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

New Dimensions of the Disruptive Impact on the Art and Creativity in Digital Social Innovation

This paper has received funding from the European Commission under the Grant Agreement number 2020-1-TR01-KA227-ADU-097776, ERASMUS+ Strategic Partnership project “New Dimensions of the Disruptive Impact on the Art and Creativity in Digital Social Innovation”.

New Dimensions of the Disruptive Impact on the Art and Creativity in Digital Social Innovation

Cooperation for innovation and exchange of good practices

KA227 - Partnerships for Creativity

Adult Education

2020-1-TR01-KA227-ADU-097776

"CREART"

D1 – Training Course Content

Revision: v.1.1

Intellectual output	IO1: Training Pack for Creativity and the Arts to Social Inclusion
Activity	Design and prepare the training course content
Project coordinator	Yenisehir Ilçe MEM, Turkey
Deliverable lead	Yenisehir Ilçe MEM, Turkey
Due date	15 December 2021
Authors	Ovidiu ACOMI, Nida AKCEVİZ OVA, Alpaslan AKILLI, Roxana Elena ANDREI, Helena AREVALO MARTINEZ, Mehmet Necmeddin DİNÇ, Gilberto MARZANO, Yeliz NUR AKARCAY, Hüseyin PARS, Özcan YÜCEL

Abstract	The evolution of technology and online learning has not only changed the way information is delivered, but also the teaching and learning processes. According to the DSI Final Report research project funded by the European Commission, DSI is defined as, "A type of social and collaborative innovation in which innovators, users, and communities work together using digital technologies to co-create knowledge and solutions to a wide range of social needs at a scale and speed unimaginable before the advent of the Internet" (Bria et al., 2015, p. 9) Arts and creativity are sociocultural constructs and reflect the social context. Accordingly, nowadays, art and creativity can be useful for the development of social innovation processes. As keys to generational formation, creativity and the arts support the vitality of cultural identities by highlighting their connections to other cultures, thus contributing to the construction of a common heritage. They help shape tolerant and dynamic citizens for our globalised world." (Unesco, 2020) A consortium formed by seven organisations conducted primary research in each country, analysing the competencies of social educators and teachers in innovative uses of creativity and the arts in social settings. Based on the data collected, the project team created an educational package to improve the competencies of social educators and teachers in developing and implementing innovative solutions that address social needs through the use of creativity and the arts. It also aims to encourage the use of creativity, art and digital technology to design and implement innovative solutions for social inclusion. This educational package contains 7 modules designed to provide the necessary knowledge and promote the development of skills and attitudes of social educators and teachers. The modules were developed according to the needs identified in the previous research: ● Creativity Theories and Models ● Individual and Social Creativity ● Creative Teaching and Teaching Creativity ● Machine Creativity ● Pedagogical use of the Arts ● Creativity and the Arts at School ● Creative Thinking
Keywords	Creativity; arts, adult education; creative thinking, thinking styles, problem-solving; lifelong learning; digital social innovation; machine creativity, digital technologies; pixel art; interactive art; machine creativity; creative teaching; creativity innovation; social creativity; creativity models

Acknowledgement

This paper has received funding from the European Commission under the Grant Agreement number 2020-1-TR01-KA227-ADU-097776, ERASMUS+ Strategic Partnership project “New Dimensions of the Disruptive Impact on the Art and Creativity in Digital Social Innovation”.

Disclaimer

The European Commission support for the production of this publication does not constitute an endorsement of the content which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Copyright notice

Contents

Introduction 8

Learning objectives 8

Target Groups and entry standards 9

Learning outcomes 9

Module 1. Creativity Theories and Models 11

Learning Objectives 11

Introduction 11

1.1 An Overview of Creativity 13

1.2 Creativity and Genius 28

1.3 Creative Problem-solving 38

1.4 Innovation and Creativity 47

1.5 Assessment 59

Module 2. Individual and Social Creativity 61

Learning Objectives 61

Introduction 61

2.1 The Nature of Creativity 62

2.2 Creativity Types and Improve them 72

2.3 Social Creativity Progresses 80

2.4 Deep Analysis of Creativity 90

2.5 Assessment 99

Module 3. Creative Teaching and Teaching Creativity 101

Learning Objectives 101

Introduction 101

3.1 Educational Purpose of Creative Education 102

3.2 The context of creativity and education 109
3.3 Creativity is as important as literacy 118
3.4 Introduction to Stem Education 124
3.5 Assessment 133
Module 4. Machine Creativity 135
Learning Objectives 135
Introduction 135
4.1 Creativity Definitions 135
4.2 Intelligent Machines 143
4.3 Can Machines Be Creative? 151
4.4 Machines vs Humans: The Singularity 159
4.5 Assessment 166
Module 5. Pedagogical use of the arts 168
Learning Objectives 168
Introduction 168
5.1 Creativity - Concept, characteristics and how to enhance it 170
5.2 Creativity, arts and digital technologies 176
5.3 Pixel art and interactive art 181
5.4 DSI examples and case studies 187
5.5 Assessment 191
Module 6. Creativity and the Arts at School 193
Learning Objectives 193
Introduction 193
6.1 Nurturing Creativity at Schools 194
6.2 Creative Education at School 202

6.3 Art Integration in Schools 210
6.4 Transforming Art Education in Digital Age 219
6.5 Assessment 228
Module 7. Creative Thinking 230
Learning Objectives 230
Introduction 230
7.1 Creativity tools 232
7.2 Thinking styles 239
7.3 Inventive problem solving 246
7.4 The SCAMPER method 253
7.5 Assessment 260
Recommendations for course delivery with target groups 262
Transferability 263
About the authors 263
About the partner organisations 266
Bibliography 269
Appendix. Evaluation quiz check sheets 286

Introduction

The evolution of technology and online learning has not only changed the way information is delivered, but also the teaching and learning processes. This training package focuses on the relationship between arts, creativity, and education in the digital age. According to a recent study in OECD countries, there is an inherent mismatch between students' knowledge and use of ICT and DSI and teachers' ability to use their competencies and skills. This suggests that teachers' inexperience and lack of skills are often underlying factors preventing the effectiveness of creativity, ICT, and DSI use in the classroom. A digitally competent teaching profession can then influence school practices and ultimately the digital literacy of all students. In this context, the project partners created this training package to achieve the following goals.

- Promote practices of distance learning and support for marginalised and disadvantaged people;
- Improve the skills of social educators and teachers;
- Integrate current teaching and learning methods such as online participatory learning, online social learning, online peer learning, and web-based self-learning methods;
- Encouraging educational institutions to use online technologies for social inclusion.

In this way, the skills and expertise of social educators and teachers in social innovation and creative thinking will be improved.

Learning objectives

This course aims to:

- define the basic terms related to creativity, brilliance, and innovation;
- to help understand the creative process and be able to classify it and develop ideas to improve it;
- explain the historical and intellectual context of creativity and İdentify the context of creativity and education;
- explain 21st-century learning skills, such as STEM, and apply them in the classroom;
- better understand the impact of digital technologies and how to master them;
- identify the concept of creativity and the types, techniques and applications to provide theoretical and practical elements to develop creativity;
- apply the pedagogical use of the different types of digital art and learn the importance of digitalization in the social environment;
- develop a comprehensive model to measure creativity and in this way be able to identify and implement creative teaching approaches;

- define thinking styles;
- apply activities to promote creative thinking;
- explain what critical thinking is;
- learn about the method SCAMPER;
- and develop modern pedagogy methods.

Target Groups and entry standards

This course is for adults and adult educators who want to improve their competences in the areas of creativity and arts. Those interested in the course may be social educators, teaching staff, those working in social enterprises and social services, people interested in digital social innovation. There are no prerequisites for this course; any adult or adult educator with a desire to learn something new and develop his/her skills can join.

While designed for adults and adult educators, the course may be useful to other categories, such as youth workers, trainers, VET teachers.

Learning outcomes

Knowledge

On completion of this course, learners will be able to:

1) Master the basic concepts of creativity (theory and models).
2) Use creative teaching-learning methodologies.
3) Understand the importance of creativity and arts at schools.

According to the Bloom's taxonomy (https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/ and https://tips.uark.edu/blooms-taxonomy-verb-chart/), learners will be trained to:

1) Recall facts and basic concepts related to creativity and arts.
2) Explain ideas and concepts related to creativity and arts.
3) Apply the acquired knowledge in new situations.
4) Draw connection using the acquired knowledge.
5) Leverage the acquired knowledge to evaluate creative applications.
6) Produce creative outcomes.

Skills

On completion of this course, learners will improve their creative and critical thinking skills. They will improve their ability to think about a task or a problem in a new or different way. They will be trained to use the imagination to generate new ideas.

Attitudes

On completion of this course, learners will improve their attitudes in:

1) Problem solving.
2) Creative thinking.
3) Critical thinking.
4) Innovation

Module 1. Creativity Theories and Models

Authors: Yeliz NUR AKARCAY, Alpaslan AKILLI

Learning Objectives

Upon completion of this Learning Unit, trainees will be able to:

- Define basic notions related to creativity, brilliance, innovation
- Comprehend components of creativity
- Explain creativity theories and models
- Understand the creativity process
- Comprehend the relationship between creativity and genius
- Define creative problem-solving
- Acquire the basic components and steps of creative problem-solving
- Recognize the benefits of creative problem-solving
- Distinguish the relationship between creativity and innovation
- Apply activities to encourage creativity

Introduction

"I have not failed; I have just found 10,000 ways that won't work." – Thomas Edison

"It's kind of fun to do the impossible." – Walt Disney

"Logic will get you from A to B. Imagination will take you everywhere." – Albert Einstein

"Creativity is just connecting things." – Steve Jobs

"Be less curious about people and more curious about ideas."- Marie Curie

"Learning never exhausts the mind." – Leonardo Di Vinci

"If I have seen further, it is by standing on the shoulders of giants." – Isaac Newton

Throughout history, people have been exhibiting creativity and creative behaviours, which have been proven through archaeological and biological evidence as well. People all over the world are familiar with highly creative people who contributed to human life both in the past and present. The innovative and curious nature of some people paved the way for important inventions and discoveries that changed the lives of people and countries worldwide in dramatic ways forever.

The achievements of these people and their creations have been subject to much research and attracted so many people's attention. While billions of people take an ordinary route through life like attending school, probably going to university, finding a job, etc., relatively few others show an outstanding creative talent even from an early age and achieve fame and international recognition (e.g. Mozart, Picasso, Chopin, Pascal, etc.). The extraordinary talented nature of these well-known people was demonstrated even in their limited life experiences.

Although highly creative people have managed to obtain international recognition, the concept of individual creativity reveals itself as a surprisingly recent concept. Creativity is often associated with art and science, and thus creativity is considered to contain activities such as drawing, painting, composing, designing, etc. Thinking of the extraordinary talents of people in history may cause individuals to underestimate their potential as creative people in their own life. However, all humans are distinguished from animals by their creativity as they possess the cumulative genetic code of Mother Nature's creativity. However, not all individuals are equally effective in being creative in purposeful ways. Gehani (2011) summarises the indicators of creative individuals as follows:

1) Cognitive abilities including general intelligence
2) Mastery of a discipline
3) The subjectivity of their actual creative output such as performance on creativity tests involving puzzle-solving ability.

An individual's creative thinking can be improved through learning and experience and some specific cognitive abilities are associated with individual creativity. For instance, Vincent et al. (2002) reported that divergent thinking, or a capacity to flexibly generate a variety and a large number (fluency) of ideas, was associated with creative problem-solving that was not attributable to expertise or intelligence. On the other hand, Amabile (1996) and Weisberg (1999) highlight the importance of domain-specific knowledge in the creative problem-solving processes.

This module introduces the notion of creativity, highlighting the main historical turning points and presenting three distinct domains in which creativity is deemed to occur, namely:

- Philosophy, that focuses on the theoretical essence of creativity as well as its aesthetic and ethical dimensions;
- Art, that focuses on the creation of objects intended to be beautiful;
- Science, that focuses on creating innovative artefacts, including models purposed for a specified problem domain.

The module provides information about creativity theories and models. Creativity and genius have been two associated concepts. In this module, the relationship between these terms with some examples from genius people can be found. Humanity needs creative solutions to its problems. Hence, this module includes another important component of creativity: creative problem-solving. The module presents and discusses the relationship between creativity and innovation and strategies how to develop creativity and innovation.

1.1 An Overview of Creativity

In ancient times, creativity was deemed to be a divine attribute, while, with the coming of the Christian era, only God was believed able to create something from nothing. With the advent of the Renaissance, however, creativity came to be considered linked and convergent in a single personality, the genius.

Modern creativity research began in the 1950s. The first research wave was focused on studying the exceptional characteristics of creators; then, in the second wave (1970-1980), the interest of researchers shifted to cognitive aspects; while, in the third wave (1980-1990), the social dimensions of creativity were investigated, integrating the psychological view with the contribution of social sciences.

Nowadays, creativity is seen as the cherry of human abilities, and many new research fields have been developing beyond the traditional disciplines. Educational sciences, Artificial Intelligence, and Neurosciences are opening new and integrated research perspectives.

Source: 15 Quotes to Awaken the Creative Inside of You

What is Creativity?

Source: https://www.nadeenschool.com/what-is-creativity/

The root of the term *creativity* lies in the Latin verb *creare*, meaning to bring something forth, to produce something. For several centuries, this term was not applied to human activities. It was, rather, associated with the generative powers of Gods and of nature.

Although creativity indubitably played a crucial role in human history, the word creativity was documented for the first time in 1875, with a reference to Shakespeare's *poetic creativity* in Adolfus William Ward's *History of Dramatic English Literature* (Weiner, 2000, p. 89). The concept of creativity only began to assume its current popularity after World War II and, in fact, the term 'creativity' was not widely used before the 1950s. There were, however, some prior experimental scientific studies that anticipated the investigation of people's creative attitudes. In the 1930s, Catherine Patrick examined the differences that creative thought may assume in the domains of the arts and the sciences (1935; 1937; 1939). The author offered the first systematic attempt to analyse the creative process, asking people involved in creative writing, drawing, and scientific problem-solving to describe their thoughts while working. In 1937, Patrick carried out an experiment involving 50 artists and 50 non-artists, representing a wide variety of people including psychology students, secretaries, teachers, economists, biologists, nurses, engineers, lawyers, librarians, and home-makers. From this experiment, four stages of creative thought emerged, to which the author applied the terms *preparation*, *incubation*,

illumination, and *verification*, although Von Helmholtz had already used the first three of these terms previously (1896), whilst Wallas (1926) had used all four. In 1937, the General Electric Corporation organised the first creativity training programs, and by the mid-1940s, the word *creativity* could be found in most English language dictionaries (Weiner, 2012).

In the 1950s, the literature concerning creativity proliferated, and it is significant that the work *On creativity and the unconscious* by Freud*,* which had first appeared in 1925, was reprinted in 1958. At the end of the 1940s, many authors criticised the fact that the scope of most studies on creativity was restricted to genius behaviour, and the notion of creativity started to be analysed in all its various dimensions. With this shift, the social aspects of creativity began to be scientifically investigated, and multicultural aspects came to be considered for the first time (Stein, 1953), along with the relationship that exists between creativity and spontaneity (Moreno, 1955). For the most part, psychologists and pedagogues dominated the study of creativity (Anderson, 1959; Guilford, 1958; May, 1959; Morgan, 1953), but research on creativity also attracted the interest of philosophers (Nelson, 1958; Tomas, 1958), as well as of political scientists (Lasswell, 1955). Researchers also brought their attention to bear on social aspects. Carl R. Rogers, the American psychologist who was among the founders of the client-centred approach, also turned his attention to developing a theory of creativity, arguing that there was a "desperate social need for the creative behaviour of creative individuals" (Rogers, 1954, p. 249).

In the early 1970s, creativity came to be viewed as a basic factor of human activity beyond psychological studies. *In Language and Mind*, Chomsky observed that "The normal use of language is, in this sense, a creative activity. This creative aspect of normal language use is one fundamental factor that distinguishes human language from any known animal communication system" (Chomsky, 1972, p. 100). For Chomsky, verbal creativity is an aspect of mental creativity, and both define what it is to be distinctively human. Subsequently, Pinker argued the same idea: 'Words and rules give rise to the vast expressive powers of language, allowing us to share the fruits of the vast creative power of thought" (Pinker, 1999, p. 321).

Modern research rejects the conditional relationship between creativity and genius, since a person can exhibit creativity without being a genius or, conversely, can be a genius without being creative (Simonton, 2008). Another prominent aspect of modern research is that it considers creativity not as an absolute but as a relative notion, presenting clear differences in various cultures, e.g., in the Western and Eastern worlds.

According to Sawyer (2011), the most common assumptions about creativity in the Western world are that:

- creative ideas emerge mysteriously from the unconscious;
- creativity is based in the right brain;
- creativity and mental illness are closely connected;

- creativity is an essential healing, life-affirming activity, contributing to the fullest realization of the human experience.

These assumptions, however, may well be seen as absurd from a Hindu or Buddhist perspective:

"[…] either nothing new ever comes into the world, or there is an endless stream of *new* but insignificant things. Individuals who desire to create something new live in ego illusion. There is nothing to create" (Weiner, 2000, p. 160).

Nevertheless, globalization is accelerating the transition towards Western models. In China, there are efforts to actively encourage employees to adopt Western management practices (Song, Gu, & Wang, 2019; Zhou, Zhao, Tian, Zhang, & Chen, 2018), although this is not easy because of different political and economic barriers (Fu & Tsui, 2003) and philosophical views, such as Confucianism and Daoism (Ma & Tsui, 2015).

Nowadays, creativity is considered a multifaceted notion, and its investigation represents a broad field due to its interdisciplinary nature and the multifarious interests that spark around it.

The following paragraphs highlight the main historical turning points that have marked the path of the concept of creativity. Following this, the three main domains in which creativity is deemed to occur, namely philosophy, the arts, and science, are briefly presented and discussed.

Creativity Definitions

The literature throws up various definitions of creativity. The widely accepted view is that creativity is the capability to develop both *original* and *valuable* ideas. Runco and Jaeger (2011) discussed this bipartite definition of creativity, addressing it as the *standard definition*. Accordingly, creativity should require both *originality* and *effectiveness*. Original things should be effective to be creative, while effectiveness should take the form of value. Here are some of the most popular definitions of creativity:

''The creative work is a novel work that is accepted as tenable or useful or satisfying by a group at some point in time'' (Stein, 1953, p. 311).

''Originality is vital but must be balanced with fit and appropriateness'' (Runco, 1988, p. 4).

"[…] novel product, idea, or problem-solution that is for value to the individual or a larger social group" (Hennessey & Amabile, 2010, p. 572);

"[…] the process of having ideas that have value" (Robinson, 2011, p. 198);

"A creative idea is marked by three attributes: It must be original, it must be useful or appropriate for the situation in which it occurs, and it must actually be put to some use" (Martindale, 2013, p. 211).

"[…] the process of creating ideas, artefacts, processes, and solutions, that are novel and effective" (Henriksen, Richardson & Mehta, 2017, p. 4).

Creativity and Philosophy

Many terms, such as *consciousness*, *imagination*, and *empathy* existed as philosophical terms before becoming psychological notions. Creativity is no exception. Historically, philosophers have demonstrated much interest in this subject. In ancient Greece, human creativity was believed to be the result of *inspiration*, a divine force that gave creative ideas to human beings.

The current philosophical literature on creativity not only focuses on aspects that concern its essence, nature, and value but also tackles many different subjects such as the role of imagination in creativity and creative conscientiousness (Dennett, 2004; McGinn, 1991). Much philosophical literature is concerned with creative acts and procedures, and often authors introduce constructs such as *minimal creativity*, *cognitive manipulation*, *creating agents*, or *mental processes* to support their ideas (Anderson, 2013; Gaut & Kieran, 2018).

Recently, many philosophers have begun to borrow concepts from psychology and cognitive science, and discuss them in the light of the ideas and theories of famous philosophers from the past or to suggest general structural models. In this regard, Baehr, professor of philosophy at Loyola Marymount University in Los Angeles, developed an account of creativity as an *intellectual virtue* (Baeher, 2017). According to his structural model for intellectual virtues (Baehr, 2011; 2015; 2021), creativity or, better, *intellectual creativity*, has four primary dimensions:

1. *Skill or ability dimension*, which concerns a skill or competency that provides a way of distinguishing a certain intellectual virtue from others, e.g., what differentiates open-mindedness from other intellectual virtues like curiosity and intellectual humility.
2. *Motivational dimension*, which concerns the motivation to practice a certain skill, e.g., the desire for or commitment to epistemic goods like truth, knowledge, and understanding.
3. *Affective dimension*, which concerns the pleasure or satisfaction gained from practising a certain skill, e.g., an open-minded person enjoys taking up and considering alternative perspectives.
4. *Judgement dimension*, which concerns what criteria guide when, where, or how a skill ought to be practised.

Creativity and the Arts

In the past, artists and other creative individuals attributed their best and most creative ideas to supernatural and unknown forces, and the word *inspiration* has been used to indicate the internal creative push to do something. As such, creativity and inspiration are considered two crucial, although inherently different, factors in a creative process. The scientific literature on creativity includes a number of research studies on inspiration, especially in the scope of art and artistic expression.

Indeed, inspiration is a topic variously investigated by many psychologists (Fulmer, 2007; Hart, 1998; Nordstrom & Korpelainen, 2011; Peterson, 2020). According to Thrash and Elliot (2003), inspiration has three core characteristics: *transcendence*, *evocation*, and motivation. Transcendence means that one gains something better than usual and sees better possibilities. Evocation means that one does not feel directly responsible for becoming inspired. Finally, inspiration involves motivation, a force that guides one to express or manifest that which is newly apprehended. Nevertheless, some would argue that, in creativity, inspiration is less important than effort (Martindale, 1989; 2001; Sawyer, 2006). This opinion is shared among modern artists, too. Beuys, the German artist, teacher, and theorist of art who founded the art movement known as *Fluxus* and who is famous for the dictum "everybody can be an artist" (Pietras, 2017), claimed:

"[…] during my studies at the academy, I found that this question about the impetus and source of art, the need for the world to develop and evolve through art, did indeed remain unresolved" (Beuys, 2007, p. 9).

Modern artefacts, instead, introduce the novelty that creativity might not be associated exclusively with the artist. The user (*les regardeur*, to use Duchamp's expression) may become a co-creator of an artwork. According to this perspective, art can be defined by a specific kind of relationship or interaction – what may be termed an *aesthetic relationship* – between the object and the user (Genette, 1997). Paradoxically, artists could resign from their exclusive position, sharing their role as creators with the users, thus changing the traditional relationship between creator and user. This is particularly evident in artistic interactive installations.

However, we should ask, what exactly is essential for the creation of an artwork and the recognition of an object as an artwork? Danto proffered an important contribution to this question. He observed that beauty is unnecessary to the definition of artwork since artistic excellence can be found in an artwork that is not beautiful. Furthermore, he argued that beauty, truth, and goodness are essential in human life but not in art. One might conclude that the creativity of the artist is also not essential for a work to

be considered art. Indeed, from Danto's perspective, "anything can be a work of art" since "there are no one-place necessary conditions", although it doesn't follow from this that everything is one (Danto, 1981, p. 65). Danto claims that beauty is unnecessary to the definition of art, or in other words, that it can be artistic excellence in a work of art that is not beautiful. Furthermore, he argues that beauty, truth, and goodness as well, is essential in human life, although nonessential art.

It is notable that, over the last decades, socio-philosophical studies on creativity in the context of contemporary society have dramatically increased. Within the scope of these studies, a new research area, that of the so-called *creative industries*, has emerged. The German sociologist and cultural theorist Reckwitz (2017) is one of the most representative scholars on this topic. Criticising the contemporary imperative of *permanent innovation*, Reckwitz claims that late modern society has been fundamentally transformed by the expectation and desire to be creative. There is a tendency in modern society to produce and value what is culturally new at economic, artistic, and lifestyle levels. He indicates five agents that are characteristic of modernity, putting together philosophical instances and negatively interpreting technological advances (Reckwitz, 2017, pp. 19-20):

1. The expansionism of art, that is due to art movements and bourgeois art.
2. The media revolution, that is due to the unprecedented revolution in media technology.
3. The rise of capitalism, understood as an expansionist economic system for producing and selling goods with the aim of reinvestment and capital accumulation.
4. The expansion of the world of objects, that is due to the unprecedented growth in the inventions, production, and distribution of new artefacts.
5. The rise of the subject that began in the late eighteenth century under the influence of technologies and subjectivism, and was brought to fruition with the affirmation of human sciences such as psychology.

The concepts and constructions of philosophers of art heavily influenced the ideas of art historians and the way art history was taught, especially under the push of postmodernist and humanistic authors after World War II. However, in the same period, psychologists and educators also contributed with important investigations of their own (Eisner & Day, 2004; Read, 1948; Stankiewicz, 2001). Thanks to the scientific progress that has been made in the human sciences, nowadays the situation is changing, although the legacy of the intellectuals of the past is hard to overcome. What makes the difference now is the renewed interest in art education and education through art (Merten, 2011; Milbrandt, Miraglia & Zimmerman, 2018).

Creativity and Science

The study of creativity is pervasive in contemporary sciences. Since the 1950s, psychologists as well as an increasing number of education scientists, sociologists, anthropologists, biologists, and historians have turned their attention to creativity. In the last few years, studies and experiments on creativity have grown, also in the fields of neuroscience and Artificial Intelligence. In addition, the potential links between creativity and psychopathology have been studied, and experiments have been undertaken concerning the simulation of creativity in a machine.

Sawyer synthesized the reasons why research on creativity is worthwhile and useful (Sawyer, 2012, pp. 4-5):

- It can help identify and realize every person's unique creative talents.
- It can help leaders respond better to the challenges facing modern society.
- It can help improve problem-solving capabilities.
- It can help realize the importance of positive, peak experience for mental health.
- It can help educators teach more effectively.

Indeed, creativity is a topic of considerable interest, especially in educational and psychological research. Pioneering studies have been conducted under the presupposition that creative talents cannot be accounted for in terms of Intelligent Quotient (I.Q.). These studies have argued that creativity should be seen in the light of factorial conceptions of personality (Guilford, 1950) and, later, that it should be investigated in relation to the structure of intellect and divergent production (Richards, 2001; Sternberg & Grigorenko, 2001). Many studies have been developed on creative thinking abilities, their assessment, and nurturing, and the multiple talent approach (Taylor, 1968; Torrance, 1962; 1972).

The principal interest of early researchers was focused on creative problem-solving (Meadow & Parnes, 1959; Osborn, 1963; Parnes, 1967). Nowadays, that research on creative problem-solving is still topical and encompasses many new dimensions, including that of machine problem-solving (Lewis, Knoblich, & Poe, 2018; Lumsdaine & Lumsdaine, 1994; Puccio, 2020; Treffinger, 1995; Treffinger, Isaksen, & Stead-Dorval, 2005). In recent research, problem-solving is investigated, not only through a focus on problem formulation, creative ideation/generation, and creativity in decision-making/evaluation and implementation (Allwood, Selart, & Selart, 2001; Barbot, 2018; Taylor, 2017; Taylor & Getzels, 2017) but also by exploring new dimensions, such as team and crowd-based problem-solving (Riedl & Seidel, 2018; Riedl & Woolley, 2017; Roser, DeFillippi, & Samson, 2013).

Most current research shares the position that an important contribution to being more creative is understanding the points of strength and the biases underlying the western cultural model of creativity (Simonton & Ting, 2010). Recently, research on cultural psychology has been growing, although its findings were initially difficult to interpret (Cole, 2003) since the study of the culture's role in the mental life of people often rested on the political and critical assumptions of authors engaged in activism (Ratner, 2008). In the last decade, the cultural psychological approach has enriched the debate on creativity, clarifying the relationship between individual creativity and socio-cultural contexts (Glăveanu, 2010). The cultural psychology of creativity proposes a multidisciplinary approach and conceives creativity as a fundamentally relational, intersubjective phenomenon. The basic premise of cultural psychologists is the interdependence between human beings and their socio-cultural context.

An important contribution to the science of human innovation is provided in Sawyer's *Explaining Creativity* (2012). In this work, the author addresses several dimensions of creativity, illustrating individual and sociocultural approaches, and explores creativity in the domains of the arts and sciences as well as creativity in everyday life. He identified ten beliefs that "contains a grain of truth, but many of them are more myth than reality" (Sawyer, 2012, pp. 405-409):

1. The essence of creativity is the moment of insight - scientific research shows that creativity rarely comes in a sudden burst of insight.
2. Creative ideas emerge mysteriously from the unconscious – research by cognitive psychology and cognitive neurosciences show that insight can be understood in terms of the previous mental trajectory of the creator.
3. Creativity is more likely when you reject convention – research shows that education is essential to creativity, and formal schooling doesn't blow out an artist's creativity.
4. Creative contributions are more likely to come from an outsider than an expert – experience shows that creative people are rarely outsiders.
5. Creative people are more creative when they are alone – experience shows that creative people spend time alone, but they spend a lot of time communicating with other people.
6. Creative ideas are often ten steps ahead of their time – radical breakthrough ideas are often resisted initially because they threaten the *status quo*.
7. Creativity is a personality trait – research has proven that creativity is not hereditary.
8. Creativity is based on the right side of the brain – research shows that people use their entire brain in a creative act.
9. Creativity and mental illness are closely connected – there is no solid evidence that mental illness is more common among creative people than it is among the general population.

10. Creativity is an essential healing, life-affirming activity – it seems that this belief is more associated with individualist cultures than collectivistic ones.

To complete the picture of creativity and the sciences, some research fields should be briefly outlined. One of these encompasses studies on trends in creativity that have occurred across individuals, creative periods, domains, and even societies (Sawyer, 2012; Simonton, 2008; 2018). In this regard, research has been conducted in a vein of historiometry – a term coined by Woods in 1911 – focusing on:

- exceptional creativity, examining whole lifespans of illustrious creators (Simonton, 2013).
- the foundations of creativity, encompassing intellectual precocity, childhood trauma, family background, educational and special training, and the role of mentors and masters (Simonton, 1997).
- the manifestation of creativity, exploring changes in creative styles through the ages, and the differential and social psychology of phenomenal creativity (Damian & Tou, 2017; Mumford & Higgs, 2020).

A second research strand concerns the intersection of art and science. *Art-based research* (ABR) is a "transdisciplinary approach to knowledge building that combines the tenets of the creative arts in a research context" (Leavy, 2018, p. 4). ABR aims to disrupt the standardized criteria of research while evoking and provoking alternate possibilities for understanding. ABR practices should be beneficial for research projects that aim to describe, explore, discover, or problem-solve through the capability of the arts to mirror real life. ABR research aims to complement the use of psychology to study art, and the use of art to study psychology:

"[…] ABR helps to dissolve artificial disciplinary boundaries as further concentration on ways of knowing and the creation of methods of inquiry-based on the effort to design the best approach to addressing particular questions and issues" (McNiff, 2018, p. 24).

Further to these, a brief mention should also be made of two research fields that have seen increasing growth in the last decades. The first of these is Artificial Intelligence (AI), while the second is neuroscience. AI research has approached creativity in relation to the possibility of a machine being creative, e.g., How can a programmed machine be creative or original? In this regard, in the 1980s, Minsky, the famous American cognitive and computer scientist and co-founder of the Massachusetts Institute of Technology's AI laboratory, proposed the *puzzle principle*. The assertion was that a computer can be programmed to solve any problem by trial and error, without knowing how to solve the problem in advance. Instead, the computer should be provided only with an algorithm to recognize when the problem has been solved (Minsky, 1985). While easy to theorize, this is difficult to implement, since the generation of the possible solution to be evaluated depends heavily on the size of the problem domain.

Nowadays, AI research on creativity encompasses several fields, including machine learning, deep learning, adaptive learning, social robotics and, of course, computational creativity. The theme of creativity appears indirectly in many current studies about autonomous choices, for example in regards to autonomous vehicles applications. Additionally, over the last few years, a wide variety of algorithms have been implemented to help users make choices. Some of these algorithms make decisions by processing information gathered via intelligent devices or other programs connected through the internet – as with the so-called *Internet of Everything* (Lawless, Mittu, Sofge, Moskowitz, & Russell, 2019). This is also the case of algorithms that automatically identify a user's needs and search on the internet to satisfy them. Autonomous assistants affect the act of choosing, identifying the algorithms that meet the user's needs, comparing them, and selecting the most appropriate one. In essence, this represents a simplified application of Minsky's puzzle principle.

Finally, scientific research on the *neuroscience of creativity* is a new, challenging field of investigation (Abraham, 2018; Jung & Vartanian, 2018; Sawyer, 2011). Two primary objectives have motivated this kind of research over the last decades, namely: understanding what causes creativity and discovering the *neural correlates* of creativity (Vartarian, 2021). Research has been carried out following the brain mapping approach to isolate the regions of the brain involved in generating creative ideas. Most of these studies have used magnetic resonance imaging to measure neuron activity in a particular region of the brain. The early studies in this field were developed to measure the neural correlates of creative idea generation in problem-solving, divergent thinking, drawing, and so on. Neuroscientific research on creativity has also been used to better understand brain structure. Many questions remain open, however. Is the neural machinery that supports creativity in famous and eminent people the same as in ordinary people? Are there differences between creative artists and creative scientists? What is the relationship between creativity and higher-order cognitive processes such as reasoning, planning, and decision-making? Is creativity a spontaneous process, or can it be regulated? Is creativity determined by the thinker or by the context of the problem space?

