Hattie (2012), must be clear, connected to students' pre-knowledge, linked to meta-cognitive aspects, in relation to intentional learning and academic success criteria; it should also be just in time and should provide clear and useful indications to the students in order to elicit self-correction and continuous improvement, activating their self-regulation strategies. It is also important to pay attention to motivational and inclusive dynamics, considering socio-emotional learning (SEL).

A common protocol used to elicit peer feedback is the "ladder of feedback" (Fig. 3), from Project Zero, Harvard Graduate School of Education, which helps the teacher to guide a fruitful discussion among the students, leading them to actively listen to the presentation of the different groups. A speaker appointed from each group will generally present the product and at the same time the process, the dynamics, and the learning pathway. The classmates will have to note down possible clarifying questions, possible strengths and weaknesses and

will provide suggestions for alternative solutions or improvement. Each step will take a certain time, as also time awareness needs to be taken into account.

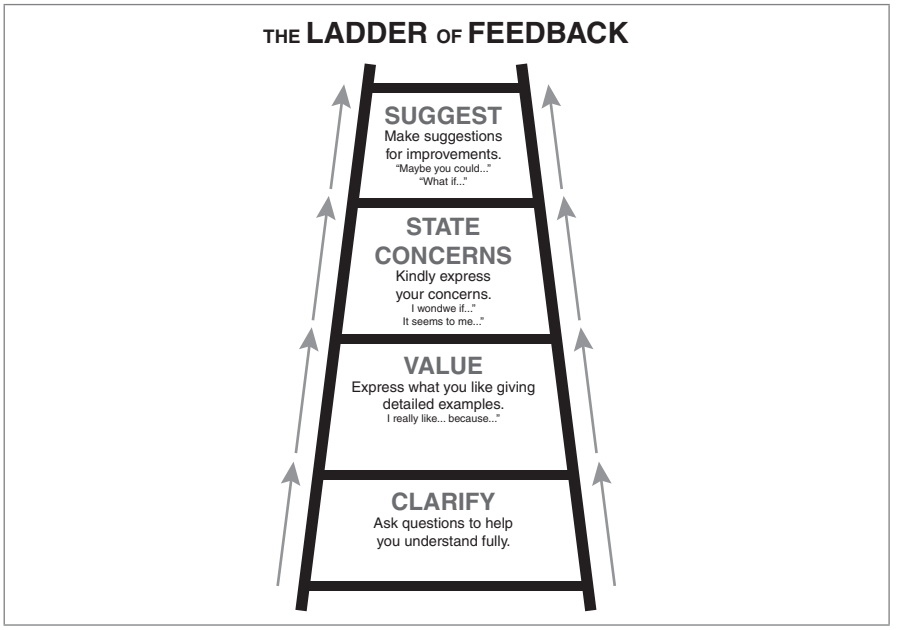


Figure 3 - The ladder of feedback

THE STUDENTS' ROLES IN TEAL

One of the important aspects of TEAL is the distribution of the roles among the different students.

The graph below includes possible roles in a TEAL cycle:

- *Technician*, dealing with the use of the tablet or other devices for finding information, resources, and data to be included in the presentation,
- *Presenter*, who will present the product to the classmates and to the teacher, also highlighting the process and the results,
- *Documenter,* who will take notes about the learning experience through a blog or a learning diary,
- *Critical friend*, who will pose questions and doubts and will call for the teacher if needed,
- *Secretary,* assigning roles, checking that everybody is active and important for the group and for the achievement of the results.

The above-mentioned roles are only some examples, but the teacher's creativity can make the difference and invent other possible roles. The students

themselves may think of other roles and any student can be responsible for a task which is in line with his/her own preferences and learning style.

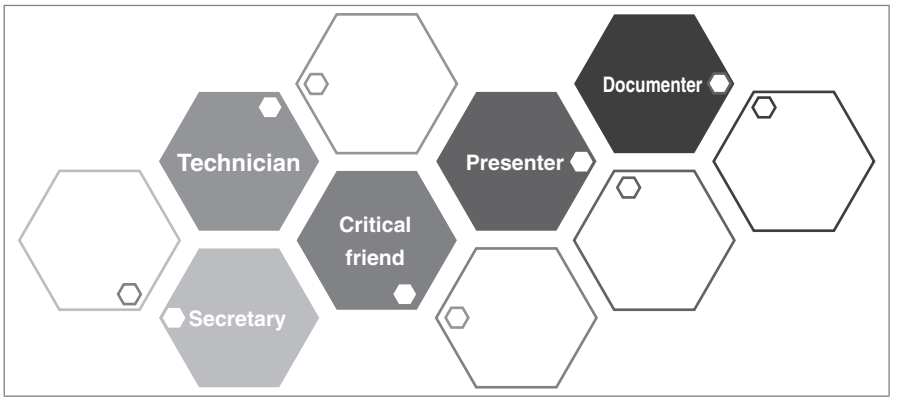


Figure 4 - Possible roles in TEAL

BLENDED TEAL

In recent years, even before the COVID-19 pandemic, the TEAL model has embraced more and more blended forms of teaching and learning, in order to make the model increasingly flexible and granular. In particular, a new way of designing activities was emerging, based on learning sequences, specifically:

- pre-learning sequence;
- video-lecture;
- post-learning sequence.

A key role is represented by the "lightboard video-lecture", a particular type of video-lecture realized through a specific technique, called "lightboard studio"[1]: the teacher, while illustrating the concepts or contents of a lesson, accompanies the explanation with drawings, graphs or maps made on a transparent blackboard, and in doing so s/he makes the training episode captivating and engaging (Figure 5). The lightboard studio uses a very innovative software, with a glass board to write on with colored markers without the mirror effect of the webcam: the result is a multimedia product with a strong cognitive and emotional impact, which is very close to the videos made by the famous Khan Academy[2] platform. The goal of Dourmashkin, who has already made many of his video lectures available for free on the MIT platform, is to create a vast digital library of

1. https://lightboard.info
2. https://en.khanacademy.org/

videos and other study materials, such as problems, concept questions, simulations. These materials can be useful from a flipped learning perspective, assigning the videos to the students in the pre-class phase, or in other cases as a follow-up activity, with the aim of making in-class activities more effective and productive.

Blended TEAL can be implemented in any educational scenarios, face-to-face, hybrid, blended, especially considering the unprecedented times of the COVID-19 pandemic, from which educators learned the need to provide "hyflex" models of instruction.

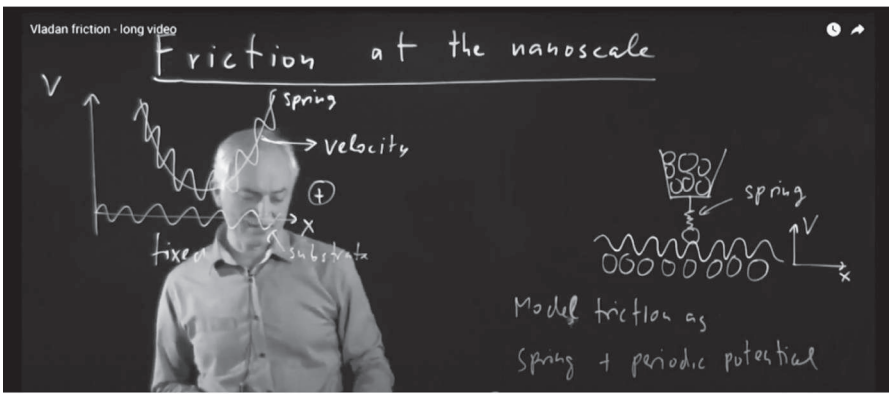


Figure 5 - The lightboard studio[3]

TEAL IN ITALY

TEAL[4] is one of the innovative ideas of the Gallery of the "Educational Avant-Gard[5]", a movement founded by INDIRE (Italian Institute for Documentation, Innovation, Educational Research) in 2014, which at the present collects more than 1300 schools all over Italy. The movement aims at circulating innovation among Italian schools, considering the different dimensions of the school model: organization, methodologies, learning environments, setting, schedule. It is a holistic perspective, aiming at rethinking and reshaping the traditional old-fashioned top-down lecture-based model.

3. "Lightboard videos in Physics": Dourmashkin's lecture available at the following link: https://www.youtube.com/watch?v=s_ipgnRQUiE
4. https://pheegaro.indire.it/uploads/attachments/2462.pdf
5. https://innovazione.indire.it/avanguardieeducative/teal

TEAL has been widely adopted by Italian schools both for STEAM and humanities, learning from Peter Doumarshkin, who has visited different Italian schools and ran seminars, lectures, interviews[6].

Italian teachers particularly appreciated the wide and differentiated use of technologies (mobile devices, projectors for group work, etc.). Flexibility is the key word they particularly liked from Dourmashkin's presentations, as it allows for the adjustment of setting, material, equipment and learning environment according to the specific needs and goals of each school. Among the teaching and learning strategies adopted in a TEAL class, the emphasis on the implementation of challenging and motivating tasks, involving the use of technology with the constant monitoring by the teacher observing and documenting the learning process, has turned out to be particularly powerful and effective.

In Italy, some schools have adopted TEAL as an integral part of the curriculum, with particular reference to STEM disciplines, but recently also in the humanities (especially history and philosophy), as well as in English, in CLIL (Content and Language Integrated Learning) mode. This has been a remarkable effort, as the adoption of the TEAL model in Italy represents a switch from the academic context, where the model was created at MIT, to the school context: upper secondary school first and lower secondary school in recent years.

TEAL FOR CLIL

TEAL is particularly effective when applied in a foreign language in CLIL mode (Cinganotto, 2016; 2018; 2021), a dynamic and interactive approach that makes use of a wide range of teaching techniques and strategies aimed at placing the student at the center of the learning journey, especially through manipulative and laboratory activities, such as those provided by the TEAL model. In TEAL CLIL, students, generally divided into groups, are asked to collaborate in the search for a solution to a problem posed by the teacher. In this phase they can interact in the foreign language, search for information, data, and authoritative sources on the Internet, through a tablet, or other mobile devices. Then, they can discuss and share the hypothesized solutions within the group and with the teacher through the single point of projection of the group and later with the entire class. Final in-class negotiation and discussion will lead to the presentation of the best solutions validated by the teacher. Oral interaction, simulations, experimentations, and group discussions in a foreign language within a TEAL environment can contribute to the implementation of a high quality CLIL path for both humanities and STEM and many Italian schools are already experimenting this way with success. The great flexibility of the TEAL model,

6. An interview to Peter Dourmashkin by the author of this chapter is available here: https://www.youtube.com/watch?v=Cga6n00K38o

the role of the teacher as a coach, the extensive use of technologies, the innovative arrangement of the learning environment, and the furniture, make TEAL a very powerful solution with a great impact on learning outcomes, regardless of the discipline to be conveyed through CLIL.

Collaborative processes, brainstorming, research, peer teaching, and group learning are among the pillars of CLIL methodology, which fosters active learning intertwining subject content and language competence. That is why TEAL can effectively enhance CLIL, especially when using immersive and virtual environments, where students will be asked to use the foreign language for authentic and meaningful tasks.

A recent development of CLIL is represented by the PTDL model[7] (Pluriliteracies Teaching for Deeper Learning) (Coyle, Meyer, 2021; Cinganotto, Cuccurullo, 2019), promoted by the European Centre of Modern Languages in Graz (ECML)[8], which is based on the importance to promote the vast range of literacies (or "pluriliteracies") needed by the 21st century students, among which the subject-specific literacies, and taking into account genre, style, register of a specific subject. Among the aims of the model, there is the importance of guiding the students to examine and investigate the world through the eyes of a scientist, a historian, a mathematician, etc. This is exactly in line with TEAL goals and methods.

TEAL CLIL is often implemented in the Italian classes not only for STEAM or humanities, but also for civics, dealing with SDGs related issue, Constitutions, or digital citizenship, which are the three pillars of civics, recently introduced in the Italian school curricula as a transversal and cross-curricular topic.

CONCLUSION

TEAL methodology could be easily introduced into Indian school curricula, especially at upper secondary school level, adopting the typical TEAL cycle (Activation, Production, Elaboration, Closure) in any subject, both STEAM and humanities. Individual learning, peer teaching, and group learning can activate socialization among the students, and foster critical thinking skills and creativity in the elaboration and presentation of the work and the artifact produced. The use of learning technologies will be an added value to any subject teaching, even if it is not necessary to have a highly advanced and fully equipped TEAL room. A possible adjustment can be made to the furniture and to the infrastructure, according to the specific context ("Easy TEAL").

Active and interactive methodologies which represent the core of the TEAL model will help Indian teachers rethink and reshape their teaching strategies and

7. The author is a member of the consultancy team of the PTDL project.

8. https://pluriliteracies.ecml.at/

style, by encouraging the students' active participation and responsibility in the choice of resources, information, media, and type of artifact to be presented to the classmates and to the teacher. Each student's positive interdependence within the group will help promote personalization and individualization of the learning pathways, without leaving any students out.

Considering the flexibility of the TEAL model, it can really represent an added value to Indian educational scenarios of the future.

REFERENCES

Cinganotto L. (2016). CLIL in Italy: A general overview. In Latin American Journal of Content and Language Integrated Learning, 9 [2], pp. 374-400.

Cinganotto L. (2018). Apprendimento CLIL e interazione in classe, Aracne.

Cinganotto L. (2021). CLIL & Innovazione, Pearson.

Cinganotto L. Cuccurullo D. (2019). Rethinking literacy in the 21st century: A pluriliteracies approach to CLIL. In Lublin Studies in Modern Languages and Literature, [S.l.], v. 43, n. 3, pp. 3-11, nov. 2019.

Cinganotto, L., Panzavolta, S., Garista, P., Guasti, L., & Dourmashkin, P. (2016). TEAL as an innovative teaching model Insights from "Educational Avant-Garde" Movement in Italy. In Journal of E-Learning and Knowledge Society, 12(2).

Coyle D., Meyer O. (2021). PTDL – Pluriliteracies Teaching for Deeper Learning, Cambridge University Press.

Deutsch M. (1968). Field theory in social psychology. In Lindzey G., Aronson E. (Eds.), The handbook of social psychology (Vol. 1, 2nd ed., pp. 412–487), Reading, MA: Addison-Wesley.

Dori Y.J., Belcher J. (2005). How does Technology-Enabled Active Learning Affect Undergraduate Students' understanding of electromagnetism concepts? In The Journal of the Learning Sciences, 14 (2), pp. 243-279, 2005.

Dori Y.J., Hult, E., Breslow, L., Belcher J.W. (2007). How Much Have They Retained? Making Unseen Concepts Seen in a Freshman Electromagnetism Course at MIT, Journal of Science Education and Technology, Vol. 16, No. 4, August 2007.

Hattie J. (2012). Visible learning for teachers: maximizing impact on learning, Routledge.

Piaget J. (1926). The Language and Thought of the Child, Routledge & Kegan.

Vygotsky L.S. (1978). Mind in society: The development of higher psychological processes, Harvard University Press.

Chapter 20

Becoming an Innovation Coach

Essi Silvennoinen & Graham Burns

Pedagogical change will start from and by teachers and the teachers are the real change makers. The fourth industrial revolution requires co-learning, co-creating, and reflecting skills from teachers before they can coach students to do the same. Deep learning exists only when it's adapted into experience (Kolb 1984; Kouzes & Posner 2008, 2018; Lombardo et. al 1996, Ruhalahti 2019). Team based learning (Katzenbach & Smith 2001, 2015, Kouzes & Posner 2018, Wenger 2000) and experimental learning theories (Kolb 1994, Wenger et. al. 2002) are stating the need for shared vision and understanding before pedagogical change is possible. That is the reason why our training for teachers is utilizing the tools from peer-to-peer learning, collaborative working and pedagogical decision making in teams. 70% of learning exits when it's adapted into experience (Lombardo et. al 1996, Sjöblom et.al 2019, Heikkinen et. al. 2012).

As the fourth industrial revolution gathers pace, workforces around the world are facing an ever-increasing number of new challenges. Globally, it is understood that employers need workers with different skills because of emerging and developing technologies. This requirement will increase exponentially in the future with further advances in AI and robotics, for example. Entrepreneurial skills are seen as being the core of this requirement, but they need the right environment in which to develop. These new skills are often referred to as so-called 21st century skills; the ability to apply critical thinking to texts and the ability to apply a creative approach to problem-solving through collaboration.

INTRODUCTION

The Teacher to Innovation Coach Programme concentrates on the idea of shared responsibility within the framework outcome-driven tasks and is designed to develop one's professional skills. The learning process can be greater, in terms of effort, than the outcome as it involves continuous discussion and guided feedback cycles. Developing one's teaching and learning skills in this way involves using innovative methods such as flipped learning, dialogical interaction, and peer learning to enable a deeper understanding of the required knowledge. In

turn, this allows teachers to apply new knowledge and skills more effectively. The ideas contained within the *Teacher to Innovation Coach Programme* can be used in Teacher Education programmes at bachelor, master, and/or doctoral level when collaborative learning methods and student-centred approaches will clearly provide beneficial results. In this program a teacher is learning as an active participant by solving learning process challenges with other colleagues. Multidisplinary teacher teams are recommented as a learning platform for teachers.