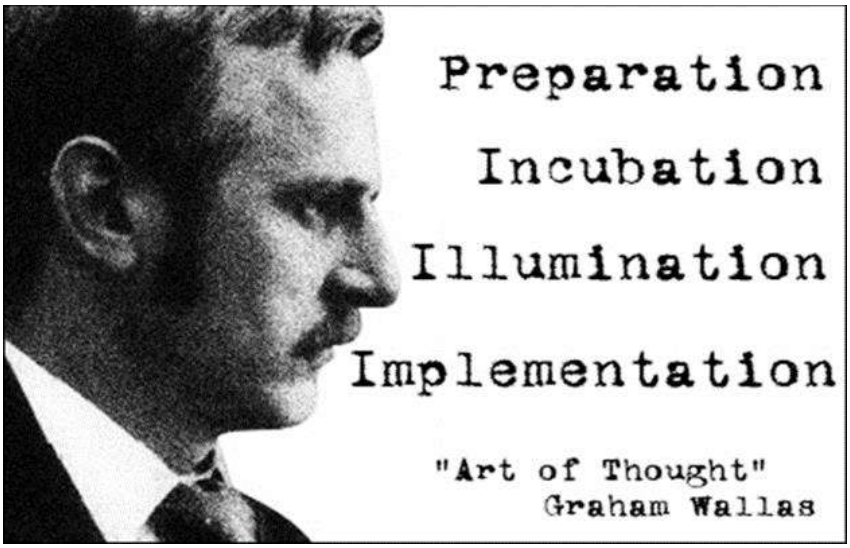
Creativity Theories and Models

Many theories explain creativity, so creativity theories have been categorized using different approaches by different researchers. It is impossible to mention a successful or widely accepted theory of creativity because the concept is so complex and multifaceted in nature.

There are studies in the literature that categorize theories. For instance, Sternberg and Lubart (1999) used six major diagrams to explain creativity; these included mystical, pragmatic, psychodynamic,

psychometric, cognitive, and social-personality. Although they present certain defects or flows, each of these categories explains one side of creativity. Kozbelt, Beghetto, and Runco (2010) classified the theories of creativity into 10 categories that included developmental, psychometric, economic, stage & componential process, cognitive, problem-solving & expertise-based, problem-finding, evolutionary (Darwinian), typological, and systems. They mentioned the primary assertions, key concepts, the 6 P's (Person, Process, Product, Place, Potential, and Persuasion) focus.

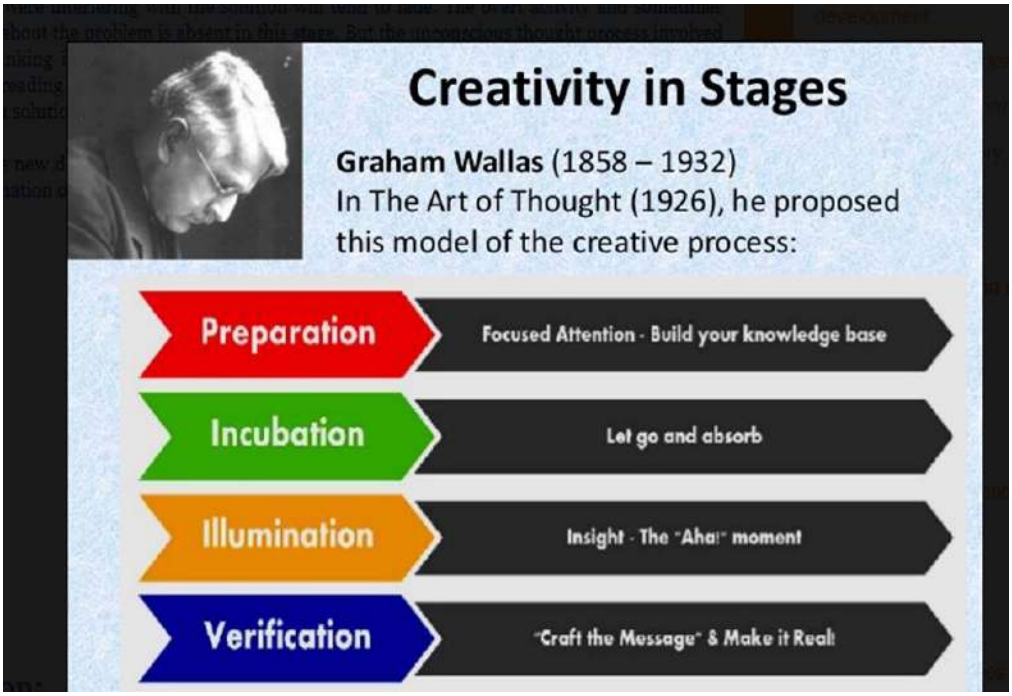
Wallas Model of Creativity



Source: Graham Wallas's Theory: What is Creativity?

One of the first formal models of creativity was proposed by Graham Wallas. This simple and insightful model has inspired people worldwide. The four stages of creativity are as follows.

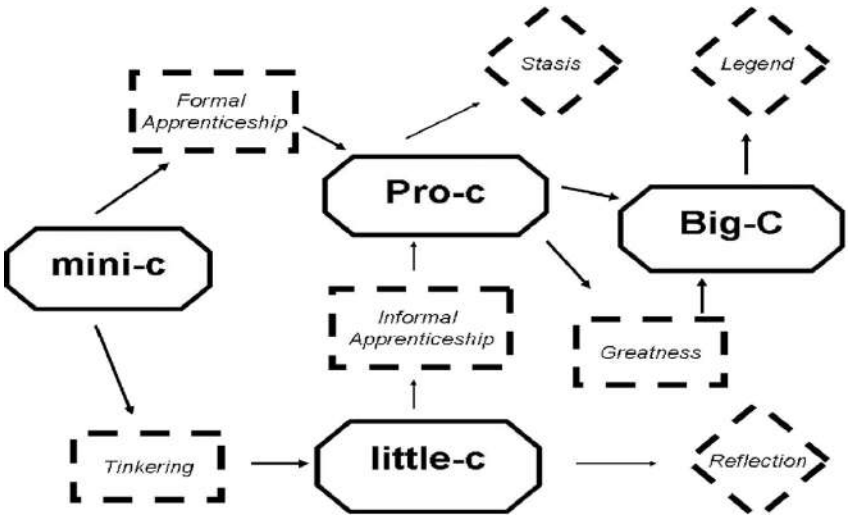
a) Preparation: This stage involves the investigation of the problems in all directions. The problem, need or desire are defined, information is gathered, and criteria are set up to verify the solution's acceptability.
b) Incubation: This stage involves unconsciously thinking about the problem. The individual steps back from the problem and let his mind contemplate and work it through. This stage, similar to the preparation stage, could last minutes, weeks, even years.
c) Illumination: This stage involves the appearance of the "happy idea" together with the psychological events. Different from the other stages, illumination is often very brief and involves a tremendous rush of insights within a few minutes or hours.
d) Verification: This stage involves the verification of the results and the deduction of the consequences. This stage determines whether what emerged in illumination satisfies the need.



Source: https://www.slideshare.net/ProfSethuraman/innovation-and-regulations-in-medical-education

Now, almost 100 years after Wallas originally wrote these four stages, the model hasn't been proven wrong and it has been greatly expanded on. The creative process consists of not only these four dominant stages, but each stage houses numerous requirements itself, each of which increases the likelihood of serendipity, connection of ideas, and successful incubation leading to insight.

The Four C Model of Creativity



Source: Beyond big and little: The four-c model of creativity (Kaufman and Beghetto, 2009).

The Four C Model (Kaufman & Beghetto, 2009) offers a useful and whole-life span conception of creativity, running from the everyday creativity that is present in all individuals to the eminent creativity that is found in geniuses. The authors sustained that a level of creativity is involved any time one attempts a new task. The four levels of the Four C model are:

- The mini-c level of creativity
- The little-c level of creativity
- The Pro-c level of creativity
- The Big-C level of creativity

The mini-c level of creativity occurs when one creates something that might not be revolutionary but is anyway new and subjectively meaningful. An example is a child who brings home their first painting from school. It is the child's first attempt to perform a new and meaningful task appropriately.

The little-c level of creativity is the creativity exhibited in everyday life and reflects an aspect of growth from the mini-c level. Advancements are made from the mini-c level through appropriate feedback. What has been created may be meaningful and of value to others. An example is the parent who loves the new painting by their child and exposes it on the wall of their office, taking pleasure from looking at it.

The Pro-c level of creativity is the professional or expert level. To reach this level, one requires many years of deliberate practice and training. Indeed, attaining Pro-c level is not easy. The creator must acquire a high level of competence in their field to make a ground breaking contribution but not necessarily become a genius. What seems creative at a certain point in time might be considered only average in the context of history.

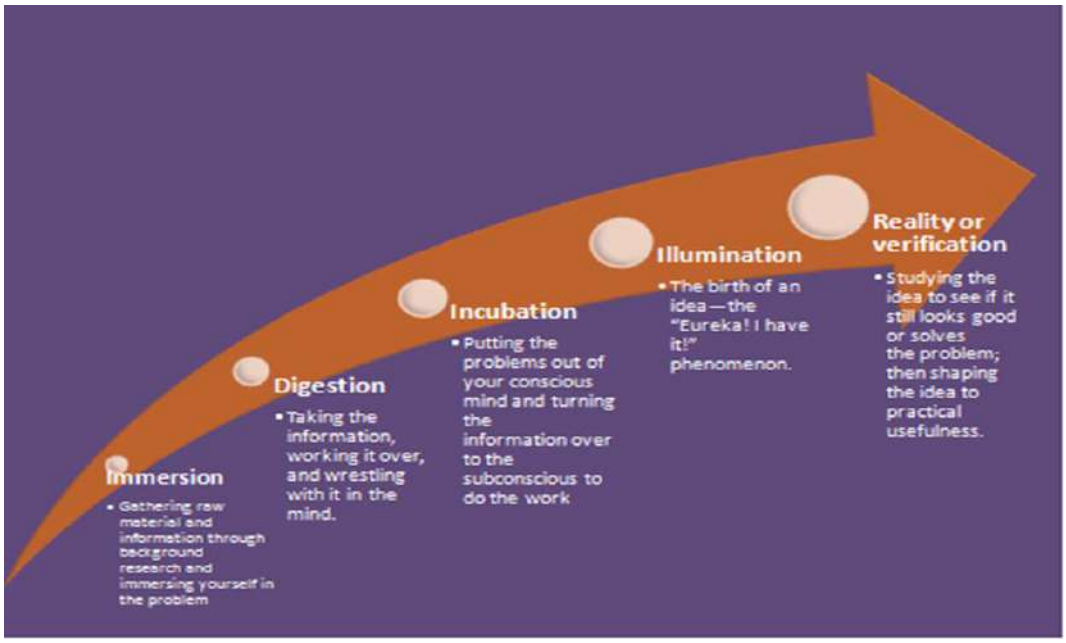
The Big-C level of creativity describes eminent creativity and can be considered the genius level. Those at the Big-C level are ground breaking artists, scientists, and world leaders remembered in human history. Membership in such an elite group of creators may depend on tangible achievements, such as Nobel Prizes or Academy Awards.

One of the main contributions of the Four-level model to creativity is introducing the mini-c level that emphasizes the subjective side of creativity since such creativity need not even be shared or acknowledged by anyone other than the creators themselves.

Young's Model of the Creativity Process

A real cognitive process is involved in producing new ideas and transforming old ideas into something new, and this process is called the *creative process* by James Webb Young. His 5-step technique for creating new ideas has effects on various areas ranging from business and advertising to marketing. In its basic meaning, Young believed that the creative process is the act of creating "new" connections from existing concepts.

According to Young, being "creative" is about connecting ideas from what is already available around you. The figure below demonstrates the five-step model.



Source: Portfolio H 5 Creativity Thoughts for All

1: Immersion: This step involves gathering background information that is needed to solve the problem through research and study.

2. Digestion: The digestion step involves taking the information and working it over.

3. **Incubation**: This step involves ceasing analysis and putting the problem out of the conscious mind for a time

4. Illumination: This step involves the birth of an idea.

5. Reality or Verification: This step involves studying the idea to see if it is a solution to the idea.

Young made a simple, but profound statement about generating creative ideas, which he believed always happened in the five stages mentioned above.

To him, creative thinking is not about generating something new from a blank slate. It is more about taking what is already present and combining those bits and pieces in a way that has not been done previously, which requires the ability to see relationships between concepts.

Key concepts

Creative talent: the ability to find new solutions to practical problems by untried moves and unused methods, by identifying new relationships

Originality: the ability to think independently and creatively, the quality of being novel or unusual.

Novel idea: a unique idea across all design sessions in a condition

Inspiration: the process of being mentally stimulated to do or feel something, especially to do something creative.

Creative Behaviour: the production ideas that are both new and useful

Reflection

What is Creativity?

What unique characteristics make it different from other similar concepts?

Can you give examples of creative people you know?

Additional resources

What Is Creativity? 21 Authentic Definitions You'll Love: https://copyblogger.com/define-creativity/

Creativity and Culture: Stein, M. 1953. Creativity and culture. Journal of Psychology, 36:311–322.

Video materials

We Need a Bigger Definition of Creativity: https://www.youtube.com/watch?v=MTCOExd0hDk

FourCs (with James C. Kaufman): https://www.youtube.com/watch?v=oR70dV53jBM&t=3s

1.2 Creativity and Genius

The relationship between creativity and intelligence has been subject to investigation. For instance, according to the Threshold hypothesis (indicating an IQ of 120), high creativity requires high or at least above-average intelligence. According to Guilford (1967), above-average intelligence forms a necessary but not sufficient condition for high creativity. Higher intelligence levels have been associated with high creativity. However, solely intelligence does not guarantee creativity. Some personality characteristics

are also hypothesized to have roles. For instance, while openness to experiences predicts creative potential, conscientiousness is negatively related to creative potential. Hence, high intelligence and high openness predict creative potential, which, in turn, predicts creative achievement (Jauk et al., 2013).

What are Creativity and Genius?

The reason behind some people's higher potential to provide new solutions to old problems is associated with the concept of creativity. It is the driving force that has moved civilizations forward (Hennesey and Amabile, 2010). Sternberg and Lubart (1999) referred to two dimensions of creativity as creative potential and creative achievement. While the former refers to the individual's ability to generate something novel and useful and reflects a normally distributed trait, the latter refers to the actual realization of this potential in terms of real-life accomplishments. Some examples include writing a novel, making a scientific discovery, etc. (Carson, Peterson, and Higgins, 2005).

Assessment of creative potential can be done through tests that measure divergent thinking ability, which is defined by Guilford (1959) as thinking that goes off in different directions. Some examples are as follows:

- The Torrance Test of Creative Thinking TTCT developed by Torrance (1996)
- The Guilford tests developed by Wilson, Guilford and Christensen (1953)
- The Wallach and Kogan tests developed by Wallach and Kogan (1965)

Divergent thinking tests include some open problems to which one can find various possible solutions. They also require respondents to find creative uses for everyday objects. Creative achievement, on the other hand, is usually assessed through self-reports. For instance, respondents indicate their achievements in various domains such as music, arts, etc. The Creative Achievement Questionnaire (CAQ) (Carson et al., 2005) is a popular example. The test is reported to accurately discriminate between more and less creative persons, and the test scores are significantly predicted by intelligence.

Simonton (2008) states that a person can exhibit creativity without being a genius, and s/he can be a genius without being creative; both characteristics can exist in a single personality. Geniuses in history such as Newton, Leonardo da Vinci, Beethoven, etc. are considered the highest and purest manifestation of creativity and genius, which is highly valued.

The current meaning of the word *genius* dates from the eighteenth century. About genius, Richard Gregory (1981) offers two quotes. The first links knowledge with novelty and is from the painter Henry Fuseli, who wrote in his *Lectures on Painting*: "By genius I mean that power which enlarges the circle of

human knowledge: which discovers new materials of Nature, or combines the known with novelty." The second sustains the opposite, and comes from the English novelist Henry Fielding, who wrote in *Tom Jones* (1749): "By the wonderful force of genius only, without the least assistance of learning."

Gregory argued that the lines from Fuseli and Fielding both suggest that "genius is attributed to high Kinetic intelligence – and that it creates special Potential Intelligence, which can be used or appreciated later" (Gregory, 1981, p. 317). Distinguishing between *Potential Intelligence* and *Kinetic Intelligence*, the author argues that Potential Intelligence makes solutions and answers available that have previously been created, perhaps in the distant past, by Kinetic Intelligence. Accordingly, education increases individual Potential Intelligence through the transmission of knowledge, solutions, and aids that others have made available. Kinetic Intelligence, on the other hand, intervenes when Potential Intelligence solutions are not adequate. Gregory observes that sometimes, thanks to Potential Intelligence, the solution of a problem requires only a small component of Kinetic Intelligence:

"As civilization advances, Potential Intelligence becomes more and more important, for it provides ever larger chunks of part-solutions for problems which generally require ever-smaller components of Kinetic Intelligence for their solution.

As a result of this, we may judge ourselves more intelligent and more creative than our ancestors, but this is only because we have the benefit of a vast store of potential Intelligence which was created by their Kinetic Intelligence" (Gregory, 1981, p. 312).

Simonton claimed that creativity and genius are highly desirable:

"Parents are usually pleased to learn that they have given birth to a "budding genius", and will often fight hard to get their child enrolled in special programs for the gifted" (Simonton, 2008, p. 679).

She observes that creativity workshops have proliferated in the last few years since employers, especially in high-tech industries, often wish their workers to be more creative. Nevertheless, the qualities of a genius remain rather elusive.

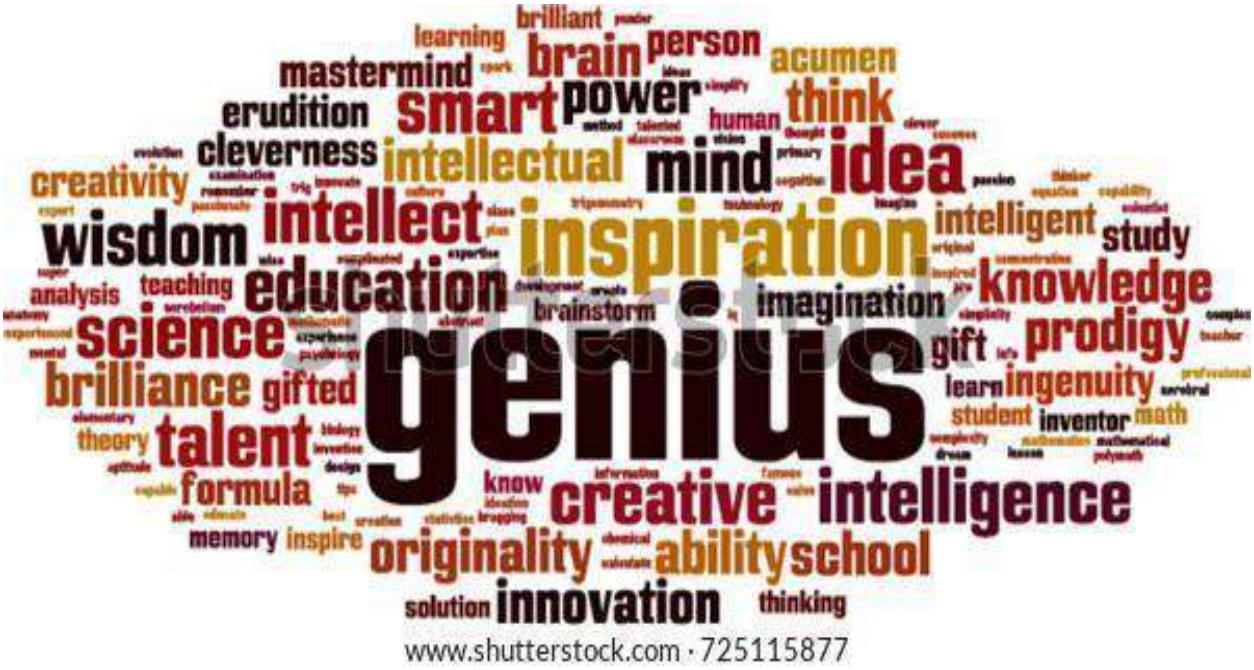
What is it, then, that characterizes a genius like Leonardo da Vinci, Isaac Newton, Galileo Galilei, Alan Turing, Henry Matisse, Wolfgang Amadeus Mozart, or Gioacchino Rossini?

Minsky sustained that a genius needs to accumulate knowledge and skills and, accordingly, needs effective learning capabilities:

"I think that genius needs one thing more to accumulate outstanding qualities, one needs unusually effective ways to learn. It's not enough to learn a lot; one also has to *manage* what one learns. Those masters have, beneath the surface of their mastery, some special knacks of "higher-order" expertise, which help them organize and apply the things they learn" (Minsky, 1986, p. 80).

However, although creativity has been broadly assumed to be a genius's quality, experience shows that an individual can be creative without being a genius, and be a genius without being creative.

One question concerning genius has entangled many researchers in the past: is creativity and genius influenced by nature or nurture? Francis Galton (1874) believed that genius was a biologically transmitted trait and cited Lamarckian inheritance to explain how the genius trait evolved through the generations. Nowadays, creativity is seen as an emergent trait. There is growing evidence that creative ideas emerge from the interaction of multiple large-scale brain networks. Contemporary research is sceptical about the classical image of genius. It is broadly accepted that creativity occurs not only in a genius but in everyone who has the potential to be creative. The digital revolution has multiplied how to express this potential creativity. In the last few decades, the internet has democratized individual communication. Everybody has the opportunity to express their personal feelings, thoughts, and ideas through social media. Digital technology influences creative processes, with online brainstorming software and crowd-based applications that can involve a multitude of people in innovating activities. In the near future, perhaps current ideas of genius will change again, and advances in AI will lead to artificial genius.



Source: https://www.shutterstock.com/tr/image-vector/genius-word-cloud-concept-vector-illustration-725115877

Characteristics of Genius

Source: What Makes a genius? Definition, Characteristics, and Qualities Explained

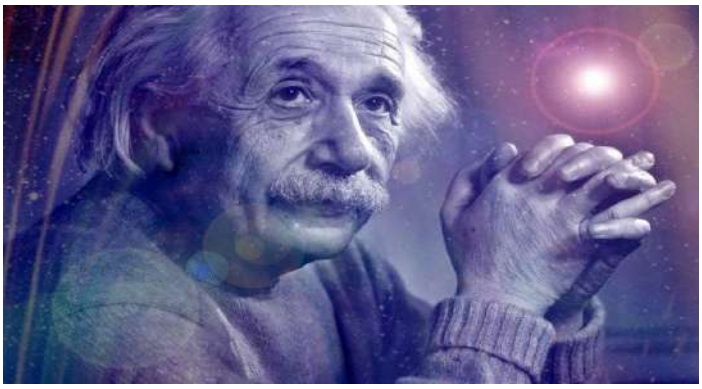
Characteristics of Genius are listed below:

1. They have a curious mind: Excellence can be achieved through a high degree of curiosity. Previously unexplored ideas can be developed through new ways of thinking. Genius people pursue knowledge in an almost obsessive manner.

2. They are abstract thinkers: People who have genius traits think about problems much more dynamically, in an abstract way. Hence, instead of accepting information and facts at face value, they want to test conventional thinking. They also wish to challenge your way of thinking.
3. They take risks: They want to push boundaries. They do not want to take a safe route, especially when they are close to a discovery. Such an attitude puts them at risk, yet ground-breaking work could also happen like this.
4. Reject Routines: genius may find it hard to conform to a normal routine because their minds are full of ideas and questions. They even continue to work on explorations in their minds when everyone else is asleep.

Genius People Who Changed Humanity

Albert Einstein



Source: About Albert Einstein: The life & work of the genius scientist, and why he mattered.

Albert Einstein is probably the first person that comes into many people's minds as a genius. The German-born physicist was the person who single-handedly redefined science in the 20th century. He developed the theory of relativity, which became one of the pillars of modern physics. He changed our understanding of the universe forever.

Leonardo da Vinci

Leonardo da Vinci was unique among his fellow geniuses. He had a high level of understanding of concepts and processes that were beyond his time. Things found in his piles of notebooks reflected

things that took almost five centuries to come to reality.

Source: https://www.fikriyat.com/galeri/biyografi/leonardo-da-vinciye-dair-30-gizemli-gercek

William Shakespeare

Shakespeare had an innate talent for thought in the 16th century when much of the population could not read or write. He redefined English literature and inspired so many authors even in the 21st century.

Source: Getty Images

Shakespeare had an almost godlike status. He became the nation's foremost poet and the unchallenged epitome of literary genius. He was also widely regarded as the greatest English-speaking writer and dramatist to have ever lived.

What Makes a Genius

Great talents and great minds have always attracted people's attention throughout history. In ancient times, people believed that geniuses were a divine gift. For instance, Michelangelo was considered to be sent to earth to serve as an example of a true artist. Aristotle believed that the source of a creative genius is the abundance of black bile in the body (a symptom of Melancholia). However, in time more scientific and secular ideas were adopted to explain creative genius, which indicated that the divine foundation was lost. It was believed that geniuses are born only through nature and genius was not something that can be taught or made, the idea was popularized by Francis Galton, who believed that genius was inherited and reported that genius throughout history owed their success to genetics only. Although this idea gained popularity, there was no measure to identify the qualities of the genius, until Lewis Terman, a professor at Stanford University, developed the IQ test in 1916. Terman conducted long-term studies to prove that measuring and predicting genius can best be done by intelligence tests.

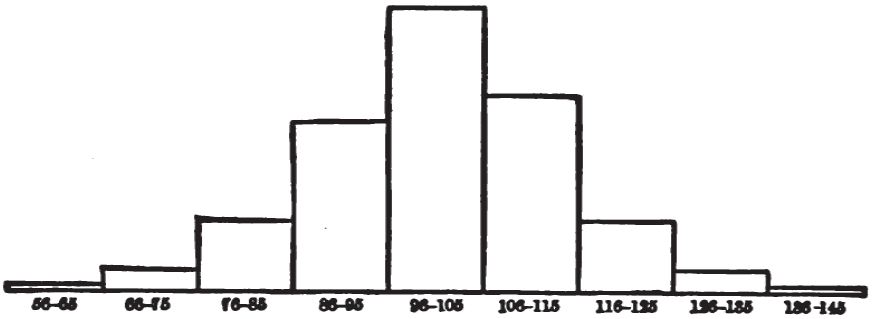


FIG. 2. DISTRIBUTION OF I Q'S OF 905 UNSELECTED CHILDREN, 5–14 YEARS OF AGE

Source: https://en.wikipedia.org/wiki/IQ_classification#/media/File:Terman1916Fig2IQDistribution.png

He conducted a long-term study to see what children with high IQ did in their adulthood years, around the age of 40. Unlike Terman's predictions, their lifetime achievements were modest and what is more interesting, two children who failed to meet the test requirements later won a Nobel Prize in physics (Luis Alvarez and William Shockley). They found that intelligence on its own was no guarantee of monumental achievement. Some participants, despite their towering IQ scores, struggled to thrive. Hence, the origin of genius became even more puzzling for scientists.

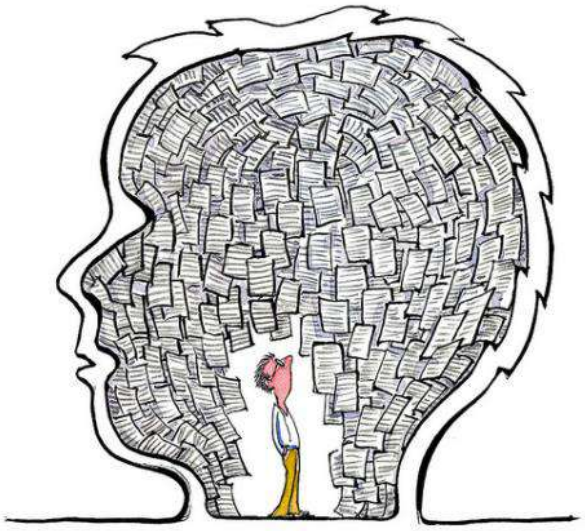
Scientific breakthroughs are impossible without creativity, and Terman could not measure this strand of genius. Kaufman studied creative people's experiences in their achievements. The aha moment, the flash of clarity happened at unexpected times, often after a period of contemplation. For instance, in a

dream, in the shower, on a walk. To Kaufman, information comes in consciously while the problem is processed unconsciously. As a result, the solution comes when the mind least expects it.

Neuroscientists also study the mind of creative brains and conclude that there is more communication between the left and the right hemispheres that can occur in highly creative people. According to Newberg, their thought processes are more flexible and take input from different parts of the brain. There is dialogue among frontal, parietal, and temporal lobes.

Natural gifts and nurturing environment might not produce genius unless motivation and tenacity are propelling one forward. Although to many people genius is associated with effortless great achievements, no matter how brilliant a person is, fortitude and discipline are key to success according to some researchers. For instance, a professor of psychology at the University of Pennsylvania, states that when you look at people accomplishing something great, you see that it is not effortless. Sometimes by sheer good fortune, promise and opportunity collide.

Scientists have been investigating genius from very different aspects (nature, nurture, discipline, brain features, DNA, etc.) to unravel the origins of genius. This effort may never reach an endpoint. The mysteries of genius seem to continue to challenge researchers like the universe.



Source: Illustration by Frits Ahlefeldt Laurvig

A genius is a genius not because of their clothes,
Not because of their parents or the size of their nose.

Not because of the place that they like to call home,
A genius isn't a genius because of what's in their dome.

A genius is a genius not because of their IQ,
Not because of their talents or what their friends do.
Not because they have money, or a lab, or a bed,
A genius is the person who just thinks with their head.

A genius is a genius because of what they can *do*,
Like having lots of ideas, much more than me or you.
And trying and trying even though they might fail,
A genius solves problems, no matter the scale.

A genius is someone who thinks quite a lot,
They are someone who regularly has a new thought.
They like to ask questions again and again,
And a genius is someone who often likes to pretend.

So, if you were to ask what makes someone so smart,
The answer is always that they just have a lot of heart.
They love what they do and they care quite a lot.
To be a real genius remember that it takes all you've got,
But it's not who you are and it's not who you're not.
No, the thing that can make you a genius today,
Is believing in yourself, and getting out there to play.

By Tanner Christensen

Key Concepts

Intelligence: the ability to acquire and apply knowledge and skills.

IQ (Intelligence quotient): a number representing a person's reasoning ability measured using a problem-solving test as compared to the statistical norm or average for their age,

Creative Thinking: intentionally gaining new insights and different ideas through existing information.

Abstract Thinking: the ability to consider concepts beyond what we observe physically.

Genius: an exceptionally intelligent person or one with exceptional skill in a particular area of activity

Reflection

Do you know any people with extraordinary talent in the history of mankind?

Can you give examples of inventions that changed humanity?

If for one day you had been given the chance of being in a genius's shoes, who would you choose?

Additional resources

What Makes a genius? Definition, Characteristics, and Qualities Explained: https://oxbridgehomelearning.uk/blog/characteristics-of-a-genius/Unhelpful thinking styles

Leonardo da Vinci was arguably the greatest genius of all time: https://www.thesun.co.uk/news/hold-ye-front-page/1978997/leonardo-da-vinci-was-arguably-the-greatest-genius-of-all-time/

Video materials

10 Most Intelligent People of All Time: https://www.youtube.com/watch?v=cNP8j1Xs3nk

Leonardo da Vinci's brilliant mind: https://www.youtube.com/watch?v=aYATCavD_IU

1.3 Creative Problem-solving

The analytical or procedural approach to problem-solving that is often taught in schools is an analytical or procedural approach. This method nearly entirely leverages left-brain thinking patterns. It is competitive and highly relies on individual effort. Different from problem-solving, creative problem-solving encourages whole-brain. It requires iterative thinking with its most effective sequences. Since it is cooperative in nature, it can become most productive when it utilizes a team effort.

Definition of Creative Problem-solving

Creative problem-solving (CPS) is a way of solving problems or identifying opportunities when conventional thinking has failed. Sometimes fresh perspectives are needed to come up with innovative solutions in order to formulate a plan to overcome obstacles and reach goals.

CPS is implemented in a variety of settings and by individuals from all age groups for solving problems. CPS can be utilized by individuals from early childhood through adulthood

Source: https://99designs.com/blog/creative-thinking/creative-problem-solving/

There are different approaches to creative problem-solving and it has been around because human beings think creatively and solve problems. However, it was first formalized as a process by Alex Osborn, who invented traditional brainstorming, and Sidney Parnes. Osborn's work consisted of the roots of CPS. He aimed to promote creativity for finding new and useful solutions so that it can be possible to develop opportunities for enhancing any situation. According to Osborn, every individual had the potential for creative behaviour. He saw imagination and judgement as essential contributors to creative productivity.