This method is based on years of developmental work and combination of different theoretical frameworks. One of the key theoretical backgrounds is a design thinking theory as it consists of a series of developmental discussions facilitated by a teacher and a real challenge from a stakeholder. This gently forces the students to think from another perspective and collaborate which creates the skills of co-creation, creative and critical thinking and involving active participation self and peer evaluation by students. Innovative learning process is presented in figure 1. This learning structure is the same to students and for teachers, who are practising the coaching skills and developing new competences as a teacher. It is a vehicle for enhancing critical and creative thinking and learning to work in interdisciplinary teams. At Jyväskylä University of Applied Sciences in Finland, this method has been found to be particularly effective when used with groups of students from different fields of study. Interdisciplinarity of team members increases the value of the outcomes as students often see the same problem from different points of view and thus contribute accordingly.

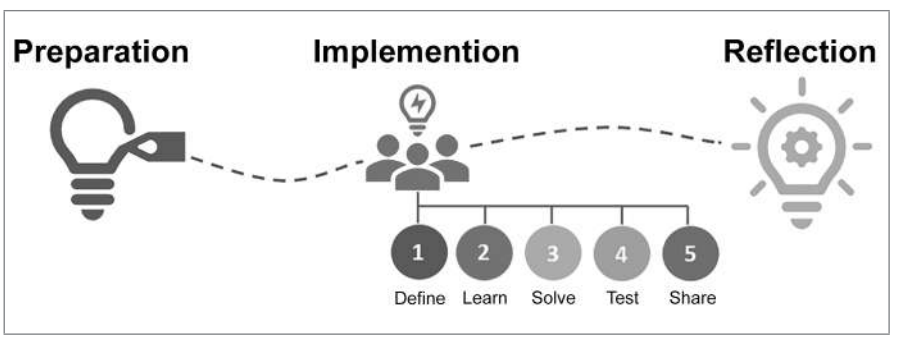


Figure 1 - Phases in Innovative learning process

BACKGROUND OF THE TOOL

In order to coach the teachers needs to understand the nature of student centred learning, theory background from Design thinking and use of those tools. The best way to learn these is to simply- try those as a learner. Creating learning goals and achieving them creates a deep understanding of the changes in a teacher's role, which is the transformation from content provider to facili-

tating learning processes. Also, professional growth requires practical experience and reflection towards the learning theories and given educational competence requirements for degree programs. Through collaborative learning the teachers will find suitable tools for their context and peer-to-peer support and network. This learning path to become an Innovation Coach is presented in figure 2.

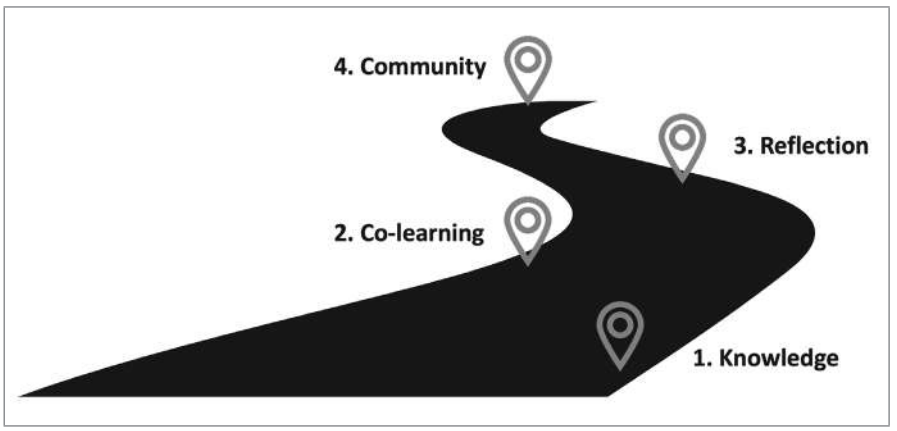


Figure 2 - From teacher to Innovation Coach holistic learning path

Understanding the learning process as a series of actions that a teacher has created with pedagogical principles instead of method-based tricks in one class, is a massive change but evitable in teachers' thinking. In this path teachers are constructing their own learning all the time and finding solutions for their own environment in a co-creational way. This guarantees that their professional development is sustainable and fitting their subject.

The process starts from creating the sufficient pedagogical knowledge and learning theory background but also understanding about the teams and development of teams and design thinking tools and process. This part is individual based work that can be done online. To check this theoretical understanding, the online test is a good method. In the co-learning part teachers are actively working as a team but also working with other stakeholders outside the school environment but also inside the school network – for example parents boards, company representatives or other NGO agents. Co-creating the challenge with stakeholders and the teacher team for students' learning process is time consuming but rewarding. Decision making is the first slow process and developing pedagogical thinking happens is interaction. The series of learning activities e.g. steps how the students can solve challenges in teams with collaborative methods is created together to meet requirements of curriculum. Reflection is an essential part of the process because that also creates professional growth but also wisdom for the use of the whole school community. Guided reflection needs to be

done to ensure professional growth but also as a teacher team to ensure learning quality and the process is supporting the learning goals. Last part is the community where teachers are collaboratively working with school staff and building learning environments that are beneficial for a larger audience than just their own students.

THEORETICAL BACKGROUND OF THE TOOL

This method's deep roots are in Kolb's Cycle of Experiential Learning as, in essence, it is all about learning by doing and value creation pedagogy and specific elements of it can be seen throughout the process Kolb (1984), Lackeus (2016, 2019) and Lombardo et. al (1996). Figure 3 is showing the pedagogical framework in detail.

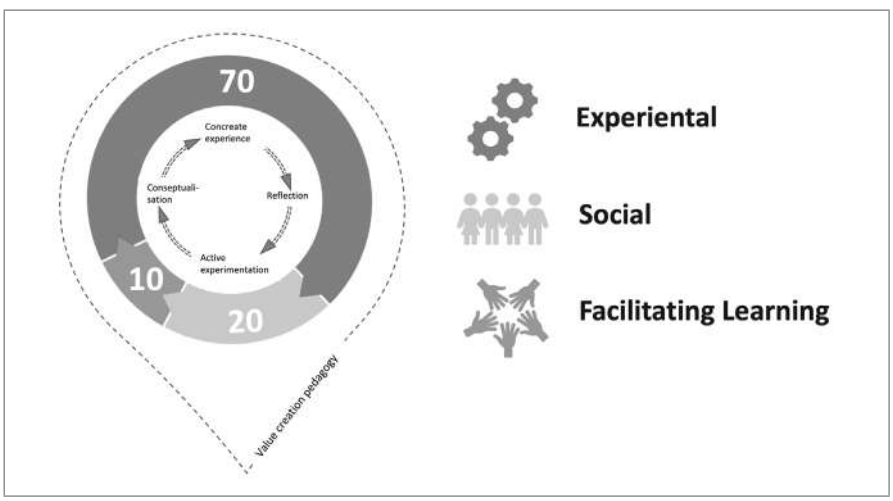


Figure 3. Pedagogical framework modified from Kolb (1984), Lackeus (2016, 2019) and Lombardo & al. (1996)

This forms the framework of the design thinking approach. Design thinking is a human-centred approach to innovation – anchored in understanding customer's needs, rapid prototyping, and generating creative ideas – that will transform the way you develop products, services, processes, and organizations. By using design thinking, you make decisions based on what customers really want instead of relying only on historical data or making risky bets based on instinct instead of evidence (Martin 2009, Dunne & Martin 2006). When learning creates value outside the student's own interest, it is shown that it creates natural motivation for students. Value creation pedagogy is when teachers let their students learn by applying their competencies (future or existing) to create something of value to at least one external stakeholder outside their own group, class,

or school. The value that the student creates for someone else can be economic, social, enjoyment, harmonical and influential (Lackeus 2016).

The 70-20-10 model is giving the insight for teachers to design the learning process. 70% of students time is action-based team learning whereas 20% of students time is social, meaning peer to peer learning and evaluation is happening and 10% of students time is teacher lead training or formal content based teaching (Lombardo et al 1996). In this model teachers are playing a key role by planning the learning process, principals, and activities that students are experiencing 90% of their time. This shifts the teachers work where teachers are more planning the activities and creating the framework and guidelines for students to work together and practising their creative and critical thinking in teams with the context of the challenge. Giving the needed theoretical understanding or insight the teachers need to plan the formal teaching content to meet the needs of the learning process. Most often the teachers underestimate the student's skills for seeking information and creating solutions.

Value creation pedagogy and 70-20-10 model both are supporting the students to take a role in their own learning process. Motivation towards learning is supported as the learning process continues. Teachers' role is to show the meaning of this tool from a wider perspective of life or as a citizen or work life skill. Also, the teachers role is to support the team and individual to know their skills and the good actions as a team member or in self leading skills. In a conflict situation a teacher's role is to help to solve the conflicts and maintain the safety of the learning environment and a good working spirit (Lackeus 2016).

Co-learning is happening in a group of 4 to 6 teachers. The theory behind this comes from peer-group mentoring, which is a modern model of supporting professional growth of teachers. When traditional mentoring is that a senior and more experienced worker will transfer the knowledge to younger colleagues, whereas Peer-group mentoring is based on the idea the relationship between the mentor and mentee is reciprocal and both parties have something to give to each other. This is based on a constructivist view of learning, where knowledge us such cannot be transferred between individuals because we always interpret new knowledge on the basis of prior knowledge, conceptions, experiences and beliefs (Heikkinen & al. 2012, 16). Discussions are the key element to create a common and shared understanding. In our model those reflection stops are preparing, implementation and reflection phase are creating and ensuring the development of shared understanding and professional growth as innovation coaches are gained.

Co-learning and reflection as an activity are required from teachers sharing and reflecting on their experiences, discussing problems and challenges they are facing during the implementation phase. Also, teachers need to have a safe and trust based learning environment where listening, encouraging one another and learning from each other can happen. Principles that need to be keep in mind where organising this kind of actions are:

1) All the members of the group are equal participants. (Teacher, coaches, stakeholder, teacher trainers). Everyone's voice will be heard, and nobody will dominate the discussion.
2) Shared experiences in a team will not be shared outside.
3) Participants are learners as well and making mistakes is part of the learning process (Mälkki 2019, Heikkinen et. al. 2012).

In the community part innovation coaches are understanding their active role in schools' stakeholders context and they are managing and developing their professional network. Also understanding the impact of the value, they are creating to a wider audience than just running a course. Students solving real-life challenges are creating an impact on other parties as well.

EXPLANATION OF THE TOOL

Components:

- Teacher trainees
- Experienced innovation coach
- Students

Steps of the implementation:

1. Pre-work
    - Teacher trainees will create their individual learning tasks and the learning process is planned to support those.
    - Tasks and activities to support knowledge creation about Design Thinking philosophy, Design thinking tools, pedagogical understanding of experimental learning and value creation pedagogy and understanding the role of teamwork and stakeholder's role in a process.
    - Understanding the 70-20-10 model and pedagogical principles to design learning processes.
    - Teacher and challenge owner defines the challenge/problem according to agreed schedule.
    - Teacher creates the learning process and main activities (pre-work, action, reflect) together with experienced innovation coach and other teacher trainees.

- Students, that are taking part, are divided into interdisciplinary teams.
- Students work through previously planned pre-tasks (getting know team and process).

2. Implementation phase

   Planned learning process is carried out with the students and teachers' team. Co-learning moments are facilited to meet the teacher trainees' individual learning targets but sharing the experiences and sharing understanding about coaching, pedagogical model and design thinking tools is done in the whole learning group (experiment coaches and teacher trainees together). In our model there are 2 reflection stops during the week program. First reflection stop is about creating meaning, meaningful learning and how to start this learning process. The second reflection stop is sharing experiences, findings, and good tools. Also, to define the teachers own professional skills in cocreative and experiential learning process owner – creating own professional identity as a coach.

3. Reflection

   In this part the team of teachers are evaluating how the learning process is worked with a simple formula. Questions for that:

   1. Did our students solve the challenge?
   2. What were the learning targets and did this learning process meet those targets?
   3. What went very well?
   4. What do we need to reconsider or improve?
   5. What did we learn as teachers?
   6. What will we do differently for the next time?

   Sharing experiences, tools and learning processes components to a wider audience to increase learning is a larger level. Reflection to individual level to ensure professional growth and expanding the stakeholders' network.

4. Setting, place layout

   For teachers to become innovation coaches: an online platform to create new knowledge and a space for connecting to other teacher participants and teams where to co-learn and plan the learning process can happen. In the implementation phase the teachers are active actors in their teach-

er teams and with students. Then a space where to meet, discuss, share experiences, and reflect is needed for teacher teams.

Real learning environment set up for implementation phase for students:

- Stage – for presentations & pitching and giving instructions for a day and to teams.
- Team working space where to do collaborative teamwork (table, 5 chairs and flap paper and wall).
- Online platform (Moodle):
  - Pre-tasks and material for self-learning before the action part.
  - Design thinking tools are also available here (timely opened mornings/afternoon).
  - Outputs, reports, reflections, and other material to be shared to teacher/other teams.
  - Assessment.

ROLE OF STUDENTS AND TEACHERS

Teacher role:

- Teachers are designing and running the whole process
- Making sure that the result and outcomes are achieved (NOT judging ideas/outcomes)
- Creating the suitable challenge with the client (value creation for the client and students)
- Helping students to understand the meaning of these tools as work life competences

Student role:

- Active participation is required

5. Assessment

- Not really needed but we have this kind of criteria's for teachers' trainees:
  - After completing this course, you will have learned:
    - Innovation and working life skills:
      - You are able to describe the basics of user-oriented method, based on references.
      - You know how to build a solution based on customer need, with your team.
      - You are able to create a learning process in your own teaching.

- Communication skills:
  - You are able to create good and powerful questions to create learning and handing the learning process.
  - Grounding your insight, giving instant feedback and practising collaborative communication skills in multiple ways to your collegues, challenge owner, student teams and other stakeholders.
- Learning skills, information management skills, reflection skills:
  - You are able to critically examine your and your teacher team's work in designing learning process, implementation phase when students are producing a solution for a customer-oriented problem.
  - You are able to reflect the development of your skills and knowledge and support the development of the skills and knowledge of your team members.

EXPECTED OUTCOME

Challenge owner:

- 1000 ideas, 10 tested concepts and 10 reports and other material.
- Real connection and talking with the students (usually summer jobs offerings and contacts but also continuing the work with teachers).

Teacher:

- Coaching skills upgrade.
- Multidisciplinary teams (wider perspective to see learning and current generation).
- Collaborative work with other teacher/coaches and with work life partners.

CONCLUSION

This is an effective way that requires teachers time to design and set up the process at the beginning. It develops skills to collaborate with stakeholders and skills to tolerate uncertainty which is always present in experimental learning processes. Also, teachers' skills on how to lead the change are developed. The key is to understand the teacher's agency. To create the change the teacher's need to change first themselves. In JAMK university of applied sciences we practised this over 10 years now and one of the learnings during these years is that the starting is the most important in this iterative process and this is constant developmental work. It is advisable to start from small groups of students and over

short time periods. A team size of 5 members is good and good resourcing is 2 coaches per 12 teams.

It is really required that the teachers are also learners in this experiential learning process. Purpose is to create an understanding of the learning process and the challenges the student might face during the learning process or in teamwork. Change cannot happen when teaching is done the same way.

Buddy teaching is a collaborative work where trust plays a role. Trust can be earned by actions. This means that teachers need to agree on the steps of the learning process and in implementation face communicating with each other truthfully and finding corrective actions together. Sharing the same understanding about the learning helps teachers to collaborate. Also, the teachers need to discuss and agree about pedagogical principles. Mostly this will have an effect in the implementation phase when the teams are needing constructive feedback and guidance on how to solve the problem together and also in peer-to-peer learning tools. Teachers' attitude is really showing to students but the wording, actions and how the teachers are treating students.

REFERENCES

Dunne, D., & Martin, R. (2006). Design thinking and how it will change management education: an interview and discussion. Academy of Management Learning & Education, 5(4), 512– 523.

Katzenbach, J.R.; Smith, D. K. (2001): The Discipline of Teams. John Wiley & Sons 2001. 0-87584-936-9

Katzenbach, J.R.; Smith, D. K. (2015): Wisdom of teams: Creating the High-Performance Organisation.

Kolb, D. A. (1984). Experiential learning: experience as the source of learning and development. Englewood Cliffs, NJ: Prentice Hall.

Kouzes, J. M., & Posner, B. Z (2008). The student leadership challenge: Five practices for exemplary leaders. San Francisco, CA: Jossey-Bass.

Kouzes, J. M., & Posner, B. Z (2018). The student leadership challenge, 3rd edition.

Lackéus, M. (2015). Entrepreneurship in Education. What, Why, When, How. Entrepreneurship360, Background Paper, European Commission: OECD.

Lackéus, M. (2016). Value creation as educational practice— - towards a new educational philosophy grounded in entrepreneurship? Doctoral dissertation, Ch

Leavy, B. (2010). Design thinking—a new mental model of value innovation. Strategy & Leadership, 38(3), 5-14.

Lombardo, Michael M; Eichinger, Robert W (1996). The Career Architect Development Planner (1st ed.). Minneapolis: Lominger. p. iv. ISBN 0-9655712-1-1.

Mansoori, Y. & Lackéus, M. (2019). Comparing effectuation to discovery-driven planning, prescriptive entrepreneurship, business planning, lean startup, and design thinking. Small business economics 2019-02-28, Vol.54 (3), p.791-818

Martin, R. (2009). The design of business. Boston, MA: Harvard Business School Publishing.

Ries, E. (2011). The lean startup: how today's entrepreneurs use continuous innovation to create radically successful businesses. New York, NY: Random House Digital.

Sonalkar, N., Mabogunje, A., & Leifer, L. (2016). Developing a design thinking curriculum for venture creation in a resource constrained environment. International Journal of Engineering Education, 32(3), 1372-1384.

Osterwalder, A., & Pigneur, Y. (2010). Business model generation: a handbook for visionaries, game changers, and challengers. Hoboken, NJ: John Wiley & Sons

Wenger, E. (2000). Communities of practice and social learning systems. Organisation (London, England) 2000-05, Vol.7 (2), p.225-246.

Wenger, E.; McDermott, R. & Snyder, W.M. (2002): Cultivating communities of Practise – A guide to managing knowledge. HBS Press. 1-57851-330-8.

Chapter 21

The Teaching Interplay for honing analytical, critical, and creative thinking skills - Instructing to Learn with In-service and Pre-service Teachers

Dr Niyati Chitkara, Dr Parul Sood, Dr Honey Chitkara, Ms Dolma Pathela, Ms Piyusha Sharma

INTRODUCTION

Teachers play a chief role in providing quality education for all. Forbye, as envisioned in Sustainable Development Goal (SDG) Number 4, Target 4.c, "By 2030, substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least developed countries and small-island developing States", it is imperative to train teachers. More so, the task of training demands interplay of the pre-service teachers and in-service teachers in order to enable them to continue developing their knowledge and skills like critical, creative & analytical to keep pace with the perpetual changes coming in the field of education in the wake of Industry 4.0.

Linking pre-service and in-service teachers further gives an opportunity to explore what lies beyond the existing practices and methodologies of teaching and to aid in their mutual skill enhancement. This collaborative effort allows novice and experienced teachers to be active learners and mutually learn from each other, interpret, and ultimately reform the learning experience of the students.

The present chapter deals with the pedagogical tool **"The Teaching Interplay- Instructing to Learn with In-service and Pre-service Teachers"**, which was designed by Chitkara College of Education, Chitkara University, Punjab

(CCE) and Chitkara International School (CIS) and the tool is duly assessed and approved by the Internal Quality Team of the university and was found to foster analytical, critical and creative thinking skills among the pre-service and in-service teachers. The tool fosters a strategic approach that ensures synergetic relation between a beginner and experienced teacher to allow the meaningful learning to emerge and overhaul the established pedagogies. Consequently, it provides a framework of training in-service teachers and pre-service teachers through mutual partnership wherein they learn about teaching and teach about learning.

THEORETICAL BACKGROUND

Researches done in the field of student achievement clearly emphasise the role of trained teachers for the success in the field of education. As iterated by Agbo (2003), to enhance the professional development of pre-service teachers, there should exist a collaboration between learning community and professional development community and this collaboration must facilitate "learning about teaching and teaching about learning". This mutual sharing of learning is only possible when one of them is an experienced teacher/mentor or Teacher educator. According to Aitken and Mildon (1992), the pre-service teachers must talk to more experienced teachers during the process of becoming qualified teachers. Further, National Education Policy (2020) lays due stress on the training of the in-service teachers for enhancing their skills and learning the latest innovations and advances in the profession. The policy also recommends that in-service teachers must dedicatedly devote 50 hours on their professional development.

Correspondingly, the tool "The Teaching Interplay- Instructing to Learn with In-service and Pre-service Teachers" was conceived by Chitkara College of Education in collaboration with Chitkara International School and it functions as one of the most important tools which provides a combined platform for training of both in-service and pre-service teachers in a most natural setting, to ensure quality teaching- learning experience in the classrooms.

LITERATURE REVIEW

EL-Deghaidy, Mansour & Alshamrani (2015) in their study have provided a framework for the professional development of the science teachers which is based on the socio-constructivist approach and tries to find answer to 2 important questions i.e. "How does a teacher learn effectively?" and "What does a teacher need to learn?". This further emphasises on the learning of the teacher which takes place during social interaction and in social context which is dominated by action. In another study conducted by Elliot & Campbell (2015), a positive impact of using andragogical model for training the teachers during

Continuous Professional Development (CPD), has been well established. This study posits the fundamental role of the universities for providing lifelong learning to the teachers. It also suggests the partnership between school and university to support the everlasting learning. In "Learning to improve or improving learning: the dilemma of teacher continuing professional development" Sachs (2007) has proposed four essential elements of the CPD viz. retooling, remodelling, revitalising and reimagining in order to achieve two interrelated objectives i.e., to achieve improvement in the student's learning and to support a strong autonomous teaching profession.

Another study conducted by Weibenrieder, Roesken-Winter & Schueler (2015) titled, "Scaling CPD through professional learning communities: development of teachers' self-efficacy in relation to collaboration" reported a dire need to initiate the collaboration in professional learning communities (PLCs) and explicitly support the teachers to actively engage in professional learning communities.

Gelfuso, Andrea, Dennis, Danielle, Parker & Audra (2015) in their work titled, 'Turning Teacher Education Upside Down: Enacting the Inversion of Teacher Preparation through the Symbiotic Relationship of Theory and Practice' report that teacher education must work on the reflection practices of the pre-service teachers and should also be supported by Vygotsky's theory of more knowledgeable other. Pratt (2014) conducted a study titled, "Achieving symbiosis: Working through challenges found in co-teaching to achieve effective co-teaching relationships" which emphatically provides strategies for co-teaching and for preparing students for collaborative partnership during practice.

EXPLANATION OF THE TOOL

"The Teaching Interplay - Instructing to Learn with In-service and Pre-service Teachers" is a pedagogical tool which is an integral part of the teachers' training at pre-service level and in-service level. This tool is important and is needed to train both in-service and pre-service teachers to upskills them and to help them learn new pedagogies and strategies emerging in teaching, learning and assessments in light of Industry 4.0.

The tool also provides opportunity to both in-service and pre-service teachers to learn from each other as collaborative team members, wherein pre-service teachers learn from the experienced teachers for example the techniques of handling children in a class or ways and methods to assess students. The in-service teachers can upskill themselves in the areas related to technology or innovations in pedagogy as pre-service teachers are being trained keeping in mind the needs of z-generation and Alpha generation learners.

A. Aim of the Tool:

- To empower the pre-service teachers to develop conceptual and practical understandings of teaching in actual school environment;
- To enable pre-service and in-service teachers to instil positive attitude towards constructive criticism;
- To assist in-service teachers and pre-service teachers to collaboratively gain hands on experience of learning;
- To foster symbiotic relation between in-service teachers and pre-service teachers, where one learns from the other and
- To keep in-service teachers abreast with evolving pedagogies.

B. Expected Outcomes:

The pre-service teacher will be able to:

- implement and develop the specific strategies to engage the learners in the class catering to all the three domains of learning;
- work independently in tandem with the school counsellor for implementing strategies for the inclusive classrooms and sessions;
- enhance their critical and creative thinking skills by adopting multi level teaching and evaluation;
- prepare the students for intra school and inter school competitions and events;
- plan and execute activities related to global exchange, international collaborations;
- learn to function as a teacher under the guidance of an experienced teacher;
- gain practical exposure of all the activities that are to be conducted under the guidance of experienced teacher and
- facilitate the staff members in maintaining different school records.

The in-service teacher will be able to:

- implement latest pedagogies;
- enhance their critical and creative thinking skills by adopting multi level teaching and evaluation and integrate technology into their respective subjects and focus on learner centred and collaborative learning.

C. Role of In-service and Pre-service Teachers

For the effective implementation of 'The Teaching Interplay- Instructing

to Learn with In-service and Pre-service', pre-service and in-service teachers need to follow an operative and structured model of training which ensures hands-on experience. The in-service and pre-service teachers play the role of both the students and facilitator. While one shares his/ her expertise, the hat of facilitator is being worn. On the other hand, while learning from the other the hat of student is being worn. Proper hand holding should also be ensured at all times by the pre-service teachers and in-service teachers. The success of 'The Teaching Interplay' is directly related to the active engagement of the pre-service teachers and in-service teachers and mutually working on each other's feedback.

D. Steps to Use the Tool

"The Teaching Interplay - Instructing to Learn with In-service and Pre-service Teachers" is implemented in four stages, which have been premised on the Socio-Cultural Theory, proposed by Lev Semyonovich Vygotsky. It firmly upholds Vygotsky's views on students' learning in school setting that can be associated with the in-service teachers' continual professional development and pre-service teachers' internship experience. The pedagogical tool hence includes the following 4 steps:

Step 1: Explain

Step 2: Model

Step 3: Scaffold

Step 4: Demonstrate

Step 1: Explain

"Explain" constitutes the introductory stage of Teaching Interplay, wherein the in-service teacher meets his/her teaching counterpart i.e., pre-service teacher. In this step, the teachers get acquainted with each other and thereafter share their experiences and teaching beliefs. While the in-service teacher may share the "most effective way of ensuring discipline in class" or "the most interactive way of instructing students in a traditional classroom setup", the pre-service teacher may apprise his/her partner of the innovations and latest advancements in the sectors of teaching, learning and assessment, respectively.

Step 2: Model

This step comprises the demonstration of tasks/methods by the pre-service and the in-service teacher, which were discussed by them with each other under Step 1. Correspondingly, the pre-service teacher makes observations of different lessons being delivered or methods being employed

by the in-service teacher. On the other hand, the in-service teacher amasses knowledge of the latest teaching practices or tools from her lesser experienced counterpart. In this regard, the pre-service teacher showcases the proper employment of all of these tools to his/her Interplay partner.

Step 3: Scaffold

After effective explanation and demonstration, the pre-service and in-service teachers help one another enter and explore their Zone of Proximal Development (ZPD). It is at this step that the "guided role-reversal" takes place, wherein the pre-service teacher practises the methodology of the in-service teacher, and the in-service teacher employs the latest tools and techniques as suggested to her by the pre-service teacher. The undertaking of these strategies by the pre-service teacher or the in-service teacher occurs under the guidance and supervision of his/her Interplay partner.

Step 4: Demonstrate

The ultimate step of the Teaching Interplay comprises demonstrating performances at the end of the in-service teacher and the pre-service teacher, wherein each of them leverages a healthy balance of the "methods learnt" and the "methods shared" to improve his/ her teaching effectiveness with the chief goal of augmenting the learning experience of students.

Example of Zone of Proximal Development (ZPD) being conducted at each stage

Step 1: Explain

Role of In-Service Teacher: In- service teacher shares her experience of teaching students. These examples can be related to stages of childhood mapped to various school stages, explaining about the guidelines issued by the governing bodies from time to time, explanation about the role of the counsellor, the assessment techniques being used, various co-curricular activities conducted in the school etc.

Role of Pre-Service Teacher: Pre- service teacher shares her theoretical knowledge related to different stages of childhood, discusses the role, responsibility of the counsellor, the latest techniques in teaching, learning and assessments, discusses about the synchronisation of curricular and co-curricular, the innovations in the tools and techniques for teaching, learning and assessments, need of collecting the evidence for shaping their portfolios etc.

Step 2: Model

Role of In-service Teacher: At this stage the experiences shared by the In-service teacher are being directly observed by the pre-service teacher during class

observations. The pre-service teacher observes and reflects upon the mapping of school stages as per the stages of child development and develops insight related to the aspect of individual differences that exists within the class, based on the individual differences how the In-service teacher uses various teaching strategies in order to cater to diverse group of students. Pre-service teacher also observes how the compliance of the norms of the governing bodies are being taken care by school and are implemented in the classes.

Role of Pre- service Teacher: The pre-service teacher shares her observation with the In-service teacher and then both reflect and with mutual discussion propose some strategies which can be improvised upon with the help of knowledge and skill of Pre-service teacher. Pre-service teacher observes the In-service teacher implementing specific strategies to engage the learners, observes the In-service teacher while she is drafting the question paper etc.

Step 3: Scaffold

Role of In-Service Teacher and Pre-Service Teacher: They work as a team and jointly work on the planning stage to implementation stage of lesson delivery, keeping in mind the inputs from both in-service and pre-service teacher. Pre-service teacher assist the In-service teacher in implementing the specific strategies to engage the learners in the class by maximising the use of IT tools and techniques. They jointly frame the rubrics to assess the students based on the latest techniques of assessment etc.

Step 4: Demonstrate

Role of In-service teacher and Pre-service Teacher: Both In-service teacher and Pre-service Teacher demonstrate the skills learnt from each other. Pre-service teacher handles the class independently, she teaches the students on her own and even assess them as per the norms of the governing bodies. Whereas In- Service teacher is able to develop her evidence-based portfolio, she starts making use of IT more often in order to supplement her teaching material.

Assessment

Assessment means to gauge the worth of an individual with the aim of giving him/her job or a more advanced level of a study course. It is the proper amalgamation of all inclinations, responses, and capacities of the learner (Kapoor & Natarajan, 2014). Since the present pedagogical tool aims to hone the skills of the practitioners of learning, it focuses on evaluating the various aspects of a fruitful content delivery or lecture. It is the formal presentation of the subject matter by the subject expert, for ensuing learning and recollection in the examination by the learner (Sood & Dutt, 2017).

In this context, "The Teaching Interplay - Instructing to Learn with In-service and Pre-service Teachers" allows the members of the Interplay (pairs of pre-service and in-service teachers) to not only learn beneficial methods from one another but also contribute to the elevation of their partners' method of teaching through timely assessment and prompt feedback. Thus, an "Observation Sheet" for the pre-service teacher and the in-service teacher is to be maintained by the Coordinators/ Supervisors on the basis of which, the effectiveness of the movement of pre-service and in-service teachers from Novice to an Expert level can be gauged.

Rubrics for the Assessment of Pre-service / In-service Teacher (Stage-wise)

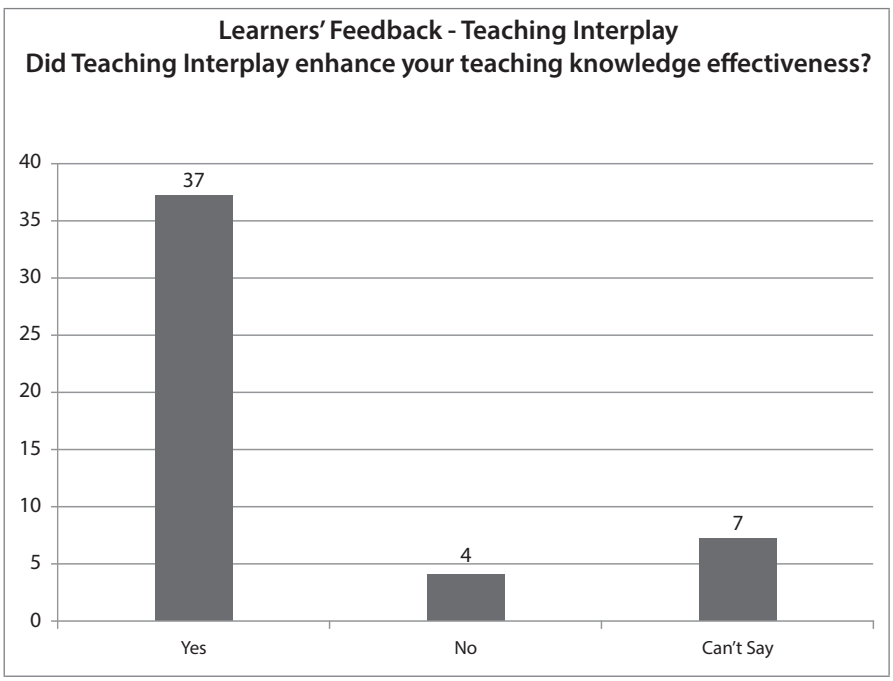
Stage ➡ / Level ⬇	EXPLAIN	MODEL	SCAFFOLD	Demonstrate
Novice	The Pre-service/ In-service Teacher is able to remember the concept (pedagogy/ tools of ICT) introduced	The Pre-service/ In-service Teacher is unable to identify, highlight the concept (pedagogy/ tools of ICT) introduced	The Pre-service/ In-service Teacher is unable to categorize, correlate, deduce, illustrate the concept (pedagogy/ tools of ICT) introduced	The Pre-service/ In-service Teacher is unable to execute the concept (pedagogy/ tools of ICT) introduced
Competent	The Pre-service/ In-service Teacher is able to remember and somewhat explain the concept (pedagogy/ tools of ICT) introduced	The Pre-service/In-service Teacher is somewhat able to identify, highlight the concept (pedagogy/ tools of ICT) introduced	The Pre-service/ In-service Teacher is somewhat able to categorize, correlate, deduce, illustrate able to remember the concept (pedagogy/ tools of ICT) introduced	The Pre-service/ In-service Teacher is somewhat able to execute the concept (pedagogy/ tools of ICT) introduced
Expert	The Pre-Service/ In-service Teacher is able to remember and explain the concept (pedagogy/ tools of ICT) introduced	The Pre-service/ In-service Teacher is able to identify, highlight the concept (pedagogy/ tools of ICT) introduced	The Pre-service/ In-service Teacher is able to categorize, correlate, deduce, illustrate the concept (pedagogy/ tools of ICT) introduced	The Pre-service/ In-service Teacher is able to execute the concept (pedagogy/ tools of ICT) introduced

Source: Chitkara College of Education, Chitkara University, Punjab

E. Learners' Feedback

Many schools realise the significance of creating effective performance enhancement plans for educators, but only a handful are able to devise such plans or measures, and thereafter use the same for everyone's betterment (Chitkara, 2021).