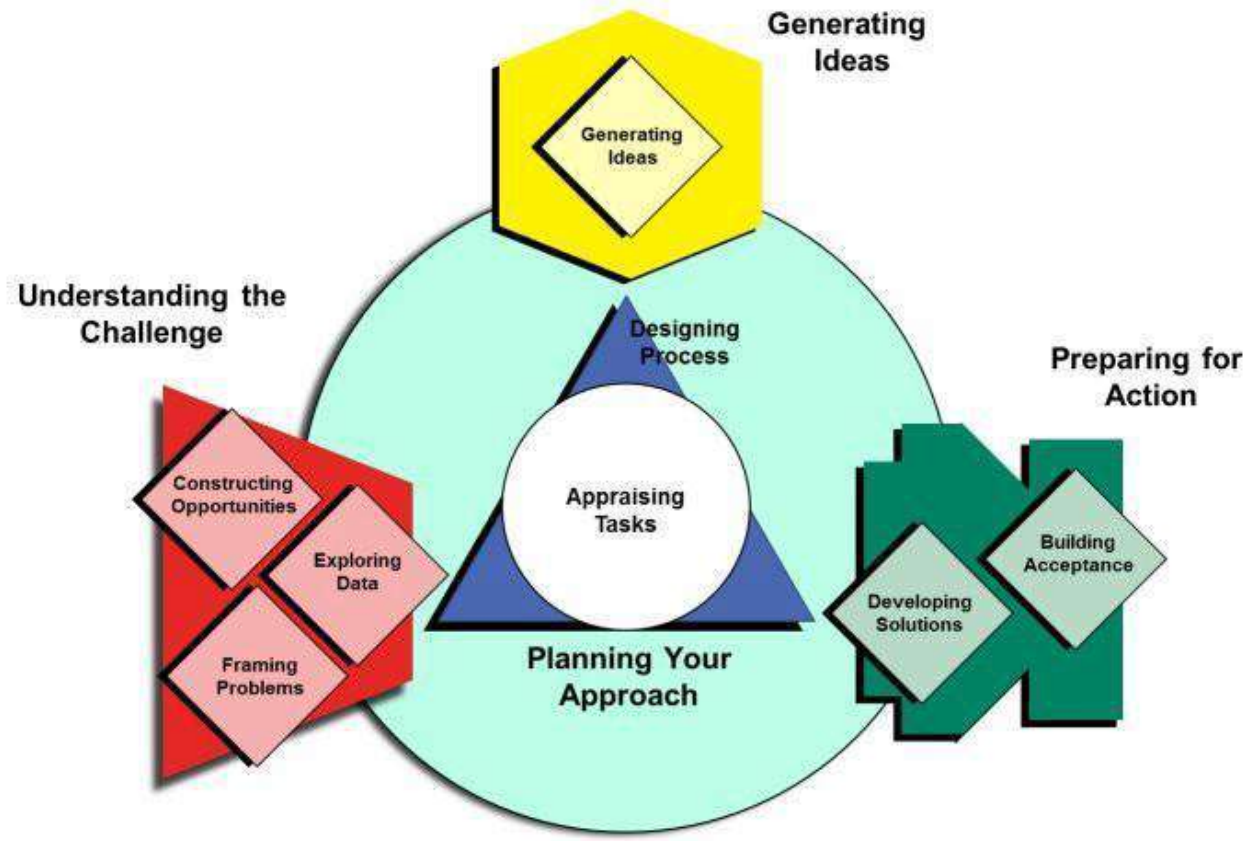
Some assumptions of CPS are as follows:

- People hold creative potential
- There are infinite numbers of ways to express creativity among all people in an extremely broad
- array of areas or subjects (Torrance and Salter, 1990)
- Creativity is usually approached or manifested according to the interests, preferences, or styles of individuals.
- People can function creatively, while being productive or demonstrate different degrees of accomplishment.
- Individuals can make use of their creative styles better and enhance their creative accomplishment levels to realize their creative potential better.

Steps and Principles of Creative Problem-solving

The creative problem-solving process as used by highly creative people includes the following steps:

- breaking down a problem to understand it,
- generating ideas to solve the problem and
- evaluating those ideas to find the most effective solutions.



Source: https://www.perspectiv.co.uk/complex-problem-solving

1. Understanding the Challenge: The importance of the first step cannot be underestimated because it explores the information and frames the problem. First, all the needed information should be examined and the opportunities to pursue should be chosen.

2. Generating Ideas: As the name suggests, generating ideas component is about coming up with different ideas, which could be developmental or exploratory. The ideas or improvements could fit within the existing system and might be quick to implement. Improvement ideas could be for more radical changes, creating new structures and systems, or be ideas for solutions disrupting the existing system. These ideas take longer to implement.

3. Preparing for Action: This final phase is about solutions. The problem has been understood and time has been spent generating and classifying possible ideas on how to solve the problem. At this stage, the individual can solve the problem and build acceptance.

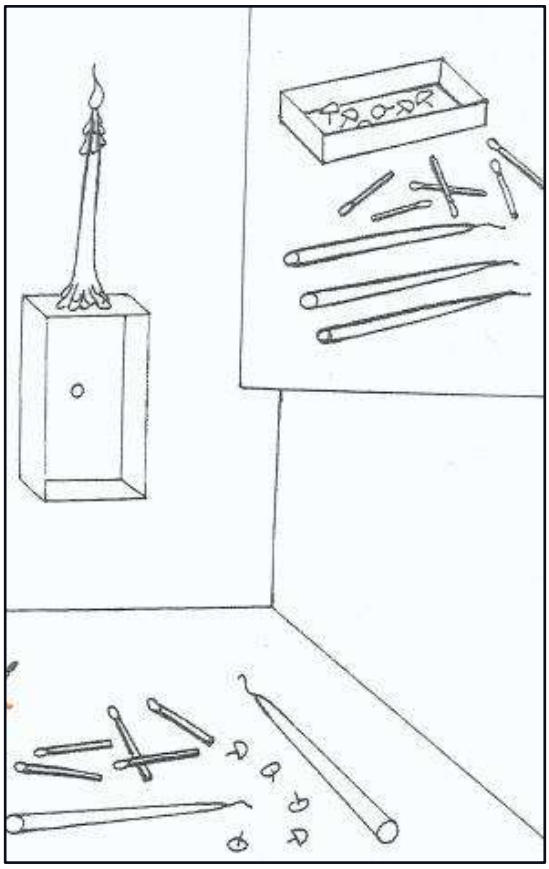
There are four core principles of Creative Problem-solving. Firstly, there should be a balance between divergent and convergent thinking. Creativity could be achieved by learning how to identify and balance divergent and convergent thinking (performing them separately and knowing when to practice each one). Secondly, finding a solution becomes easier when the problem is rephrased and open-ended questions with multiple possibilities are asked. Thirdly, judgments should be deferred or suspended because judging solutions early on tends to shut down idea generation. Ideas can be judged during the convergence stage. Finally, remember that language matters when information and ideas are generated. Using "yes, and" produces more effective outcomes than "no, but".

Creative problem-solving is commonly associated with brainstorming. However, it is not the case. It is rather a well-defined process in which you define the problem and implement solutions. People do not suddenly have those creative ideas. Creative ideas happen after trying to solve a specific problem or achieving a particular goal. For instance, Einstein's Theory of relativity was a result of a huge amount of mental problem-solving. Highly creative people such as Da Vinci, Edison, and other creative geniuses have worked in the same way, without waiting for creative ideas to strike them.

An example of creative problem-solving: While many companies focused on developing a better vacuum cleaner filter, James Dyson, inventor and founder of Dyson® vacuum cleaners, realized that he had to think differently and find a more creative solution. As a result, he devised a revolutionary way to separate dirt from the air and invented the world's first bagless vacuum cleaner.

Creativity and Problem-solving

Dunker's (1945) candle problem is brought up as an example of how to test creative problem-solving. The problem, proposed by the German psychologist Karl Dunker, is to attach a candle to the wall, having available a book of matches and a box of tacks or nails. Gestalt psychologists adopted Dunker's problem as an example to show how past experience interferes with productive thinking. To solve Dunker's problem, the box must be fixed to the wall with some tacks or nails, and then the box can be used as a platform on which to put the candle.



Source: The solution to Dunker's candle problem (Sawyer, 2012, p. 109).

Paul Torrance was a pioneer in creativity studies. He was one of the first to describe creativity as an iterative process. His legacy on creativity encompasses an incredible number of books and articles. He is famous for the creation of the *Future Problem-solving Program International*, the *Incubation Model of Teaching*, and the *Torrance Tests of Creative Thinking*. He was persuaded that all individuals are creative and that creativity can be enhanced or blocked in many ways.

In the 1970s, he proposed a model of five problem-solving activities (Torrance 1972, p. 5):

1. becoming sensitive to the problem;
2. identifying the difficulties;
3. searching for solutions;
4. testing the solutions;
5. communicating the result.

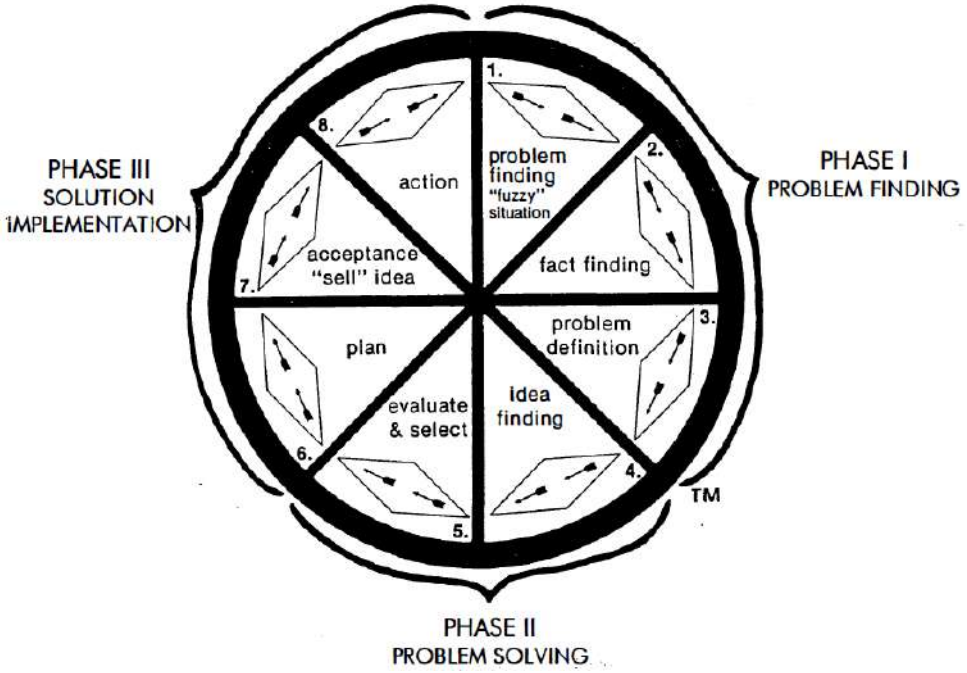
In the 1980s and 90s, Min Basadur developed an individual creative problem-solving methodology known as the *Basadur Creative Problem-solving Profile* (CPSP). He modelled organizational, group, and individual creativity and innovation as a continuous, circular, multi-phase, multi-stage process of

thinking. Basadur designed CPSP using **established constructs** from models of intelligence, such as **Guilford's** SOI and, later, **Sternberg's** WICS (Basadur, 1981; 1983; 1991; 1995).

In 1998, Basadur defined an eight-step circular process for problem-solving creativity:

1. problem finding (anticipating future problems and seeking current problems);
2. fact-finding;
3. problem defining;
4. generating potential solutions;
5. evaluating potential solutions;
6. action planning;
7. gaining acceptance;
8. taking action.

Figure below displays the eight steps creative processes, beginning with problem finding and progressing towards taking action, in a never-ending flow.



Source: Basadur's eight steps creativity processes (Basadur, 1998, p. 13).

Basadur's research highlighted that employees in a dynamic and effective organization should develop new thinking skills and reframe their jobs, e.g., by becoming creative problem finders and solvers and solution implementers. To this end, organizations should provide a framework for directing these creative thinking skills to support their important goals and objectives.

Sawyer (2012) integrated the various stages previously proposed by different authors for the creative process and developed his own eight-stage process:

1. *Find and formulate the problem.* The first step is to identify the problem and reformulate it in such a way that a creative solution can be applied.
2. *Acquire knowledge relevant to the problem.* Applying a creative solution requires practice and expertise.
3. *Gather a broad range of potentially related information.* The more information one possesses the more likely one will be able to implement creative solutions.
4. *Take time off for incubation.* The unconscious mind will process and associate relevant and potentially related information in an unpredictable and new way.
5. *Generate a large variety of ideas.* Unconscious incubation generates potential solutions to the problem.
6. *Combine ideas in unexpected ways.* Many creative solutions result from the combination of existing ideas.
7. *Select the best ideas, applying relevant criteria.* It is necessary to choose the optimal ideas, evaluating them according to the problem to be solved. Having the idea doesn't complete the creative process. The idea should then be implemented and applied.

Teaching Problem-Solving Skills

Centre for Teaching Excellence, University of Waterloo summarizes the basic principles for teaching problem-solving. The model provides an example for the implementation of the principles in classroom teaching.

The principles are as follows:

- **Model a useful problem-solving method**: Problem-solving is often difficult and tedious. Students should be taught how to be patient and persistent as well as how to follow a structured method.
- **Teach within a specific context**: The problem-solving skills should be taught in the context where they will be used. Teachers use real-life problems in the explanations.
- **Help students understand the problem**: Students need to define the end goal to be able to solve the problems. Beyond the questions of what and why, finding the answer to how will be easier.
- **Take enough time**: Understanding the problem, defining the goal, dealing with questions, making, finding and fixing mistakes and solving entire problems in a single session require time.
- **Ask questions and make suggestions**: Explaining why something happened and asking students to predict what would happen if... are important components. This is how they develop analytical and deductive thinking skills.
- **Link errors to misconceptions**: Errors can be used as evidence of misconceptions. Determine the misconceptions and correct them.

Wood's Problem-solving Model

1. Define The Problem
    - **The System:** Help students interpret the information given in the problem statement, maybe using a diagram to make it more effective.
    - **Known (s) and concepts:** Make a list of the things known about the problem, and identify what knowledge is needed to understand to solve it.
    - **Unknown(s):** One unknown is generally the answer to the problem, but other unknowns could also exist. Students should be able to understand what they are expected to find.
    - **Units and symbols:** Students should be taught how to select, interpret, and use units and symbols. Whenever applicable, units of symbols should be utilized.
    - **Constraints:** There are some stated or implied constraints of all problems, teach students how to identify them.
    - **Criteria for success**: From the beginning, students should be encouraged to think of logical types of answers.
2. Think about It
    - **Let it simmer:** This stage is used to ponder the problem. Developing a mental image of the problem usually happens during this stage.
    - **Identify specific pieces of knowledge:** the required background knowledge needs to be determined by students themselves from illustrations, examples, and problems covered in the course.
    - **Collect information:** Students are encouraged to collect pertinent information, which includes conversion factors, constants, tables, etc. needed to solve the problem.
3. Plan a Solution
    - **Consider possible strategies**: The type of solution is usually determined by the type of problem. Computing, simplifying, using an equation, making a model, drawing diagrams, tables, or charts; or working backwards include some common problem-solving strategies.
    - **Choose the best strategy**: Depending on what they are required to find or calculate, students should be helped to choose the best strategy
4. Carry out the Plan
    - **Be patient:** Most of the time, problems are not solved quickly or when you first attempt to solve them.
    - **Be persistent:** Students should be encouraged to be persistent if a plan does not work immediately.
5. Look Back
    - Students should be taught and encouraged to reflect. If a solution has been reached, they should ask if the answer makes sense, if it fits with the criteria established in step 1, if the questions are answered, etc.

Benefits of Creative Problem-solving

Source: Creative Problem-solving and Decision Making (http://www.firstselectbh.com)

Creative problem-solving can provide many benefits; some of them include the followings:

- Creative problem-solving can provide more innovative solutions. Encouragement of creative thinking and creative problem-solving pave the way for more innovative solutions, which in turn brings more and more innovations.
- Creative problem-solving enhances approachability. In businesses, approachability is an important point because it determines how active employees are. An approachable environment can be enhanced through creative problem-solving.
- Creative problem-solving enhances solutions with less bias. Supporting diverse thinking can be effective in providing better and more creative solutions. No matter how creative they are, most people carry their biases into a problem-solving situation, which is not a good thing. Enhancing creativity and diverse thinking can often be the solution.
- Creative problem-solving boosts employee engagement. The more creative the workplace is, the more people tend to get creative. When they see other creative solutions, they start to think more outside of the box, which will encourage idea sharing by making the environment more approachable.
- Creative problem-solving enhances solutions that work. Most solutions, although they seem to be working for the current case, could lose their impact soon. Creative problem-solving solutions often work much more effectively because they offer a more custom approach.

Key concepts

Creative problem-solving*:* a way of solving problems or identifying opportunities when conventional thinking has failed.

Productive Thinking: thinking in which a given question is regarded carefully utilizing objectivity as well as respect for the problem as a whole.

Creative Idea: the result of two or more notions coming together in the mind to create an all-new notion.

Brainstorming: a method of generating ideas and sharing knowledge to solve a particular problem.

Reflection

Can you give examples of creative problem-solving from daily life?

What are the steps and principles of creative problem-solving?

Additional resources

The benefits of Creative Problem-solving: https://getwideideas.com/the-benefits-of-creative-problem-solving

Activities for problem-solving: https://www.wrike.com/blog/top-15-problem-solving-activities-team-master/

Video materials

What is Creative Problem-solving: https://www.youtube.com/watch?v=QbxyiUG5RRI

Navi Radjou: Creative problem-solving in the face of extreme limits: https://www.youtube.com/watch?v=cHRZ6OrSvvI

1.4 Innovation and Creativity

Innovation and creativity are two closely related concepts that are sometimes used interchangeably. Throughout history, humanity benefitted from innovations that changed daily lives in significant ways. The words creativity and innovation refer to both a product of human creativity and to the processes involved in the development of a product. Without innovation and creativity, the world would be quite different today. The challenge is dealing with the combination of these concepts: creativity as an ability of single individuals and innovation as a collective phenomenon.

Source: How to be creative and innovative in the workplace?

What is the Relationship between Innovation and Creativity?

We can think of creativity associated with human potential as one of the most complex and fascinating dimensions. Creativity is believed to enhance innovative activities. It is known that an innovation process consists of two main activities, which include creativity and innovation. While novel and useful ideas are included in creativity, implementation of these ideas into new products and processes are included in innovation. Although this sequence seems quite logical and evident, what is experienced in this process actually entails many challenges and obstacles. Hence, maintaining a smooth and balanced innovation process because innovation processes are multifaceted and characterized by tensions Sarooghi et al. (2015) and are affected by variations factors such as institutions, cultures, organizations, and external environments. As Anderson et al. (2004) suggest, creativity and innovation do not always proceed linearly. They rather follow a long-winding, uncertain path that includes unfavourable outcomes. Rosing et al (2011) state that the process of the convention of creative ideas into innovation is composed of two different processes that can even be considered opposing processes:

- Idea generation: it requires experimentation, challenges common assumptions, and disrupts routines, is related to explorative activities
- Idea implementation: it requires a process, efficiency, goal orientation, and routine execution and is related to exploitative activities (March 1991).

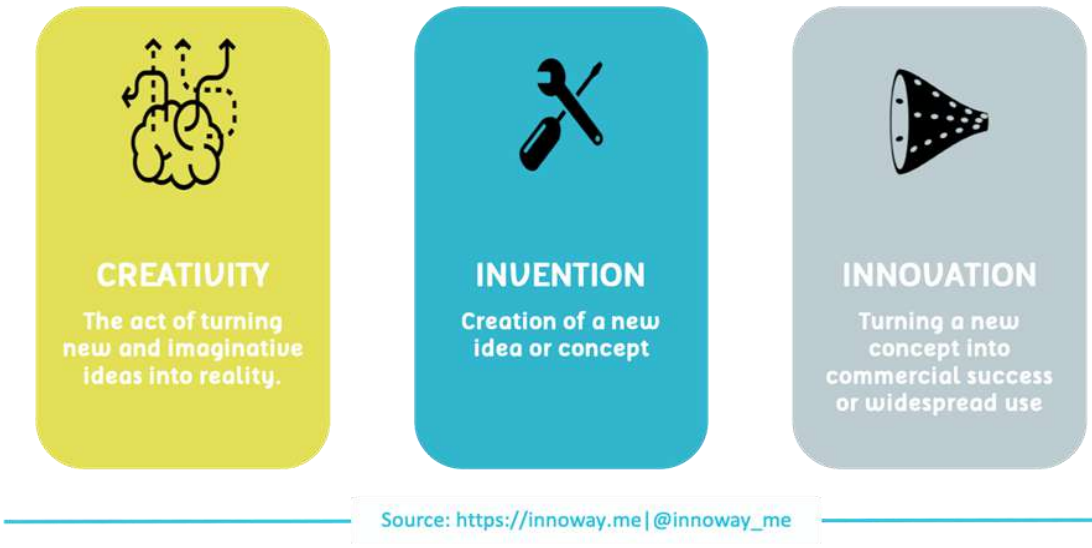
Source: What is the Difference Between Creativity and Innovation? https://weareive.org/what-is-the-difference-between-creativity-and-innovation/

The word creativity was rarely used until around the 1920s, but when it was used it usually referred to new productions and changes in a culture or an individual. Back in the 1950s, Guilford defined creative people as those who have “novel ideas”, and thus creativity was associated with the abilities that are most characteristic of creative people”. However, very soon it was realized that merely having new ideas was not enough; those ideas have to result in something of value. Hence, creativity was defined by Stein as “novel work that is accepted as tenable or useful or satisfying by a group in some point in time” (Stein, 1953). This definition of creativity associated with novelty has dominated for a very long time.

Source: https://dyppeakperformance.com/manage-your-energy-improve-creativity/

Innovation is a concept that is frequently used with creativity. They are related but separate notions. Hunter defines innovation as "Innovation is the implementation or creation of something new that has realized value to others." Innovation is more concrete than creativity as it could be seen in the form of a

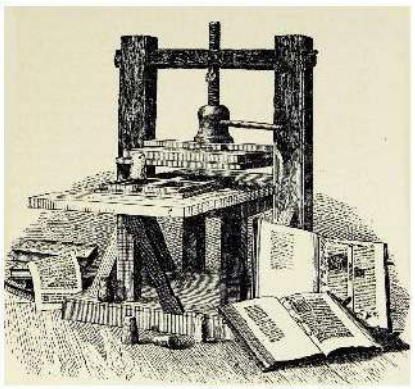
tool, physical benefit, or aid that solves a problem or creates an advantage. Society has benefited from creativity and innovation in the invention of medicine, music, transportation, art, communication, etc. Changes, growth, and innovation in the world have been possible with creativity and innovation. It is not possible to enhance innovation without creativity. Creativity and innovation are two terms that are used in tandem, and sometimes interchangeably; however, there are some things to be taken into consideration to realize the difference between them.



Innovation, Invention, and Creativity: definition, difference, and examples.

Examples of Creativity and Innovation

As the definitions provided above suggest, innovation should include a commercial success or widespread use of some kind. Creativity and innovation work together to create a solution to a problem or bring a new experience to society. The following examples including creativity and innovation could be used to exemplify this notion.



Source: Getty Images

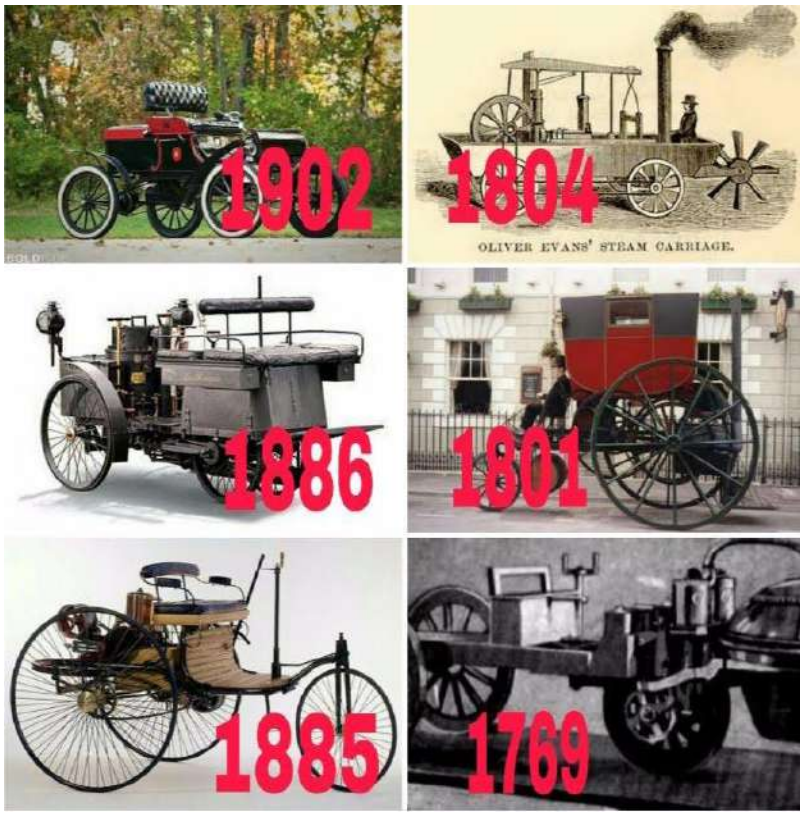
Printing Press: Printing press, developed by Gutenberg around 1440, was the most effective innovation in history that made the spread and democratization of knowledge possible.

Source: Getty Images

Compass: The Compass was invented in China in the 14th century. The impact of the compass on early navigation and exploration was priceless. It provided explorers with a reliable method for traversing the world's oceans.

Source: Getty Images

Electric Bulb: Before gas or electric lighting were invented, the light source indoors mainly came from the **fixed fire in the grate**. Home activities had to be done using hearth, with candlelight or oil lamps providing dim (but mobile) light around.



Source: Getty Images

Automobiles: There used to be horse-drawn carriages, trollies and trains before the automobile. There was a need for faster-personalized transportation. After automobiles, the way people travel changed forever. The innovation of the first automobile fuelled subsequent innovations.

Source: Getty Images

Ride-hailing: Ride-hailing is a service where a customer orders a customized ride online via a smartphone application. The first company to offer this service creativity conceptualized ride-hailing and contractor-based individual driving systems, which aimed to make flexible job opportunities and vehicle for hire access quicker and more affordable. Other companies also began to utilize similar services.

Source: Getty Images

Chiaroscuro: Chiaroscuro is a method used in art and it aims to use sharp contrasts between darkness and light to create a unique atmosphere and composition. The person who created this idea wanted to invent a creative process for producing more realistic imagery and a sense of three-dimensional volume. This innovation led to an actual technique that other artists could use to generate the same or similar effect.

More examples of modern innovations could be as follows:

Source: https://www.merriam-webster.com/dictionary/vertical

Search engines: Search engines online are the most common examples of contemporary innovation. They have become one of the leading tools of technology and internet information acquisition, they function as knowledge base search systems.

Source: Getty Images

Cell phones: The global use of cell phones led to significant changes in the ways people communicate. Before cell phones were used widely, people used to rely on landlines and other communication methods. Cell phones were invented due to the need for communication that is not confined to a cord. Now, the modern digitalized age is also evolving the ways cell phones are utilized.

How to Develop Creativity and Innovation

Creativity and innovation are among the components of 21st-century skills in this rapidly changing world. Education must keep up with the changing environment and tackle educational difficulties successfully (Whattananarong, 2011). High-quality educational innovation can help students learn more in less time and enhance learning competence. As a result, fostering high-quality innovation in education is critical and unavoidable. According to Sintapanon (2009), generating innovation in education is critical for learning since it helps learners understand content and lessons clearly. Learners create learning processes that influence their desirable features.

Creativity influences how teaching is delivered; the capacity for creative thinking develops educational innovation that is original, meaningful, and beneficial in the classroom. Previous research found that adopting a systematic educational approach centred on boosting creative thinking could significantly improve students' abilities to be creative (Prompan, 2007) and solve creative problems (Kanchanachaya, 2012). However, the earlier study did not focus on integrating creativity in the creation of educational innovation.

The design of problem-solving activities and challenging tasks are of great importance for learners. The model proposed by Prompan (2007) is believed to increase learners' creativity, and is composed of seven stages as follows:

i. preparation,
ii. setting the learning goals,
iii. learning and transformation,
iv. defining the concept and application,
v. development,
vi. presentation, and
vii. evaluation and celebration of the learning.

Today's learners like to learn through social media and mobile devices. Lecturers must design their classes to be more interesting and challenging both in the classroom and online, which is known as flipped classrooms. Before beginning the class in the classroom, they could provide students with

learning assignments to read and study on social media. They could assign the learning tasks in the classroom to discuss, brainstorm with peers, and work on a project together.

Source: 30 Solid Strategies for Fostering Creativity in Learning

It is not possible to teach creativity directly to others, but the purpose could be to teach creativity.

(National Advisory Committee on Creative and Cultural Education -NACCCE, 1999) indicated the principles of teaching for creativity as follows:

- encouraging young people to believe in their creative identity,
- identifying young people's creative abilities and
- fostering creativity by developing some of the common capacities and sensitivities of creativity such as curiosity, recognizing and becoming more knowledgeable about the creative processes that help foster creative development and providing opportunities to be creative with a hands-on approach.

Hence, teachers can encourage students to be creative and reward creative behaviours when they occur. Learners' creative abilities are considered to develop in an atmosphere in which the teacher's creative abilities are properly engaged'.

Clifford (2012) suggests 30 strategies to foster creativity in classrooms. Some of them can be summarized as follows:

- Embrace creativity as part of learning
- Use the most effective strategies
- Think of creativity as a skill
- Participate in or create a program to develop creative skills
- Use emotional connections

- Use a creativity model
- Consider how classroom assignments use divergent and convergent thinking
- Creativity flourishes in a “congenial environment”
- Be aware during discussions
- See creativity in a positive light
- Try the Incubation Model
- Use a cultural artefact
- Establish expressive freedom
- Be familiar with standards
- Gather outside resources
- Allow room for mistakes
- Allow space for creativity
- Give students time to ask questions
- Creativity builds confidence
- Encourage curiosity
- Structure is essential
- Observe a working model of creativity
- Consider the work of current experts in the field
- Explore different cultures
- Find ways to incorporate and integrate art, music, and culture
- Use a collaborative creative thinking model to solve classroom problems
- Design multidisciplinary lessons when possible
- Tapping into multiple intelligences is key
- Understand that creativity is important to students’ future in the job market
- Teach creative skills explicitly

Creativity and innovation are related concepts, but they are not the same. Innovation enables individuals to discover new ideas and get the highest possible value out of them.

Sternberg (2010) suggests the following items to encourage creativity in the classroom:

- **Define and redefine the problem:** Creative performance can be promoted by encouraging students to define and redefine their problems. Not providing them with choices helps them develop good judgment.
- **Question and analyse assumptions:** Although they may not share, everyone has assumptions. Questioning assumptions is part of analytic thinking involved in creativity.

- **Teach students to sell their creative ideas:** Persuading other people of the value of their ideas is something that should be learned by students.
- **Encourage idea generation:** Suggest new approaches when suggested ideas do not seem to have much value. Creative people like to generate ideas.
- **Recognize that knowledge is a double-edged sword:** One cannot be creative without knowledge. On the other hand, those who have an expert level of knowledge can experience tunnel vision, narrow thinking, and entrenchment.
- **Challenge students to identify and surmount obstacles:** Teachers can prepare students for disappointment by sharing examples of obstacles faced by creative people.
- **Encourage sensible risk-taking:** Students should be helped to learn to take sensible risks and to develop a sense of how to assess risks.
- **Nurture a tolerance of ambiguity:** Teachers should encourage students to accept and extend the period in which their ideas do not quite converge.
- **Foster self-efficacy:** Creative people's belief in the value of what they are doing is extremely important since creative work generally does not receive a warm reception.
- **Provide an environment that fosters creativity:** Students' creativity cannot be developed when they are told to be creative but when they are shown how they can be creative.
- **Teach students the importance of delaying gratification:** Teachers should remind students that their creativity is not usually rewarded immediately. The creative work of people is often ignored or punished.
- **Help students find what they love to do:** Teachers can ask students to demonstrate their talent or ability for the class, anything they like to do is accepted.

Key concepts

Innovation: a new idea, method, or device: novelty; the introduction of something new.

Curiosity: a strong desire to know or learn something.

Divergent Thinking (also referred to as lateral thinking): the process of creating multiple, unique ideas or solutions to a problem.

Convergent thinking: the type of thinking that focuses on coming up with a single, well-established answer to a problem.

Reflection

What do you think are the most important innovations of our age?

Additional resources

7 Creativity and Innovation Examples: https://www.indeed.com/career-advice/career-development/creativity-and-innovation-examples

Creativity Is Not Innovation (But You Need Both): https://www.businessnewsdaily.com/6848-creativity-vs-innovation.html

Video materials

What is the Relationship between Creativity and Innovation: https://www.youtube.com/watch?v=a-_ICMxQPpU

What is the difference between Innovation and Creativity? https://www.youtube.com/watch?v=TL2d2t2iZkY

Top 10 Inventions in Human History: https://www.youtube.com/watch?v=FJIpcyax8_g

Top 5 Innovations from History that Changed Everything: https://www.youtube.com/watch?v=CJdu66rmYuQ

1.5 Assessment

1) What does IQ stand for?
   a) Intelligent Question
   b) Intelligence Quotient
   c) International Quota

2) Genius people …
   a) can accomplish things without much effort
   b) have a natural talent from family
   c) use both intelligence and hard work

3) Creativity and innovation …
   a) are two completely different concepts
   b) work together to bring something new to society
   c) can be achieved by anyone

4) Creative problem-solving …
   a) is the same thing as problem-solving
   b) has no relationship with intelligence
   c) is utilized for problems in which conventional thinking has failed

5) Creativity is a concept that requires
   a) genius and above-average knowledge
   b) originality and effectiveness.
   c) Certain age

6) Which one does not assess creativity?
   a) The Torrance Test of Creative Thinking TTCT
   b) The Wallach and Kogan tests
   c) Intelligence Quotient Test

7) Dunker's (1945) candle problem is about
   a) Creativity and problem-solving
   b) Innovation and genius
   c) Intelligence and abstract thinking

Module 2. Individual and Social Creativity

Author: Özcan YÜCEL

Learning Objectives

Upon completion of this Learning Unit, trainees will be able to:

- Comprehend the distinction between creativity types
- Define creativity types
- Classify types of creativity
- Explain the steps of the social creativity process
- Classify frameworks for social creativity
- Apply frameworks of creativity
- Analyse barriers to creativity
- Generate ideas for enhancing creativity
- Define historical and intellectual context for creativity

Introduction

Creativity is often seen as an individual trait that can be manifested both in the process and the product or artefact created through the creative process. While everyone has a different level of development of creativity competency, all subjects can develop their creative potential by developing a better awareness of the creative processes such as divergent thinking and also the creative criteria to self-regulate the quality of the creative solution.