For the purpose of establishing the effectiveness of the tool, a sample of 50 teachers (both in-service and pre-service) was taken from Chitkara College of Education, Chitkara University, Punjab, India and Chitkara International School, Chandigarh, India, and their feedback was collected on "Did Teaching Interplay enhance your teaching knowledge / effectiveness?"



Source: College of Education, Chitkara University and Chitkara International School, Chandigarh, India

Graph 1 Interpretation: About 76% of the teachers found "Teaching Interplay" to be effective, whereas 8% and 16% of the teachers did not gain from the tool or were unsure of its effectiveness, respectively.

Roll No· – 2170991031

CHITKARA UNIVERSITY ANATOMY OF TEACHING PRACTICE

CHITKARA UNIVERSITY COLLEGE OF EDUCATION

ANNEXURE - 1

CHECKLIST OF SUGGESTED ACTIVITIES UNDER EXPLAIN STAGE FOR ASSOCIATE SCHOOL

SESSION 2021-23 (Sem 1)

Name of the αLPHA Teacher Pragya

Name of the Associate School Chitkara International School, Chandigarh

Suggested Activities for Stage 1 (Explain)	Done	Not Done and Intimated CCE
A session to the αlpha Teachers about the overview of the stages of childhood mapped to the various school stages	• School visits – Gained knowledge about the topic through [illegible]	we got to know about the [illegible] juniors & seniors on the basis of stages of childhood
A session by the administrative staff explaining about the contemporary working of the schools as per the guidelines of the CBSE, NCERT and other governing bodies	• Attended a session during orientation at CIS Chd.	• knowledge about the CBSE norms followed • Inclusive classroom • learning outcomes to be achieved • Have a knowledge about the NCERT [illegible] being followed during the orientation
A session by the school councellor highlighting his/her role and a peak into her/his daily schedule	• Session attended • Councellor ensures smooth working of the school.	
Overview about the assessment pattern or procedure and different tools and techniques used for the same	• Word wall • Word web • OBR Exam • Unit test • daily performance.	
Briefing about the records to be maintained by the teachers and their upkeep (samples could be shown)	• They have their diaries to maintain. • Maintaining a record of the students.	
Briefing about global exchange, international collaborations, activities or any international board being followed by the associate school (if any)	• Session attended on the 'global exchange program' in university.	
Session by HR / Administrative Incharge explaining the Human Resource Management Process of the Associate School and maintaining an evidences to build the profiles.		✓
A session by the Co-curricular incharge explaining the various Co-curricular activities, Clubs including community work initiatives of the school and expectations from the αlpha Teachers for the same.	• Attended squads during school internship • Attended a session on [illegible] by Dr. Niyati Chitkara	• The teachers discuss certain topics with the students as per their squads. • I have attended the RASA Squad. • [illegible] organised.
Session by IT Team explaining the various IT tools and Techniques being used for engaging the learners in a hybrid mode		✓
School tour, presentations by respective heads covering the overall working, rules and regulations of the Associate Schools, Introduction to the Associate School staff etc.	School visits @ CIS Chd and CIS Pkl.	• @ CIS Chd, we were shown the auditorium, the medical room, tech lab, classrooms which are specially designed for the students. • walls which have been allocated to different squads to present their activities.

Pragya 28/02/2022

*To be filled by the αLpha Teachers

Countersigned By
Associate Teacher/Coordinator

Source: College of Education, Chitkara University and Chitkara International School, Chandigarh, India

Qualitative Assessment

F. Visualized Examples

The pedagogical tool 'The Teaching Interplay-Instructing to learn with In-service and Pre-service Teachers' is extremely important tool as it helps both inservice teachers and pre-service teachers to mutually benefit from each other. At Chitkara College of Education, Chitkara University, Punjab, India this tool is extensively used in order to train Pre-service and In-service teachers.

The following illustrations relate to the stage-wise assessment record of pre-service teachers.

CHITKARA UNIVERSITY ANATOMY OF TEACHING PRACTICE

CHITKARA UNIVERSITY COLLEGE OF EDUCATION

ANNEXURE - 6

STAGE-WISE STUDENT ASSESSMENT RECORD

Sample Format for the Alpha Teacher's Assessment Stage-Wise as per the Rubrics

Name of the Alpha Teacher: Simran

Name of the Associate School: Chitkara International School

Name of the Associate Teacher: Ms. Mani Khurana

Name of the Associate School Co-ordinator: Ms. Alka Thapa

Stage Assessed: Kindly tick the appropriate box

Stage 1: Explain ☑ Stage 2: Model ☐ Stage 3: Scaffolding ☐ Stage 4: Independent ☐

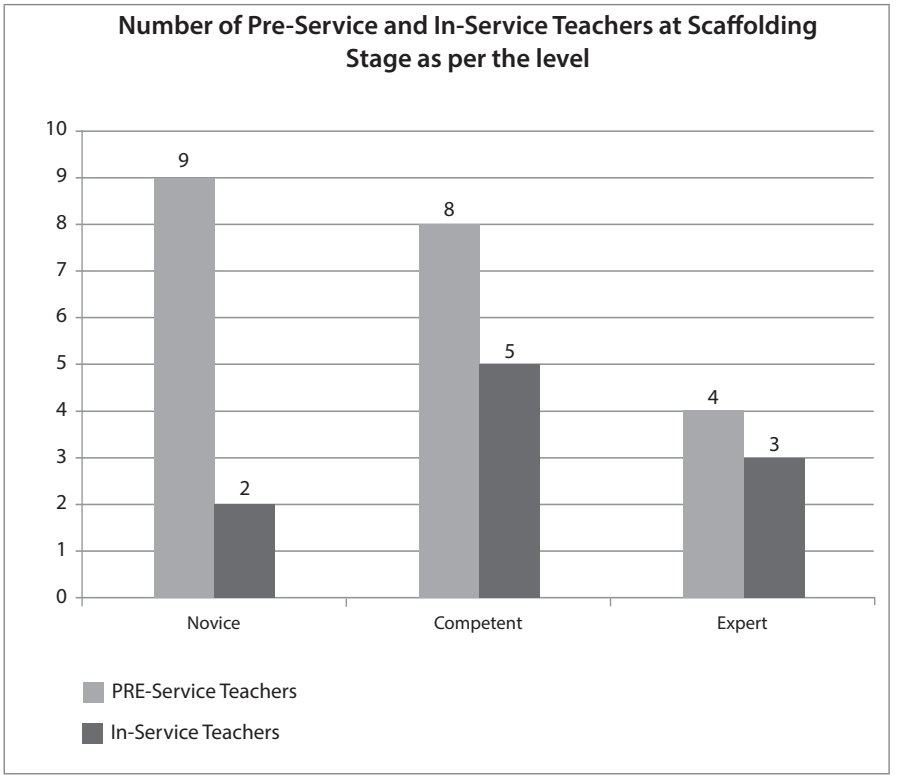
Module	Activity/ Session Organised	Alpha Teachers' Assessment (Kindly tick whichever is applicable. Rubrics for your reference are listed in Annexure 5)				
		Novice	Advanced Beginner	Competent	Proficient	Expert
EDExpert	✓		✓			
EDLearner	✓	✓				
EDTutor	✓	✓				
EDManager	✓	✓				
EDMentor	✓	✓				
EDSocial	✓	✓				
EDGlobal	✓					
EDProfile	✓					
Overall Remarks by the Associate Teacher/Coordinator		She is adjusting well in class & she is taking keen interest in the working of the class.				
Signature of the Associate Teacher/Coordinator		Mani				

Mani

Counter Signed By
Associate Teacher/Coordinator

*To be filled by the Associate Teacher of the Associate School.

Source: Chitkara College of Education, Chitkara University, Punjab, India
Picture 1 - Sample of the Stage - wise Pre-service Teacher Assessment



Source: Chitkara College of Education, Chitkara University, Punjab, India

Graph 2 (Interpretation): 9 Pre-service Teachers and 2 In-service Teachers are at Novice Level, 8 Pre-service Teachers and 5 In-service Teachers are at Competent Level and 4 Pre-service and 3 In-service Teachers are at Expert level.

CONCLUSION

It has become important to widen the scope of teaching, from mere relaying of facts to understanding the epistemological domains of the same. Educational reform requires making a clean break from viewing teaching as a mere conduit and putting the act itself under the microscope. "The Teaching Interplay-Instructing to Learn with In-service and Pre-service Teachers" stresses on imparting of their sustained experience of classroom teaching by the experienced teachers to the beginners and sharing of the evolving pedagogies by beginners to experienced, to enable both the parties to gauge effective patterns in diverse classroom settings. To be critically and creatively trained to use and devise teaching strategies that brings the highest good of the greatest number, represents the best amalgamation of long-standing wisdom and the enterprise of the new.

REFERENCES

Chitkara, H. (2021). Using Students' Feedback to Improve Teaching Effectiveness Based on Kaizen Philosophy of Continuous Improvement. V, 10-13.

Dely L. Elliot & Theresa Campbell (2015). 'Really on The Ball': Exploring the Implications of Teachers' PE-CPD Experience, Sport, Education and Society, 20:3, 381-397, DOI: 10.1080/13573322.2013.765400

EL-Deghaidy, H., Mansour, N. & Alshamrani, S. Science Teachers' Typology of CPD Activities: A Socio-Constructivist Perspective. *Int J of Sci and Math Educ* 13, 1539–1566 (2015). https://doi.org/10.1007/s10763-014-9560-y

Gelfuso, A., Dennis, D. V., & Parker, A. (2015). Turning Teacher Education Upside Down: Enacting the Inversion of Teacher Preparation Through the Symbiotic Relationship of Theory and Practice. *Professional Educator*, *39*(2), n2.

Kapoor, N. & Natarajan, V. (2014). Assessing Scholastic and Non-Scholastic Areas of Learning of Primary School 4th and 5th Graders in English, Mathematics & Science. 2 (1.1), 14-16.

Pratt, S. (2014). Achieving Symbiosis: Working Through Challenges Found in Co-Teaching to Achieve Effective Co-Teaching Relationships. *Teaching and Teacher Education*, *41*, 1-12.

Sachs, J. (2007, January). Learning to Improve or Improving Learning: The Dilemma of Teacher Continuing Professional Development. In *Proceedings of the 20st Annual World ICSEI Congress* (pp. 3-6).

Sood, P. & Dutt, S. (2017). Productive Pedagogies for Active Learning. Lambert Academic Publishing, 1(1.1), 18-19.

Weibenrieder, J., Roesken-Winter, B., Schueler, S. *et al.* Scaling CPD Through Professional Learning Communities: Development of Teachers' Self-Efficacy in Relation to Collaboration. *ZDM Mathematics Education* 47, 27–38 (2015). https://doi.org/10.1007/s11858-015-0673-8

https://indiaeducationdiary.in/new-national-education-policyemphasizes-on-continuous-professional-development-cpd-for-improvement-of-skills-of-teachers-education-minister/#:~:text=Each%20teacher%20is%20expected%20to,of%20learning%20outcomes%2C%20competency%2Dbased

Chapter 22

1+1=1
The path to the invisible

Patrizia Fazzini, Marco Ghelardi & Francesco Maria Marelli

CREATIVITY AS A PROCESS

The subtitle immediately refers to the core of the tool: the path to the invisible. The didactic practice we propose, in fact, does not foresee a predetermined final product. The goal is to encourage maximum creativity by the participants during the process, therefore it is not possible to predict the final outcome in practical and concrete terms. It is part of the educational game. The teaching methodology, on the other hand, is defined at each step of the work and it requires careful attention by the teacher, even from the setting and the working environment.

One and One - are One -
Two - be finished using -
Well enough for schools-
But for inner Choosing -
Emily Dickinson, All poems, J769 (1863) / F497 (1862)

This teaching practice starts from the theories on creative intelligence developed in Italy since the 1960s. From this point of view, a group of scholars were the guides and the pioneers. Maria Montessori, Gianni Rodari, Mario Lodi, and the designer educator Bruno Munari dedicated their analysis to the functioning of the creative and the atypical mind. The focus of our activity is represented by the object (One Thing Leads Into The Next, Bruno Munari) which is decontextualized but at the same time it does not lose its history and identity. Indeed, it is precisely from the stimuli that they offer that the creative and transformative path can begin to find new solutions, new functions and an original story.

THE ROLE OF THE TEACHER

It is important that the teacher is aware of the methodology. Therefore, training is fundamental, and it must take place both through a theoretical approach (reading and keeping oneself up to date regarding the functioning of the mind in the creative field) and through first-person practical experience. The teacher

has the role of facilitator of the processes taking place both at an individual and group level. For this reason, no judgment must be formulated during the creative process: all responses to inputs in a serious and concentrated context of work by the student are to be considered positive. Everything is possible. The assessment will be possible only at the end of the activity and involves a dialogue between teacher and student in a self-assessment context.

The teacher becomes a "counselor". A promoter of creativity. [...] he or she is an adult who is next to the children, so that they can express the best of themselves and develop an attitude to creation, imagination, constructive commitment though a series of activities that should now be considered all equal: that of pictorial, plastic, dramatic, musical, affective, moral, cognitive (scientific, linguistic, sociological), technical-constructing, recreational production [...] there is no hierarchy of subjects (Rodari, G. (1981). La grammatica della fantasia. Einaudi. pg.174).

The skills consolidated by the teaching practice concern:

- Critical Thinking:
  - Analysis of the input object of the activity, its History, and the natural context to which it belongs or in which its use is normal;
  - Texture of the narrative;
  - Identification of the most effective forms of expression in communications.
- Creative Thinking:
  - Decontextualization of the object;
  - Interactions between the objects (by intuition too).

THEORETICAL BACKGROUND OF THE TOOL

Art has always consisted in the discovery of the new. Nineteenth-century Romanticism broke every barrier in search of the infinite, placing the artist's creativity at the center of a cognitive path that takes place outside a purely logical procedure. The most evident contribution to this development, however, lies in the provocation of the Dada movement and in Twentieth Century Surrealism. They identify the decontextualization of human objects and experiences as the beginning of both artistic making and the cognitive process. "The essential is invisible to the eye" says the Little Prince of Antoine de Saint Exupery. Each object hides a mystery that allows us to go beyond the limit of what is known and to find new solutions. In an era in which artificial intelligence works according to standardized methods, in which the use of social networks favors a quick and often superficial approach to reality, we need to return to look at

everyday life in a different way and to train our thinking to solve problems with new strategies and to cultivate and follow intuition.

> "As beautiful as the casual meeting of an umbrella and a sewing machine on an anatomical table".
>
> Isidore Ducasse, Count of Lautremont. Songs of Maldoror

LITERATURE REVIEW

According to the American Psychologist H. Gardner there is not just one type of intelligence but a multiplicity of forms, that is biological potentials present from birth which in every human being assume a particular combination of levels of development, making his/her intellectual profile unique (Gardener, 1983). The educational intervention desidered by Gardner is not that of a notional education but of a didactic mediation that, in face of the unpredictability of the adult of the future, favors the understanding of basic contents and above all the mastery of access tools to the various cultural spheres, so that the subject can build his/her personal knowledge independently also through the possibility of choosing that knowledge most similar to his/her nature.

Gardner uses as a point of departure his concept of seven "intelligences" ranging from musical intelligence to the intelligence involved in understanding oneself. He examines seven extraordinary individuals – Sigmund Freud, Albert Einstein, Pablo Picasso, Igor Stravinsky, T.S. Eliot, Martha Graham, and Mahatma Gandhi – each an outstanding exemplar of one kind of intelligence (Gardener, 2011). From there he draws the attributes common to the seven personalities and highlights the role creativity has played in defining their intelligence.

Rodari highlights that it takes great imagination to be a great scientist, to imagine things that do not yet exist, to imagine a better world that the one we live in and get to work to build it. Rodari is convinced that imagination has its place in education, he claims the importance of developing creativity and imagination in the classroom (Rodari, 1996). Fantasy helps to uninhibit the mind, to get it out of preconceived patterns.

Nursery rhymes and stories in the name of error: distracted pupils, boring professors, athletes who are not up to date with their spelling... "Often mistakes are not in words, but in things; we must correct the dictates, but above all we must correct the world" (Rodari, 1964). Rodari takes us into a broken down and disordered linguistic universe, but it is not a text of boring grammatical exercises because the magical Rodari gives rise to laughter from every oversight, changes the rules of our grammar at stake, opens a dense and very rich dialogue with the readers.

Gaita, in an essay that can be read as a novel, explains the story of a psychoanalysis and a musician, using simple language in evocative territories of our mental functioning: the way in which music makes us think about something without being able to say it with words; the mechanisms by which a perfume irresistibly triggers a memory: or the profound patterns by which a fantasy, a landscape or a melody sets our minds in motions.

Pitruzzella developed a survey on creativity born from the field of Arts Therapy, a discipline having a growing diffusion in Europe. After a general definition of creativity, Pitruzzella analyses its importance in the healthy development of the person and its value as a resource in the educational, therapeutic, and social fields (Pitruzzella, 2009), Next, she proposes a detailed description of how the creative process works and the possibilities activating, governing and evaluating it.

Munari is a great Italian artist, known throughout the world for the whimsy and lightness of his creations. He demolished the myth of the artist-star once and for all to replace it with the figure of the 'designer'. Through a compelling analysis of works and themes, conducted with clear and enjoyable drawings and images, Munary provides an extremely comprehensive presentation of design and mental strategies in the design phase (Munari, 2008)

EXPLANATION OF THE TOOL

Preparing setting:

- Open space;
- Objects chosen with care: the teacher can ask students to bring an object with a symbolic value or that reminds them of a particularly pregnant and meaningful memory. Each object is accompanied by a card that reconstructs its 'history';
- The teacher prepares other objects to interact with in the activity – two of them for each student: the choice can be random but done with care;
- The teacher prepares a series of questions aimed at facilitating the decontextualization of the object;
- The teacher prepares a series of questions aimed at finding new relationships between objects;
- Colors of various types and materials for artistic manipulation (for example clay);
- Sheets and drapes.

All the objects will be made available to students who will then make their choices. The basic rule is to take care of both the tidiness (each object must be

shared and therefore must be stored with care) and of each phase of one's work, as well as of the work environment.

1. ESTRANGEMENT: decontextualize objects from their everyday life function.
2. TO ARRANGE TOGETHER DIFFERENT THINGS: unexpected combinations.
3. THE BENEFIT OF A DIFFERENT POINT OF VIEW: FRAMING OPEN QUESTIONS.
4. LEARNING BY DOING: the intelligence of the hand. Experimentation phase of the multiple potential interactions between objects. The final choice is the student's.
5. TRANSCODING INTO SOUND AND MOVEMENT: each work can then be presented and in turn generate a musical, dance, theatrical performance.

Expected outcome

Students:

- Promote the emotional and emotional aspect of studying;
- Promote intuition as a resource in problem-solving;
- Encourage flexibility when applying procedures to interpret reality;
- Integrate logical intelligence with the intelligence of doing (rediscover the playful dimension of learning);
- Open possibilities for integration between the various disciplinary fields;
- Support effective communication of one's work;
- Manage self-assessment.

Teacher:

- Acquire new data for the skill assessment by observing the process and the final interview with the student;
- Encourage collaboration with teachers from the team and other disciplines.

CONCLUSION

In this chapter, the authors outline the essentiality of creativity. They break the existing stigma that creativity is a skill that should only serve the 'artistic' professions. The authors go through the literature review to prove that in all great professionals and personalities analysed, creativity is a common constant.

In order to bridge the gap between the lack of creativity in schools and the importance this skill plays in personal and professional development, '1+1' becomes an effective solution. This innovative pedagogy presents students with the right scenario to find imaginative solutions to 21st century problems. Our societies no longer require problem-solving but rather problem-analytical skills. Our societies have become interwoven, sophisticated, and complex and without developing creative minds, we will not be able to face the myriad of challenges our future lies ahead. The authors outline the importance of teacher training and preparation to nurture creativity in the classroom and they provide the readers with detailed guidelines to effectively use '1+1' in any learning setting.

REFERENCES

Gaita, D. (2000). Il pensiero del cuore. Bompiani.

Gardner, H. (2011). Creating Minds: An Anatomy of Creativity Seen Through the Lives of Freud, Einstein, Picasso, Stravinsky, Eliot, Graham, and Ghandi. Paperback.

Gardner, H. (1983). Multiple Intelligences: The Theory in Practice. Basic Books.

Munari, B. (2008). Design as art. Penguin Classic.

Pitruzzella, S. (2009). The Mysterious Guest: An Enquiry on Creativity from Arts Therapy's Perspective, Iuniverse Inc.

Rodari, G. (1964). Il libro degli errori. Einaudi.

Rodari, G. (1981). La grammatica della fantasia. Einaudi. pg.174)

Rodari, G. (1996). The Grammar of Fantasy: An Introduction to the Art of Inventing Stories. Teachers & Writers Collaborative.

Rodari, G. (2020). Thelephone tales. Enchanted Lion Books.

Chapter 23

Resilience and coping styles for transformative teaching and learning

Patrizia Garista

EDUCATION IN TIME OF CRISIS: FROM A PANDEMIC PEDAGOGY TO A RESILIENT PEDAGOGY

Across the world, teachers and school leaders are under great stress due to the highly complex challenges they have to face today. They are asked to teach in increasingly multicultural classrooms, integrate students with special needs, use ICTs to teach more effectively, engage in evaluation and accountability processes, involve parents in schools, and deal with growing pressures from students, parents, education systems and other stakeholders, all of which are increasingly demanding and too often contradictory. Furthermore, teachers are supposed to be innovative and creative to contribute to the ambitious purpose of "rethinking education" according to rapid changes in today's society.

Henry Giroux, theorist of critical pedagogy, entitled his latest essay "Pandemic Pedagogy. Education in time of Crisis "(Idem, 2021). The title outlines a field of action in pedagogy characterized by the effects and consequences of Covid-19, expanding its analysis to the emergency needs of the education system and not only those related to health emergencies. According to Giroux, contemporaneity is a very distinctive story of various global emergencies that place human beings' development at risk: the pandemic, racial violence, gender-based violence, migratory processes, wars, educational poverty, economic crises, the psychological and social hardships among the population. Following his perspective, all emergencies need to be read as a separating and founding gesture at the same time (Foucault, 1975), which, according to Giroux, has isolated and generated a specific field of knowledge: a pandemic pedagogy. This pedagogy has rethought educational and didactic actions in a virtual scenario. Assisted by new technologies, it has expanded spaces for learning and emergency training, but has nevertheless highlighted the risk of alienation and oppression, if it is not critically rethought and oriented through an empowerment and resilient perspective (Freire, 2004; Freire & Macedo, 1987). And even if there are school communities where emergencies are not present, we can affirm that

this vision highlights what occurs when a system, the educational system, is outside of its comfort zone, which is the case when introducing innovations that foster teachers to rethink education and themselves (Abbott, MacTaggart, 2010).

The pandemic pedagogy defined by Giroux intends to explore issues concerning knowledge-building, agency, desires and values that animate current educational processes, promoting actions of resistance to every possible attempt to subjection and passive roles (Annamma, 2018). The recent pandemic has produced a temporality marked by a pedagogic frailty caused by uncertainty, fragmentation, and apprehension. However, according to Giroux, this pause in the chaos offers an opportunity to face and reorganize new visions of educational work, by focusing attention on issues such as the agency of those in training, the values that can be traced to the affirmation of human rights and sustainable development, and the fight against inequalities, and by putting values such as inclusion or differences at the center of educational policies. Henry Giroux's vision therefore highlights something more than an educational model that has been outlined to respond to an emergency. He argues that the practices deployed by pandemic pedagogy are not just *adaptive actions* to respond to a health crisis, but define the space of a system of knowledge, ideas, values, and desires that aim to build specific identities, relationships, and distinct hermeneutics of the present and the future (Giroux, 2021).

During times of crisis and renovation urgent questions and training need to always emerge, which call for transformative teaching and learning practices characterized by reflexivity and meaning-making.

Despite this scenario, we ground our reflection and proposal in a theoretical background of the ecological paradigm for knowledge building (Maturana & Varela, 1984), the critical pedagogy movement (Freire, 2004; Mezirow, 2000) and Nussbaum theories (2001) on the importance of frailty in knowledge building. These models are confirmed by a number of initiatives aimed at supporting teachers and school leaders in addressing these numerous challenges. Teachers and school leaders are too often alone when facing them in their daily work. This situation may cause a number of them to give up, feel lost, depressed, passive, and exhausted or to suffer the so-called 'burnout syndrome'[1]. Practitioners, teachers, and leaders build their knowledge through their experience, *in action and on action* (Schön, 1993), inside specific situations. According to this shift, teaching strategies should be rethought, moving towards a more active choice,

1. Data are grounded in the following documents: TALIS - The OECD Teaching and Learning International Survey; Supporting Teacher Professionalism - Insights from TALIS 2013 (OECD); Rethinking Education Towards a global common good? (Unesco, 2015)

through which the learner becomes the producer of knowledge from the beginning of his/her education and throughout life (Garista et al., 2015).

According to different studies (Alimatu et al., 2021; Griffith et al. 1999; Hidalgo-Andrale et al., 2021), teachers' uneasiness influences their performance and well-being. This situation implies psychological, or even physical, suffering and leads to negative consequences for teachers themselves, for their students and impacts the educational system, affecting quality of life and academic success (Garista et al., 2019). Alternatively, if we adopt a pedagogical perspective, focused on making visible transformative practices, we realise that there are a number of teachers and schools that have succeeded in efficiently and creatively, addressing today's education questions, introducing innovative learning activities and routines, inspiring students and colleagues, and contributing to the necessary innovation and performance in their classrooms and schools. We can call them "Best performers in education" (Benedetti et al., 2020) and they represent a treasured asset in educational practices as they show how current challenges can effectively be mastered. Over the years, they have developed and tested positive and effective strategies that, adequately transferred and exploited, can stop and even reverse the vicious circle of passivity and withdrawal, replacing it by a virtuous circle of motivation, empowerment, effectiveness, and innovation. According to their stories, the scenario of a pandemic pedagogy can be turned into a resilient pedagogy: making possible the shift from negative to positive dynamics for teachers and schools.

RESILIENT TEACHING: BORDERING A PATH FOR POSITIVE EDUCATION

Resilience is becoming a very common term in relation to inclusion, disability, life skills, teachers' training, leadership, mentoring, and guidance. Capacity to create new opportunities, resources, and skills are the most important factor of resilience: in other words, new learning, emerging from a stressful, disadvantaged, chaotic, or traumatic situation. Resilience could be understood as a metaphor of learning and culture, as it is a process capable of transforming people, their knowledge, and abilities to cope with situations and solve problems.

Resilience refers to a process that can affect people, schools, communities but can also become a lens for reading the stories of great educational innovations that have helped to promote inclusion at school. The French pedagogist Goussot argues:

> Pedagogical action is an area of important elaboration and implementation of the resilient process. [...] Resilience can become a prism to re-read the thinking of those involved in education, to retrace the bridge between resilience and learning (Goussot, 2014, pp 12-16, *our translation*).

The construct of resilience has been researched in education for many years (Brown et al., 2001; Newman, 2002; Ungar, 2021). Resilience and coping styles are generally associated with studies in the field of educational psychology. In this chapter we take an alternative approach by selecting and adopting reviews connected to pedagogical studies.

Looking at the literature dealing with the training of teachers/educators on resilience (Brown et al. 2001; Milstein & Henry, 2008, Garista, 2018), everyone agrees on the ethical need to reflect on one's own resilience, recovering its narrative root and biographical dimension (Goussot, 2014), to become aware of it and, in so doing, becoming able to promote resilience in other people. Two different models approach resilience education in schools, defining resilience as a process and not an outcome (Brown et al. 2001; Milstein & Henry, 2008). Both attempts to promote a transformative approach to resilience, centered on protective factors to foster resilience in young people and support educators' resilience. We know that teachers can respond positively or negatively to challenges, so resilience could help them foster both individual (or biographical) and collective capacity to cope with these stressful situations. There is no magic formula to make a school resilient, but the quality of the teaching and learning environment, the cooperative organization, a holistic view of school work, a sense of belonging to the school, social networks and, above all, "being connected" could help and promote the resilient process. For instance, the European network of E-Twinning schools represents one of the best ways to create resilience by connecting with other schools and educational agencies (Garista & Cinganotto, 2017).

LESSONS FROM THE PAST: EDUCATORS' NARRATIVES FOR TRANSFORMATIVE TEACHING

Within social sciences, resilience first appeared among stories. Its epistemology can be reconstructed in a phylogeny anchored to many micro-narratives, collected in research, and it has been enriched gradually through the imagination of further stories, handed down orally in many countries (Garista et al., 2015), collected by several research methods. These narratives represent a cultural heritage of resilience, each country produces its own. They have come down to us as cultural products of various communities that use art, literature, music, nature, traditional stories, to teach how it is possible to rebuild oneself after a traumatic event or with respect to difficulties of a depriving everyday life. Often narrative pedagogies in various communicative forms (fable, traditional stories, popular legend) have helped us to positively reconstruct revolutions and metamorphoses, both from a personal point of view and from a social point of view.

Starting from this assumption, resilience can become, as Goussot suggests (2014), a prism to re-read many educational innovations, to retrace the bridge

between resilience and learning, focusing on crucial aspects for education and relationships. According to Goussot (2014), biographies of famous resilient and innovative pedagogues (Montaigne, Decroly, Pestalozzi, Montessori, Itard, Vigostky, Freire, Rousseau, Helvétius, Séguin, Freinet, Makarenko, Korczak, La Garanderie and others) show an attitude which is contrary to the school situation of their time, turning their gaze towards human resources not considered in the school context, but fundamental to overcome difficulties and differences. They were educators who have been able to build educational devices of resilient processes, working on spaces, times, materials and on the educational relationships (ibidem). Goussot (ibidem) listed the pedagogical words of resilience: encounter, mediation, interaction, compensation, intrapsychic and interpsychic zone of proximal development, narration, dialogue, historical-cultural dimension of development, self-esteem, understanding, connection to oneself, connections to the world, cooperation, and inclusion. These are generative words of resilience, but also of democratic life at school.

When introducing an innovative strategy or when, as a teacher, you are facing a complicated situation, questions would be:

How to transform the resistance of those who do not want to learn into a learning possibility?

Is it possible to recover vulnerable, fragile, and traumatized individuals and make these difficulties a resource for change?

A pedagogical reflection on how to foster resilient teaching and learning is the idea that one cannot fully develop one's resilient self in an alienating or hostile setting (Giroux, 2021; Freire, 2004).

Goussot (2014) and Mayo (2007) note the importance of Freire's development of an educational model for literacy as a form of empowerment. Part of Freire's biography, masterfully told by Mayo, is also proposed in a resilient key by Goussot (2014). Freire, who grew up as a child in a wealthy family, went through the economic crisis of 1929, and lived within a context in which the rights to health and education are guaranteed on the basis of economic affiliations. When, after overcoming this phase of deprivation, he began to work to affirm a rights-based educational model, emancipation, social and political participation of all citizens, he underwent violent interrogations, prison, exile, the denial of the right to freedom of expression. Freire recognized *the power of words*, the generating themes coming from everyday life, that found knowledge through the construction of real and meaningful stories.

Antonio Gramsci, in another place and social context, experienced different traumas but, like the Brazilian pedagogist, he experienced prison. His physical frailty slowed him down but did not prevent him from studying, working, and fighting for a more equitable society. Gramsci, like Freire, intuited the power of narratives and the need to use clear and understandable language with an emancipatory purpose to promote *critical and analytical thinking*. Among his writings,

we can reread the "Letters from prison" where he reminded his children of the popular tales of his land. Among these, one in particular today can be reread with the lens of resilience and sustainable education. It is the fable of the "mouse and the mountain" in which a protagonist, the mouse, apparently with few skills, when faced with a problem, does not allow himself to be demoralized, but begins to *dialogue and debate* with everyone, to create bonds of individual responsibility in the vision of a common good (Garista et al., 2015). The protagonist's resilience lies in knowing how to listen to everyone, accept their requests but also mediate, dialogue, mobilize resources and offer hope for the future. In sum, the mouse embodies the words of resilience listed by Goussot. A fairy tale, in fact, can be considered the place of all hypotheses as it donates keys to understanding reality through new paths. In Gramsci's fable, the hero is able to "relier" (a French word that means "to connect"), to stage that process of "reliance", recalled by the systemic thinker Edgar Morin. To face uncertainty, chaos, mistakes, critical events, and challenges, we need to develop a *systemic and creative thinking* that helps us to practice the possibility of "binding together", acting to bring out the human face, fragile, poetic, sensitive, but also capable of finding a channel for dialogue with the world.

Pestalozzi is another pedagogist mentioned by Goussot (2014). He became orphaned very young. When he grew up, he decided to become an agricultural entrepreneur. But he found himself repeatedly in crisis and economic difficulties until bankruptcy. He found a mentor who encouraged him to write and when he began to take care of the popular education of orphans and the poor, he had the opportunity to develop his pedagogical model. Pestalozzi affirmed the need, as educators, to continually question oneself, to exercise the *pedagogical doubt* about educability and one's own competence. Pestalozzi brings back to the center of the discourse the power of emotions and the importance of affectivity in learning, where fragility caused by an obstacle can become an engine for change. His educational project is permeated with life skills, relationships, and mutual recognition. Learning, therefore, becomes a compensation for human frailty. As Goussot points out, Pestalozzi felt the "connectedness" capacity of resilience, that is the search for harmony between the natural, social, and personal, corresponding to the dimensions that we can define as bio-genetic, socio-cultural and physics. The Swiss educator defined the importance of reflecting on his own biography:

> *Who am I? What is meant by humankind? I want to understand what my life has made of me: I also want to know what has become of humanity throughout history (Goussot, 2014: 68, our translation).*

A TEACHING CARE MODEL: TIPS FOR RESILIENCE AND COPING STYLES

Given these premises, a few examples and evidence from research, we can use these narratives to create stories about school innovations.