Source: https://researchnet.com

Creativity has been mostly studied from an individual point of view in the field of psychology, but there are a growing number of studies in the field of education, not only in individual tasks but also in social activities engaging students in different types of creative projects. For a long time, research on creativity focused on individual creativity. However, there is much to be said about distinguishing social creativity as a separate type of creativity. Some creative tasks can be managed by single individuals, but many tasks require collaboration between people with different skills. In two studies, individual creativity and social creativity even correlated negatively (Eisele, 2017a, b). Also, social creativity is not the same as social competence or social skills (see e.g. Fischer, Giaccardi, Eden, Sugimoto & Ye, 2005)

Supporting the development of creative competency is important for the actual challenges of society. However, creativity has been mainly approached individually, without considering the specificities of creative processes. Much human creativity is social, arising from activities that take place in a context in which interaction with other people and the artefacts that embody collective knowledge are essential contributors. Creative activity grows out of the relationship between individuals and their work, as well as from the interactions between individuals. Creativity does not only happen inside people's heads but also in the interaction between a person's thoughts and a socio-cultural context. This learning unit is suitable for every instructor who wants to create more creative lessons and it examines:

(1) how individual and social creativity can be integrated by employing proper collaboration models and tools supporting distributed cognition;

(2) how the creation of shareable externalizations (“boundary objects”) and the adoption of evolutionary process models in the construction of meta-design environments can enhance creativity and support spontaneous design activities (“unselfconscious cultures of design”);

(3) how a new design competence is emerging—one that requires passage from individual creative actions to synergetic activities, from the reflective practitioner to reflective communities, and from given tasks to personally meaningful activities.

(4) discuss barriers to creativity and how to enable them.

2.1 The Nature of Creativity

What is the Nature of Creativity?

Creativity is a complex and mysterious concept, and therefore it is difficult to define creativity because of the ambiguity about the concept and no accepted definition for it in general. The earliest definitions

of creativity were based on the concept of the creative individual when Guilford (1950: p.444) defined creativity as “the abilities that are most characteristic of creative people”. That definition became dominant during the 1950s and it is popular among creativity researchers (Amabile, 1996: p.21). Although each individual has different creativity, the real payoff appears when the creative process is leveraged in an organization at the organizational level (Cook, 1998a). Creativity has been defined in various ways.

Creativity is often associated with ideas and discoveries that are fundamentally novel with respect to the whole of human history (historical creativity). Creativity, however, also happens in daily real problem-solving activities, and not only in research labs or art studios as exceptional events. Researchers are concerned with ideas and discoveries in everyday work practice that are novel concerning an individual human mind or social community called psychological creativity which is a capacity inherent to various degrees in all people and needed in most problem-solving situations. Analysing the contributions of outstanding creative people [Gardner, 1993] helps to establish a framework for creativity, but understanding creativity in the context of everyday activities is equally important for people to create better work products (daily creativity). The analysis of everyday design practices [Rogoff & Lave, 1984] has shown that knowledge workers and designers have to engage in creative activities to cope with the unforeseen complexities of real-world tasks.

Source: https://istock.com

The nature of creativity has four essential pieces:

1. Originality.
2. Expression.
3. Social evaluation.
4. Social appreciation within a community.

Originality means people having unique ideas (mostly in the realm of psychological creativity) or applying existing ideas to new contexts. These ideas or new applications are of little use if they are only internalized; they need to be expressed and externalized so that social evaluation can take place where other people (with different backgrounds and perspectives) can understand, reflect upon, and improve them. Last, social appreciation refers to the effects of social rewards, credits, and acknowledgements by others (e.g., reward structures such as in a gift economy and a market economy) that motivate further creative activities [Fischer et al., 2004].

What is the definition of creativity?

There is no single, commonly accepted definition of creativity. Perhaps this lack of agreement on a single definition is appropriate given the nature of creativity, but it is nonetheless useful to look at what various writers and scholars have written about the concept.

Creativity has been described as “any form of action that leads to results that are novel, useful, and predictable” (Boone & Hollingsworth, 1990, p. 3); as “seeing things that everyone around us sees while making connections that no one else has made” (Wycoff, 1995, p. 21); as “a process or change from what is and has been to what might be” (Singh, 1985, p. 108); and as “the entire process by which ideas are generated, developed, and transformed into value” (Kao, 1996, p. xvii). Definitions and interpretations of creativity differ, in part, because they emphasize different aspects of creativity in different settings.

Perspective on Creativity	Main Points	Practical Implications
Creativity as a trait	People have innate characteristics that predispose them to be creative.	Some people have traits that make them naturally creative; such people probably

		will be creative wherever they are situated.
Creativity as cognitive skills and abilities	Creativity is based on conceptual skills and abilities such as divergent and abstract thinking.	Creativity can be enhanced by learning and improving certain cognitive skills.
Creativity as behaviour	Creativity is whatever results in the formation of new ideas or solutions that are useful.	The value of creativity lies in what useful outcomes are produced.
Creativity as a process	Creativity is a process of generating and testing ideas.	The creative process may or may not yield a new product or process; individuals can play different roles in the process.
Integrated views of creativity	Creativity is a function of the interaction between the person, the environment, and the task.	Some types of tasks and organizational environments can be more or less conducive to creativity.

Creativity as a trait:

One way to look at creativity is in terms of the traits, attributes, or characteristics that predispose a person to be considered "creative." In this view, if a person possesses these traits, then this person is deemed to be creative. The trait perspective also assumes that personal characteristics are more important than the nature of the organizational environment in which the person works. In other words, creative people probably will be creative wherever they are situated. Conversely, in this view, people who do not have these characteristics will not be creative, regardless of where they are situated. For example, some people are said to be naturally intuitive in that they do not amass facts and test theories; they simply "sense" things and therefore are thought of as creative. Creativity also has been described as synonymous with originality. People who demonstrate originality also have been found to be more intelligent and to have a preference for complexity—traits that also are associated with creativity (Foundation for Research on Human behaviour, 1958; Gundry et al. 1994).

Creativity as Conceptual Skills and Abilities:

Creativity also has been described as involving the use of a particular set of conceptual skills and abilities. This perspective differs from trait approaches in that it focuses more on cognition than on personality characteristics. Koestler (1964), for example, suggested that creativity is based on the ability to think on more than one plane or more than one level at a time. As Dimock (1986) characterized it, "The more adept a person is at rising from lower applied areas to higher intellectual and imaginative planes, the more creative such a fortunate individual is likely to become" (p. 5) Although there is a degree of overlap between views of creativity that rely on personal characteristics and those that emphasize conceptual and cognitive skills, there is an important distinction. Skills can be learned, whereas characteristics

cannot. Accordingly, in this view, we all can learn to be more creative by expanding and enhancing our conceptual and cognitive abilities.

Creativity as behaviour:

The behavioural view of creativity focuses on actions and activities that result in the development of something new. Thus, creativity is something a person does rather than what the person is. The emphasis is on the behaviour, not on the innate characteristics or cognitions of the individual. This view of creativity focuses on the outward behavioural manifestations of creativity and places them in context. Importantly, this view of creativity adds the element of usefulness, thereby distinguishing creativity from simply bizarre or unusual behaviour. Accordingly, creativity not only brings forward new ideas; it is a process that results in actions or behaviours that are functional and useful in a given situation. In that sense, it is not nonconformity for its own sake but rather nonconformity with a purpose.

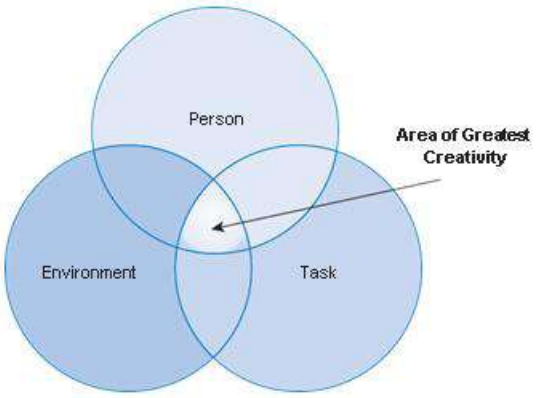
Creativity as Process:

Creativity also can be seen as a process. In this view, creativity is a highly complex phenomenon involving multiple phases and stages. Torrance (1988), for example, described creativity as a process of sensing problems, making guesses, formulating hypotheses, and communicating ideas. Drazin, Glynn, and Kazanjian (1999) defined creativity as the engagement of a person in a creative process where the person "behaviourally, cognitively, and emotionally attempts to produce creative outcomes" (p. 290). The emphasis here is on the process rather than on the out- come. The creative process involves both the generation of ideas and the testing of ideas. As such, creativity in the generation of ideas may or may not result in creative outcomes. This process perspective on creativity is useful for thinking about the stages in the creative process and about the roles that different individuals might play in each of these stages.

Creativity as an Integrated Perspective on Creativity

Finally, some have suggested that creativity is best viewed as encompassing all of these views. For example, Amabile (1997) offered what she called a componential theory of creativity that takes into account expertise in a particular domain, creative thinking ability, and the intrinsic motivation of the individual in a particular work or social environment. Similarly, Woodman, Sawyer, and Griffin (1993) linked individual, group, and organizational factors to creative outcomes. They indicated that creativity can be viewed as the development of a valuable and useful new product, service, process, or procedure by people working together in a com- plex social system. This integrated perspective is illustrated below

which indicates the mutual influence of personal factors, environmental characteristics, and the nature of the task.



Source: https://shutterstock.com

This approach is a useful one for public administrators and students of organizational behaviour. It recognizes that we all are potentially creative, although some of us might be more naturally suited to some parts of the creative process than others. It suggests that we can learn skills that will enhance our own creativity and that we can support creativity in others. It recognizes that creativity takes place in context and that creativity must be useful and appropriate to the setting or problem at hand.

What is The Creative Process?

Creativity is more than a flash of insight. Instead, creativity can be thought of as a process with five identifiable steps or stages: (1) preparation, (2) concentration, (3) incubation, (4) illumination, and (5) verification (Boone & Hollingsworth, 1990).

Preparation is the first step in the creative process. In the preparation stage, all parts of the problems are thoroughly investigated. This includes consciously gathering and examining information, defining the problem, and generating alternative ideas for addressing the problem. The purpose is to ensure that all parts of the problem are fully understood. In the preparation stage, a person not only searches for facts but also searches for ideas and alternative perspectives. Preparation is a conscious mental activity. Therefore, most efforts at enhancing creativity are focused on this stage of the creative process.

In the ***concentration stage***, the energy and resources of the person (or of the organization) are focused on solving the problem. The individual, in essence, concentrates his or her efforts on the problem or situation. There is a choice to engage with the process and a commitment to finding a solution. This stage is not so much a matter of mental activity as it is a matter of choice.

Source: herbertlui.net

The ***incubation*** stage is a largely unconscious phase of the creative process. It is, in essence, the "black box" of creativity. There is an internalization and subconscious ordering and reordering of information gathered in the preparation stage. The person cannot force this process; the best that the individual can do is attempt to relax and allow the subconscious to work and ideas to surface. This may involve the combination of previously unrelated thoughts and a subconscious struggle between what is and what might be. Conscious thought and effort probably interfere, rather than help, in this stage.

Illumination is the "Eureka!" of the creative process. This is the moment of insight or discovery when the answer simply seems to arrive in the person's conscious mind from his or her subconscious mind. It has been called an epiphany, a revelation, or a brainstorm—a sudden realization of something new or novel. But when viewed as part of the creative process, such insights actually occur after the individual has gathered information and gone through a period of subconscious mental activity during which the brain has "worked on" the problem.

The final stage of the creative process is ***verification***. This involves testing and verifying the idea or insight as viable. In other words, the creative solution is evaluated against some standard of appropriateness or acceptability, and the creator seeks corroboration and acceptance of the idea.

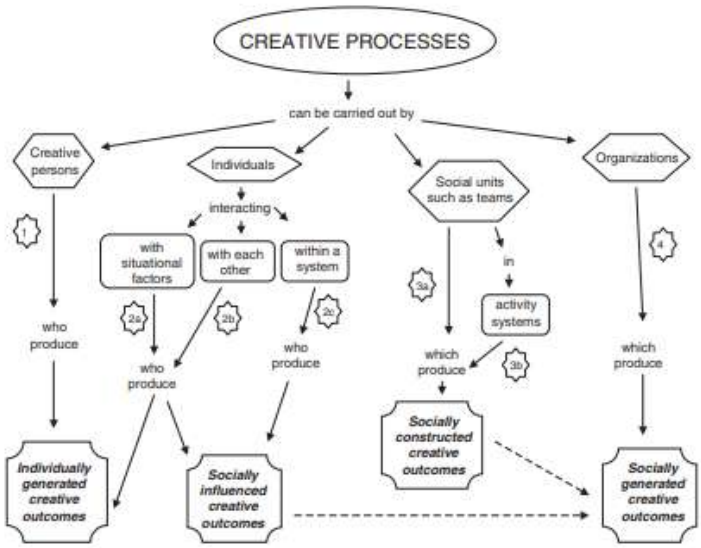
In addition to these identifiable stages, Foster (1995) provided a useful summary of the characteristics of the creative process, including the following:

- Long rather than short in duration.
- Ambiguous rather than certain and concrete.
- Information-rich rather than based on "existing" information.

- Involving multiple mental models rather than a particular point of view.
- Oriented to defining problems rather than finding short-term fixes.
- A continuing process rather than a one-time event.

Social Creativity Conceptualized

Reviews of the creativity literature, as described in the Methods section of this article, led to the codes or categories that described the research orientation. For the "who or what creates" question, four categories emerged. They are, first, the purely individual, independent actor as creator and agent—the creative person. Second is the individuals who interact with other individuals, with situational variables or within a system, and then either create as independent actors or produce outcomes that have been influenced by the interaction. Third, the actor is the social unit, such as a team. Fourth, the actor is the organization. Both team and organization are collective-level agents. The concept map organizes the results. It provides a structure for a sample of views on the actors who create and the sites believed by researchers to be where actors' creativity occurs. It organizes concepts present in the literature into a map that shows aspects of the process, person, product, persuasion, and place, along with vocabulary for the creative outcomes that are the product of individuals, groups, and organizations. The concept map uses a pattern that connects concepts with linking words. The basic structure reads like a sentence with alternative paths for the completion of the sentence. It identifies the creative actor and proposes a name for the type of creative outcome that is produced. In this way, the map can illustrate the levels involved while taking into account the questions of who or what creates and in which site the action occurs.



The map will be discussed by tracing each set of arrows and restating them in sentence form. After the information in the map is converted into text, representative authors for each of the actors, sites, or processes will be discussed. The map begins with “Creative processes can be carried out by” and goes on to complete the sentence in different ways. The map reflects the typology of person, product, process, persuasion, and place discussed in the context of creativity and creative thinking definitions provided earlier in this article. The first step of the map completes the initial idea by identifying the “person” or actor(s) involved in the creative process. Four possibilities are offered, which are as follows: creative persons, individuals, social units such as teams, and organizations. Additional details are offered for the category of the individual because the sites of an engagement or the context for individuals involved in creativity is a key factor for distinguishing between various research streams. For individuals, they either interact with each other, with situational factors or within a system. After the actor is identified, the mode of creativity he or she produces is named. Four names are offered for the type of outcome he or she creates and are reflective of the “product” portion of the “Ps” typology. The four names are as follows: individually generated creative outcomes, socially influenced creative outcomes, socially constructed creative outcomes, and socially generated creative outcomes.

Creativity as the Servant of Society

Even in the ancient world, there was interest in creativity as a socially useful phenomenon. To take two examples: Plato’s Ion emphasized society’s need for creative people and urged the state to foster their development. The Chinese Emperor, Han Wu-di, who lived in the second century BCE, was intensely interested in fostering creative fantasy because he saw it as an important resource of the state. There are two aspects to the socially useful dimension of creativity: (a) creativity as an aspect of spiritual-aesthetic life that helps society become more enlightened, humane, and “healthy” (see Cropley, 1990), and (b) creativity in the sense of human capital (see Walberg and Stariha, 1992), that increases physical well-being and financial prosperity, and makes the nation strong and safe. The more abstract, spiritual-aesthetic effects of creativity on society were discussed by Cropley (1990) in terms of mental health. He saw creativity as fostering healthy psychological adjustment, tolerance, and openness in society, while at the same time itself being facilitated by a mentally healthy society. Early in discussions following Guilford’s (1950) paper, writers such as Toynbee (1962) emphasized the importance of creativity for not only the spiritual but also for the physical survival of society. In the last two decades, creativity has increasingly come to be seen as a vital resource in business and government (e.g., Higgins, 1994). In emerging economies, creativity is often seen as the key to rapid economic and social development, especially modernization and its hoped-for benefits of improved education, better health care, and the

like. The relationship between creativity and the social environment is reciprocal: The environment permits or calls forth creativity and directs or guides the products it leads to, but creativity also changes the environment. For instance, Sosa and Gero (2003) argued that the Sydney Opera House in Australia not only introduced novel architectural and building techniques, but became part of the Australian consciousness and, in their view, increased the society's openness to novelty. It thus seems that there is little reason for teachers to fear that fostering creativity involves giving advantages to individuals at the expense of the larger group. On the contrary, fostering creativity is good for society.

Key Concepts

Historical Creativity: It is a creativity type that is associated with ideas and discoveries that are fundamentally novel with respect to the whole of human history.

Daily Creativity: It is the ability to think divergently and demonstrate flexibility and originality in one's daily activities.

Incubation: It is a largely unconscious phase of the creative process. It is, in essence, the "black box" of creativity.

Reflection

What is the most challenging step in the creative process for you? Please, explain why?

After reviewing the definitions of creativity, can you define your own creativity?

Additional Resources

Baer, J. (1998). The case for domain specificity of creativity. Creat. Res. J. 11, 173–177. DOI: 10.1207/s15326934crj1102_7

Sadler-Smith, E. (2016). Wallas' four-stage model of the creative process: more than meets the eye? Creat. Res. J. 27. DOI: 10.1080/10400419.2015.1087277

Weisberg, R. W. (1988). "Problem-solving and creativity," in The Nature of Creativity: Contemporary Psychological Perspectives, ed R. J. Sternberg (Cambridge: Cambridge University Press)

Video Materials

6 Signs You're Highly Creative: https://www.youtube.com/watch?v=L0bfkw7v9-A

The 6 Habits of Exceptionally Creative People: https://www.youtube.com/watch?v=JmQPNJhw5kQ

The Creative Process: https://www.youtube.com/watch?v=3SJ0Rd7XU4Y

2.2 Creativity Types and Improve them

Beyond binary choices

Individual Creativity

Creative individuals can make a huge difference, as analysed and shown by Gardner [Gardner, 1995] in exemplary cases, such as movie directors, champions of sports teams, and leading scientists and politicians. Individual creativity comes from the unique perspective that the individual brings to bear on the current problem or situation. It is the gestalt result of the life experience, culture, education, and background knowledge that the individual has, as well as the personal meaningfulness that the individual finds in the current situation. Creative actions obviously cannot be planned actions; rather, they can only be situated actions, after reflecting upon the situational talk-back of the environments, either technical or social. In this sense, individual creativity can be greatly enhanced by providing appropriate socio-technical settings. Studies show that most individuals have the capability of being at least moderately creative, so if organizations want to help individuals develop their creativity, they can leverage the three components of creativity. The three components of creativity suggest that creativity lies at the intersection of motivation, expertise and develop creative thinking skills.

Expertise—technical, procedural and intellectual knowledge—is the foundation for all creative work. You wouldn't expect someone who knows very little about software programming to come up with creative solutions to problems. The potential for creativity in a given area is enhanced when the individual has an exceptional grasp of the information around a problem or issue. Organizations can have a positive impact on increasing employee expertise with training, mentorship programs, etc.

Creative thinking skills encompass all those personality traits we talked about earlier that are common to creative leaders. Organizations, when cognizant of the traits that foster creativity, can interview and select candidates for hire that have these characteristics.

Motivation here means that an individual wants to work on a particular task because it's interesting and engaging. An individual who is more intrinsically motivated is likely to have an easier time developing creativity than one who is more extrinsically motivated. Motivation determines the extent to which an individual will engage his expertise and creative thinking skills.

Because there are different stages in the creative process, and because we differ from one another in terms of personality and preferences, it can be useful to think of the different roles that people can play in the various stages of creativity. As Filipczak (1997) pointed out, "Once you understand that all

employees are creative, the next step is finding out which part of the creativity spectrum each employee occupies" (p. 34). One way of thinking about roles in the creative process is to consider the different types of creativity. Hollingsworth (1989) defined four types:

1. ***Innovation*** sees the obvious before anyone else does. (e.g., Some states have innovated by offering multiple services at one site such as offering kiosks in shopping malls or one-stop service centres.)
2. ***Synthesis*** combines ideas from various sources into a new whole. (e.g., A city police department, a state social service agency, and the courts might create a multi-agency approach to dealing with child sexual abuse investigations and prosecutions.)
3. ***Extension*** expands an idea to a new application. (e.g., Many jurisdictions have taken the fast-food idea and created drive-through services such as book drops in libraries.)
4. ***Duplication*** copies a good idea from others. (e.g., As cities have experimented and had success with photo-radar technologies in traffic control, other cities have learned from those experiences and followed suit.)

Social Creativity

The power of the unaided individual mind is highly overrated [John-Steiner, 2000; Salomon, 1993]. Although creative individuals are often thought of as working in isolation, much of our intelligence and creativity results from interaction and collaboration with other individuals [Csikszentmihályi & Sawyer, 1995]. Much human creativity arises from activities that take place in a social context in which interactions with other people and the artefacts that embody group knowledge are important contributors to the process.

Source: pxhere.com

According to Csikszentmihályi that “an idea or product that deserves the label ‘creative’ arises from the synergy of many sources and not only from the mind of a single person”, does not exclude individual creativity. (Csikszenthmihalyi 1996). Creativity needs the “synergy of many”, and this kind of synergy is facilitated by meta-design. A defining characteristic of social creativity is that it transcends individual creativity and thus requires some form of organization. Elements of organization can and frequently do stifle creativity [Florida, 2002], so our experiences in collaborative design have exposed two barriers to capturing information [Fischer et al., 2004]. Individuals must perceive a direct benefit in contributing that is large enough to outweigh the effort [Grudin, 1989]. These two barriers must be overcome to sustain the passage from individual creative actions to synergetic activities.

Team creativity

Innovation takes place when different ideas, perceptions and ways of processing and judging information collide. Team-role theory suggests that in advanced teamwork the members of the team are able to establish the roles by themselves through self-discovery and the perception of the needs of the team as a whole (Belbin 2007, p. 1). If the needs of the team are observed, assuming the ability of self-discovery, it is possible to produce intelligence on how the team roles could be divided between team members. Belbin (2007, p. 1) argues that team members do not normally decide their roles, but are instead usually given roles; yet teamwork based on self-organization is considered one of the most efficient ways to accomplish complex tasks and missions.

Source:pixaby.com

Co-creation

It is defined as the process leading to the emergence and sharing of creative activities and meanings in a socio-technical environment. [Giaccardi, 2004], Co-creation is a situated experience, usually engendered by a combination of synchronization and improvisation [Nonaka & Konno, 1998], and supported by enabling users in the socio-technical environment to share emotions, experiences, and representations. To support both the individual and the social aspects of creativity, as well as the interplay between them, co-creation may take on different forms, such as:

- Serial: creating something (perhaps in isolation) that is then brought into the social venue so that others can build upon it (either in the social context or in isolation).
- Paper parallel: separately creating elements that are then brought together and combined into something new.
- Simultaneous: jointly creating something at the same time.

Historical and Intellectual Context

Assumptions about creativity established during the Renaissance, Romanticism, and the Industrial Revolution, continued to shape the cultural imaginary and the academic study of the phenomenon. Until the 1980s, research on creativity in the West was situated mostly in the discipline of psychology and focused primarily on what was known as the four Ps: person, process, product and press). In the dominant four P's model, the who of creativity was a person and was therefore by definition limited to an individual. Groups, organizations, cultures, and relationships were not included, and in fact popularly depicted as representatives of conformity and compliance, and mostly viewed as potential obstacles for the creative person. The genius or more generally the creative person was viewed as being in an oppositional relationship with other people and more generally with society. A number of intellectual and social developments in the late 20th and early 21st century have questioned the foundations of Western thought. They directly or indirectly led to questioning, critiquing, and proposing alternatives to the dominant individual-centred approach to creativity.

- Psychologists with a social constructionist orientation as well as sociologists have argued that who or what we call "creative" is the result of a social judgment, and that creativity is therefore socially constructed and does not exist "naturally," independently of that judgment.
- Authors in the movement loosely known as postmodernism have critiqued the notion of the autonomous individual. They proclaimed the death of the "subject" and the "author," and ushered in "the birth of the reader." This involves foregrounding readers' individual interpretations and rejecting the dominant role of the author. They also stressed the commercial and political interests and power dynamics embedded in

the discourse of creativity. Postmodern thinkers criticized the image of genius, and the notion of originality, discussing the role of “bricolage,” the combining and recombining of existing materials, summarized in the expression “everything is a remix.”

- From the perspective of systems and complexity theories, creativity research has viewed individuals as closed systems, unaffected by their context. An open system approach situates individuals in their social context and a network of Social Creativity relationships. The self-organization and emergence of natural and social phenomena attracted attention, as did the role of “swarms,” with a bottom-up, distributed, rather than a top-down approach, stressing the significance of recursive, mutually causal interactions.
- Researchers studying the psychology and creativity of women have argued that the creativity of women cannot be assessed without taking into account social and cultural factors. Women were portrayed as fundamentally not creative in the same way as men are, and through much of history, women were not allowed to participate in those very domains in which one would be recognized as creative.
- Cultural psychology is an interdisciplinary field that draws on a wide variety of disciplines including anthropology, neuroscience, cultural studies, and the philosophy of mind. For cultural psychology, mind and culture are not only inseparable but mutually constitutive. Minds shape culture and culture shapes minds, and the emphasis is on studying the nature of this process.
- Management and organization theorists have developed an interest in creativity as part of the larger process of innovation. Whereas the creative process has traditionally been viewed as something that goes on inside an individual and leads to the proverbial lightbulb going on, the process of innovation includes idea generation but is much more extended in time and space. Idea generation is important, but part of a larger process that goes all the way to implementation and is therefore by its very nature more social.

Myths about creativity

Here some of the best known social-cultural myths about creativity are enumerated below (Boden, 1991):

- Creativity is Fun.

The flow state of peak experience is extremely positive and self-actualizing, but it would be misleading to describe it as "fun." Creativity is not easy or peaceful.

- Creativity Is a Burst of Inspiration.

Creativity is not a sudden burst of inspiration, a gift from above, or a divine moment. Rather, creativity is a long, extended process over time, in which many small, mini-insights occur throughout the work day.

- Creativity Is an Individual Trait.

Creativity is not just a property of individuals, it's also a property of social groups. Modern creativity is more like an improvisation jazz ensemble or as the development of the Windows operating system than a poet writing in solitude. Individual creativity is more likely to occur in collaborative groups than in solitude. It's no accident that jazz musicians play better in groups and in front of live audiences than they do alone at home or in group rehearsals with no audience. Creators in all fields of life report their most significant insights emerging from collaborations (JohnSteiner, 2000). Creativity is a social phenomenon involving variation and selection at multiple overlapping levels of analysis. In fact, for the most part, creativity accepts and builds on convention, which means interaction between people and creativity starts from here. "Being empathetic means to be able to recognize the feelings of others, even when those feelings may not be obvious. A direct consequence of empathy is a better way of managing relationships, listening, and relating to others. They avoid stereotyping and judging too quickly, and they live their lives in a very open, honest way." 308 (M. Rusu, 2018). There is a small component of novelty in most creative products, but it's always smaller than we think at the time. With 50 or 100 years of distance, almost everything being created today will sound and look the same, even though it looks like an incredible variety. There was no freedom of social coercion that led to Einstein, Michelangelo or Shakespeare. Most social systems have interests in the status quo, and true creative novelty is often perceived as dangerous for those in power. As a result, what really needed creative people is not the common sense of humanistic psychology, but rather the thick skin and the great ego that sustained the existentialist Salvador Maddi (Maddi, 1975, p. 182). Of course, this type of person does not sound very beautiful, and what has claimed Maddi does not fit our cultural concepts of creativity as the pure and good expression of the self-actualized individual.

- Choose a Domain That's Right for You.

Domains that are widely available are more likely to experience creativity. In some cultures, and historical periods, elites have restricted access to the domain; only a certain privileged class of people could participate.

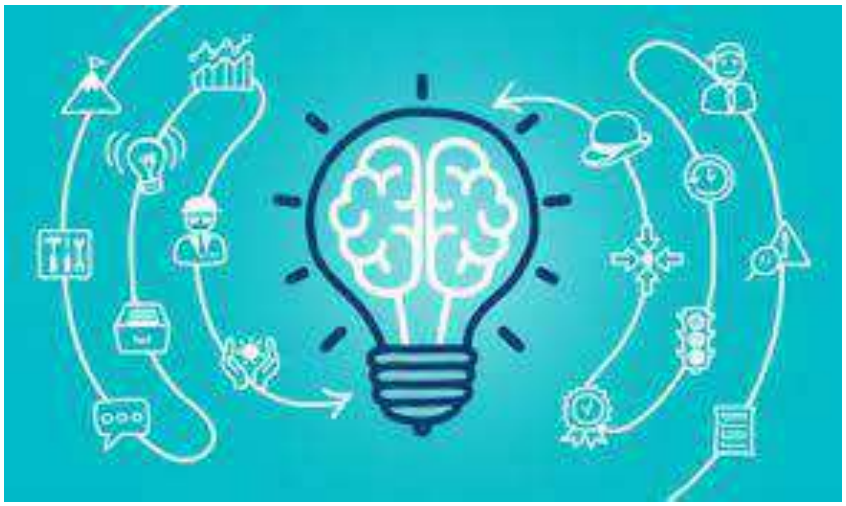
- Choose a Field That's Right for You.

A field is more likely to experience creativity if it has formal systems of training, with teachers, mentors, and experts who can pass on the domain of knowledge. An area is more likely to experience creativity if it offers opportunities for newcomers to work in the field. Young talented people will not choose a career if there are no employment opportunities or if the field only accepts elderly people. You can increase your chances of creativity, making sure you work in a field that fits your personality and style.

Some fields are very large and require a lot of networks to stay involved and connected. That's good if you're an extrovert, but a more introverted person might be intimidated because it will have 5000 people at the annual conference. Introverts could be more comfortable in smaller fields.

Techniques for Improving Creativity

Creative skills can be enhanced by learning and practising. For every level of education, teachers and education authorities use creativity training to build and foster creative approaches and skills. The following subsections offer a sampling of some of the tools used to enhance creativity.



Source: https://edx.org

The Idea Box or Matrix Analysis

In matrix analysis, a two-dimensional “idea box” is used to explore new ideas or alternatives (Miller, 1987). There are four steps to generating an idea box: (1) specifying your purpose or what you are trying to accomplish, (2) identifying the parameters of the problem, (3) listing variations, and (4) trying different combinations. Consider a situation in which your purpose is to gain citizen input and involvement in the city’s recreation department, but you are not sure how to do it and resource limitations are such that you will be limited in the number of approaches you can use. You could begin by asking yourself what the parameters of the problem might be. For example, perhaps you could consider methods of input, timing or frequency, subjects, and target groups as your parameters. For each of those parameters, you would develop options. Methods of input might include citywide open meetings, neighbourhood forums, mailed questionnaires, or suggestion boxes. For target groups, you might think about seniors, teenagers, preschool children, and businesspeople.

Synectics

Synectics is a technique developed by Gordon (1961) for improving creative problem-solving. The word *synectics* means joining together different and apparently unconnected or irrelevant elements. In synectics, problems are defined by "making the strange familiar," and ideas are sought by "making the familiar strange" (p. 33). In the former case, the aim is to understand or define the problem using terms that are familiar to you. In the latter case, the purpose is to make the familiar strange by purposely distorting, inverting, or transposing the problem to something unfamiliar. This can "transpose both our usual ways of perceiving and our usual expectations about how we or the world will behave" (p. 36). Synectics uses four types of metaphors in this process: (1) the personal analogy, (2) the direct analogy, (3) the symbolic analogy, and (4) the fantasy analogy.

Mindmapping

Mindmapping is a technique designed to help us think visually and spatially about issues and problems. Mindmaps help to guide us through mental explorations in much the same way as ordinary maps help us in our travels (Rickards, 1988). Mindmapping uses pictures and images to define a vision, a problem, or a situation. It can be a simple representation intended to be used as a memory trigger or as a detailed representation of a situation, process, or "territory." Wycoff (1995) suggested that a mindmap should begin with a central image in the middle of the page. Then colours, pictures, and symbols should be used to map the situation, using only one keyword per image. All lines branch from the central image. Mindmapping can be a highly useful tool for organizing information, generating and communicating ideas and creating a framework for solving problems. There are a number of variations, such as a tree and a fish bone map. Using a tree, some dominant idea or problem is linked to a set of its components or branches. In fish boning (a technique popular in Japan), problems are diagrammed in terms of cause and effect.

Design Thinking

Design thinking is an approach to using creativity to solve problems that incorporates graphic and industrial designers' original methods to "engage people, communicate information, generate ideas, or inquire into a design problem" (Junginger, 2006, p. 2). This process, based on the process used in the physical design of objects (e.g., chairs, computers, and bicycles), is being applied to organizational problems as well. It offers a way to approach issues and problems that are directed at "inventing" ways of doing things that make sense to the humans who use them in a particular context. Some see design thinking as a complement to scientific thinking. In scientific thinking, the scientist analyses facts to find

patterns and insights. In design thinking, the designer “invents new patterns and concepts to address facts and possibilities” (Owen, 2006, p. 17; 2007).

Key concepts

Individual Creativity: *Individual creativity* is ideas or innovations by a *single individual* – an author writing a book or a process manager thinking of a new process, for example

Social Creativity: Social creativity is an umbrella term used to describe a number of different approaches that go beyond psychology’s traditional focus on the individual.

Synectics: Synectics is a technique for improving creative problem-solving which means joining together different and apparently unconnected or irrelevant elements.

Reflection

Which techniques do you use to improve creativity in your class?

Which types of creativity is a must in the education system?

Additional Resources

Ghiselin, B., ed. 1952. *The creative process*, New York: Mentor. [Google Scholar]

Martindale, C. 1989. “Personality, situation, and creativity”. In *Handbook of creativity*, Edited by: Glover, J.A., Ronning, R.R. and Reynolds, C.R. 211–232. New York: Plenum. [Crossref], [Google Scholar]

White, J., ed. 1972. *The highest state of consciousness*, New York: Anchor. [Google Scholar]

Video Materials

Creativity: Four Types of Thinking https://www.youtube.com/watch?v=AQVK6ZelAG4

Creative Thinking: Increasing the dots https://www.youtube.com/watch?v=cYhgIlTy4yY

8 Creative Thinking Exercises https://www.youtube.com/watch?v=pfg9a9diN40

2.3 Social Creativity Progresses

Related notions and concepts

Social creativity is an umbrella term used to describe a number of different approaches that go beyond psychology’s traditional focus on the individual. It initially emerged in an effort to address social factors and issues in the study of creativity. The increased interest in social creativity has drawn attention to

such topics as relational creativity, creativity in relationships and groups, the role of the environment in fostering or inhibiting creativity and has also questioned and articulated the roots and philosophical stances of various approaches to creativity.

1. Two dimensions in social creativity

To better represent the nature of creative social interactions, researchers propose to describe it along two main dimensions:

- degree of novelty
- the size of the social group

One axis derives from the psychological-historical continuum posited by Boden (1992). Accordingly, a behaviour may span from psychologically creative if it is novel to the individual (and possibly known to others in time and space), up to historically creative if the behaviour is the first occurrence in human history. In this view, historical creativity represents a sub-sample of psychological creativity. Social creativity thus spans from small behavioural changes each time we use a behaviour that is novel to us (but known to others) in order to solve an —everyday social problem or improve a social situation, up to ground breaking social inventions and practices that dramatically alter the groups' social rules.

A second axis pertains to the size of the social group in which social creativity is observed. Novel social behaviours are relevant (or not) to groups of various sizes, from dyadic relations to larger groups. Within dyads, it is proposed that social creativity is expressed each time the two parties cooperate in order to increase their mutual well-being. As the size of the group increases, social problems to be solved become more complex and require societal creativity, as expressed in the lives of union, political and religious leaders and followers. At the very end of the group size dimension lies social creativity concerned with future generations. At any given moment, a creative social behaviour can thus be positioned in this two-dimensional space. Yet a creative behaviour realized in a group can sometimes move upward on both psychological-historical and group size dimensions, if it is performed by a growing number of individuals in a coordinated fashion, as in large scale protests, boycotts, or uprisings.

2. Social creativity within social development

Only social behaviours that are both adapted to the context and novel at least to the self can fit into this definition of social creativity. Not every social act can thus be equated to a creative act, as many social behaviours simply stem from mere learned routines. Three psychological perspectives have been proposed the functional perspective proposed by Spivack and Shure (1974) and Dodge (1986).

Source: https://epthinktank.com

Spivack and Shure (1974) originated a series of studies that aimed at implementing intervention programs in kindergarten and primary schools. One important goal of these intervention programs was to train teachers to promote social problem-solving skills in their pupils. In their theoretical framework, which lay the groundwork for both intervention programs and assessment tools, discrepancies in social problem-solving abilities could be explained in terms of discrepancies in one or more of the components of the problem-solving process. Three social abilities are judged to be essential:

Each ability identified by Spivack and Shure has relevance to social creativity. Each draws on divergent thinking (see Runco, this volume), a mode of thinking that is central to creativity. In addition, divergent thinking is not promoted as a general ability, but in socially oriented cognitive tasks. Accordingly, when facing a social problem, a divergent mode of thinking in both interpreting social situations and finding solutions will increase the likelihood of finding a socially creative answer.

- the structural perspective elaborated by Piaget (1932) and Kohlberg (1968)

A different perspective on development--the structural perspective--proposes that abilities (social or else) go through a universal and constant series of stages, each corresponding to the unfolding of distinct abilities. The structural perspective has gained attention in developmental psychology via the works of Piaget, in some of which aspects of social development were examined (1932). This approach provides an additional framework in which social creativity development can be considered. According to Piaget, one central moment in children's social development is when they reach autonomy in

Source: https://nancywilson.com

moral reasoning, as opposed to an earlier heteronomous stage. It can be drawn from this perspective that higher levels of social creativity should be observed in the latter stage, since it allows for more complex interactions, integrating moral principles such as cooperation and reciprocity. Piaget did not provide a precise account of how children reach the creativity compatible moral reasoning stage. He merely emphasized the role of peer interactions-- especially in collective games--over interactions with adults. Contrary to most interactions with adults, he wrote, interactions between peers allow for a more balanced practice of cooperation and reciprocity.

- Selman's mixed approach to the development of social problem-solving

After proposing a sequential development of decentration in a Piagetian framework, Selman and collaborators (Selman et al., 1986; Yeates & Selman, 1989) attempted to integrate the functional and structural perspectives when considering interpersonal negotiation. strategies (INS) in children. Their INS model is structural as it is grounded on Selman's previous model of development of decentration, proposing four successive stages in negotiation strategies **(0) impulsive, (1) unilateral, (2) reciprocal, and (3) collaborative/cooperative**. Selman and Yeates's model of interpersonal negotiation strategies provides a useful and multipurpose frame for investigating the development of social creativity, as it includes both divergent thinking (idea generation) as well as convergent thinking stage. Also, the INS model makes specific predictions on the strategies.

Frameworks for Social Creativity

It is grounded in the basic belief that there is an "and" and not a "versus" relationship between individual and social creativity. Creativity is an interactional process occurring in the relationship between an individual and society and between an individual and the technical environment. Therefore,

a systemic approach—based on processes in which individual and social creativity mutually reinforce each other—is necessary to enhance creativity effectively. Individual and social creativity can be integrated by means of proper collaboration models, appropriate community structures, boundary objects, process models in support of the natural evolution of artefacts, and meta-design. The combination of the above elements can enhance this integration by providing the right environment and interactions. This section delineates the relationship between each element and creativity.

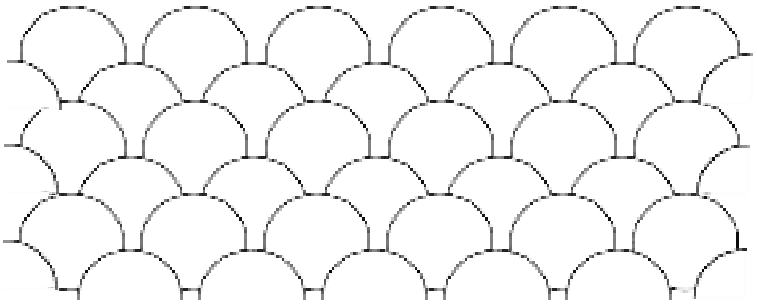
- The Fish-Scale Model for Collaboration

The traditional model for collaboration, the "division of labour," is inadequate in addressing issues of social creativity. Division of labour [Levy & Murnane, 2004] refers to specialized tasks within a given framework of reference; in contrast, social creativity is a matter of emergent interactions and meanings. The fundamental difference between social creativity and division of labour can be summarized as the following:

- social creativity: collective outcome > sum of individual efforts
- division of labour: collective outcome = sum of individual efforts

Division of labour tries to divide tasks among a group of people by functions. For social creativity, people collaborate with each other by taking up tasks that fit well with their knowledge and personal interest.

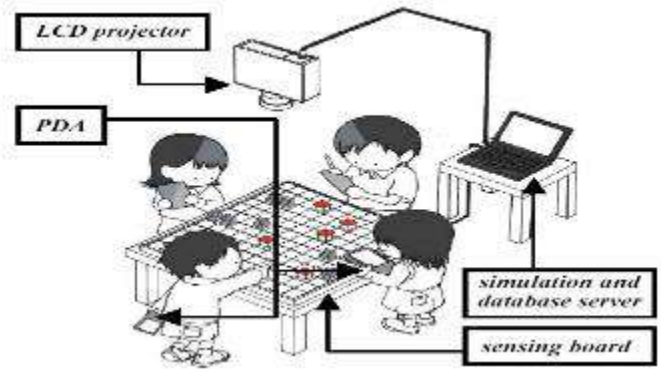
The fish-scale model [Campbell, 1969] can be considered an alternative to the traditional division of labour that can augment social creativity. The basic objective of Campbell's model of omniscience, which we address here as a model of collaboration, is the "collective comprehensiveness through overlapping patterns of unique narrowness". The model depicts a competence that can never be embodied in a single mind, so a new focus is necessary: "Make me a novel fish-scale. Let my pattern of inevitably incomplete competence cover areas neglected by others" [Campbell, 1969]. Creating sufficient overlap is essential for the fish-scale model to succeed. For example, many software design problems transcend the individual human mind and require collaboration from different minds because knowledge is distributed across domains and individuals (Curtis et al., 1988; Bennis and Biederman, 1997; Arias et al., 2000; John-Steiner, 2000).



The Fish-Scale Model

- Caretta: Integrating Personal and Shared Spaces

Caretta is a system for supporting face-to-face collaboration by integrating personal and shared spaces [Sugimoto et al., 2004]. This system is used to support users in urban planning tasks, which are categorized as open-ended social problems. In urban planning tasks, all the stakeholders want to devise their "best" ideas and need to discuss and negotiate with each other to create mutually agreeable design plans. Participants individually try to come up with their own ideas, and other participants collectively evaluate existing plans. Therefore, collaborative urban planning tasks are spiral and entwined processes that require the smooth integration of individual and social creativity; individual creativity drives social creativity, and social creativity triggers further individual creativity.



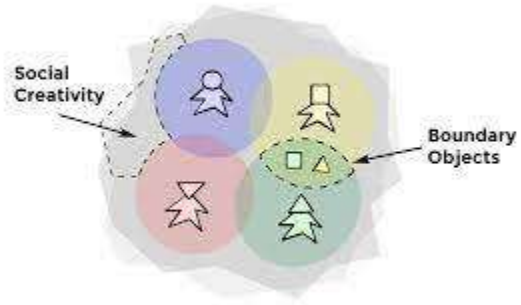
Caretta can support users in seamlessly conducting their tasks in both spaces, and enhance collaborative problem-solving processes that require individual and social creativity.

Individual creativity drives social creativity and social creativity triggers further individual creativity. Existing computational media, however, do not fully support users' individual and group activities at the same time (Gutwin and Greenberg, 1998). Caretta is designed to overcome this shortcoming. It provides users with personal spaces for individual reflections, a shared space for group

discussions and intuitive transition methods between these spaces. In Caretta, a multiple-input sensing board, appropriately called Sensing Board (Sugimoto et al., 2002), is used for the users' shared space, and Personal Digital Assistants (PDAs) are used for individual users' personal spaces, as shown in Fig. 6. Users of Caretta can discuss and negotiate with each other in the shared space by manipulating physical objects, each of which is enhanced by a radio frequency (RF) tag for rapid object recognition. An augmented reality technology for overlaying virtual graphics onto the shared space through a liquid crystal display (LCD) projector creates an immersive collaborative environment that enhances interactions and mutual awareness among users.

- Boundary Objects in Support of Distributed Cognition

Boundary objects [Arias & Fischer, 2000; Bowker & Star, 2000; Star, 1989] are objects that serve to communicate and coordinate the perspectives of various constituencies. They serve multiple constituencies in situations where each constituency has only partial knowledge and partial control over the interpretation of the object. Boundary objects perform a brokering role involving translation, coordination, and alignment among the perspectives of specific CoPs.

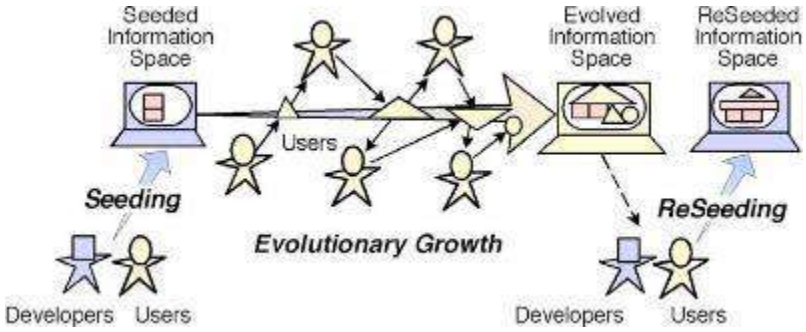


Source: https://polkadot.network/

Boundary objects can be described as a means of representing, learning 4 about, and transforming knowledge to resolve the consequences that exist at a given boundary (Carlile, 2002). Boundaries are the locus of the production of new knowledge and therefore an important source of creativity. They are where the unexpected can be expected, where innovative and unorthodox solutions are found, where serendipity is likely and where old ideas find new life. The diversity of CoIs may cause difficulties, but it also may provide unique opportunities for knowledge creation and sharing.

- The Seeding, Evolutionary Growth, and Reseeding (SER) Process Model

The seeding, evolutionary growth, and reseeding (SER) process model [Fischer&Ostwald,2002] depicts the lifecycle of large evolving systems and information repositories. It postulates that systems that evolve over a sustained period must continually alternate between periods of activity and unplanned evolutions, and periods of deliberate (re)structuring and enhancement.

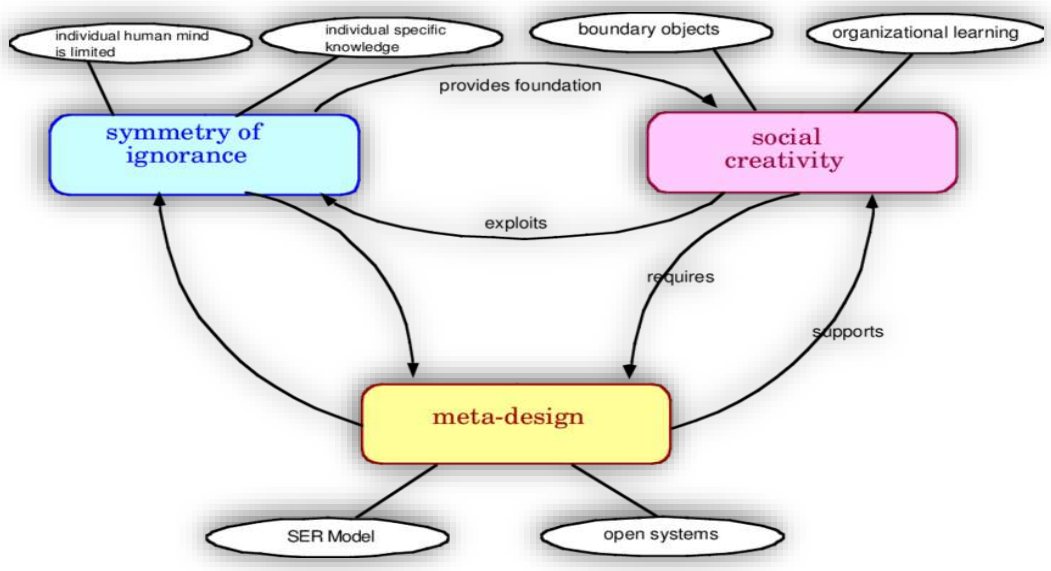


The Seeding, Evolutionary Growth, and Reseeding Process Model

The SER model provides a framework that supports social creativity through supporting individual creativity. Users of Seed are empowered to act not just as passive consumers, but as informed participants who can express and share their creative ideas. System design methodologies of the past were focused on building complex information systems as "complete" artefacts through the large efforts of a small number of people. Conversely, instead of attempting to build complete and closed systems, the SER model advocates building seeds that can be evolved over time through the small contributions of a large number of people. During the evolutionary growth phase, the seeded system plays two roles simultaneously: (1) it provides resources for work (information that has been accumulated from prior use), and (2) it accumulates the products of work, as each project contributes new information to the seed.

- Meta-Design: Creating Opportunities for Creativity

To bring social creativity alive, media and environments must support meta-design. The perspective of meta-design [Fischer 2004] characterizes objectives, techniques, and processes to allow users to act as designers and be creative.



The Relationships among Symmetry of Ignorance, Social creativity and meta-design

Meta-design creates the foundations for an unselfconscious culture of design or socio-technical know-how embodied in the evolving practices of fluid and interdependent communities. It has the potential to establish a new level of social creativity by providing resources for users to become active contributors in personally meaningful activities that arise in unpredictable environments. By supporting creativity of use, meta-design encourages users to be naturally active and creative, provides them with infrastructures and process models that sustain such an attitude, and introduces a change in our cultural mindsets and habits.

Key Concepts

Boundary objects: They are objects that serve to communicate and coordinate the perspectives of various constituencies.

Division of labour: It refers to specialized tasks within a given framework of reference.

SER Model: The seeding, evolutionary growth, and reseeding (SER) process model depicts the lifecycle of large evolving systems and information repositories.

Reflection

How do you foster social creativity? Which methods do you use?

Additional Resources

D. T. Campbell, "Ethnocentrism of Disciplines and the Fish-Scale Model of Omniscience," in Interdisciplinary Collaboration — An Emerging Cognitive Science, S. J. Derry, et al., Eds., Mahwah, NJ: Lawrence Erlbaum, 2005

E. G. Arias, et al., "Transcending the Individual Human Mind— Creating Shared Understanding through Collaborative Design," ACM Transactions on Computer Human-Interaction, vol. 7

National-Research-Council, Beyond Productivity: Information Technology, Innovation, and Creativity. Washington, DC: National Academy Press, 2003.

Video Materials

Creative Thinking Lesson https://www.youtube.com/watch?v=JEuGCx3loRA

Creativity is Social https://www.youtube.com/watch?v=UQJM9I21GHQ

The power of creative constraints https://www.youtube.com/watch?v=v5FL9VTBZzQ

2.4 Deep Analysis of Creativity

Barriers to Creativity

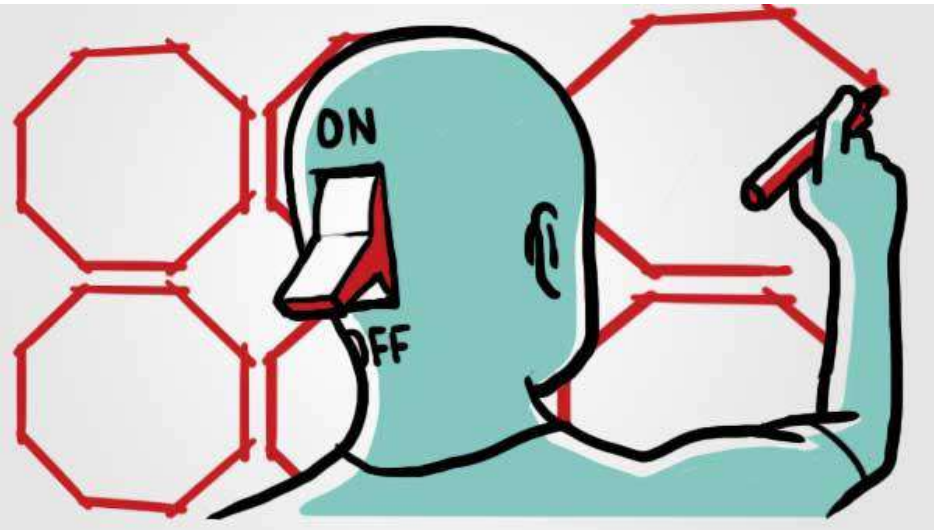
There are a number of common impediments or barriers to creativity (Gundry et al., 1994). Removing these barriers can be the first step in fostering creativity in ourselves and others. Each of these impediments is considered in the following subsections

- Defining the Problem Incorrectly

If the problem is defined incorrectly, incompletely, or inappropriately, then creative approaches to solving it will be misplaced. One of the ways in which this can occur is when individuals engage in what de Bono (1992) called *vertical thinking.* Vertical thinking occurs when a problem is defined in a single way and there are no deviations or alternative definitions considered until the solution is reached.

- Evaluating Too Quickly

This barrier - evaluating too quickly - **is not an easy one to remove.** Everybody has a well-developed capability of evaluating ideas, and this is applied almost instinctively when ideas are put forward. As with the ‘automatic no' response, we tend to analyse and too often reject ideas which are slightly offbeat or new: **'that's silly', 'that won't work' or 'we tried it last year and it didn't work** are common phrases. The idea is then buried and a chance has been lost to develop new approaches.



Source: https://soject.com

- Language Barriers

Language also can be a barrier to problem definition. If people are accustomed to, and limited by, using only certain terms and language in defining a problem, then they will think about that problem only in a manner that the terms will allow. In this way, the language can actually serve as a barrier between the thinker and reality (Koestler, 1964). In addition to verbal language, there are other languages, such as symbolic, emotional, sensory, and visual languages. In other words, sometimes it is useful to represent problems or ideas using symbols or drawings (to consider their emotional aspects) or even to express them in terms of touch, smell, or sensation.

- Judging Ideas Too Quickly

People often reject ideas that are inconsistent with their current thinking. We all have heard people defend current practices by saying, for example, “We’ve always done it that way.” Although constancy and consistency might be a human need and a virtue in certain circumstances, blind adherence to the status quo in organizations is not.

- Stopping at the First Acceptable Idea

People often are under pressure to come up with solutions to problems, sometimes the response is to accept the first good idea that comes along. Time pressures, different problems competing for our attention, or simply lack of recognition that other ideas might be better can lead us to choose alternatives too quickly. Obviously, this can result in forgoing what might have been a later—but better—idea.

- Lack of Support

Creative ideas can wither on the vine. If someone comes up with an interesting and original idea but no one listens or considers it, then the idea probably will not go anywhere. We might learn over time that curiosity and questioning are not welcome in our environment. Sometimes we are not creative because it takes a great deal of mental energy, and the demands of our daily jobs simply consume all of our reserves. Moreover, thinking does not *look* like working. We might be concerned with appearing busy and engaged with our work and, as a result, become mentally and creatively lazy. The truth is that it often is easier and less demanding to keep doing things and thinking about things in the way we always have.

- Hostility to Sharing Knowledge

In some classes, there is not only a lack of support but also an outright hostility to creativity and the sharing of ideas. It is suggested that “it is unrealistic to expect or assume that individuals are basically willing to share knowledge even when incentives are introduced”.

Beyond conventional and routine

Some other ideas for enhancing your creativity are:

- Turn Your Gaze Outward Instead of Inward. Begin by becoming aware of the field that you are working in. Talk to people working in the area.
- Market Yourself. The most successful creative people are very good at introducing their ideas to the field. They know who the key people are, and they know how the selection process works. They know how their new product is likely to be perceived.
- Do not try to become creative in general, focus on one domain. Try out as many domains as possible. Start with something you love and then branch out from there.
- Be motivated intrinsically. Do not expect to be creative if your goal is to become rich and famous. Creativity almost always results from intrinsic motivation. It is often said that even the sexiest careers involve only 10% of the fun stuff, the remaining 90% being work that most people find boring. The most creative are those who choose a career in which they actually enjoy 90%.
- Do not get comfortable. The flow state of peak experience tends to occur when your skills are matched by the challenges of the task. If you find that your work is becoming easier as your experience and skill levels increase, then do not just sit back and get comfortable.
- Balance out your personality. Many creative people have what seem to be contradictory personalities; they can work at both ends of the personality spectrum. They are both masculine and feminine; they’re both introverted and extroverted.
- Look for the most pressing problems facing the domain. Work at asking good questions. Do not get caught up in solving the easy, known problems.
- Collaborate. Develop a network of close colleagues that you can discuss with. Share your ideas with like-minded colleagues. Use creative work habits. Work hard. Spend long hours working on a task. Expect to work more than 40 hours a week, sometimes much more. Do not give up easily.
- Be confident and risk. Shyness, anxiety, and fear always come in the way of creativity. Many creative people seem to be arrogant or have big egos because they have tremendous self-confidence that allows them to take risks. Once you have some successes, you will be more confident. The idea of the lone hunter, or the lone voyager or explorer, who’s guided by his principles and is going to get there against all odds, that self-image, as romantic and foolish as many people might consider it, is a very powerful force in making a major scientist (E. O. Wilson, quoted in Csikszentmihalyi, 1996, p. 269)

Fostering Creativity

Amabile (1999) suggested that an individual's intrinsic or inner motivations are essential to creativity. She argued that extrinsic motivations (those coming from outside a person), like money, are much less effective: "Money doesn't necessarily stop people from being creative, but in many situations, it doesn't help" (p. 6). Instead, not interfering, and trying to build on people's natural interests and passions, most effectively fosters creativity. The motivation to be creative resides in part within individuals, but people's social environment also influences creativity.

Source: pixnio.com

A positive climate can create an atmosphere in which creativity and innovation flourish, whereas a negative one can squash such efforts. Scott (1965) stated, "Creative behaviour, a product of the creative individual in a specifiable contemporary environment, will not occur until both conditions are met. An unfavourable contemporary environment will inhibit creative behaviour no matter how talented the individual" (p. 213). It is also necessary to have the capacity to adapt and use innovations developed elsewhere. Innovation requires resources and time, and organizations do not possess limitless amounts of either. This does not suggest deemphasizing internal innovations but creating an organization that can benefit from a combination of internal and external innovations.

What can we do to create a climate that encourages creativity? Three organizational factors seem particularly important: (1) challenging work, (2) supportive supervision, and (3) an organizational and workgroup culture that supports and encourages creativity.

- Challenging Work

Intrinsic task motivation is an important component of creativity. Intrinsic task motivation is driven by deep interest and involvement in the work, curiosity, enjoyment, or a personal sense of challenge. Intrinsic motivation is the motivation to work on something because a person wants to—because it is exciting, satisfying, involving, challenging, and personally interesting. A key factor in this regard is choice. Research has shown that if a person chooses to do something just because he or she wants to, then that person will approach the task more creatively than if given external incentives or rewards. Obviously, then, intrinsic motivation is heavily influenced by an individual's preferences, values, interests, and attributes. But it also has to do with the nature of the task. Even the most curious, committed, and creative individual might not exhibit these talents if placed in a repetitive, rigid, and uninteresting job. A positive sense of challenge in the work is one of the most important predictors of creativity, it is imperative to match people to work that utilizes their skills, stretches their skills, and is clearly valued by the organization. As much as possible, all work should be designed to maximize intrinsically motivating aspects.

- Supportive Supervision

Supervision that is supportive of employees fosters their creative achievement, whereas supervision that is controlling usually diminishes it (Cummings & Oldham, 1997). Supervisors can be supportive by demonstrating concern for employees' feelings, encouraging employees to voice their concerns and needs, providing positive and information-rich feedback, and facilitating worker skill development. Doing so can bolster people's feelings of self-determination and control, which in turn can positively influence intrinsic motivation and creativity. Because offering people more choices in what they do can enhance intrinsic motivation, participative decision making also is important in creating an organizational climate supportive of creativity. Plunkett (1990), for example, found that persons who believed that they had meaningful input into organizational decision making were more creative than those who did not. Thus, management and supervisory approaches that increase opportunities for participation can enhance creativity.

- Organizational and Work Group Culture

In addition to supervision, creativity is influenced by overall organizational culture and climate. Hollingsworth (1989) identified the following key elements of a creative organizational climate:

Key Elements of a Creative Organizational Climate	
Trust	People are allowed to suggest and try new things without fear of reprisal.
Open communication	Everyone in the organization feels free to put forward ideas and is kept informed of needs and goals.
Diversity	The organization provides for the presence of different personalities and recognition of the varying contributions that each can make to the creative process.
Change	The organization values innovation and change, and it recognizes its importance to organizational success.
Rewards	The organization rewards creativity including both the development and the implementation of new and useful ideas.

Source: Nonprofit World. http://www.snpo.org

Creative cultures as those in which there is fair and constructive evaluation of ideas, reward and recognition for creativity, mechanisms for developing new ideas, and a shared vision. An organization with a climate or culture that supports and enhances creativity might express these values in a number of ways. In addition to supervisory attitudes and practices discussed in the preceding subsection, organizations can cultivate these values, for example, by talking about the values of creativity, developing a shared sense of organizational vision, providing time and opportunities to develop new ideas, offering special recognition and rewards for creative solutions to problems, providing creativity training and education, and other activities and actions that reflect an attitude or mindset that is receptive to creative efforts. The climate of an individual's workgroup also can have a positive effect. When group leadership is democratic and collaborative, the structure is flexible, and the group is composed of people with diverse backgrounds, creativity is enhanced.

Cultural artefacts are also important in communicating and reinforcing a culture of innovation. Higgins and McAllaster (2002) have suggested that cultural artefacts "shape the attitudes and behaviour of new

as well as veteran employees" (p. 77). In order to create a culture of innovation, organizations often have to modify or even create new myths and stories, language, and metaphors. Telling success stories about innovation can reinforce those cultural values and make the employees feel free to express their ideas. Value systems and behavioural norms are also powerful tools that can enhance innovation. If innovation is rewarded over time, employees can become more aware that the organization values such behaviour.

- Pressures and Resources

The effect of pressure on creativity is difficult to measure. On the one hand, excessive workload demands can undermine creative efforts. On the other hand, some degree of pressure or urgency can have a positive influence, particularly when it arises out of the nature of the problem itself. Similarly, sometimes pressure can enhance creativity, but too much can stifle it. Part of the issue seems to be whether the time and workload pressure is externally imposed as a form of control (in which case it would tend to hamper creativity) or the urgency and challenges come from the person's perception of the problem or the work itself (in which case creativity can be enhanced).

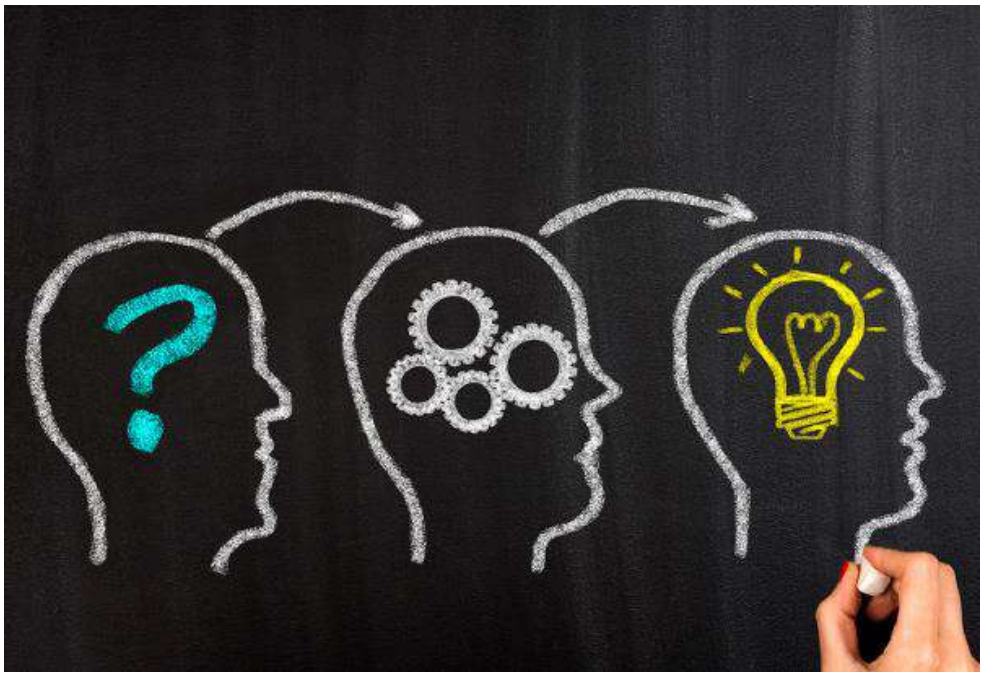
The resources allocated to a project also can affect creativity. The obvious effect of extreme resource restriction is to limit what people can accomplish. However, if an organization does not commit adequate resources to a particular project or task relative to others, then that also can have a psychological effect in that it may lead to the belief that the work is not valued or considered important by the organization.

- Positive Emotions

Emotions also play an important role in creativity. Put simply, positive emotions foster creativity and creativity fosters positive emotions. Positive emotions can lead people to discard time-tested ideas and think in novel ways. They also found that individuals who are successful with creative problem-solving often experience positive emotions as a result. Conversely, individuals who could not develop appropriate solutions often had negative feelings (anger, dissatisfaction, etc.). In fact, positive affect and creativity can happen at the same time. Individuals may start some process of solving a problem, and as they feel satisfied or pleased with the progress, their creativity may increase even more. This can produce an "organizational affect-creativity cycle . . . whereby influences at any point can begin a dynamic pattern of increasing or decreasing positive affect and creativity" (Amabile et al., 2005, p. 386). This suggests that when people have opportunities to exercise creative problem-solving and have succeeded in doing so, they can experience positive emotions, which can lead to more creativity.

Enhancing Your Personal Creativity

In our efforts to create a positive climate for others to be creative, it also is important to think about how to support our own creativity. Miller (1987) made a number of suggestions, summarized and adapted in the following paragraphs, for individuals to improve their own creative process. Many are analogous to the types of things that help to foster creativity in others, but it also is worthwhile to think about them as things that we can do for ourselves.



Be aware. To be creative, it often is necessary to have an understanding of the current situation. What are the facts? What information is available? In the public sector, this means not only being well-versed in current practices in our own and other jurisdictions, but also being knowledgeable about the legal parameters, community concerns, political considerations, and other factors that might be important in our understanding of the issue. By immersing ourselves in a particular subject, we ground our creativity in reality. After all, as noted earlier, creativity is the development of novel and useful ideas. How can we know what is novel or useful if we do not know how things work at present?

Be persistent in your vision and values. Applying consistent energy in a particular direction increases the probability of realizing your goals. A vision, or purpose or goal, guides our efforts and motivates us to be persistent. Creativity is, at its core, a personal enterprise in that it brings forth something that you, as an individual, value. Maintaining a vision requires self-reflection, the creation of a clear idea or picture of what you want to accomplish, and a conscious investment of energy.

Consider all of your alternatives. Dream up as many ideas as you can. Do not rush to find a solution. Avoid mental idea killers such as when we say to ourselves, “Oh, that will never work,” “That’s dumb,” or “We already tried that and it didn’t work.” Keep your evaluation of alternatives separate from your development of ideas and alternatives.

Entertain your intuition. Allow your intuition to give the answers that you are seeking. Relax and allow your mind to work. Creativity involves hard work, but the importance of the intuitive part of the creative process cannot be overlooked. Your intuitive self compiles information and creates new images and symbols that can lead to new inspirations.