What successful stories will it be possible to talk about our school and in our school?

The reflective path proposes thoughtful activities, actions to familiarize oneself with theoretical models and to transfer them into one's own context and self-assessment activities. Becoming aware of your own resilience will help you to recognize the needs and resources in other people. As Brown and colleagues (2001) argue, by reflecting on weaknesses and strengths, teachers will be able to observe, analyze and move towards transformation, enabling their role to to develop as reflective practitioners. Milstein & Henry's (2008, p. 13) "wheel of resilience" and its dimensions (positive connections; clear, consistent & appropriate boundaries; life guiding skills; nurture and support; purposes and expectations; meaningful participation) will enable recognition of the complexity of resilience education (Tisseron, 2017). The expected outcome to increase teachers' and students' wellbeing and, consequently, their capacity to cope with innovative teaching and learning methodologies and to deal effectively with social and historical challenges.

As a practical example of shifting theories into practices, we cite an action research grounded and developed within the European community of e-twinning schools (Garista, 2022), where participants (422 enrolled from all over Europe) were able to share their different experiences of resilience education, making them explicit and visible through narratives and drawings. Some participants (328) created a metaphor and drew an image of resilience with a brief written explanation. Participants agreed on the importance of sharing practices and problems, without fixing actions or dimensions of resilience. The risk could be to exclude and not include, to judge and not to help. The importance of offering, without forcing, different types of tools to communicate thoughts, emotions and experiences can be considered an added value. The resilience represented in the visual and narrative compositions was situated between the relationships where "sharing" and "trust" could help teachers solve problems, without setting actions or dimensions of resilience in an overly structured way but offering a multidimensional, flexible, and complex framework. Materials for developing reflective practices in teaching are not difficult to find and use. Reflective practices through narratives and visual exercises need just pens and papers and a safe setting.

Based on these premises we think that tips for teachers, which support resilience and coping responses to educational challenges and innovation could be summerised as: critical and reflexive practices; emotional routines; relational and networking actions. They need to be read just as inspiring examples that can be adopted, reinvented, modified to face the chaos and transform it in a creative

dance of possibilities in education. Students are not involved but they can be asked to give feedback on the teaching process of their educators. All the activities can be organized in a first phase, dedicated to individual reflection, and a second phase for sharing one's own thoughts within a group. The second phase is not mandatory. This type of activity does not require a formal evaluation although a final briefing with colleagues can be useful for metacognition, to transform reflection into new actions and to support a better quality of life and teaching.

Critical/reflexive practices

Faced with challenges teachers can catch solutions in their personal box of experience or in that of other colleagues' communities. Useful practices are grounded in narratives that stimulate reflection on experience and insights for new solutions. Narratives can be related to one's own experience, for instance, writing an unsolicited diary made of words and images, or they can come from the outside looking at a film, reading a book, visiting a museum, or reading a scientific paper. All these narratives become material for pre-reflexive activities (as in the case of expressive methods such as picturing or dancing) and for reflective activities (as in the case of writing a logbook or a critical event). Some guiding questions to start a logbook are reported in fig. 1.

Fig. 1 - Reflective questions for stimulating writing, critical and creative thinking (adapted from Garista & Pocetta, 2022a, in press)

Logbooks may be solicited or unsolicited diaries. Not all Teachers felt comfortable with an open task to write something for reflection. Some prefer following guiding questions.
The suggested format for writing can be flexible.
Guiding questions' examples:
What is your role in the school? What are your feelings about your role and activity? How do you think your job will contribute to academic success? Do you have any personal objectives to reach by the end of this project?
How have you contributed to the project lately? What adjective would you use to describe this contribution? Did you come across any particular challenge which made you reconsider your work? Have there been any constraints that limited the development of your work? What do you think about communication with students or other colleagues?
Is there an event or a situation you would like to share with others? L*ooking back at your log … have your feelings changed about teaching?*
Do you feel you have achieved/learnt something you weren't expecting to learn?

Emotional routines

We know that teaching and learning are human practices full of emotions that influence the way we participate, observe, reflect, and transform teaching practices (Brown et al., 2001). Mindfulness proposals are well described in the literature. Amongst them is an easy one represented by "The emotional cup". Something that teachers can experience and also propose to their students.

The emotional cup is a mindfulness suggestion for teachers. It recalls a negative capability strategy aimed at stopping and observing reality to restore and find new solutions (Garista, Cinganotto, 2017). Teachers can imagine their coffee break as synthesized in fig. 2.

Fig. 2 - The emotional cup

When teachers' emotional cup is empty, we may see behaviors such as these emerge:
• attention seeking behavior to alert us that they need a refill.
• think they have to fight or flight to get a refill.
• demonstrate a sense of anxiety once they approach empty.
In this case suggestions are: stop and think about: *What causes an empty cup?*
Stress and pressure to achieve, isolation, yelling, evaluation, failing, fatigue, being frustrated by student's response
So, think about: *What refills my teacher's emotional cup?*
Relaxing, Friendship and relationships with other colleagues, Love and affection, Connection, success, being given the choice to do what you master and prefer.
As adults we can see how the emotional cups will need to be observed carefully, but is it also important to know how full your own cup is? If you are running a little bit low too, take some time to do what you love, listen to music, read a romance, watch a film, or make a connection with a long-lost friend.

Relational and networking actions

Connectedness, mentorship, and networking have shown their potential to help teachers to cope with educational challenges. A suggestion could be trying to find a friendly and professional community to share doubts, critical events, cases to discuss. An interesting practice that enhances *critical thinking* may be organizing a *Journal club* on new evidence from the literature. It can be organized in informal contexts, such as a café or outside in the school outdoors and gives the chance to briefly discuss interesting solutions from the literature to solve everyday educational challenges (Montuori, 2005). The rules are flexible.

Time may be very short, a brief introduction of an interesting paper by a member of the group and debate (if it occurs). The choice of informal setting is based on theoretical assumptions stemming from competency development theories, and principles of holistic development. The idea is to create a friendly appealing atmosphere, enticing the members to discuss the scientific papers proposed in an informal situation, full of salutogenic and resilient resources: good food, cultural heritage, nature, comfortable seats. This alternative setting makes it possible to foster the pleasure of reading, developing critical reading skills necessary for information literacy, while sipping coffee and nibbling on good food (Golde, 2007; Garista & Pocetta, 2022b). In addition, it offers a tangible experience of how unusual and neutral settings, already available within the community free of charge in each city throughout the world, can be set up easily for knowledge building and sharing. At the end of the journal club, participants had more time available to socialise and extend their discussion through a senso-biographic walking (Boero & Mason, 2021) back to their classroom.

CONCLUSION

Nowadays the social and educational system calls for performance. In this scenario, attention is given to top performers at school and at work. This knowledge building system "is alienating and dehumanising students, teachers, and families who are looking for what would help to orient themselves toward a changing and unpredictable world" (Todd, 2016, p. 619). According to Todd, and her interpretation of Anna Harendt's thoughts on "time of present", we should refocus on education rather than on learning. The latter has a close relationship to outcome, outputs, and performance. In doing so, we can understand deeply the importance of transformation and uncertainty in transforming people's lives and their way of coping with "uncertainty meaningfulness". In brief, learning demands action and decision-making, education highlights inaction, reflective inaction, and the ability to use transformation and new challenges to produce transformative learning. The poet John Keats best described this life process through the expression of "negative capability". If a positive capability is related to problem-solving and decisive action, negative capability describes "reflective inaction" (Garista, Cinganotto, 2017). Its possible contribution turns out to be the creation of an "educational zone", a sort of mental and emotional space, where new learning can emerge from narratives. Resilient narratives finally became powerful tools when they could be also listened to and shared within a community.

REFERENCES

Abbott J., MacTaggart H. (2010), *Overschooled but undereducated. How the crisis in education is jeopardizing our Adolescents*, Continuum, London.

Alimatu Cecilia Issakah, Isaac Nyame, Fatima Iddrisu Abu (2021). Perceived Stress and Coping Mechanisms among Teachers in Three Special Schools in the Northern Parts of Ghana. Universal Journal of Psychology, 9(2), 9 - 22. DOI: 10.13189/ujp.2021.090201

Annamma, S.A. (2017), *The Pedagogy of Pathologization. Dis/abled girls of color in the school-prison nexus*, London, Routledge.

Bateson, G. (1972), *Steps to an ecology of mind*, San Francisco, Chandler.

Benard, B. (2004), *Resiliency: What we have learned*, San Francisco, WestEd.

Benedetti F., Cinganotto L., Garista P. (2020). Connecting best performers in education: insights from a European project. In: (a cura di): Caldin R, Le Società per la società: ricerca, scenari, emergenze. II tomo • Sezione SIPeS Ricerca, scenari, emergenze sull'inclusione. p. 54-63, LECCE: Pensa MultiMedia.

Brown, J.H., D'Emidio Caston, M., & Benard, B. (2001). *Resilience education*. Thousand Oaks (CA): Corwin Press.

Foucault M. (1975), *Surveiller et punir*. Gallimard, Paris.

Freire, P. (2004), *Pedagogia dell'autonomia. Saperi necessari alla pratica educativa*, Torino, Gruppo Abele.

Freire, P. & Macedo, D. (1987). *Literacy: Reading the word and the world*. MA: Bergin and Harvey.

Garista, P., Mereu, A., Sardu C., Campagna, M. and Contu, P. (2015), «The mouse gave life to the mountain. Gramsci and health promotion», Health Promotion International, 30(3), pp. 746-755.

Garista, P. & Cinganotto, L. (2017). Keats' "negative capability" for digital resilience education. Exploring boundaries among English language, social network, and resilience as resources for communication and inclusion. ANNALI ONLINE DELLA DIDATTICA E DELLA FORMAZIONE DOCENTE, vol. 9, p. 127-140, http://annali.unife.it/adfd/article/view/1425

Garista, P. (2018). *Come canne di bambù. Farsi mentori della resilienza nel lavoro educativo*. Milano: FrancoAngeli.

Garista P., Pocetta G., Lindstrom B. (2019), Picturing academic learning. Salutogenic and health promoting perspectives on drawings, Health Promotion International, https://doi.org/10.1093/heapro/day027

Garista P. (2022), *Drawing as a reflective practice*, IMG Proceedings, Springer, *in press*.

Garista P., Pocetta G. (2022a) Making Reflexivity and Emotions visible. The contribution of Logbooks and Polar Semantic Maps in Health Promotion Research, Eds: Potvin L., Didier J., *International Handbook of Health Promotion Research*, Springer, *in press*.

Garista P., Pocetta G. (2022b), Health Educators love reading: introducing the journal club for life-long learning, Eds: Akerman M., *International Handbook of Teaching and Learning in Health Promotion*, Springer, *in press.*

Giroux H. (2021). *Pandemic Pedagogy. Education in times of crisis*. LA: Bloomsbury.

Golde, C. (2007). Signature Pedagogies in Doctoral Education: Are They Adaptable for the Preparation of Education Researchers? Educational Researcher, 36(6), 344–351. doi:https://doi.org/10.3102/0013189X07308301

Goussot, A. (2014), *Pédagogie et Résilience*, Paris, Le Harmattan.

Griffith, J., Steptoe, A., & Cropley, M. (1999). An investigation of coping strategies associated with job stress in teachers. British Journal of Educational Psychology, 69(4), 517–531. https://doi.org/10.1348/000709999157879

Hidalgo-Andrade P, Hermosa-Bosano C, Paz C. Teachers' Mental Health and Self-Reported Coping Strategies During the COVID-19 Pandemic in Ecuador: A Mixed-Methods Study. Psychol Res Behav Manag. 2021;14:933-944 https://doi.org/10.2147/PRBM.S314844

Maturana H., Varela FJ (1984), L'albero della conoscenza, Milano: Garzanti.

Mayo, P. (2007), *Gramsci, Freire e l'educazione degli adulti*, Sassari, Carlo Delfino Editore.

Mezirow J (2000), a cura di, Learning as transformation. Critical Perspectives on a Theory in Progress, Jossey Bass, San Francisco (CA).

Milstein, M.M., & Henry, D.A. (2008). *Leadership for Resilient Schools and Communities*. CA: Corwin Press.

Montuori, A. (2005). Literature review as creative inquiry. Reframing Scholarship as a creative process. Journal of transformative learning, 3(4), 374-393.

Nussbaum M. (2001), L'intelligenza delle emozioni, Il Mulino: Bologna.

Schön, D. (1993). Il professionista riflessivo, Dedalo: Bari.

Tisseron, S. (2017), *La résilience*, Paris, Presse Universitaires de France/Humensis.

Todd S. (2016), Facing uncertainty in education: beyond the harmonies of Eurovision education, *European Educational Research Journal*, 15, 6.

Ungar, M. (2021), Editor, *Multisystemic resilience: adaptation and transformation in contexts of change*, New York: Oxford University Press.

GLOSSARY OF TERMS

Abstraction - Abstraction in computational thinking enables us to navigate complexity and find relevance and clarity at scale. Decomposition and pattern recognition broke down the complex, and abstraction figures out how to work with the different parts efficiently and accurately. This process occurs through filtering out the extraneous and irrelevant to identify what's most important and connects each decomposed problem.

Active Observer - An individual who watches what happens in the group work, records, and reports the noticed interaction and behaviour of the group.

Adaptive learning - Adaptive learning is one technique for providing personalized learning, which aims to provide efficient, effective, and customized learning paths to engage each student. Adaptive learning systems use a data-driven approach to adjust the path and pace of learning, enabling the delivery of personalized learning at scale.

Advanced Beginner - After getting some experience in applying the rules in real situations, they begin to recognize situational elements that they need to consider from their actions.

Agile - The Agile methodology is a way to manage a project by breaking it up into several phases. It involves constant collaboration with stakeholders and continuous improvement at every stage.

A production process - A production process is the method of using economic input or resources, like labor, capital equipment or land, to provide goods and services to consumers.

Blended Learning - It combines online digital media with traditional classroom methods.

Brainwork Assignment Preparation Checklist (n) - A list of steps needed to be undertaken by the educator to prepare a comprehensive brainwork task.

Case Study - A process or record of research into the development of a particular person, group, or situation over a period of time. [Oxford languages, URL: https://languages.oup.com/google-dictionary-en/] A document which can be used in classrooms in the form of a "teaching" case study. The case method is a teaching approach that uses decision-forcing cases.

Clickers - Clickers are an interactive technology that enables instructors to pose questions to students and immediately collect and view the responses of the entire class. The system instantly collects and tabulates the results, which instructors can view, save, and (if they wish) display anonymously for the entire class to see.

Coaching - Coaching is a pedagogical technique that leads to a student-centric learning process where the teacher takes the role of a coach to co-create learning goals and facilitate the learning process.

Co-coach - A teacher with some experience on design thinking or innovation processes. He/she is a buddy teacher to the main course teacher.

Co-curricular squads (n) - Co-curricular clubs for singing, dancing, acting, photography, animation, sports, etc.

Cognitive Reflections - It is a questioning situation to compel a person to rethink and reflect on the acquired information and knowledge.

Co-learning - Co-learning aims at the collaborative construction of knowledge, in which co-learners are able to expand their social networks, integrate open learning with collective research and co-author collaborative productions.

Collaborative Learning Activities / Intra-Group Discussion - It is an environment to enhance the individual thinking ability in a group setting, following the group norms and social norms.

Competent - Independently fills & compiles the students' assessments following the set pattern or procedure and different tools and techniques used for the same. Can independently correct the notebooks of the students and frame the question paper as per the bloom's taxonomy.

Competitive Debate - In competitive debates, teams compete against each other and are judged the winner by a list of criteria that is usually based around the concepts of "content, style, and strategy".

Computational thinking - Computational thinking allows us to take a complex problem, understand what the problem is and develop possible solutions. We can then present these solutions in a way that a computer, a human, or both, can understand.

Concept - An abstract idea. A unit of knowledge created by a unique combination of characteristics (ISO 1087-1:2000, 3.2.1).

Concept Formation - A teaching strategy for gaining understanding of a notion (or idea) by studying, analysing, categorising a small set of examples of the concept.

Daily Teaching Nib - It is an academic tip which fosters Pre-Service and In-service teachers to use different pedagogies in their classrooms as a part of teacher's toolkit. This will help to enhance their teaching experience and will help in engaging the students in their classes positively.

Decomposition - The process of breaking down complex problems into smaller, more manageable parts. With decomposition, problems that seem overwhelming at first become much more manageable.

Deduction - The process of drawing logical conclusions that are specific in nature through the method of reasoning.

Deep Learning - Deep learning engages students as active members in knowledge-co creation, wherein students' skills and knowledge are simultaneously developed. The core skills that are developed include skills to learn-unlearn-relearn, communication skills, global citizenship, creativity, critical thinking.

Design thinking - Design thinking is a method to solve modern and wicked problems and challenges from the user's perspective. Wicked problems are complex problems that require creative and critical thinking skills to solve.

Dictogloss - It is a classroom dictation activity where learners are required to reconstruct a short text by listening and noting down key words, which are then used as a base for reconstruction.