Assess your alternatives. In evaluating your alternatives, two factors are critical. First, be open to the best solution. Let go of your ego, hidden agendas, desire for a convenient solution, and even self-interest in considering what the best solution might be. Second, use not only your analytical abilities but also your intuition (or “gut feelings”) in evaluating alternatives. Are you excited about the idea? Does it feel right?

Be realistic in your actions. If your creation is to be realized, then it usually requires you to take action. Even the greatest idea will be unlikely to go anywhere unless someone sells it, works out the details, and implements it. Even Einstein had to defend his data and ideas. New ideas have to be supported within formation and then effectively communicated to others. Once you are committed to an idea, share that commitment with others and figure out how to accomplish, or put into practice, what you have envisioned.

Evaluate your results. Many of us want external praise and rewards for our creative efforts. It also is important to set up constructive feedback for yourself. For most of us, the creative process needs a point of completion when we acknowledge what we have accomplished and the results we have achieved. Even if things do not turn out as we hoped they might, self-reflection allows us to evaluate the parts of the process that did and did not work well.

Key Concepts

Intrinsic task motivation: It is an important component of creativity. Intrinsic task motivation is driven by deep interest and involvement in the work, curiosity, enjoyment, or a personal sense of challenge.

Creative intuition: It is the ability to quickly identify valuable or useful creative ideas without conscious thought.

Reflection

As an instructor, what barriers do you stumble upon while reinforcing creativity during the lesson?

To create a positive climate for your lesson to be more creative, which steps do you follow?

Additional resources

Davis, G. A. (1999). Barriers to Creativity and Creative Attitudes. In M. A. Runco & S. R. Pritzker (Eds.), Encyclopaedia of Creativity (Vol. 1). USA: Academic Press

Adam, J. (1999). Conceptual Blockbusting: A guide to better ideas (4th ed.). New York: Basik Book

Video materials

Barriers to Creativity: https://www.youtube.com/watch?v=M66TzNqrlfg

Secret to Creativity: https://www.youtube.com/watch?v=X_Y-T_guM1I

2.5 Assessment

1) Which is not among the essential pieces of creativity?
   a) originality
   b) expression
   c) tradition

2) Which is not a step of the creative process?
   a) readiness
   b) incubation
   c) illumination

3) “the tendency, described in social identity theory, to draw comparisons between the ingroup and other groups in domains in which the ingroup is more successful, and to avoid making any comparisons in areas in which other groups surpass the ingroup.” This statement belongs to which of the following?
   a) Individual Creativity
   b) Social Creativity
   c) Team Creativity

4) Which is a framework for creativity?

a) team collaboration
b) the fish-scale model
c) personal creativity

5) SER stands for
   a) Seeing, evolutionary growth, and reseeding process
   b) Seeding, examining and reseeding process
   c) Seeding, evolution and reseeding

6) ”It is a situated experience, usually engendered by a combination of synchronization and improvisation [Nonaka & Konno, 1998], and supported by enabling users in the socio-technical environment to share emotions, experiences, and representations.” This statement belongs to which of the following?
   a) co-creation
   b) team creation
   c) crew creation

7) “... view of creativity focuses on actions and activities that result in the development of something new” Which of the following words should come in the blank?
   a) Creativity as a process
   b) Creativity as an integrated perspective
   c) Creativity as behaviour

Module 3. Creative Teaching and Teaching Creativity

Author: Hüseyin PARS

Learning Objectives

Upon completion of this Learning Unit, trainees will be able to:

- Recognize the types of creativity
- Acquire the teaching method of creative education
- Distinguish the stages of teaching method of creative education
- İdentify the context of creativity and education
- Distinguish the domains of creativity
- Apply the effective teaching strategies
- Generating six principles of effective teaching
- Explaining three stands of influence for approaching creativity
- Classifying the step-by-step process for creativity session
- Explain 21st-century learning skills
- Apply STEM during the lessons

Introduction

Education throughout the world faces challenges, and they may be economic, technological, social, and personal. This requires a high degree of flexibility and adaptability of the education system to these challenges. Accordingly, researchers stress the need for a greater degree of promotion of creativity in learning based on broader conceptions of young people's abilities and better powers of communication. New approaches are also needed to find a way to promote students' "motivation, self-esteem and skills. According to Loveless: "Education systems in the twenty-first century are having to adapt to the changes, aspirations and anxieties about the role of creativity in our wider society, not only in realising personal learning potential in an enriching curriculum but also in raising achievement, skill and talent for economic innovation and wealth creation" (Loveless 2007, p. 5).

The teachers are key figures to implement change, but they need support to understand and accept creativity in their practices. Creative teaching may be defined in two ways: firstly, teaching creatively and secondly, teaching for creativity. Teaching creatively can be described as teachers using approaches to make learning more interesting, engaging, exciting and effective. Teachers have to attract the students‟ interest and attention in a new way, and as a result, the development of creative approaches is called for. The NACCCE report (1999) made a distinction between teaching creatively and teaching for creativity in its characterization of creative teaching. The former is defined as 'using imaginative approaches to make learning more interesting and effective'. Teaching for creativity is defined as forms of teaching that are intended to develop young people's own creative thinking or behaviour. Education has a pivotal role in fostering creativity and creative practices, and thus the skills needed to create new knowledge. Indeed, "schools and initial education play a key role in fostering and developing people's creative and innovative capacities for further learning and their working lives" (Cachia et al. 2010, p. 5). Creativity is central to societal progress and the formation of new knowledge—thus schools must pay attention to the construct.

3.1 Educational Purpose of Creative Education

Creative education defines human nature as creativity, and the educational purpose of creative education is explained as "the development of human creativity". Creativity in creative education is sought not from a special human field but human generality. Accordingly, creativity is the essence of personality in the sense of the whole person having diverse physical, psychological, emotional, and social properties and fundamental human nature (Lee Jong-Rok, 2001).

What makes the difference?

1. Teaching about creativity

In Beghetto's (2017) opinion, the purpose of teaching about creativity is to provide students with knowledge of creative phenomena and to help them to understand such phenomena. This type of teaching includes, therefore, a presentation of the definition of creativity, manners of understanding and expressing it, and what a process of creative development looks like, as well as pointing to individual and contextual factors facilitating or inhibiting that development. Knowledge needed for this type of teaching, which should be mastered by a teacher, includes key concepts of creativity, theories and research related to that topic, as well as pedagogic expertise in how to teach groups of people who differ in age or for instance the discipline they represent.

2. Teaching for creativity

Teaching for creativity consists in developing skills of creative problem-solving, strengthening creative attitudes, teaching principles of creative thinking, and forming the ability to transfer skills for creative problem-solving to the sphere of real challenges in personal and professional life. Activities performed during teaching creativity help to reach its main goal, which is to increase the level of students' creativity. As in the case of teaching about creativity, students' creativity may be developed in the context of specific thematic areas or with direct reference to creativity development programs.

3. Teaching with creativity

The third type of creative teaching distinguished by Beghetto (2017) refers to a creative approach to teaching. Creativity is present here in the act of teaching rather than in its subject or result. Creative teaching may, therefore, create a context facilitating the support of students' creativity. This type of

activity helps to create conditions of learning in a group, where students are encouraged to show similar behaviour. It also facilitates modelling behaviours characteristic of people with a creative attitude, such as readiness to take risks, learning from one's mistakes, or searching for and examining various ideas.

Types of creativity?

$C = [O \times TA]_{Context}$

As illustrated in the above formulation, creativity requires both originality and task appropriateness as defined within a particular context. Something that is deemed as original in one context (e.g., primary school science fair) may, for instance, be judged as quite mundane in a different setting (e.g., university science lab).

Source: https://thinkers.co

1. **Big-c:** these outcomes change in substantial ways how a culture knows, thinks, feels and lives. They lead to paradigm changes in a domain such as science, music, art or literature. They allow a culture to progress. They require high levels of expertise, high creative thinking, particular personality and emotional dispositions and institutional and cultural opportunities.

2. **Little-c:** these outcomes lead to smaller, novel changes in everyday contexts. It requires domain knowledge and skills, the ability to use creative processes and thinking skills, task motivation and environmental opportunities, creative attitudes and dispositions such as unconventionality, inquisitiveness and imagination, and the ability to display or share the creative outcomes

3. **Mini-c**: these are outcomes that lead to creative changes in how an individual acts or what the individual knows; they don't necessarily lead to changes in how others operate. It can draw on a more

restricted domain of knowledge and skills. Mini-c outcomes may not be obvious in the classroom unless teachers know what mini-c creativity looks like and provide opportunities for it to emerge.

4. **Pro-c**: this refers to creative outcomes that lie between Little-c and Big-c in their impact or influence on a domain, institution or culture.

Teaching Method of Creative Education

The teaching method of creative education is established by the five-stage teaching. The five-stage teaching has the stages of an idea, discovery, digging, manifestation, and development as a teaching method for cultivating the creative abilities of humans. The five-stage teaching method is formed as the education method to allow students to cultivate human creative ability in the establishment of the objectives in the curriculum and subjects education by categorizing the educational objectives of creativity into the related curriculum in creative education. The common premise for applying the five-stage teaching is the encouragement of learner's freedom and willingness, and the teaching mode should be preceded by the principle of teacher's love and guidance. The details of the five-stage teaching are stated below.

1) Idea

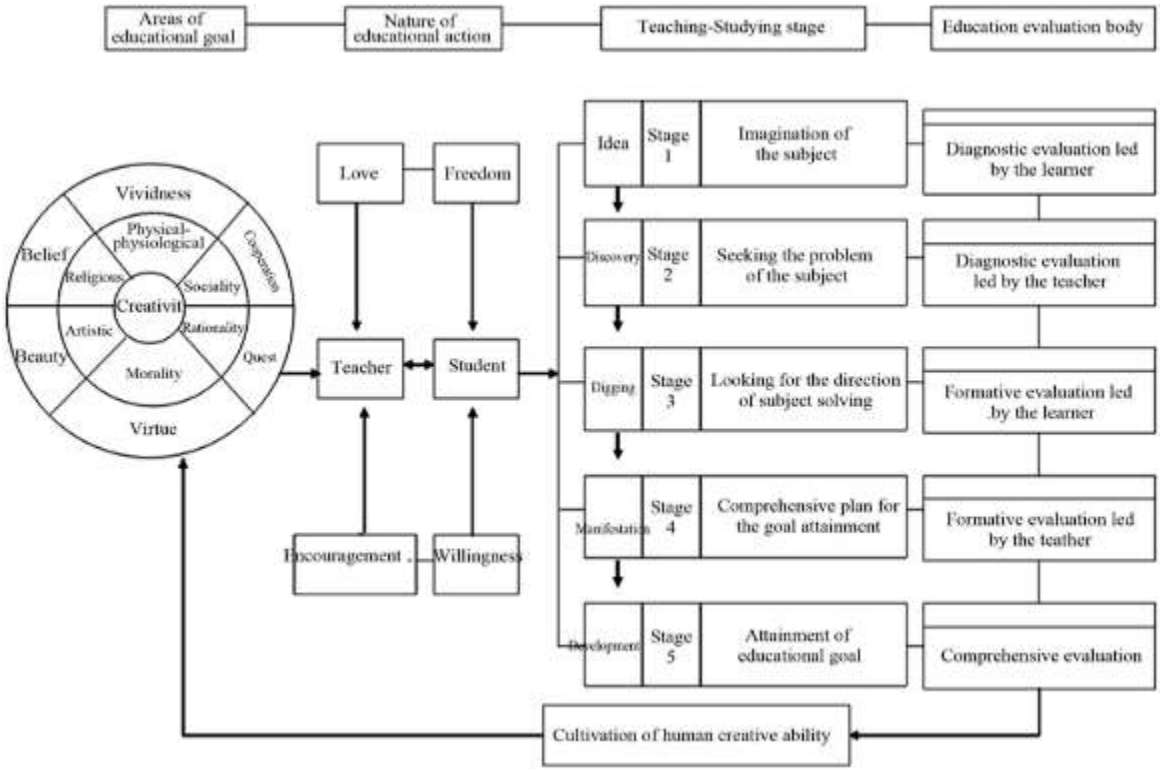
The stage of idea is that of starting imagination and it is the most fundamental stage for cultivating creativity and the stage from which creative activity is started. Imagination is personal and intuitive action that can be made from free and voluntary intuition. Personal integrity can be shown by the projection of individual desire or emotion from such imagination. Accordingly, the cultivation of creativity begins by starting the new integration of creativity by the idea that is the action of imagination.

2) Discovery

The stage of discovery is the process to accept the value presented in the stage of discovery and having desire and passion aiming at the value. The content of an idea can be expressed concretely in this stage and unity and order are to be built. In other words, the content or object to be found is materialized in this stage and creative thinking is presented externally and visibly to find the problem to be solved. The characteristic of the learner is reflected in the process. The stage of discovery is the first stage of materialization creativity through which personal characteristics can be seen in a pure state as the learner's creativity approaches the nearest visible state.

3) Digging

The stage of digging is the process where the content acquired from discovery is changed to a reasonable and systematic conception and then a goal-oriented and unified conception can be achieved for the new value.



The process of digging is to grasp the elements of the problem or content acquired from the stage of discovery and then elaborate concrete creativity. Individuality or characteristic of the learner intervenes in the experience of creative work as the thinking in the discovery stage leads to real activity. Accordingly, digging is the process where the learner's individual creative ability can be built uniquely in this stage as the external value shown in discovery is composed and elaborated.

4) Manifestation

The stage of manifestation is the process to complete meaningful content by utilizing the content and arranging it systematically. That is, the content in the digging stage is elaborated by imagination for the development state and it is presented in the process to build unity and order. Even if the stage of manifestation is not perfection but halfway preparation to reach the value of development, the purest phase can be shown prior to the stage of development.

5) Development

The stage of development is to complete a human ability by creating new value. So, it is the stage of application to practice and realize conception by using every thinking freely. However, the value cannot be accomplished by the completion of the development stage. The true value of creativity is to stimulate willingness that causes new creativity again. We can see the creative circulation process to present endless continuity of learner's development of creative ability by the five-stage teaching of creative education; it means the unlimited educational possibility of human capability cultivation. We can define it by the concept of freedom and willingness. To define the concept of the five stages of teaching by the concept of freedom and willingness means that the concept of freedom and willingness can be defined by the presentation of the learner's interest and desire. To show such five concepts by the presentation of interest and desire, defining them by freedom and willingness, is a consistent intention to define the totality of the teaching method by one concept. Thus, the concepts shown in the five stages of teaching need to consider the principle of guide for learners to study with design and motivation and the principle of teacher's love and guide both.

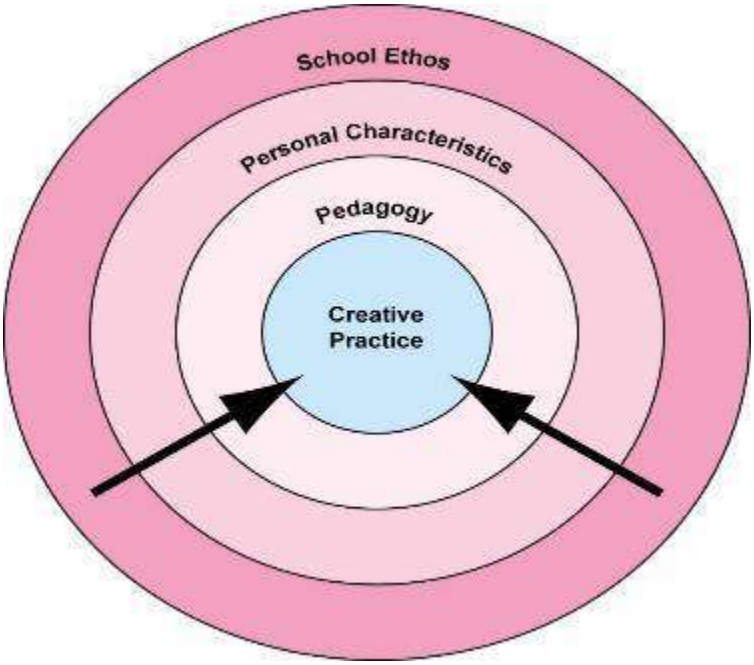
Idea-discovery-digging-manifestation-development is distinguished notionally and it is the concept to be classified stage by stagy in studying, while freedom and willingness are classified notionally only and it is a connected concept from the aspects of subject and object. The five-stage teaching of creative education, ultimately, is to build the system of teaching methods for people's creation of useful value through the change and cultivation of human ability by changing logical order to time series for thinking and then applying it to education. The learner is the subject in the study course in the five-stage teaching and it is the teaching-studying theory to cultivate value ability through the learner's thinking and experience, connecting the ideal type of thinking for value creation to the ideal type of teaching-studying. Freedom and willingness as the ideal type of thinking for value creation are explained at the theoretical level and the actual measurements for education is tried in the teaching theory by the five-stage teaching of idea-discovery-digging-manifestation-development as the ideal type of teaching-studying. In other words, creative education is to build the ideal type of thinking for value creation in advance and then present the corresponding teaching-studying. The five-stage of teaching in creative education is to build a theoretical system of education to allow students to make creative value by themselves through the cultivation of human ability, changing logical order to time series in thinking and then applying it to education.

The research recognises that learning is situated within a cultural and social context and highlights three inter-related dimensions of creative teaching, namely:

a) the personal qualities of the teacher

b) the pedagogy they adopt and

c) the ethos of the class and school.



The interplay between these three dimensions appears to be central to understanding creative practice). It is suggested that this model provides a valid structure which could be used to frame future investigations in this area.

Key Concepts

Manifestation: The stage of manifestation is the process to complete meaningful content by utilizing dug content and arranging it systematically.

Digging: The stage of digging is the process where the content acquired from discovery is changed to a reasonable and systematic conception and then a goal-oriented and unified conception can be achieved for the new value.

Idea: The stage of idea is that of starting imagination and it is the most fundamental stage for cultivating creativity but the stage from which creative activity is started.

Reflection

During your daily life which types of creativity do you encounter?

In your class, which teaching method of creative teaching is more challenging?

Additional resources

Techniques for creative teaching. http://www.celt.iastate.edu/creativity/techniques.html

Creative teaching strategies.http://www.homeroomteacher.com/infocreativeteachingstrategies.html

Irwin, S.M(1996). Creative teaching strategies, Journal of Continuing Education

Video Materials

The Secret to Creativity: https://www.youtube.com/watch?v=X_Y-T_guM1I

Why change? 21st Century Learning and Curriculum Innovation: https://www.youtube.com/watch?v=0IZyxbP8szo

3.2 The context of creativity and education

Four domains of creativity

Rising interest in creativity has occurred during a period of significant societal change due to rapid shifts and developments in technology (Collins and Halverson 2018). Technologies are altering how humans think, work, live, play and create faster than ever. It is, therefore, no surprise that this interest in digital technologies has emerged alongside creativity as critical to contemporary education (Mishra and Mehta 2017). Interest in creativity has been fuelled by the affordances provided by digital technologies, including, but not limited to, massive connectivity and the creation of virtual environments with new possibilities for learning. Digitality has altered how we live, work and connect with each other. Arguably, technological change is driven by human creativity, which in turn provides new contexts and tools for creative output. Scholars have suggested that educators and researchers must better understand and emphasize this reciprocal connection.

- Domain 1: Meanings

The domain of Meanings focuses on understanding creativity—in definitions, key ideas, and models of creativity. This domain informs what is known or believed about creativity and, thus, has an epistemological focus. This allows engaging with significant questions implying tensions, provocations, or dilemmas which have no clear or immediate resolution but demand attention. Definitions allow a shared understanding of the ideas at hand, while models and ideas guide the research, practice, and policy around implementation issues of creativity and gatekeeping are embedded in the systems model of creativity (Csikszentmihalyi 1999), which considers where creativity is, not what it is—e.g. Csik-szentmihalyi locates it in individuals (creative people), in domains (tools, technologies, knowledge,

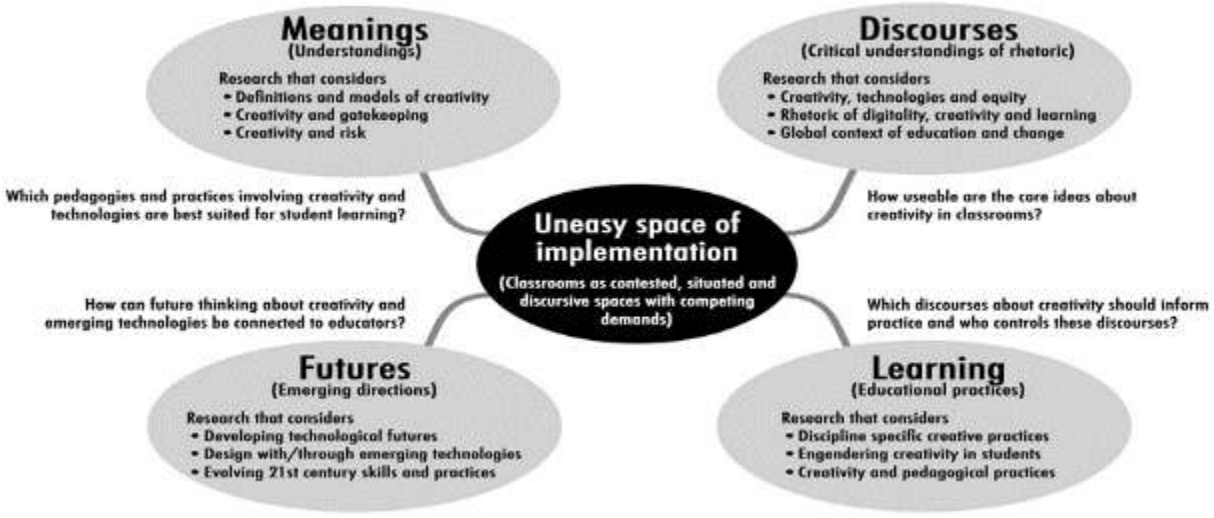
norms, and skills needed to facilitate creativity) and in fields (systems of gate-keepers, who judge creative accomplishments in disciplines). Yet this model is problematized by online and digital spaces where the lines of gatekeeping are blurred as digital tools increasingly allow creators to bypass common/authorized gatekeepers (Henriksen et al. 2016a).

- Domain 2: Discourses

The domain of Discourses focuses on academic and professional literature, and also online popular spaces, that engage rhetorically with creativity, technologies and change—thus it focuses on criticality. These rhetorical understandings shape notions about the disposition of education given a greater focus on creativity in the context of digital change. Huckin et al. (2012) point to the power of language in forming understandings of key educational ideas, and the need for criticality in unravelling the links between politics, rhetoric and institutional practices. The connection between creativity, change, technology and innovation has often been associated with organizations, teams and corporations, creating a discourse of the individual embedded within organizational and networked notions of creativity (Glăveanu 2014; Thompson and Choi 2006).

- Domain 3: Futures

There is a small but emerging conceptual, curriculum and policy literature about futures in education, linked to digitization, scalable online digital learning platforms (MOOCs being one example among many) and learning possibilities centred on creativity.



Domains of creativity and education SITE 2018 (Henriksen et al. 2018).

In the context of education, we understand the term ‘futures’ to mean trends, directions and shifts in teaching and learning that point to impending issues and needs. At the same time, we also recognize the disputed nature of this term, its transdisciplinary use, and the various ways that it has been understood and applied.

- Domain 4: Learning

The domain of Learning focuses on international pedagogical and learning practices that promote creativity with and through technology—thus, it has a practice focus. This is a perpetually shifting space since educational practices are contextual, technologies evolve, and pedagogy is deeply personal in the practices of teachers—pointing to a need for practitioner perspectives within research. The relevant literature about creativity and pedagogical practices is fragmented and does not provide a cohesive view of practical findings related to technology. As Aguilar and Turmo (2019) note in their scoping literature review, there has been more emphasis on technology as a tool for creativity, rather than on teachers’ practices.

Creative Teacher & Effective Teaching Strategies

Active learning requires teachers to be creative not only in the teaching process but also prior to teaching where a teacher can prepare authentic materials to motivate learners to learn. Creativity in the teaching-learning process can be seen as the teacher’s effort to facilitate learning to achieve teaching goals. Creative teachers use everything that they possess to actualize. Active learning to motivate learners such as thought, fact, and ideas or even the combination of thought, fact and ideas. The creativity of a teacher can be seen in his performance during the teaching-learning process and in his daily activities. Creative teachers are able to perform their teaching-learning process effectively by combining various contextual instructional materials, instructional strategies, instructional media and real-life experiences. It is argued that the ability of a teacher to prepare such teaching models has a positive effect on learner motivation because the real needs and interests of learners are fulfilled and the learners themselves are engaged in the teaching-learning process. This implies that teacher creativities are directly related to the way they serve learners as the results of learners’ needs analysis.

Teacher creativity is essential to facilitate effective learning. Halliwell (1993) suggests creativity as part of normality as part of everyday actions and ideas. This kind of creativity is necessary to facilitate effective teaching in the daily teaching-learning process where a teacher is able to overcome common problems faced by learners, such as being frightened to ask a question or to do a presentation, being shy to discuss within the group, being hesitated to play a role, and being afraid of making mistakes. Creative teachers are able to design joyful teaching where complex things can be explained in simple ways or uninterested learners become interested in the teaching process, or even able to find out acceptable examples to clarify unclear topics for learners. Creative teachers provide as much space as possible for learners in the instructional design to develop the students' particular framework of understanding. Effective teaching strategies are continuously investigated and the results of the investigation are employed to achieve the maximum performance of the learners both in and out of classroom activities. Effective teachers keep students involved in their lessons and master a variety of effective teaching strategies (Moore, 2005; DBE2, 2010).

Effective teaching has been defined differently by different authors. It is defined as teaching which produces beneficial and purposeful student learning through the use of appropriate procedures (Centra, 1993). While Braskamp and Ory (1994) define effective teaching as the creation of a situation in which appropriate learning occurs; shaping those situations is what successful teachers have learned to do effectively. The two definitions indicate that effective teaching requires effective teaching strategies. Effective teaching strategies help learners to apply, analyse, synthesize, create new knowledge, and solve new problems. It has been noted that there are some effective teaching strategies in different fields of study. The strategies, in general, emphasize the possibility to apply what has been learned to

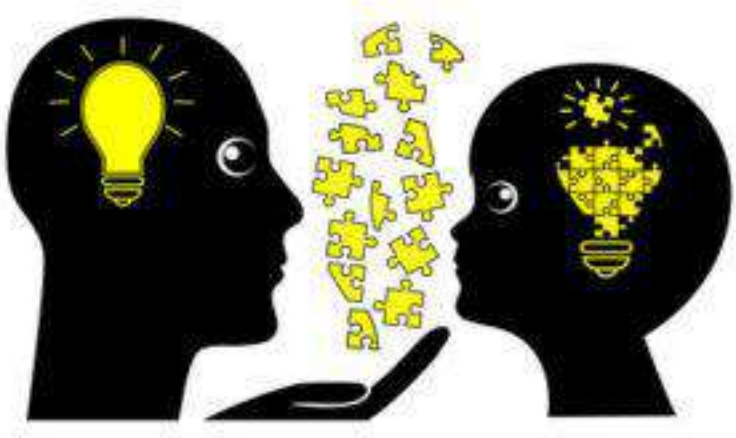
real practice to fulfil the needs of learners and other stakeholders. Among those strategies are practical examples, show and tell, case studies, guided design projects, open-ended labs, the flowchart technique, open-ended quizzes, brainstorming, question-and-answer method, software, teaching improvement, and a fast feedback form for engineering (Lacey, et, al. 1995). For active teaching in higher education, among effective models are cooperative learning, problem-based learning, direct instruction.

The research recognises that learning is situated within a cultural and social context and highlights three inter-related dimensions of creative teaching, namely:

a) the personal qualities of the teacher b) the pedagogy they adopt and

Creative pedagogy has brought new horizons in teaching learning process where there must be balance between cognitive skills and emotional skill. Emotional intelligence is the ability to think constructively and to act responsibly. Nelson and Low (2005) note that learners who are emotionally intelligent are skilled in interpersonal communication, self-management, goal achievement, and demonstrate personal responsibility in completing assignment and working effectively. By keeping the balance in the teaching learning process, the results of teaching are not only developing the cognitive skill but also the psychomotor skill. In order to get the best of the teaching learning, Ramsdan (2012) highlights **six principles** of effective creative teaching in education:

1. The ***first*** is interest and explanation. This principle is to emphasize that it is the job of every teacher to make the subject interesting. A teacher must be able to attract the student's attention on the subject so that the students are motivated to participate in. In other words, the student curiosity is built up on the subject. The curiosity can be built up when a teacher can explain things or topics in each subject clearly and a teacher remembers to clarify the reasons why a particular fact or skill is essential for understanding the whole.
2. The ***second*** is concern and respect for students and student learning. It is generally believed in conventional teaching that teacher is considered as the sole source of knowledge and more ironically a teacher is an expert and students are not. On the contrary, in teaching, a teacher must be interested in what students know and don't know, a teacher must be generous, a teacher must be able to make it easy for learners to master ideas and fact, and more importantly, a teacher must make effort to make the difficult parts easy.
3. The ***third*** is appropriate assessment and feedback. A teacher must be able to design proper assessments where the assessment matches to the material to be learned. When feedback is given, the feedback must be related to what students still need to study to get it right.



Source: https://eSchoolnews.com

4. The ***fourth*** is clear goal and intellectual challenge. A teacher must formulate teaching goals clearly. Clear statements of what is to be learned encourage a good fit between student effort and course goals.
5. The ***fifth*** is independence, control and engagement. Teaching learning process has to get students engaged with content in a way that enables them to reach understanding. The teaching process must provide learners enough space to learn at their own pace and in their own sequence. Learners need to feel in control over what they're doing, as well as feeling that a teacher is directing the learners. There must be balance for learning well and for enjoying the learning itself.
6. The ***sixth*** is learning from learners is compliment to the first five principles. Even though the first five principles are necessary but it is not sufficient for good teaching in education without learning from learners. Effective teaching means seeing the relation between teaching, learning and content as problematic, uncertain and relative. It involves constantly trying to find out how teaching affects learning, and adapting it in the light of the evidence a teacher collects.

Three stands of influence for approaching creativity in 21st century education

- Teacher education

A teacher's pedagogy is often a primary driver of how students develop and learn. Teachers who model creativity tend to fluidly enhance, support and develop the tendency in their own students (Amabile, Conti, Coon, Lazenby, & Herron, 1996). Schools must build teaching dispositions that take advantage of the affordances of new tools for learning and thinking creatively, in ways not possible without new technologies (Ertmer et al. 2012). But effective teaching is difficult in itself, even without the added elements of creative and technology-savvy practices.

- Assessment Creativity

Due to its open-ended nature, is difficult to evaluate and assess. However, if creativity is to become a part of the educational process, developing a range of assessments is essential. The arena of assessment of creativity is rife with multiple challenges, which tend to present as dichotomous tensions. We see these tensions as inherent and not ones that can be wished away. As educators we have to contend with these dichotomies, and find a resolution or compromise that works in our specific context.

- Educational policy

Creativity can be learned, but since it is a thinking skill it can only be “learned by doing” or as “learning in action.” Creativity involves approaches to thinking rather than a set body of knowledge that can be taught. However, we can reinforce and support sustained creativity as a “habit of the mind.” However, this also means that the education system and educators must recognize and support a sustained facilitation of creativity as a habit of the mind, and agree upon what that is and how to engage it. This can vary greatly across contexts and cultures. So essential challenges involve convincing policy makers, who often prefer clear answers and objectivity that it is important to infuse curricula with creativity, an area that does not have one “right” answer. Along these lines, policy must also begin to consider the intersection of technology with creativity, and offer guidelines for how these ideas can intersect in the classroom.

Limits to Creativity in Education

1. What does it mean? The limitations of terminology.

A challenge in any discussion of creativity, which could be thought of as a 'limitation' to the concept, is the difficulty of terminology. Creativity and imagination are distinct concepts (Craft, 2002; Elliott, 1971). Innovation, it could be argued, is distinct again, from both imagination and creativity. As far as creativity in the classroom is concerned, as the NACCCE report (1999) noted, there are distinctions between creative teaching and teaching for creativity. It could be argued that these are each distinct from creative learning (Jeffrey, 2001a, in press; Jeffrey and Woods, 1997). Yet, despite these distinctions in meaning, there is often slippage of the language in practice, so that we may refer, for example, to creative teaching as teaching for creativity when it is not necessarily having this effect. There are implications of such slippage in language, for what we value in practice. Valuing creative learning for example, is distinct from valuing creative teaching.

2. Conflicts in policy and practice.

The tightening of control around both curriculum and pedagogy, as well as other aspects of the management and financing of schools in England, has formed, for some, a paradox (Craft, 1997; Woods et al., 1997). For, whilst creativity was being encouraged, the means by which this and other educational goals were being achieved were extremely constraining for teachers. In response to the tightening framework within which teachers were to work, creativity became, for some, a tool for personal and institutional survival (Craft, 1997; McCarthy, 2001; Safran, 2001; Woods, 1990; Woods and Jeffrey, 1996). Other limitations to creativity produced by the application of policy to practice are the discontinuities in the curriculum, as far as creativity is concerned. For example, the differences between creativity as conceived of in the early years' curriculum, compared to the National Curriculum and the NACCCE report, are striking. The latter two are more concerned with the development of creativity as a cross-curricular - and transferable - skill. The NACCCE report acknowledges the role of playfulness in creative production, however its focus is boiling down an 'essence' of creativity. Creativity, or creative development, in the early years' curriculum, is by contrast located in a specific set of domains - the creative and expressive arts including art, design and music, and it is linked strongly with early learning processes such as play in such a way that it is sometimes not clear what the distinction between play and creativity is. There is therefore, I would argue, some inevitable discontinuity in how the child's creativity may be supported in practice in the transition across the curricula. These difficulties are explored more fully elsewhere (Craft, 1999, 2000, 2002).