EduScrum - EduScrum is a learner centric training program which includes group work and collective intelligence. It helps in learning strategies and optimize time spent in training. Its main benefit includes higher learner motivation as well as speeding the learning process.

Entry Behaviour - Entry behaviour includes the prerequisite knowledge, attitudes, or skills which the student already possesses that are relevant to the learning task or subject matter and that may be required to be demonstrated before beginning of the module.

Experiential learning - Learning by doing. The learning process where students learn by performing tasks practically and reflecting upon their experiences.

Expert - Expert's performance is marked by effortlessness and fluidity guided by intuition. Skills become part of experts. There is no need for conscious decision-making or problem-solving unless a novel situation is encountered.

Evaluation - It is the third stage of FIESI Model which involves the critical thinking to evaluate creatively generated ideas generated through ideation to make it feasible.

FIESI Model - FIESI Model is designed to develop productive thinking ability that combines creative thinking and critical thinking.

Formative Debate - A flexible teaching strategy where a teacher or a group of teachers can adopt debate within their lesson as an educational tool. The arguments and themes of the debate must touch back on course themes, and students must base their arguments on course materials as well as their own research to be effective.

Foundation - It is the first stage of FIESI Model in which the teacher motivates students to get engaged in the content by manipulating their prior understanding and teach them with the help of student centric strategies like, activities, demonstration, and teaching with technology.

Global skills - Global skills are those skills that enable us to operate in an international context. These skills include cultural awareness, language and communication skills, international commercial awareness and networking. Global skills encourage sensitivity to the needs of others, problem-solving, and how to communicate effectively with those from different cultures.

Group Conduct Document - It is a document drafted collaboratively by the team that has all the principles that the team members can use to distinguish right from wrong — it is a written collection of rules, principles, values, expectations, and behavior that the team considers fundamental to their success.

Group Process - Group process refers to how team members work together to get things done.

Head and Tails - A title of a tool for the development of critical thinking which is based on the activity of coin flipping: a head is the front side of a coin; a tail is the backside of a coin. This tool serves as a dynamic and functional tool for enhancing students' critical thinking.

High-impact experience - An educational experience in which students actively pose and solve problems, work collaboratively in a community of peers, experience real-world applications of knowledge, and reflect on their own learning processes.

Ideation - The second stage of FIESI Model is the ideation. It emphasizes creative thinking with the help of strategies like, creative writing, SCAMPER, cognitive questions, and brainstorming.

Implication - It is the fifth stage of the FIESI model where the created ideas are implied in real life situations to get value from it.

Inclusive (adj.) - Including or taking everything into account.

Inductive thinking - In inductive reasoning, we begin with specific observations and measures, begin to detect patterns and regularities, formulate some tentative hypotheses that we can explore, and finally end up developing some general conclusions or theories.

Industry 4.0 (n) - Also called the Fourth Industrial Revolution, the term refers to the idea of the cyber-physical transformation of manufacturing.

InnoFlash Process - During the JAMK InnoFlash course, students solve real working life problems in multidisciplinary student teams. It's part of JAMK mandatory course work. In The Innoflash course, the students are required to apply their 21st century skills.

INSERT Method - INSERT method (Interactive Noting System Effective Reading and Thinking) – founded by Vogan and Estes developing critical thinking ability in reading scientific texts. This method visualizes the process of knowledge accumulation from known information to the new one. Student can mark text or information as following: "v" – already know, "+" – new information, "–" – had another idea, "?" – unclear, and needs to be clarified.

Instructional Aids - Any material or device used to assist the teacher in preparation and presenting the lesson and facilitating the learning of the students.

Inter Group Sharing - Sharing of information among different groups for the purpose of developing creative and critical thinking.

Intersubjectivity - Intersubjectivity is the process wherein two participants begin a task with different understanding and arrive at a shared understanding.

Iterative - Iteration is the repetition of a process to generate a sequence of outcomes.

Kolb's learning cycle - Kolb's learning cycle is a transformational learning process that involves four stages, namely: concrete learning, reflective observation, abstract conceptualization, and active experimentation.

Learner autonomy - A condition of taking responsibility and being accountable for one's learning, focusing on the goal one needs to achieve, being actively involved, taking individual decisions according to one's necessities and preferences.

Learners' preparedness - A state of being ready to make decisions with reference to the previously gained knowledge.

Level playing field (n) - A situation where everyone has a fair and equal chance to succeed.

Long-term memory - Long-term memory consists of memories that the brain has stored over an extended period of time. These memories can be from an hour ago or from decades earlier.

Lotus Blossom method - The Lotus Blossom Technique is a structured brainstorming exercise used to expand on a central idea or problem. Teams place the original problem statement in the center box in a 3x3 matrix, then add related themes or elements of the

problem in the 8 boxes surrounding it. [https://thoughtegg.com/lotus-blossom-creative-technique/]

MAX - MAX is an acronym that stands for the three steps of the teaching framework: Motivation, Acquisition, and Extension. It is a tool to develop students' analytical and reflection skills when analysing, synthesizing, and evaluating the information obtained.

Model of Productive Thought of Douglas P. Newton (2017) - It is a structured approach of solving problems or generating creative ideas.

Muddy cards - It involves – finding the "muddiest" point of the lecture – students give feedback to analyze, increase learning retention and determine gaps in their comprehension – students are asked to reflect what they have learned - they write down the most unclear points of the lecture. The instructor may correct misconceptions by the next class or use the cards in seminars.

Multiculturalism - Multiculturalism describes the way a given society deals with cultural diversity.

Multidisciplinary (adj.) - Merging or involving various academic disciplines or subjects.

Multi-perspective Teaching (n) - An educational approach that considers different perspectives of learners.

Natural semantic categories - The combination of a set of semantic primes each representing a different basic concept, residing in minds with a propensity to acquire certain basic concepts, and a common set of rules for combining those concepts into meaningful messages, constitutes a natural semantic concept.

Novice - The novice's actions are guided by rules and a set of objective facts and features related to the skills. There is little consideration for the context of the actions.

Open Book Environment - An open book environment helps students to acquire new knowledge, to solve problems and make intelligent decisions. It helps students to perform well in the Open Book Examination.

Open Book Examination - An assessment practice wherein students are allowed to refer either to class notes or a memory aid or a textbook, or any other approved material while answering questions.

Open Ended Instructions - Open-ended tasks have more than one right answer, solution or outcome and can be completed in more than one way. They can take the form of statements, questions, tasks, projects, or teaching methods. Different learners may use different types of thinking; and there are no predetermined correct outcomes.

Pattern recognition - Pattern recognition means recognizing patterns. Specifically, with computational thinking, pattern recognition occurs as people study the different decomposed problems.

Pedagogy - Pedagogy helps in deciding the teaching strategies, teacher actions and decisions by taking into consideration theories of learning, understanding of students and their needs, and the backgrounds and interests of individual students.

Peer Teaching - It is a method of teaching, where a student teaches another student, wherein the former will be an expert and the latter a novice. This is based on the belief that "To teach is to learn twice" (Collins).

Perspective (n) - A particular way of regarding or viewing things, based on one's experiences, likes, or dislikes.

Phenomenon - A fact or situation that is observed to exist or happen, especially one whose cause or explanation is in question.

Productive Thinking - It is the cognitive ability of solving problems through a process of combining creative thinking and critical thinking.

Proficient - This stage is marked by the emergence of intuitions or know-how (procedural knowledge). Proficient performers are able to act without conscious deliberation since they can recall similar situations in the past and the course of actions taken that were proved effective.

Psychomotor Domain - The psychomotor domain includes physical movement, coordination, and use of the motor-skill areas. Development of these skills requires practice and is measured in terms of speed, precision, distance, procedures, or techniques in execution.

Questions of Cognitive Conflicts - It is a questioning situation to create conflict on the acquired information and knowledge for the purpose of compelling a person to think.

Reflection theory - Critical analysis and evaluation of one's learning experiences.

Reflective learning - Reflective learning involves students thinking about what they have read, done, or learned, relating the lesson at hand to their own lives and making meaning out of the material. It's more than just memorizing some facts, formulas, or dates.

Reinforcement - Reinforcement is used to help increase the probability that a specific behaviour will occur in the future by delivering or removing a stimulus immediately after a behaviour.

Reproductive thinking - Reproductive thinking is associated with chained behavior or repetition and ultimately leads to rote learning.

Research (n) - The in-depth or thorough study of a subject.

Rote-memorisation (n) - The process of memorising information on the basis of repetition.

Scaffolding - Refers to the successive levels of temporary support provided to the In-service teacher and pre-service teacher that helps them to reach higher levels of comprehension and skill acquisition that In-service teacher and pre-service teacher would not be able to achieve without assistance.

Seating plan (n) - (here) A diagram or a set of spoken or written instructions that directs where students should take their seats.

Short-term memory - Short-term memory, also known as primary or active memory, is the capacity to store a small amount of information in the mind and keep it readily available for a short period of time.

SMART goals (n) - Goals that are Specific, Measurable, Attainable, Relevant, and Time-Bound.

Socio-pragmatic skills - Socio-pragmatic strategies are those based on social and cultural considerations that are needed for comprehending any piece of discourse and the related speech acts including politeness issues, gendered language use, the nature of power relations, and distance.

Sprint - The heart of eduScrum is a sprint, a composite set of learning materials that ensure that the learning objectives are achieved. A sprint can be a context-rich lesson series, a project, a chapter from a book and so on. In general, a sprint will coincide with the length of a semester or period, although this is not a requirement. A sprint has a pre-set time box (period) of approximately seven weeks.

Stabilization - It is the fourth stage of FIESI Model that helps students in stabilizing the concepts acquired through the previous stages of the model.

Student-led recitations - Student-led recitations (Ticking) – appropriate for use in teaching problem solving, first used at Royal Institute of Technology (KTH) in Stockholm. For weekly recitation sessions students are asked to work through a set of problems. At session students tick on the list which problems they are prepared to present, solve, explain, and lead the classroom discussion. Students need to tick at least 75% of problems to pass the course. Students spend time on tasks, are active, reflect on how to explain the methods and argue on problem-solving strategies.

SWOT analysis - A SWOT analysis is a technique for assessing four aspects (Strengths, Weaknesses, Opportunities, and Threats) of your process, project, organization, or personality.

Teachers' Excel Sheet - A quarterly e-newsletter dedicated to sharing resources in teaching, pedagogies, learning and assessment.

TEAL - Technology-enabled active learning is a teaching format that merges lectures, simulations, and hands-on desktop experiments to create a rich collaborative learning experience. It can be categorised as Soft Teal and Hard Teal.

TED-Talk - Eight-minute video-recorded speech on different topics.

Thinkx Model of Tim Hurson (2007) - The Productive Thinking Model (thinkx), developed by Tim Hurson, is a structured approach to solving problems or generating creative ideas.

Value creation pedagogy - Value creation pedagogy is when teachers let their students learn by applying their competencies (future or existing) to create something of value to at least one external stakeholder outside their own group, class, or school. The value that students create may be social, economic, or cultural.

Visual diagrams - Includes mind map, Fishbone diagram, Venn's diagram, etc. These methods help to develop students' analytical and critical thinking abilities and reflection.

Vocational inclinations (n) - Strong dispositions to follow a specific career or activity.

WSD - World School Debate format, one of the most common competitive formats generally adopted in international tournaments and olympiads.

ZPD - Zone of Proximal Development is defined as the difference between Pre-service and In-service teacher's actual skill level as determined by independent teaching and the Pre-service and In-service teacher's potential skill level as determined through hand holding and in collaboration with more capable peers.

BIOGRAPHY OF OUR AUTHORS

Andreas Zoppf - Andreas Zopff, (Jun.-Prof. Dr. phil.). After his Abitur, civilian service and vocational training as a carpenter, Andreas Zopff studied wood and plastics technology, sociology, and vocational education at the University of Hamburg. He then worked for 20 years as a teacher in various functions (training officer, head of department, QM officer, certified learning coach) at a vocational school in Hamburg. Since 2021, he has been a junior professor of vocational education with a focus on the development of industrial-technical professions at Otto von Guericke University Magdeburg. His work focuses on vocational education for sustainable development, the linking of virtual and real learning worlds, the horizontal permeability of education systems and solution-oriented learning coaching.

Universität Hamburg

Anna Stavicka - Dr. Anna Stavicka is a senior researcher, assistant professor affiliated with the University of Latvia, Faculty of Education, Psychology and Art, Teacher Education Department. Her areas of expertise encompass: research on higher education internationalization, international HEI and teaching and learning in the multilingual and multicultural settings, intercultural communication, teaching and learning the language of instruction (LoI) to students and educators, teaching subject content through LoI, content and language integrated learning (CLIL), delivering HE pedagogical trainings, facilitating onsite, blended and e-learning, leadership and management (project coordination), course design and scientific advisory.

LATVIJAS UNIVERSITĀTE
UNIVERSITY OF LATVIA

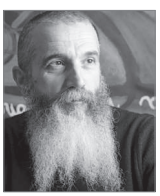
Ashutosh Biswal - Professor Ashutosh Biswal, M.A., M.Ed., Ph.D. in Education, is working as a Professor in Department of Education, (CASE), Faculty of Education and Psychology, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat. He has more than 25 years of teaching and research experience. He worked extensively in Computer Education, Value Education, Educational Evaluation, Teacher Education, Open Book Examination, Thinking and Autism. He has guided more than 18 Ph.D. Students. He has published 7 books and more than 100 papers.

सत्यं शिवं सुन्दरम्

Dolma Pathela - Dolma Pathela is a vivacious young lady who has been associated with the field of education for a period exceeding five years. Her adventures in the world of writing began on the completion of her Master's Degree in English Literature & B.Sc. in Medical Science, when she joined Chitkara International School, India. She has to her credit many thought-provoking articles and texts, published in renowned newspapers & magazines and is known for her phenomenal editing & content writing skills. Ms. Pathela envisions the excelling of all school-going children, in her region & worldwide, through functional teaching tools, and endeavors to propagate the idea of "quality learning" through the chapters – Brainwork & Multi-Perspective Teaching in this handbook.

Essi Silvennoinen - Master of social sciences (Business economics, Statistics), certified Team Coach and Business Counselor, Educator and Mother. Essi Silvennoinen has a long and broad work experience in team working, R&D product development, marketing, and coaching before becoming a senior lecturer at JAMK University of Applied Sciences, where she worked for over 11 years as a certified Team coach and pedagogical developer in a forerunning entrepreneurial BBA degree programme in Finland, Team Academy. Team Academy was awarded in WISE (World Innovation for Education) 2015 as one of the world's top 20 effective education models in entrepreneurship. Additionally, UBC (University Business Corporation) awarded Team Academy as one of the best educational models combining education and business. Since 2018 she has worked as a professional teacher educator in JAMK University of Applied Sciences and as developer and key expert in international projects focusing on innovation and entrepreneurial pedagogy as well as 21st century skills for teachers around the world. Essi Silvennoinen is a thought leader in innovation pedagogy, a holistic thinker, idea generator and a doer.

Francesco Maria Marelli - Born in Parabiago, near Milan, in 1958. He studied at art school then at "Accademia di Belle Arti di Brera" in Milan; he graduated in Sculpture in 1980. He also pursued musical and theatrical studies. At the beginning of his career, he worked as a specialist of a laboratory about expressivity and theatrical animation. From 1987, he's been professor of Plastic Discipline and Scenography. Alongside his scholastic and didactical activity and research, he follows other careers: Music and Art. Speaking of music, he played for several years in a fusion project, singing, and playing alto saxophone. As a solo artist, he pursues a project about Milanese traditional music, inspired by the figures of Milanese storytellers, between the end of XIX century and the beginning of the XX. As an artist, he started to exhibit his wood sculptures at the end of the 80s and he still pursues projects and exhibitions all around Italy and abroad.



Graham Burns - Master of Arts (Intercultural Communication, English as a foreign language for adults) is also a certified teacher and spoken language assessor for Cambridge Assessment (formerly Cambridge English). He spent 26 years gathering experiential knowledge on leadership, motivation, and project management with the British armed forces in many different places around the world before becoming an entrepreneur in 2003. During his second career, he established a language school in Central Finland through which he worked as a teacher for adults for over ten years in both private and public sectors. In this period of his busy life, Graham helped organisations to develop their English language skills and business practices to facilitate business growth. Graham now puts all that experience to good effect in his third career as a manager of international projects for JAMK University of Applied Sciences' School of Professional Teacher Education in Finland. What will be next? That simply depends on which door opens first.

Dr. Honey Chitkara - Dr. Honey Chitkara is a fervent uplifter and an impassioned educationist who holds a spectacular 19+ years' experience in the field of education. She's the woman behind numerous innovative practices that the educational landscape at Chitkara International School, India, has witnessed and as the school's Associate Director & Principal, she continues to admirably edify the youth and is known for her incredible research work on using students' feedback for improving teaching effectiveness. Dr. Chitkara is widely known for her out-of-the-box thinking and spiffing ways of leadership, which all emanate from the rich academic credentials that she holds, including a Bachelor of Arts (Humanities), Diploma in Textile Designing, Bachelor of Education (B.Ed.), Master of Arts in Education, and Doctor of Education (PhD). Her experiments with writing began early on in her life and over the years, she has come to appreciate the merits of writing, especially in terms of inspiring the youth and aspiring teachers. In this regard, Dr. Chitkara's thesis on "Using Students' Feedback to Improve Teaching Effectiveness based on Kaizen Philosophy of Continuous Improvement" has been widely acknowledged for its undeniable efficacy, and through her active contribution to the chapters, Brainwork, Multi-Perspective Teaching (MPT) and The Teaching Interplay for Honing Analytical, Critical and Creative Thinking Skills in this handbook, Dr. Chitkara endeavours to further the necessary change that educationists world over must bring to their classrooms in order to render the most effective education to learners that are growing in an ever-so-competitive Industry 4.0.