3. Limitations in curriculum organisation?

We might ask, to what extent is the fostering of creativity limited by its subject context? Is it, for example, possible to foster creativity in physical education, mathematics, information and communications technology and English, equally? I would argue that creativity is most certainly relevant across the curriculum and is not subject-specific, although it is manifest distinctly in different subjects. Indeed, although creativity is often associated with the creative and performing arts, opportunities for developing learner creativity exist across the curriculum. Mathematics, and ICT, as I have argued elsewhere, for example, both provide distinct kinds of opportunities for learner creativity and each involves different pedagogical strategies to maximise this (Craft, 2001b). But this different manifestation does not necessarily imply any limitation in the fostering of creativity; rather, in principle, the opposite. But it could be argued that the way in which the curriculum is presented and organised within the time available in a school day may offer greater or fewer opportunities for fostering learner and teacher creativity. For it might be argued that where the curriculum is taught as discrete subjects, this may constrain learner and teacher creativity, in discouraging thinking about themes which cross the subject

boundaries. But are subjects of the curriculum, taught by themselves, necessarily a constraint to developing creativity?

4. Limitations stemming from centrally-controlled pedagogy?

Clearly, the fostering of creativity may be subject to the pedagogical limitations, as may any aspect of the curriculum. However, the challenges posed by holding creativity as a goal may be greater than those posed by other curriculum areas. For the establishment of an appropriate organisational climate for stimulating creativity, we are told, includes enabling pupils and teachers to feel: "* that new ideas are met with encouragement and support; "* able to take initiative and to find relevant information; "* able to interact with others; and "* that uncertainty is tolerated and thus risk-taking encouraged. (Amabile, 1988; Ekvall, 1991, 1996; Isaksen, 1995) The establishment of these strategies in a policy climate which appears to treat teachers like technicians rather than artists (Jeffrey and Craft, 2001; Woods et al., 1997) and which attempts to centrally control both content and teaching strategies to an increasing degree, is challenging (Craft and Gabel-Dunk, 2002). Thus, it may be that the fostering of teaching for creativity, creative learning and teaching creatively, are limited by a centrally controlled approach to pedagogy in some school years or contexts.

Key concepts

Effective Teaching: Effective teaching can be defined in many ways including teacher behaviour (warmth, civility, clarity), teacher knowledge (of subject matter, of students), teacher beliefs, and so forth.

Discourses: The domain of Discourses focuses on academic and professional literature, and also online popular spaces, that engage rhetorically with creativity, technologies and change—thus it focuses on criticality.

Active Learning: Active learning is any learning activity in which the student participates or interacts with the learning process, as opposed to passively taking in the information.

Reflection

Which effective teaching strategies do you use to make active learning for your students?

What do you think is missing for approaching creativity in 21st century education?

Additional Resources

Ada, N. A. (2006). Planning instruction. In N.A. Ada (Ed), Curriculum and instruction: An introduction to general methods and principles of teaching (P 101 - 107). Makurdi: Aboki Publishers

Ukeje, B.O. (2002, September). Teachers and Teaching. A lecture delivered on the occasion of a two-day orientation workshop for lecturers of the Nasarawa State University, Keffi.

Heilmann, G., & Korte, W. B. (2010). The Role of creativity and innovation in school curricula in the EU27: A Content analysis of curricula documents. Seville, Spain: European Commission, Joint Research Centre, Institute for Prospective Technological Studies.

Video Materials

3 Effective Teaching Strategies | Classroom Management: https://www.youtube.com/watch?v=UnX-0CaxexI

The Science of Teaching, Effective Education, and Great Schools: https://www.youtube.com/watch?v=KVLTxKyxioA

Effective Teaching Strategies: https://www.youtube.com/watch?v=phcqH9zkwEs

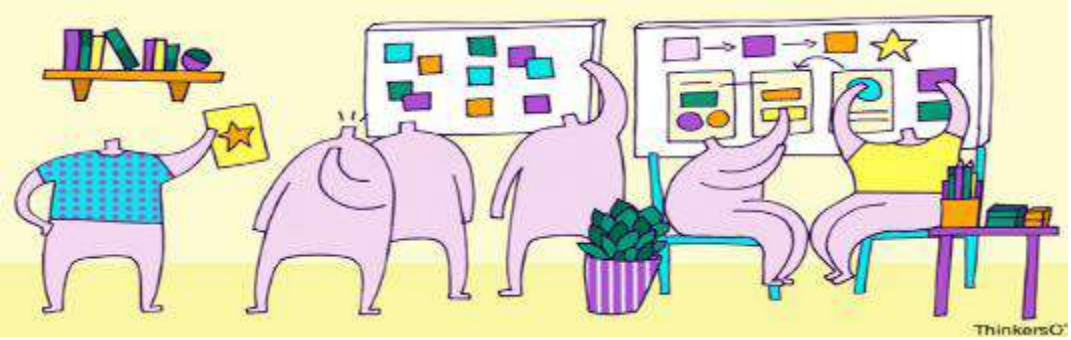
3.3 Creativity is as important as literacy

The step-by-step process for a creativity session

Similar to the steps of product development process, each step of the creativity process has two main phases: a divergent phase and a convergent phase. In other words, each phase starts with a 'problem' definition, followed by a divergent phase which includes the 'creation' or 'widening' of a field of possibilities which includes collecting and generating facts, problem statements, and ideas, without criticism. Then resultant solutions are clustered and categorized, followed by a convergent phase in which there is a narrowing of choices based on criteria of what is useful and relevant.

1. Problem definition
2. Divergent phase
3. Clustering / categorizing
4. Convergent phase

The four stages of the creativity process each demand a different attitude from the participants.



Source: thinkersco.com

- Problem definition

The formulation of the problem definition for the creativity session has a big impact on the outcomes of the creativity session. If the problem is not defined accurately, the created results might be irrelevant for the project. Guidelines for defining a problem include:

A. Formulate the goal of the creativity session in one sentence.

Formulate from the project focus (the problem) in a concise and clear way. It forces the team to tackle the core of the problem. Often a problem consists of several sub problems. It is recommended to tackle the sub- problems first, and then to bring the sub-solutions together.

B. Keep a real and tangible focus.

If the problem defined is too abstract, the results will be general and will lead to sub-optimal solutions.

Example:

How can we generate a more positive attitude towards Photo Voltaic (PV) is a broad formulation. It becomes more specific if the statement focuses on children: “How can we inform children about PV so that they develop a more positive attitude towards it?” An example of an even more focused problem statement would be “What can children play with that is made of PV?”, or “How can we motivate children to play without door play equipment made from PV?”

C. Start with ‘how’ or ‘invent’.

The pronouns ‘who, what, where, when’ and ‘why’ invite data collection. In order to stimulate solution generation, it is better to start with ‘how’ or ‘invent’. The ‘how’ question focuses on the way or principle. The ‘invent’ focus more on the end result.

Divergent phase

During the divergent phase of the creativity process, a large number of alternatives are identified. At this stage the most important rule is: 'quality is quantity' to generate as many solutions and new ideas as possible. Free association plays an important role during this stage. In addition, the rule of not judging ideas is essential. When confronted with new ideas or concepts, it is important that participants take a constructive stance.

Clustering phase

Done properly, many ideas and solutions will have been generated and collected during the divergent phase. The sheer number of new options will make it hard to come to select the best ones. For that purpose, an additional stage of 'cleaning up' and acquiring an overview of the options generated is useful before moving on to evaluation and selection. In this phase ideas are grouped together based on commonalities. At this stage some ideas may be clarified and/or elaborated upon for clarification.

Converging phase

In the converging phase, all the ideas have the benefit of the doubt (the value of the idea may not be apparent at first), but one should also make decisions and work towards the stated objective. The alternatives chosen are then evaluated and selected.

Teaching for creativity

The teachers also implemented the teaching for creativity principles (NACCCE, 1999) by:

- encouraging young people to believe in their creative identity,
- identifying young people's creative abilities and

- fostering creativity by developing some of the common capacities and sensitivities of creativity such as curiosity, recognising and becoming more knowledgeable about the creative processes that help foster creativity development and providing opportunities to be creative, a hands-on approach.

They did this by firstly making teaching and learning relevant and encouraging ownership of learning and then by passing back control to the learner (Jeffrey and Craft, 2003) and encouraging innovative contributions. Control of learning by a young person is not a new experience. On the contrary, they mainly experience it being taken away or deciding to relinquish it in favour of other 'interests at hand', such as gaining someone's affection or enjoying the feeling of belonging by agreeing to acquiesce to a group's wishes. Having control is an opportunity to be innovative and expressive.

Creative work requires applying and balancing three abilities that can all be developed (Sternberg & Williams, 1996).

1. Synthetic ability is what we typically think of as creativity. It is the ability to generate novel and interesting ideas. Often the person we call creative is a particularly good synthetic thinker who makes connections between things that other people do not recognize spontaneously.
2. Analytic ability is typically considered to be critical thinking ability. A person with this skill analyses and evaluates ideas. Everyone, even the most creative person you know, has better and worse ideas. Without well-developed analytic ability, the creative thinker is as likely to pursue bad ideas as to pursue good ones. The creative individual uses analytic ability to work out the implications of a creative idea and to test it.
3. Practical ability is the ability to translate theory into practice and abstract ideas into practical accomplishments. An implication of the investment theory of creativity is that good ideas do not sell themselves. The creative person uses practical ability to convince other people that an idea is worthy.

Creativity requires a balance among synthetic, analytic, and practical abilities. The person who is only synthetic may come up with innovative ideas, but cannot recognize or sell them. The person who is only analytic may be an excellent critic of other people's ideas, but is not likely to generate creative ideas. The person who is only practical may be an excellent salesperson, but is as likely to sell ideas or products of little or no value as to sell genuinely creative ideas. Encourage and develop creativity by teaching students to find a balance among synthetic, analytic, and practical thinking.

The majority of teachers want to encourage creativity in their students, but they are not sure how to do so. There are many methods that an instructor can foster creativity in his/her teaching.

- Build Self-Efficacy

The main limitation on what students can do is what they think they can do. All students have the capacity to be creators and to experience the joy associated with making something new, but first teacher must give them a strong base for creativity. Sometimes teachers and parents unintentionally limit what students can do by sending messages that express or imply limits on students' potential accomplishments. Instead, help students believe in their own ability to be creative.

- Question Assumptions

We all have assumptions. Often, we do not know we have these assumptions because they are widely shared. Creative people question those assumptions and eventually lead others to do the same. When Copernicus suggested that the Earth revolves around the sun, the suggestion was viewed as preposterous because everyone could see that the sun revolves around the Earth. Galileo's ideas, including the relative rates of' falling objects, caused him to be banned as a heretic. Teachers can be role models for questioning assumptions. You can show students that what they assume they know, they do not really know. Of course, students shouldn't question every assumption. There are times to question and then to try to reshape the environment and there are times to adapt to it. Some creative people question so many things so often that others stop taking them seriously. Everyone has to learn which assumptions are worth questioning and which battles are worth fighting.

- How to Define and Redefine Problems

Promote creative performance by encouraging your students to define and redefine problems and projects. Encourage creative thinking by having students choose their own topics for their work, choose their own ways of solving problems, and sometimes choose again if they discover that their selection was a mistake. A successful task is appropriate to the course's goals and illustrates a student's mastery of important ideas. You may not always be able to offer students choices, but giving choices is the only way for them to learn how to choose. A real choice is not deciding between drawing a cat or a dog, nor is it picking one province to present at a project fair. Give your students latitude in making choices to help them to develop taste and good judgment, both of which are essential elements of creativity.

21st century Learning Skills and Learning Environment:

21st century skills in the literature are often called individual qualities, thinking skills, life skills, survival skills, key competencies, necessary skills, employability skills, deep learning skills they are classified in many categories by many different institutions, organizations, and researchers. Each individual must be literate in terms of finance, economics, globalization, profession, entrepreneurship, civil, health, environment, which are the indicators of the development of countries and which master today's world

in addition to the subject's literature, foreign language and subjects of science, history, geography, and citizenship, which can be described as the fundamental disciplines. When designing learning environments, building a daily-life context about 21st century subjects and themes can help to explain these subjects. Hence, in the 21st century's knowledge society, individuals are living in close connection with the information, technology, and media, it is a necessity for these individuals to be literate of information, media, and technology. Information, media, and technology literate individuals are defined as individuals, who can access information through the media and technology and can analyse and evaluate the information/data they obtain and use the knowledge to solve the problems.

While modernizing the learning environments of the 21st century, teachers, as the persons with whom the students interact most after their family and friends, should have the knowledge and skills to successfully manage this learning environment. Thus, the success of various projects related to the establishment of the 21st century learning environment was defined with the fundamental criteria of the adaptation of the pedagogical skills of the learners and teachers. The 21st century learning environment can reach its goal only with the teachers, who know the skills of the students and can guide the teaching process in accordance with these skills (Harris, Mishra & Koehler, 2009). Thus, it is inevitable to need for teachers, who know the students very well, can create a 21st learning environment for them and guide the students in terms of teaching-learning processes. The teachers must also be able to adapt to the 21st century conditions, and the teachers should certainly learn these skills, as the teachers are also the students.

Key Concepts

Synthetic ability: It is what we typically think of as creativity. It is the ability to generate novel and interesting ideas. Often the person we call creative is a particularly good synthetic thinker who makes connections between things that other people do not recognize spontaneously.

21st century skills: In the literature they are often called individual qualities, thinking skills, life skills, survival skills, key competencies, necessary skills, employability skills, deep learning skills they are classified in many categories by many different institutions, organizations, and researchers.

Build Self-Efficacy: Self-efficacy refers to an individual's belief in his or her capacity to execute behaviours necessary to produce specific performance attainments. Self-efficacy reflects confidence in the ability to exert control over one's own motivation, behaviour, and social environment.

Reflection

Considering the step of creativity process, which step do you need to support your students the most?

Do you encourage your students to gain 21st century skills?

Additional resources

Burlacu, A. (2012) “The importance of non-formal education and the role of NGOs in its promotion”, Article for the 7th edition of the International Conference ‘European Integration Realities and Perspectives’ - Academic Excellence Workshop

Petkovic, S. (2018). Desk study on the value of informal education, with special attention to its contribution to citizenship education, civic participation and intercultural dialogue and learning, European citizenship, peace-building and conflict transformation. Commissioned by the EUCouncil of Europe youth partnership.

Video Materials

21st Century learning & Life Skills: Framework: https://www.youtube.com/watch?v=ixRBjEW_sFs

Education in the 21st Century - Student Centered Learning: https://www.youtube.com/watch?v=g1InechEQ-4

Creativity in Education (21st Century Education): https://www.youtube.com/watch?v=JJkOZ1mdx2A

3.4 Introduction to Stem Education

Connection between teaching contents and real life

It is concluded that students enjoy the lessons related to real life events. The subjects adopted real life events and students’ concerns, such as gender issues, fashion of identity, or the feelings of students. These are issues students will encounter at some point. They can share experiences with classmates, triggering responses, discussion and high-level thinking. Integrated activities help students to develop the ability to express and realize them in daily life, find real life examples to evidence what they learn, and relate what they learn to life experiences.

The subjects indicated creative ideas also come from real life; the key point is that teacher should be sensitive to feel, find, think and convert into instruction. Dewey believed ‘education as life’, claiming life and education are separable. Life injects meanings to education, and education refines our life. However, traditional education adheres to textbooks, ignoring the significance of life education. Without

life education, one will never know how to interact with people of diverse personalities, how to properly handle interpersonal relationships and unexpected challenges. As a result, education should centre on the ability to solve problems in life by unreining their creativity. According to Petrowsky: 'Life is creative in all aspects:

(a) everything is in the continuum of discovery and creation;

(b) the purpose is to find a doable solution, not a correct one;

(c) opportunities lead to more chances.'

The three subjects showed their concern of life education in their beliefs in education and lesson plans. The three subjects designed open questions for their students that stirred students' creative thinking. It is identified open questions as a characteristic of creative instructions. Besides, creative instructors always encourage students to create and imagine in group discussions. Related studies showed that teachers can have more positive influences on students by encouraging them to 'be creative'.

Source: https://teachthought.com

Teachers are expected to have the targeted 21st century skills together with the pedagogical competencies to achieve the goals determined in education. Thus, it was essential to redefine the qualities and skills of the teachers and students. The effects of the transformation in the global world on education weren't limited to the definition of the 21st century skills in education.

If we examine the literature of recent years, it can be witnessed that the development of pedagogical approaches for training individuals on 21st century skills so that the information society emerges. One of these approaches has been STEM education, which is based on the integration of the disciplines, which have been considerably emphasized and implemented in recent years. The purposes of STEM education

are not exclusively for students but they are also valid for teachers and STEM education aims to increase the knowledge of teachers on the content and pedagogical matter knowledge.

What is STEM education?

STEM education aims to help students solve problems with a multidisciplinary perspective and gain knowledge and skills in a holistic perspective. STEM education is an interdisciplinary approach which covers the whole process from kindergarten to higher education (Gonzalez & Kuenzi, 2012). STEM education can be considered as an education covering high quality learning combining disciplines, making use of current information in daily life, increasing life skills and superior and critical thinking (Yıldırım and Altun, 2015).

Supporters of STEM education think that course subjects which involve real world problems will increase students' interest, success and motivation. STEM education improves planning, critical thinking and evaluation skills as well as problem-solving. STEM education follows constructivist and student centered education. That's why STEM education is very important in terms of implementing theoretical information and transforming this information into inventions. STEM education also enables development of empirical approach, learning by doing, inquiry, research and inventing which are important for the increasing workforce quality in the world. And this will serve for production, research and development, innovation and development of technical infrastructure and closing the gap in qualified workforce (TUSIAD, 2014).

Components of STEM Education

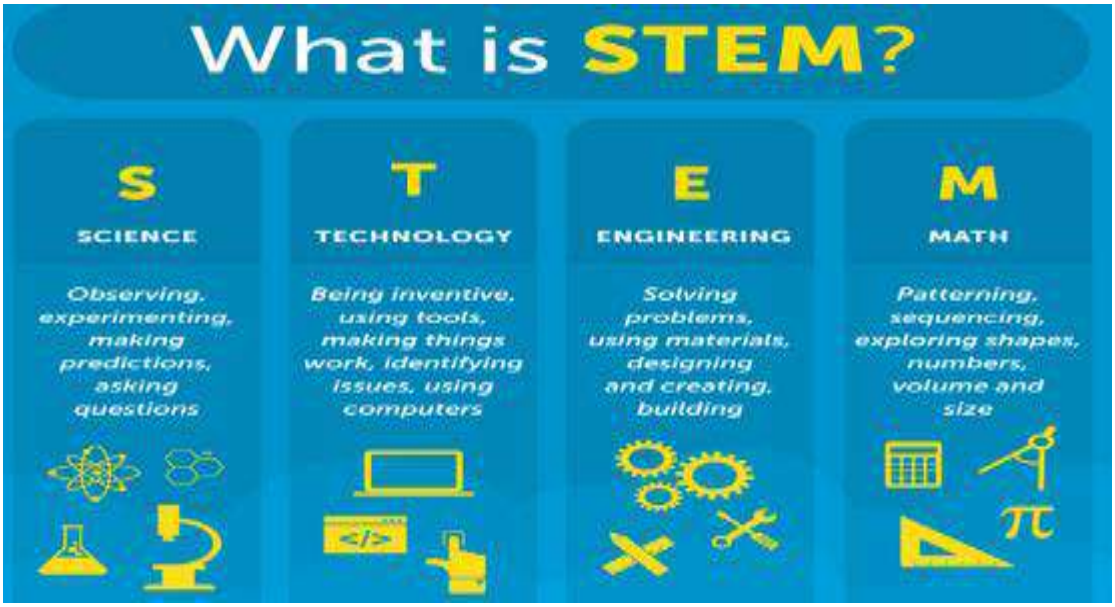
STEM is an abbreviation that stands for science, technology, engineering and mathematics. STEM is a multi-disciplinary approach which allows students to study science, technology, engineering and mathematics making connections between the classroom and the real-world. STEM education focuses on universal literacy skills. These skills are creative thinking, critical thinking, problem-solving and collaborative learning. Students need to achieve these skills. In this context, teachers' role is helping students reach the level of higher order thinking, product development, invention and innovation by leading but not teaching theoretical content knowledge on Science, Technology, Engineering and Mathematics to them.

S stands for **Science**, and how students learn about the natural world.

T stands for **Technology**. It encompasses anything computer-related but also the study of objects and how they're used to tackle a problem.

E is for **Engineering** which refers to studying how things are designed.

M is for **Mathematics**, the study of numbers, shapes, and quantities.



Source: https://shutterstock.com

Literature points to the thinking that introducing engineering and technology as stand-alone subjects will in some way bring awareness of their connections to the science and mathematics. This can be discerned from the definition of each of the four STEM disciplines. Science has three interrelated dimensions:

(1) understanding nature which relates to science as the tool for understanding universal patterns of nature,

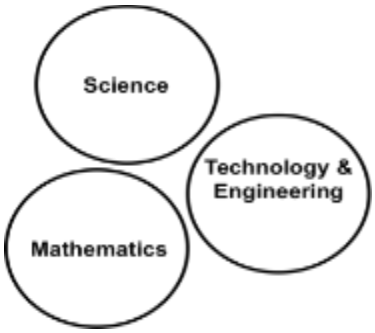
(2) scientific inquiry which relates to the methodology used for generating knowledge and

(3) scientific enterprise which relates to the human involvement in generating knowledge.

Mathematics is not only the primal language that cuts across STEM disciplines but also a network of practical and theoretical divisions that interact with other subjects as well as within. It is inclusive of numbers and operations, algebra, geometry, measurement, data analysis and probability, problem-solving, reasoning and proof and communication (including trigonometry, calculus and theory). Both engineering and technology apply science and mathematics. Engineering uses technology to innovate and create products or structures and process that improves quality of life. Three approaches for teaching STEM education are currently being practiced. The distinction between each of these methods lies in the degree of STEM content used. They include silo, embedded, and integrated approaches.

- The Silo Approach

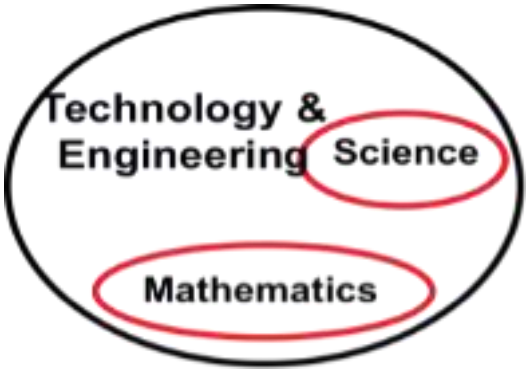
The silo approach to STEM education refers to isolated instruction within each individual STEM subject (Dugger, 2010). Emphasis is placed on “knowledge” acquisition as opposed to technical ability (Morrison, 2006). Concentrated study of each individual subject allows the student to gain a greater depth of understanding of course content. This focused instruction stirs appreciation for the beauty of the content itself (Jenny Chiu, personal communication, September 27, 2011). This is how science, technology and engineering, and mathematics education been approached in curriculum design and teaching.



Silo STEM instruction is characterized by a teacher-driven classroom. Students are provided little opportunity to “learn by doing”, rather they are taught what to know (Morrison, 2006). Morrison (2006) suggests the prevailing belief behind silo STEM instruction is to increase knowledge which generates judgment. An instructor operating within the confines of their discipline can produce quality instruction for students which must not be overlooked. It is propelled by mandates for students to learn content and pass tests.

- The Embedded Approach

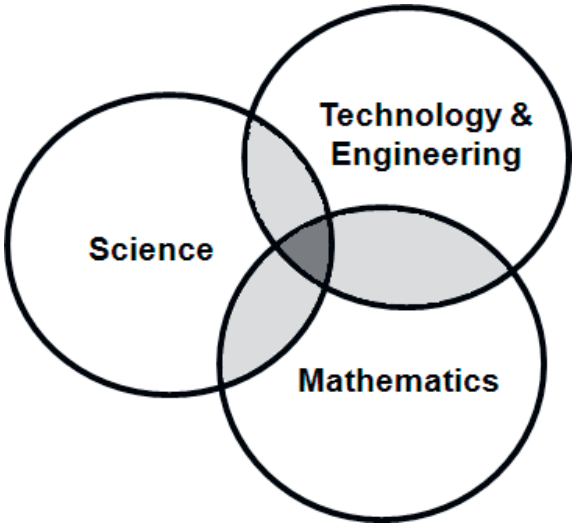
Embedded STEM instruction may be broadly defined as an approach to education in which do- main knowledge is acquired through an emphasis on real-world situations and problem-solving techniques within social, cultural, and functional contexts (Chen, 2001). In practice, embedded teaching is effective instruction because it seeks to reinforce and complement materials that students learn in other classes (ITEEA, 2007). A technology education teacher uses embedding to strengthen a lesson which benefits the learner through understanding and application.



In a STEM embedded approach, the technology education content is emphasized (just as it would be if taught in the silo approach), thereby maintaining the integrity of the subject matter. Yet, embedding differs from the silo approach in that it promotes the learning through a variety of contexts (Rossouw, Hacker, & de Vries, 2010). However, the embedded material is not designed to be evaluated or assessed (Chen, 2002).

- The Integrated Approach

An integrated approach to STEM education envisions removing the walls between each of the STEM content areas and teaching them as one subject (Breiner et al., 2012; Morrison & Bartlett, 2009). Integration is distinct from embedding in that it evaluates and assesses specified standards or objectives from each curriculum area that has been incorporated within the lesson (Sanders, 2009).



Ideally, integration enables a student to gain mastery of competencies needed to resolve a task (Harden, 2000). Training students in this way is perceived beneficial as it is a multidisciplinary world reliant on STEM concepts, which students must use to solve real-world problems (Wang, Moore, Roehrig, & Park, 2011). Additionally, instructing through integration produces the expectation of increased interest in STEM content

areas, especially if it is begun when students are young (Barlex, 2009; Laboy-Rush, 2010). Two common approaches to integrative instruction are multidisciplinary and interdisciplinary integration (Wang et al., 2011).

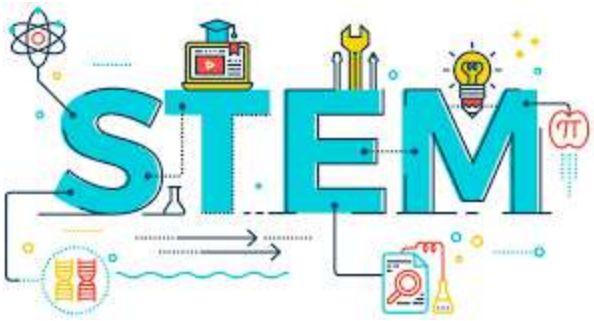
Multidisciplinary integration asks students to connect content from various subjects taught in different classrooms at different times. It relies on corroboration between faculty members to ensure content connections are made (Wang et al., 2011).

Wang et al. (2011) explain interdisciplinary integration begins with a real-world problem. It in- corporates cross-curricular content with critical thinking, problem-solving skills, and knowledge in order to reach a conclusion. Multidisciplinary integration asks students to link content from specific subjects, but interdisciplinary integration focuses students' attention on a problem and incorporates content and skills from a variety of fields.

STEM Education and 21st Century Skills

The countries need to train individuals, who can think critically, creatively, and analytically in the 21st century, have high communication skills, can develop solutions to the problems they encounter in daily life, make decisions, conduct studies, interrogate and make conscious decisions in the future career choices. Together with the transformation observed in the world and the structure of the problems, the qualifications required from individuals have changed as the educational policies, approaches and strategies have been altered as well. In addition, the curricula and teaching, professional development, strategies, and conditions for implementation should be taken into consideration for the implementation of the 21st century skills. This requires an interdisciplinary vision (Vooght & Roblin, 2010).

STEM education, which is based on the integration of disciplines particularly for solving the complex problems we encounter in everyday life and for help individuals to acquire the 21st century skills, is specifically recommended for the integration of these skills into teaching, and in recent years, many countries implement this system as one of the most effective educational approaches in the education system. STEM education signifies a teaching approach based on the integration of the disciplines of science, technology, engineering, and mathematics, aiming to train individuals so that they can provide solutions to challenges from an interdisciplinary perspective. As it is clear by its definition, STEM aims to develop skills such as scientific process skills, interrogation, critical thinking, and problem-solving skills rather than providing exclusively knowledge (Bender, 2015; Bryan et al. 2015).



Source: https://techsling.com

Comprehending the ways and processes of achieving the integration of the STEM disciplines will, therefore, make it simpler to recognize the role of STEM in helping individuals to acquire these skills. STEM education process requires the implementation of the scientific method through integrated engineering design to be able to solve authentic, realistic problems, that require the use of science and mathematics, in a meaningful, rich, and social context through integrated engineering design. The daily life problems are presented to the students and it is beneficial for the students to search for a solution to these problems so that the students can acquire problem-solving skills and develop other analytical skills. In addition, their interest and understanding of disciplinary concepts of STEM are increased (Yang & Baldwin, 2020). In STEM education, since there is more than one solution to the problems, the students are expected to present more than one solution, coherent with the scientific knowledge and the solution should be different and should have the potential to be developed. The students are also required to evaluate all the solution proposals communicated by everybody (Bozkurt Altan & Hacıoğlu, 2018). Hence, this greatly contributes to the development of the creative thinking and critical thinking skills of the students.

Implementing STEM into classroom curriculum: Teachers can integrate STEM learning into classroom curriculum by:

1. Acquainting students with modern educational technology. Giving them access to computers and cell phones during classes for learning purposes broadens their minds. The internet and various applications are resourceful tools in terms of information.
2. Introducing words like 'experiment', 'model' and 'design' to questions. This gives students the opportunity to explore and put their skills into practice. Creativity is employed at its peak ultimately preparing a student for real-life challenges. For example, a teacher can request their students to design a model of a system that will curb global warming.

3. Discern real-life problems and require solutions. By empowering students with issues that occur on a daily basis, they will discover that real-world problems have numerous solutions. These activities promote teamwork and effective communication which are important in today's life activities.
4. Introduce training programs in STEM classrooms. Structured activities and lessons can be developed to provide hands-on experience to students. Promoting active learning and practice in classrooms is a way of engaging students. A teacher can also invite experts from outside of school as an incentive to excite students about science, math, and technology.

Teachers who implement STEM learning in their classroom help to shape the future leaders in the country. Encouraging students on the importance of these disciplines and involving them assists them in illustrating their ideas. STEM learning is essential to the overall nation's economy and the increasing competition between other industrialized countries. Students need to be advised on the merits of this type of learning by parents, as it is germane to their future. The potential gap that is set to emerge in the next decade due to the advancement in technology requires a great supply of workers with STEM education.

Key Concepts

STEM: it is an abbreviation that stands for science, technology, engineering and mathematics. STEM is a multi-disciplinary approach which allows students to study science, technology, engineering and mathematics making connections between the classroom and the real-world.

Reflection

Why Stem Education is important? How do you support it in your class?

How do you use real life connections in the classroom?

Additional Resources

Angier, N. (2010, October 04). Stem education has little to do with flowers. New York Times. Retrieved from http://www.nytimes.com/2010/10/05/science /05angier.html? pagewanted=all.

Kelly, B. (2012, September). Stem: What it is, and why we should care. U.S. News and World Report, Retrieved from: http://money.usnews.com/money/careers/articles /2012/09/10/stem-what-it-is-and-why-we-should-care

White, D. W. (2014). What is STEM education and why is it important? Florida Association of Teacher Educators Journal, 1(14), 1-8. Retrieved from http://www.fate1.org/journals/2014/white.pdf

Video Materials

STEM - What is it and why is it important? https://www.youtube.com/watch?v=fH5iLx_jCUk&t=64s

What is STEM? https://www.youtube.com/watch?v=wRV28EOCGGo

STEM Education Overview https://www.youtube.com/watch?v=5GWhwUN9iaY

STEAM + Project-Based Learning https://www.youtube.com/watch?v=H7LHsL0iB_w

3.5 Assessment

1) ……. consists in developing skills of creative problem-solving, strengthening creative attitudes, teaching principles of creative thinking, and forming the ability to transfer skills for creative problem-solving to the sphere of real challenges in personal and professional life. Which of the following should be placed in the blank space above?
   a) Teaching for creativity
   b) Teaching about creativity
   c) Teaching with creativity

2) Teaching method of creative education is established by the five-stage teaching. Which is the stage that starts imagination and most fundamental for cultivating creativity and the stage from which creative activity is started?
   a) Discovery
   b) Digging
   c) Idea

3) Which of the following options is four domains of creativity?
   a) Meanings- Idea-Transform-Future
   b) Meanings-Discourses-Future-Learning
   c) Meanings- Analysing- Future-Learning

4) ……. signifies a teaching approach based on the integration of the disciplines of science, technology, engineering, and mathematics, aiming to train individuals so that they can provide solutions to challenges from an interdisciplinary perspective.
   a) STEM education
   b) Effective education
   c) Problem based education

5) …… is typically considered to be critical thinking ability. A person with this skill analyses and evaluates ideas. Everyone, even the most creative person you know, has better and worse ideas.
   a) Analytic ability
   b) Synthetic ability
   c) Practical ability

6) What does the acronym “STEM” stand for in this module?
   a) Science- Teleology- Engineering- Math
   b) Science-Technology- Engineering- Music
   c) Science- Technology- Engineering- Math

7) Which is not among the 21st century skills?
   a) thinking skills
   b) math skills
   c) key competencies

Module 4. Machine Creativity

Author: Gilberto MARZANO

Learning Objectives

Upon completion of this Learning Unit, trainees will know and understand:

- Intelligent algorithms
- Knowledge acquisition and representation
- Conscientiousness
- Computational creativity
- Machine learning

Upon completion of this course, learners will be able to better understand the impact of digital technologies and master them.

Introduction

In this learning unit, the theme of machine creativity is examined. The main questions underlying this topic are illustrated, reporting and discussing the views of authors involved in early Artificial Intelligence (AI) research. These were the scientists engaged in experiments and theoretical studies in expert systems, logical reasoning, logical programming, machine learning, and philosophy of mind.