Indra Odina - PhD in Education Sciences, Professor and Leading Researcher in Higher Education Pedagogy.

LATVIJAS UNIVERSITĀTE
UNIVERSITY OF LATVIA

Research interests: internationalization of teacher education, competence approach in education, teachers' professional identity and career, English language teaching methodology, mentoring.

She has been working at the Faculty of Education, Psychology and Art of the University of Latvia for 30 years, has prepared and accredited 3 study programmes, developed and delivered 32 study courses for master and bachelor students, 10 in-service education programmes and 26 professional development courses for teachers and students. Currently, she is the director of the Professional Master's Study Programme "Teacher" and the director of the Professional Bachelor Study Programme "Teacher", a member of the Council of Educational Sciences, Doctoral Defence Council of Pedagogy and Council of Pedagogy Professors. Author of 89 publications, 15 of them indexed by WoS. Since 2014 an expert in Higher Education of Latvian Science Council. Participated in 37 different projects (23 international, 14 local) as a coordinator, researcher, and expert, including scientific reviewer's position of the English Language Subject Curricula and Foreign Language Standard in the project "Competence Approach in Curriculum". Supervises 7 doctoral theses, two defended in 2015 and 2022; since 2004 has supervised 69 and reviewed 25 master's theses; supervised 98 and reviewed 48 bachelor's theses. Has delivered lectures abroad (Austria, Finland, Georgia, Ukraine, Belgium, Portugal, Germany, Poland), organizes annual international events for students and professors: sections of the International Scientific Conference of the University of Latvia, International Professors' Week (Erasmus + staff training), Global Education Days, summer conferences for teacher-mentors and mentor educators. Indra Odina is an expert of the Accreditation Commission of State Education Quality Service, INSET facilitator Tajikistan to the Ministry of Education and Science in the Areas of in-Service Teacher Training, Learning Assessment and Planning, Budgeting and Monitoring, Project Peer and Lead Reviewer of the Science Fund of the Republic of Serbia, a director of the Latvian Association of University Lecturers for Cooperation in Education (LAPSA)/ Latvian Association for Cooperation in Education (LACE). Reviews articles by Horizon Research Publishing, USA (HRPUB) Universal Journal of Educational Research and GESJ Educational Science and Psychology.

Jaishree Das - Dr. Jaishree Das, M.A., M.Ed., Ph.D. in Education, is working as Associate Professor in Department of Education (CASE), Faculty of Education and Psychology, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India. She has more than 25 years of teaching and research experience. He worked extensively in the area of Value Education, Guidance and Counseling, Special Education and Teacher Education. She has guided five Ph.D. Students. She has published 3 books and more than 40 papers.

Kamakshi Raipure - Ms. Kamakshi Raipure, M.Sc. (Chemistry), M.Ed., UGC-SRF is working for her Ph.D. work in the area of Productive thinking in the Department of Education (CASE), Faculty of Education and Psychology, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India. At present she is working as a teacher in the Higher Secondary section of Gujarat Refinery English Medium School at Vadodara, Gujarat. She has published 8 research papers in national and international journals.

Letizia Cinganotto - Letizia Cinganotto teaches language teaching at University for Foreigners in Perugia, Italy, former Senior Researcher at INDIRE (National Institute for Documentation, Innovation and Educational Research), Italy. She holds a PhD in synchronic, diachronic, and applied linguistics and recently achieved the national qualification as an associate professor of linguistics and language teaching. She is a member of different working groups and scientific committees on CLIL and language teaching both at national and international level. She has presented papers at national and international conferences and published articles and chapters in peer-reviewed journals and five volumes on CLIL. She is a member of the consultancy team of the "Pluriliteracies Teaching for Deeper Learning" project promoted by the European Centre for Modern Languages in Graz.

Marco Ghelardi - Marco Ghelardi (1975) is a director, playwright, translator, and drama teacher.

He trained at the Central School of Speech and Drama in London and for many years lived and worked in England, mainly in the field of opera, at the Royal Opera House, Covent Garden. He has directed more than twenty productions of William Shakespeare's texts, in England and Italy, and several contemporary English authors, often translated by him for the first time. He also wrote some original works for the theatre. He is currently drama teacher at the Liceo Candiani in Busto Arsizio, Italy.

Nidhi Waldia - Nidhi is currently working as the Innovation Manager at Savitribai Phule Pune University, Pune, Maharashtra. Nidhi is a lifelong learner who comes from a multidisciplinary background. Her areas of interest include issues of equity in education, teacher professional development, socio-emotional learning, and early childhood education.

Nisha Valvi - Dr. Nisha Valvi works as an Associate professor in the Department of Education and Extension, Savitribai Phule Pune University. With an experience of over 16 years, Dr. Nisha has worked as a teacher educator teaching in graduate and post-graduate programs, and a researcher on numerous national and international projects. Her interest areas include Education, Inclusive Education, and Zoology. Due to her love for learning, she continues learning by participating in various workshops and webinars. She has 2 books, 7 chapters, 18 journal publications, and 18 research papers published in journals to her credit. She is currently engaged in various international, national, and university-level projects.

Niyati Chitkara - Dr. Niyati Chitkara is a generation next leader, an avid educationist, and a methodical writer (of the book Assessment Quotient) whose contributions to the field of education are admired and lauded by her counterparts across her country. As the visionary Director of Chitkara International School (Chandigarh & Panchkula), India, she holds a supremely rich experience of over 20 years in the educational field and remains associated with some of the most renowned educational initiatives and practices undertaken within the educational sector. Dr. Chitkara's love for education and immense knowledge, in fact, spring from her extraordinary academic experiences and credentials, which include Master of Education (M.Ed.), Master of Commerce and Business Administration and Doctor of Philosophy (PhD). Her awe-inspiring research work in school-based assessments has effectively helped her institution come up with some of the most celebrated assessment tools like Open Book Revisions (OBRs) and Brainwork. Over the years, Dr. Chitkara has worked dedicatedly to create a sense of integrity, dignity and confidence among young learners so that they are ready to face life's challenges, which remain unique and totally distinct in Industry 4.0. Furthermore, Dr. Chitkara is an external expert for the Board of Studies of Bachelor of Education (B.Ed.), Master of Education (M.Ed.), B.A./B.Sc. Psychology and M.A./M.Sc. Psychology at Chitkara College of Education and Chitkara College of Counselling. She has been chosen among

"33 Young Rising Stars of Indian Education" by Education World and been awarded by numerous notable government and private bodies, all of which remain testaments to her commitment and passion towards school education and illustrate how by her judicious dispensation of knowledge, she has gained momentous success in all her endeavours.
Presently, through her significant insights and contributions to the chapters on Brainwork, Multi-Perspective Teaching (MPT), Integrated and Interactive Lesson Plan, and The Teaching Interplay for Honing Analytical, Critical and Creative Thinking Skills, Dr. Chitkara intends to stimulate a tech-savvy, innovation-loving, and research-centred educational landscape, where all kinds of learners are able to leverage the merits of education and gain core employability skills to thrive in Industry 4.0.

Parul Sood - Dr. Parul Sood is a mother, friend, writer, and educator, who has been involved in the field of Teacher Education for more than 20 years. As the Assistant Dean of the illustrious College of Education, Chitkara University, Punjab, India, Dr. Sood embodies a reflective leader and innate learner and works dedicatedly towards edifying aspiring and in-service teachers for the ultimate elevation of young students. Among her many academic milestones remains a rather impressive series of scholarly qualifications, which include a PhD in Education, a Master's Degree in Philosophy, a Master's Degree in Mathematics, a Master's Degree in Science in Environmental Education, and Master's and Bachelor's Degree in Education. Dr. Sood, through her invariably riveting books and journals, has often brought into light the multiple facets of a truly successful teacher in today's excessively dynamic world. Presently, with her chapters "Integrated and Interactive Lesson Plan" and "The Teaching Interplay for honing analytical, critical and creative thinking skills - Instructing to Learn with In-service and Pre-service Teacher", Dr Sood takes ahead her mission of nurturing independent, confident, tech-savvy, and well-informed instructors and further restates her belief in the inseparability of learning & teaching as well as the merits of observation and teamwork for superlative teaching performance.

Patrizia Fazzini - Graduated in Education sciences and Italian Literature, she has been teaching Italian language, Italian Literature and History at the Liceo Candiani Bausch in Busto Arsizio since 1992. In charge of the Educational offer, she contributed to the definition of the Liceo as High School of Arts in a global sense (Art, Design, Architecture, Visual Art and Media, Graphics, Theatrical acting, Scenography, Dance and Music) unique in Italy. She organized Teacher training and updating in the field of Art Therapy and Contemporary History - focused on the Second World War and genocides.

Patrizia Garista - Patrizia Garista, holds a BA Educational Sciences and a PhD in Health Education, and has been Full time Researcher in General Pedagogy at the National Institute of Documentation, Innovation and Educational Research (INDIRE) since 2014. She is an adjunct professor of Social Pedagogy and Life-long learning at the University of Perugia where she has been collaborating in publishing, research, and training activities of the Research Centre on Health Promotion and Education since 2001. She has been collaborating with EuropeanTrainingConsortium. Her research interests are focused on the connection between wellbeing and life-long learning; resilience and salutogenic pedagogy; social justice, empowerment, and sustainability; narrative and art-based research methods for teaching and learning; reflective practices.

Piyusha Sharma - Piyusha Sharma is a self-motivated, often unconventional young educator who found her passion for creating strong, stimulating pieces of writing while teaching the students at middle and secondary level of learning at Chitkara International School, India. Ms. Sharma enjoys reading inspiring texts, when not writing, and holds a Bachelor's Degree in Commerce, a Post Graduate Diploma in Business Administration (Finance) & a Master's Degree in Political Science. Her academic experiments in her English classrooms over the years have helped her conclude the existent needs of learners, which she considers to be outright distinct & diverse. Through the chapters, Brainwork & Multi-Perspective Teaching (MPT), Ms. Sharma aims to spur on the vision of her organisation, which promises the success of all school students, amid the otherwise competitive & dynamic world.

Pratibha Patankar - Dr (Mrs) Pratibha Subhashchandra Patankar is a Professor and Head of the Department of Education, Shivaji University, Kolhapur, Maharashtra (India). Her qualification is M.Sc. (Zoology), M.Ed., M.A (Philosophy), M.A (Subject Communication), M.BA (Higher Education). She has a Teaching Experience of 36 years at School, Junior college. Undergraduate and Postgraduate level of Teacher Education, she has published 70 research articles and papers in Books and Journals and Edited 3 books, completed 2 UGC Projects as Principal Investigator and Co-investigator, ICSSR, and 12 Minor Research projects sanctioned by Centre of Distance Education Shivaji University, Kolhapur Zilha Parishad, Mahatma Gandhi National Council for Rural Education (Under MHRD). Under her able guidance 20 students have completed Ph. D and 11 students M. Phil and currently 6 students are working including two foreign students. She is Academic Council member of Shivaji University Kolhapur and Autonomous Mahavir college in Kolhapur.

Dr. Sangeeta Pant - Dr. Sangeeta Pant is a woman with many hats - a sterling teacher, a candid writer and an exemplary leader who started her journey in the field of education back in 1989 and ever since, there has been no looking back. As the Dean of the College of Education, Chitkara University, India, she remains the driving force behind the distinct Teacher Education Program at her university and contributes significantly towards facilitating the university's pedagogical processes. Dr. Pant's incredible mastery in varied fields can be ascribed to her noteworthy academic qualifications, which include the Master of Arts (M.A. degree), Master of Education (M.Ed. degree) and Doctor of Philosophy (PhD) in Education. She is the Editor of Chitkara University's journal viz. "Issues and Ideas in Education" and also an integral member of the Editorial Board of the prestigious "Baltic Journal of English Language, Literature and Culture". For her organisation, she further stands as the Co-ordinator of the "Content and Language Integrated Learning" project, and "Mitigate the Impact of Fourth Industrial Revolution on Indian Society: Education Reform for Future and In-service School Teachers" project, both of which have been co-funded by the Erasmus+ Programme of the European Union. Dr. Pant's long-standing engagement in writing can be traced through the scores of thought-provoking articles that she has created so adeptly over the years for reputable Hindi newspapers and other coveted organisations. Through her chapter "Integrated and Interactive Lesson Plan" in this handbook, Dr. Pant seeks to render some truly unique and effective tips for excellent content delivery to both the in-service and pre-service teachers and further encourage them to follow a strong outcome-based educational approach to ensure the success of the learners of Generation Alpha.

Sanjeev Sonawane - Prof. Sanjeev is a multi-faceted presence in the fields of teacher education and higher education who has worked in the capacity of teacher, administrator, researcher, and author. He began his career as a mathematics and science teacher at a school and rose through the ranks to become a Senior Professor at Savitribai Phule Pune University in Pune after a 35-year journey. At Savitribai Phule Pune University, Prof Sonawane has served in multiple prominent positions including Dean, HOD, Director of School, member of the management council, and researcher. As a researcher, he is credited with the successful completion of National and International research projects funded by ISRO, ERASMUS+, Indo-Norway Higher Education Council, India-Australia council, RUSA, and PMMMNMTT. Currently, he is heading international projects like UTC Force, Tunning India, and EDUREFORM at the University. His contributions in the field of education have been honored by the Linnaeus Palme Teacher Exchange scholarship (2003 & 2010) by Govt. of Sweden, The NCPEDP Mind Tree Helen Keller National Award 2012, and the Award of Eminence IATE, 2019. He has authored 17 books in the domain of Education and Physical Education, all of which are highly referenced research publications with high h & i index.

Sören Schütt-Sayed - Sören Schütt-Sayed (Dr. phil.), born in 1979, is a senior engineer at the Technical University of Hamburg in the Institute for Technical Education and University Didactics. He is a graduate of the teacher training program for the upper level at vocational schools in the subjects electrical engineering and business administration and has taught for two years at a vocational school. His research areas include vocational education for sustainable development, professionalization of vocational school teachers, and teaching/learning research in industrial-technical subjects.

Universität Hamburg

Vaibhav Jadhav - Dr. Vaibhav Jadhav is a teacher educator, trainer, and academic- researcher in the areas of Education and Literature. He obtained his Ph.D. from the Regional Institute of Education [NCERT], Bhopal, and was awarded the prestigious C.V. Raman PostDoc Fellowship by UGC, New Delhi in 2016, and completed post-doc research at the University of Massachusetts, Amherst, the USA in 2017. He has worked on many national and international research projects like Governance & Leadership in Higher Education of India funded by NUEPA, UNESCO-Bangkok project on Telecollaboration in Teacher Education, IUCTE-MSU Barada funded project on e-Governance in Universities of western India, and Digital Citizenship Education funded by UPE Phase II- SPPU, etc. He is currently employed as Assistant Professor at the Department of Education and Extension, Savitribai Phule Pune University, and is working on multiple international projects on Teacher Education with South-Eastern Norway University, Norway, Tuning India Project with the University of Deusto, Spain, and NOTED Project funded by Government of Norway, Blended Intensive Study Programme in Pune, and Oulu (BISPPO) project with Oulu University, Finland funded by TEAM Finland Knowledge Program. His ongoing project is EDUREFORM with the European Union. His areas of interest include Information & Communication Technology, Global Citizenship Education, Educational Technology, and Philosophy of Education.

Vidyanand Khandagale - Dr.Vidyanand S. Khandagale has immense interest in collaborative research activities. Being awarded as Junior Research Fellow, UGC in Education and has been awarded PhD in Institutional Effectiveness, from University of Mumbai, started his career in academics as lecturer at Department of Education, SNDT Women University, Churchgate, Mumbai and later joined the Department of Education of Shivaji University, Kolhapur. He has to his credit research papers/articles along with 2 Major Research projects and 7 Minor Projects having transdisciplinary approach. His research areas are Management and Economics of Education, Science Education and E-Education. He is a Master trainer of Learnwise and active member of various professional associations and has been contributing to various administrative and extension activities of the University.

Wilko Reichwein - Prof. Dr. Wilko Reichwein is currently a visiting professor at the Institute for Vocational Education and Work Studies at the Technical University of Berlin. While working as a teacher at a vocational school, he started working on his dissertation on vocational education for sustainable development. After working as a research assistant in the field of education for sustainable development and teacher professionalisation within the framework of the German teacher education quality campaign, he was a visiting professor at the Institute for Vocational Education and Business Administration at the University of Hamburg. His main areas of research are Vocational education and training for sustainable development, digitalisation and its impact on VET, didactic and methodological innovations in higher education teaching and networking of subject didactics and related science discipline in teacher education.

Universität Hamburg