In addition, the issue of machine intelligence is raised in relation to Alan Turing's question: *Can machines think*?

Knowledge acquisition and representation as well as machine learning have also briefly been introduced, so as to prepare the ground for discussing the question: *Can machines be creative*?

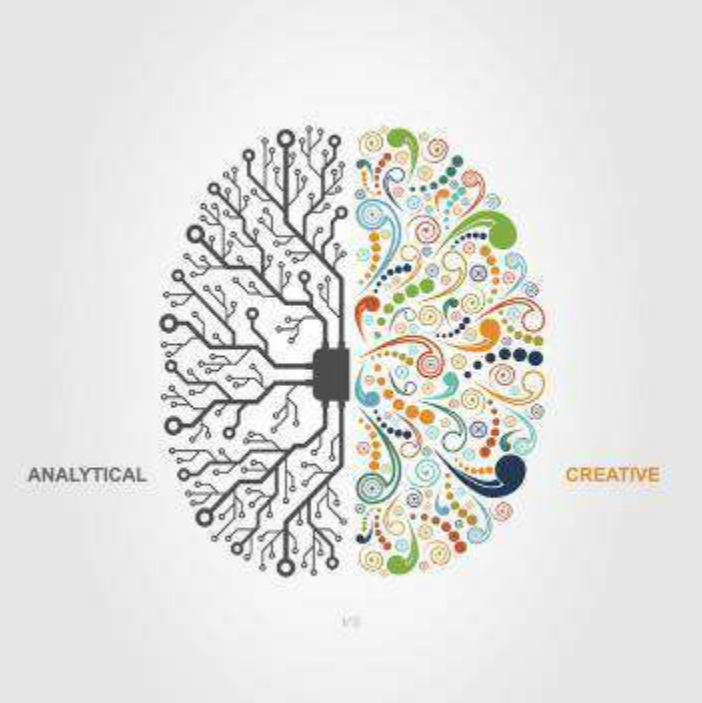
Finally, a problem that worries many journalists, socio-philosophers, and people, in general, is briefly explored, namely: *Will technology grow out of human control?* Will there be *a moment when this transformation becomes irreversible?*

4.1 Creativity Definitions

The field of creativity studies has roots in the 1950s, 1940s, and 1930s. Domain differences were examined in the 1930s (e.g., Patrick, 1935, 1937, 1938), and social criteria of creativity relying on consensual agreement go back at least to 1953 (Stein, 1953), just to name two examples.

In the early 1970s, creativity came to be viewed as a basic factor of human activity beyond psychological studies.

The *standard definition* of creativity claims that its necessary requirements are originality and effectiveness. Indeed, if something is not unusual, novel, or unique, it is commonplace, mundane, or conventional. It is not original, and therefore not creative. Accordingly, originality is vital for creativity but is not sufficient. Ideas and products that are merely original might very well be useless.



Original things must be effective to be creative. Like originality, effectiveness takes various forms. It may take the form of (and be labelled as) usefulness, fit, or appropriateness. Effectiveness may take the form of value. This label is quite clear in the economic research on creativity; it describes how original and valuable products and ideas depend on the current market, and more specifically on the costs and benefits of contrarianism (Runco & Jaeger, 2012).

4.1.1 The most popular definition of creativity

Here are some of the most popular definitions of creativity:

‘‘The creative work is a novel work that is accepted as tenable or useful or satisfying by a group at some point in time’’ (Stein, 1953)

‘‘Originality is vital but must be balanced with fit and appropriateness’’ (Runco, 1988)

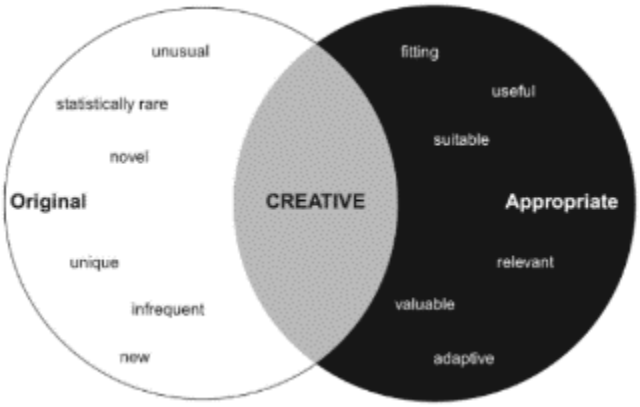
"[…] novel product, idea, or problem-solution that is for value to the individual or a larger social group" (Hennessey & Amabile, 2011)

"[…] the process of having ideas that have value" (Robinson, 2011)

"A creative idea is marked by three attributes: It must be original, it must be useful or appropriate for the situation in which it occurs, and it must actually be put to some use" (Martindale, 2013)

"[…] the process of creating ideas, artefacts, processes, and solutions, that are novel and effective" (Henriksen, Richardson, Mehta, 2017)

Figure below shows the contribution of originality and appropriateness in creativity according to the most commonly followed definitions of creativity.



Definitional elements of creativity (source: Abraham, 2018, p. 8)

4.1.2 Machine learning

Learning is something intrinsic to the human condition. Although human beings possess genetic coding at birth, they have to learn how to live as part of a community, work, apply knowledge, and use technologies. Learning is a lifelong process and is deemed to be closely entwined with intelligence. Providing a machine with learning ability was a goal of the first research in artificial intelligence.

Machine learning encompasses a vast set of theories, techniques, and tools to allow machines to learn by themselves. In the early stages of AI, conventional machine-learning techniques were limited to processing data in their raw form. For decades, machine-learning systems required engineering efforts and domain expertise to design extractors to transform the raw data into suitable representations for computer processing (Michalski, Carbonell, & Mitchell, 1983; 1986). It has been observed that, at that time, although AI researchers used terms like *induction*, their approach was "not easily relatable to work

in Philosophy and Logic" and one does not find "explicit attempts to construct learning programs that work using a Popperian refutation method" (Mortimer, 1988, p. 154). Even the probability theory was little used since learning programs were essentially symbolic, and machine learning techniques were almost entirely symbolic.

In fact, there are two approaches to machine learning: symbolic-based and connectionist. The symbolic-based approach uses symbols to represent the entities and relationships of a problem domain and, from these symbols, infers novel and useful generalizations. Instead, the connectionist approach was inspired by the biological neural system. In this approach, knowledge is represented in the form of patterns in a network of weighted nodes, and learning results from training this network.

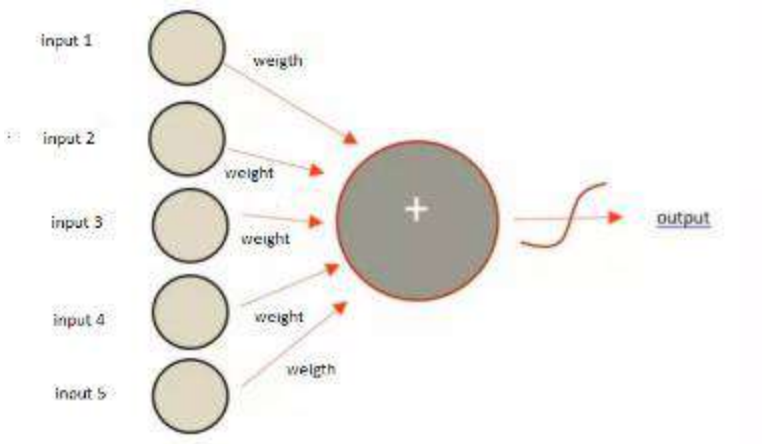
Symbolic machine learning applications employ techniques such as:

- Learning from examples - aims to infer an unknown function f from a finite set of examples.
- Learning heuristics - approaches a problem through practical methods that are not guaranteed to be optimal but are nevertheless sufficient for reaching an immediate, short-term goal or approximation.
- Learning by analogy - consists in transferring knowledge from past problem-solving episodes to new problems that share significant aspects in common with corresponding past experience, and uses the transferred knowledge to construct solutions to the new problems (Carbonell, 1981).

The earliest example of the connectionist approach based on neural computing was the McCulloch-Pitts neuron (McCulloch & Pitts, 1943). Neural networks were a promising research area in neuroscience and computer science until 1969 when Marvin Minsky and Seymour Papert, criticizing the limits of the current neural network algorithms, excluded this field of investigation from the MIT Artificial Intelligence Laboratory. In the 1980s, however, researchers developed algorithms that overcome the limitations identified by Minsky and Papert, and neural networks enjoyed a renaissance.

Nowadays, most machine learning applications use neural networks algorithms (Fanelli, 2018; Graupe, 2013; Yegnanarayana, 2009). Over the last decades, neural networks have become popular for diverse applications, from machine vision and image classification to financial prediction. A neural network is essentially an information processing paradigm inspired by the human brain. It represents an abstraction of neuron networks without their biological complexity. A neural network comprises node layers containing an input layer, one or more hidden layers, and an output layer. Each node connects to another and has an associated weight and threshold.

Figure below shows a simple neural network that calculates the output using a sigmoid function.



A simple five-variable neural network using the sigmoid function (own source)

Many neural networks use a sigmoid function because it exists in a limited number from 0 to 1. It is especially apt for models where one has to predict the probability of an output that exists between the range of 0 and 1.

Deep learning is a subset of machine learning, and essentially describes a neural network with three or more layers (Buduma & Locascio, 2017; Kelleher, 2019; Wani, Bhat, Afzal, & Khan, 2020). Deep learning allows the computer to build complex concepts from simple concepts, enabling the computer to combine several layers. Deep learning is particularly useful in a context where large datasets are available. Facebook uses deep learning to analyse users' posts, while Microsoft uses it for image searching. Autonomous vehicle applications employ convolutional neural networks (CNN) which are types of deep neural networks that use convolution as the primary computational operator. The term convolution refers to the mathematical combination of two functions to produce a third.

4.1.3 Computational creativity

Many people claim that humans and machines differ in that a machine does not possess creativity and originality. In the last few years, however, machines have demonstrated that they are arguably creative in a number of areas, both artistic and scientific.

Sawyer argued that AI applications seem to meet the individualist definition of creativity since they generate new and useful things, but they do not seem to do it in the way people do. These artificial creators "do not simulate very many of the cognitive processes and structures that psychologists have associated with creativity" (Sawyer, 2012, p. 150). Moreover, for the author, artificial creators do not model emotion, expression, communication, and motivation. In this regard, a key question related to artistic creation arises. It is broadly accepted that famous creative artists break the current rules of their

discipline, but their new artworks have a structure and form nonetheless. These artists experiment with new rules and different ways to organize their compositions. If one accepts that a human artist composes their artwork without any rules and relies only on chance, then there would be no difference between a human and a machine artefact. Randomness and chaos alike underlie their acts. This possible paradox suggests that the study of human creative processes is essential to implementing effective artificial creators.

Computational Creativity (CC) is an emerging multidisciplinary field of research within AI that focuses on machines' capacity to generate and evaluate novel outputs that, if produced by a human, would be considered creative.

CC "studies and exploits the potential of computers to be more than feature/rich tools, and act as autonomous creators in their own right" (Veale, Cardoso, & Perez, 2019, p. 2). There are CC applications where the creative impetus comes only from the machine as well as hybrid applications where the creative impetus comes from humans and machines together. As a discipline, CC develops research encompassing AI, cognitive sciences, psychology, and social anthropology. CC aims to explore a range of questions (Veale & Cardoso, 2019), such as:

- What does it mean to be creative? Is it something that is residing in the producer, in the process, in the product, or, indeed, in their combination?
- How is creativity related to expertise?
- How does creativity exploit and subvert norms and expectations?
- How can one meaningfully measure creativity?
- How does creativity emerge from group behaviour and collective actions?
- What constitutes creativity in different domains and modalities?
- What theoretical constructs offer the most insightful explanations of creativity?

CC is specific about defining such questions as these because it adopts an algorithmic perspective on creativity, focusing on automated processes, algorithms, and knowledge structures. The aim of CC is not to speculate on human and machine capabilities but, rather, to implement applications that can have a practical utilization.

One common approach is in defining CC as the machine-based implementation of a product, regardless of the process involved in generating such a product.

Geraint Wiggins suggested a general definition of CC as "the performance of tasks which, if performed by a human, would be deemed creative" or, as an even more specific definition, "The study and support

through computational means and methods, of behaviour exhibited by natural and artificial systems which would be deemed creative if exhibited by humans" (Wiggins, 2006, 451).

It has been observed that collaborative and interactive approaches to CC were increasingly recognized and studied in the 2010s:

"The expectation of automation and individualism from a creative agent has limited CC to only those situations when the interacted software is largely autonomous in its generative process. This limitation has created a gap between studying human-computer interactions (HCI) and CC" (Gu & Amini Behbahani, 2021).

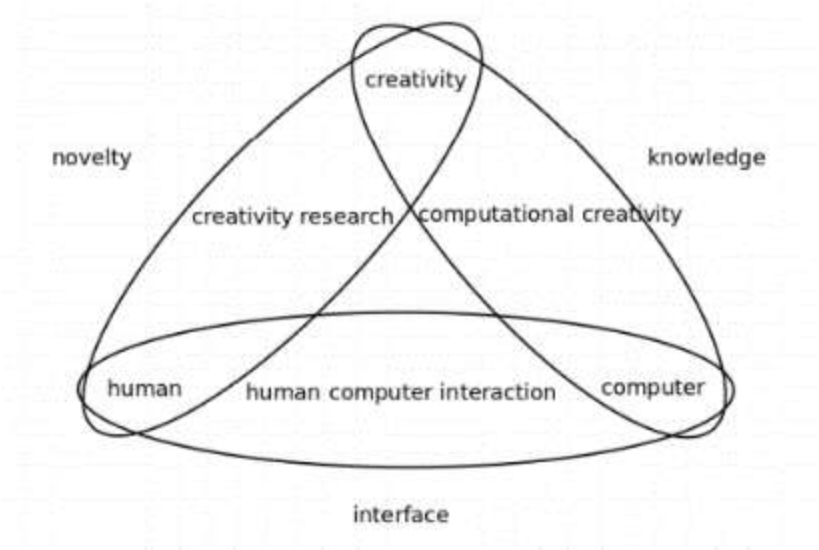
The cooperation between humans and machines can open new extraordinary possibilities. Several years ago, in 2001, Tim Berners-Lee, the creator of the World Wide Web, James Hendler, and Ora Lassila, in introducing the concept of the Semantic Web, declared:

"The real power of the Semantic Web will be realized when people create many programs that collect Web content from diverse sources, process the information and exchange the results with other programs. The effectiveness of such software agents will increase exponentially as more machine-readable Web content and automated services (including other agents) become available. The Semantic Web promotes this synergy: even agents that were not expressly designed to work together can transfer data among themselves when the data come with semantics" (Berners-Lee, Hendler, & Lassila, 2001, p. 42).

Indeed, human-computer interaction brings us to Human-Computer (Co-)Creativity (HC^3). According to Hoffmann, who coined this term:

"Human-Computer Co-Creativity is a process resulting in a creative outcome and involving one or more human individual(s) and one or more computer system(s). A model of HC^3 would therefore have to account for the role of each of these three elements as well as the relationships between them" (Hoffmann, 2016, p. 38).

Figure below illustrates the research scope of Human-Computer Co-Creativity.



Research topics for Human-Computer Co-Creativity (source: Hoffmann, 2016, p. 39).

This relationship between humans and machines opens a question that worries many journalists, socio-philosophers, and people in general: *Will technology out-grow human control?*

Key concepts

Creativity definition: creativity is defined as the tendency to generate or recognize ideas, alternatives, or possibilities that may be useful in solving problems, communicating with others, and entertaining ourselves and others (http://www.csun.edu/~vcpsy00h/creativity/define.htm).

Machine learning: it is a branch of artificial intelligence (AI) and computer science which focuses on the use of data and algorithms to imitate the way that humans learn, gradually improving its accuracy (https://www.ibm.com/cloud/learn/machine-learning).

Computational creativity: it is a multidisciplinary endeavour that is located at the intersection of the fields of artificial intelligence, cognitive psychology, philosophy, and the arts (https://computationalcreativity.net/home/about/computational-creativity/).

Reflection

Is machine learning useful?

Why is important creativity nowadays?

Additional resources

Andriopoulos, C., & Dawson, P. (2021). Managing change, creativity and innovation. *Managing Change, Creativity and Innovation*, 1-100. Available at: https://pdfs.semanticscholar.org/678f/8b22cd94ecfeba42a6e51a82d7042c0ffbce.pdf

Boden, M. A. (1996). Creativity. In *Artificial intelligence* (pp. 267-291). Academic Press. Available at: https://www.sciencedirect.com/science/article/pii/B978012161964050011X

Video materials

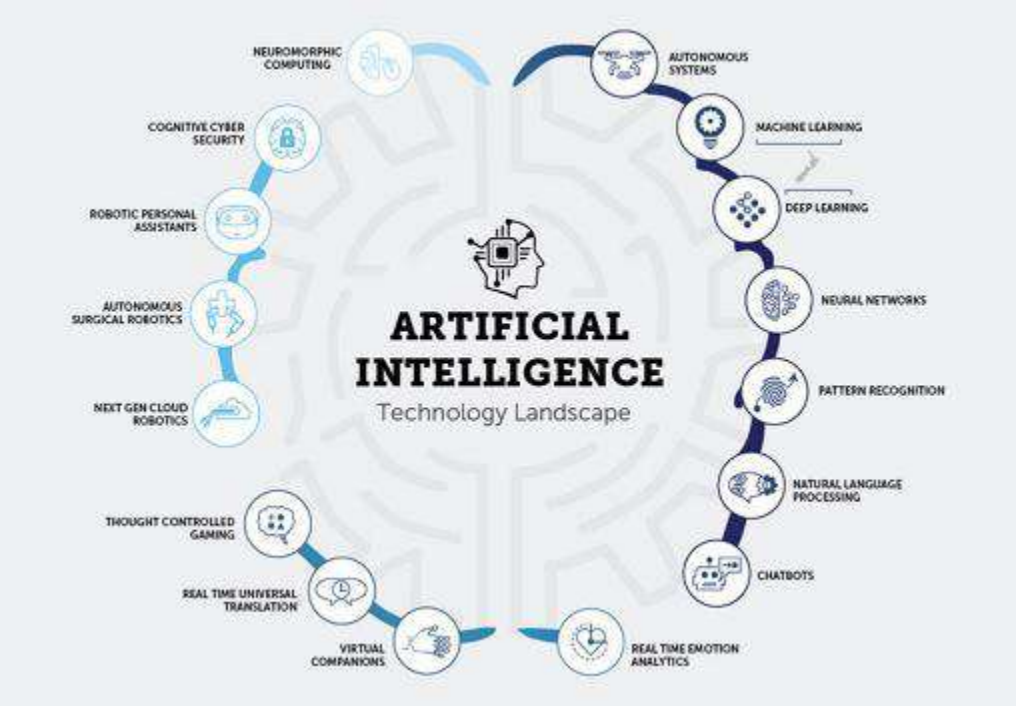
What is Creativity: https://www.youtube.com/watch?v=j5Ogg-V3OTI

What is creativity: https://www.youtube.com/watch?v=X1c3M6upOXA

4.2 Intelligent Machines

Artificial Intelligence (AI), the Internet of Things (IoT), and the Internet of Everything (IoE) has multiplied intelligent applications based on smart devices and intelligent algorithms in every field of normal life. There are intelligent applications for industry, health, education, security, and leisure. Nowadays, translation programs and intelligent information retrieval systems are more and more sophisticated and effective. The dream of the 1970s pioneers of AI seems to be coming true.

Nevertheless, Newell and Simon's idea (1972) that the human brain is essentially an information processing system that can be studied and reproduced artificially appears naive and reductionist. The extended use of neural networks in machine learning and deep learning is revolutionizing human life, but the human brain is more complex than a computer, and artificial neural networks diverge significantly from the way the brain works. That said, the idea of the brain functioning as a computer is a metaphor that still holds; however, one should not forget that, in the not-so-distant past, the brain was represented as a telephone switchboard with connections between stimuli and responses (Rumeihart, 1989).



Artificial intelligence

2.1 Intelligent application

In general, intelligent applications can be defined as applications that integrate and process data acquired from external sources with knowledge organized in a computer-readable form through intelligent agents. In AI, an intelligent agent can be any computational entity that perceives a specific environment through sensors and acts upon that environment intelligently and rationally. Depending on the application, these computational entities integrate and process data received from sensors and stored in several datasets in order to make decisions or perform specific services. In an intelligent system, each intelligent agent "does its own independent piece of the problem-solving and either produces a result itself (does something) or reports its results back to others in the community of agents" (Luger, 2002, p. 15). Indeed, many researchers in AI believe that intelligence is reflected in the cooperative behaviour of a large number of simple interacting agents (Gelfond & Kahl, 2014; Jennings, Sycara, & Wooldridge, 1998; Wooldridge & Jennings, 1995). It is notable that, in the prologue of *The Mind Society*, Minsky wrote:

"I'll call *Society of Mind* this scheme in which each mind is made of smaller processes. These we'll call *agents*. Each mental agent by itself can only do some simple thing that needs no mind or thought at all. Yet when we join these agents in societies – in certain very special ways – this leads to true intelligence" (Minsky, 1989, p. 17).

The question of machine intelligence, and consequently of their creativity, necessarily implies understanding the functioning of intelligent applications. Despite many decades having passed since the first AI applications, three main problems with their implementation remain:

1. knowledge acquisition and representation that concerns the process of extracting, structuring and organizing knowledge from one or more sources;
2. algorithm development that concerns a detailed step-by-step instruction set or formula for solving a problem or completing a task;
3. machine-learning that concerns teaching machines to learn about something without explicit programming.

2.2 Knowledge acquisition and representation

In general, knowledge acquisition is a process that is fundamental to human beings, which continues through the individual's entire life span. Theories have been elaborated and revised over time with a view to understanding knowledge acquisition and its relationship with learning. For people to succeed in a particular field, they need to invest in learning and acquiring knowledge. Sawyer (2012) reports that studies show performance at a top world-class level is only possible after a person has invested about 10,000 hours of deliberate practice in that specific domain. In this regard, the research of Ericsson, Krampe, and Tesch-Römer (1993) was pivotal. They introduced the *monotonic benefits assumption* for which the amount of time an individual is engaged in deliberate practice activities is monotonically related to that individual's acquired performance. From their research on groups of adult violinists and pianists, it emerged that expert performance is not innate, except in only a very few cases. Although there are differences between expert performers and normal adults, these differences overwhelmingly reflect a life-long investment of deliberate effort to improve performance in the specific domain. However, it does not follow from the rejection of innate expert performance that everyone can easily attain high levels of skill:

"Contemporary elite performers have overcome a number of constraints. They have obtained early access to instructors, maintained high levels of deliberate practice throughout development, received continued parental and environmental support, and avoided disease and injury. When one considers, in addition, the prerequisite motivation necessary to engage in deliberate practice every day for years and decades, when most children and adolescents of similar ages engage in play and leisure, the real constraints on the acquisition of expert performance become apparent" (Ericsson, Krampe, & Tesch-Römer, 1993, p. 400).

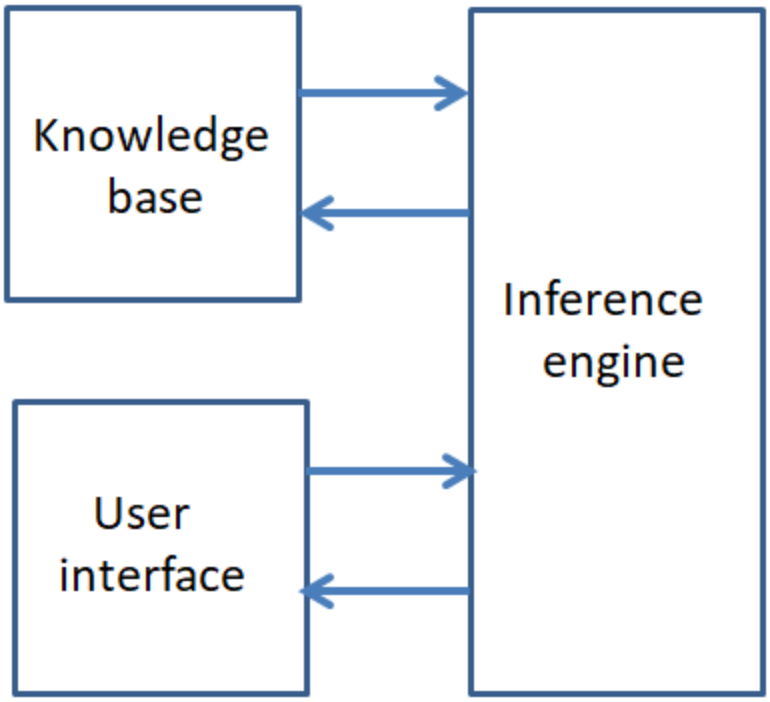
How is it possible that a machine acquires knowledge?

This was a topical problem for expert systems in the 1980s (Forsyth, 1984; Hayes-Roth, Waterman, & Lenat, 1983; Sell, 1985; Waterman, 1985). In the early 1980s, the dominant market for expert systems was expected to be microcomputer-plus-TV-based home entertainment. In this case, the concept of home entertainment incorporated consultation and advice intended for a broad range of consumers, running from financial issues to questions about gardening and plant care (Feigenbaum, 1981).

For the pioneers of AI, the dominant belief was that knowledge would be elicited from human experts and that their expertise would then be collected and organized. In general, in the AI perspective, knowledge acquisition is the process of eliciting and collecting the knowledge and expertise related to a particular field (domain) in order to represent and use it in a computerized system. Knowledge acquisition is necessary for building any intelligent system. However, knowledge acquisition entails many issues: How may one establish the proper knowledge for the system functioning? How may one know that the whole necessary knowledge has been acquired? How may one ensure continuous knowledge and the updating of expertise?

Research and experience show that the task of knowledge acquisition depends on the ultimate destination of the knowledge, and on the nature of the problem to be solved. Moreover, the process of knowledge acquisition is closely related to the process of translating that knowledge into a computer-readable form and making it functional to the application for which it is required.

In its early days, AI research investigated knowledge acquisition intending to create expert systems. The essential structure of an expert system was based on three main components: knowledge base, intelligent engine, and user interface.



The basic structure of an expert system (own source)

Knowledge was deemed to be something that could be distilled by human experts since they possess a store of facts and evidence, as well as rules of inference connecting constellations of facts for problem-solving situations (Brulé & Blount, 1989; Hart, 1992; Olson & Rueter, 1987). Direct and indirect techniques have been proposed and applied to implementing the knowledge base of expert systems. Direct techniques encompass questionnaires, interviews, observation, and flow analysis, while indirect techniques include lists, tables, categorical hierarchies, inferential flows (decision trees), networks, physical space, and physical models. Both of these techniques have advantages and disadvantages. Direct techniques, for example, depend on the experts' competence, while indirect techniques depend on the situation modelling. In developing expert systems, knowledge engineers have a primary role. They are responsible for modelling the expertise in the domain, as well as conducting interviews with the domain experts. However, knowledge can also be represented in terms of rules that say what to do or what to conclude in different situations. Rule-based systems are intelligent systems that apply rules in order to draw a conclusion from a premise. Prolog (Programming in Logic) is a rule-based/logic-programming language developed in 1972 by Alain Colmerauer and Philippe Roussel, based on Robert Kowalski's procedural interpretation of Horn clauses (Sterling & Shapiro 1994). In Prolog, a rule is a

predicate expression that uses logical implication (:-) to describe a relationship among facts (Ford, 1989). A Prolog rule takes the form:

love (romeo, X) :- like (X, music)

According to this rule, Romeo loves all people who like music.

A rule-based expert system consists of three important elements (Kreutzer & McKenzie, 1991):

- Set of Facts: assertions or anything relevant to the beginning state of the system;
- Set of Rules: lists all the actions that should be taken within the scope of a particular problem, and specifies how to act on the assertion set;
- Production system interpreter: determines whether or not a solution exists, as well as when to terminate the process.

Nowadays, neural networks and machine learning are improving the capabilities of a machine to solve problems, providing them with the ability to learn from large datasets. Neural networks have revolutionized many domains such as image recognition, speech recognition, speech synthesis, and knowledge discovery (Alber et al., 2019; LeCun, Bengio, & Hinto 2015). Recently, thanks to advances in research, neural networks are increasingly being used in practical applications and critical decision-making processes, particularly in the fields of autonomous driving and medical imaging analysis. However, even though in certain applications the decision-making process underlying a neural network solution should be clear, they are treated as black boxes because their complex internal workings and the basis for their predictions are not fully understood.

Moreover, machine and human perception differ, as does their representation of experience and the generalizations they draw from that experience. Rudolf Arnheim, the art and film theorist and perceptual psychologist, sustained that one accesses reality only through the senses. As such, a person's first accessible generalizations about their experience in a given context will be represented visually before a unifying concept exist:

"Unless the image is organized in forms so simple that the mind can grasp them, it remains an incomprehensible, particular case. Only through the generalities in its appearance is the imaged thing seen as a kind of thing, and thus made understandable. In the arts, elementary and early images showed this conspicuously. The same is true for early models in science" (Arnheim, 1969, p. 274).

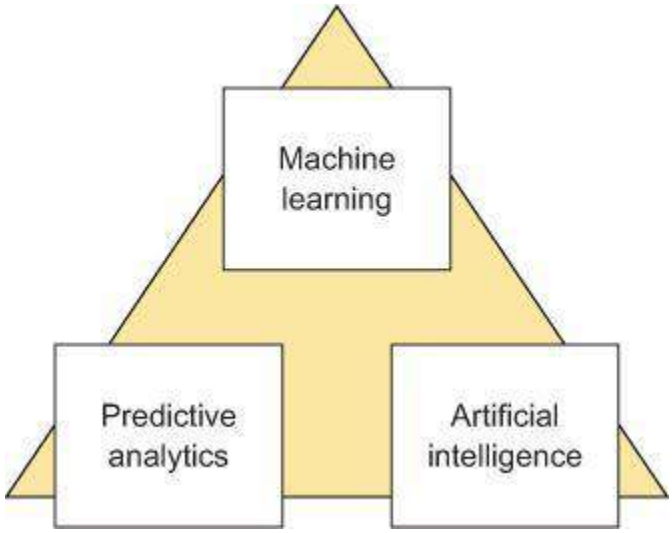
The book *Imagery* (1981) by Ned Block contains articles by cognitive psychologists, computer scientists, and philosophers discussing whether images are basically pictures in the head or are more like the

symbol structures in computers. Some of them argue that if the picture-in-the-head theorists are right, then computers will never be able to think like people.

Four decades later, following the disruptive advances of digital technology, other crucial questions essentially revolve around more technical aspects and concern the effectiveness of models and strategies for intelligent applications. They have to do with the design and implementation of intelligent algorithms and the practical applications of machine learning. Indeed, if intelligent applications aim to support human beings in performing high-level tasks, the issue of whether a machine can behave and represent perception like a human has scant importance.

2.3 Intelligent algorithms

Intelligent algorithms are sequences of well-defined instructions for tackling and solving a variety of challenging problems through AI.



The intelligent algorithm in machine learning

Nowadays, *algorithm* is a word that one hears used much more frequently than in the past. Newspapers write about algorithms used in connection to marketing, industry, and science.

Algorithms are employed for calculation, data processing, automated reasoning, analytics, and a myriad of applications that encompass every field of human life. They are transforming contemporary society; impacting the labour market, health-care, and human relationships:

“The profession of mail carrier is disappearing? Algorithms are destroying jobs. Does an insurance compensate the victim of an accident? A cynical algorithm computes the amount of the compensation. Does the stock market take a dive? Trading algorithms are responsible for the crash. Do laws restrict civil

liberties? Government algorithms are spying on us. Algorithms beat humans at chess and Go? Algorithms will soon govern us" (Abiteboul & Dowek, 2020, p. 1).

The recent progress of digital technology contradicts the claim that a computer does exactly what one wants it to do step by step. Intelligent algorithms based on artificial neural networks and hybrid AI approaches exhibit various levels of autonomy. An increasing number of programs and systems are able to perform high-level goals and determine how to achieve them with little or no human supervision. A growing research field is autonomous robots, and intelligent controls aimed to implement solutions to compensate for system failures without external interventions. Consequently, questions concerning the liability of smart autonomous robots and artificial intelligence programs are becoming topical (Barfield, 2018). In 2016, a motion for a European Parliament resolution was presented that called for the classification of robots as *electronic persons*:

"[…] at least the most sophisticated autonomous robots could be established as having the status of electronic persons with specific rights and obligations, including that of making good any damage they may cause, and applying electronic personality to cases where robots make smart autonomous decisions or otherwise interact with third parties independently" (Delvaux, 2016, p. 12).

It has to be noted that creativity has also been expressed in the development of new algorithms. In this regard, there are algorithms inspired by Swarm Intelligence (SI), which is defined as "*the emergent collective intelligence of groups of simple agents*" (Bonabeau, Theraulaz, & Dorigo, 1999, p. XI). Examples of SI include the group foraging of social insects, cooperative transportation, nest-building of social insects, and collective sorting and clustering (Ab Wahab, Nefti-Meziani, & Atyabi, 2015). Two fundamental concepts that are considered necessary properties of SI are self-organization and the division of labour. Self-organization is defined as the capability of a system to evolve its agents or components into a suitable form without any external help. The ant colony optimization (ACO) metaheuristic is considered a novel and up-and-coming research field that lies at the crossing between artificial life and operations research (Deng, Xu, & Zhao, 2019; Dorigo, Di Caro, & Gambardella, 1999; Kumar, Manogaran, Sundarasekar, Chilamkurti, & Varatharajan, 2018).

Key concepts

Intelligent algorithms: They are, in many cases, practical alternative techniques for tackling and solving a variety of challenging engineering problems (https://ep.jhu.edu/courses/525770-intelligent-algorithms/).

Artificial neural network: it is a computational model that consists of several processing elements that receive inputs and deliver outputs based on their predefined activation functions (https://www.sciencedirect.com/topics/earth-and-planetary-sciences/artificial-neural-network)**.**

Reflection

How is it possible that a machine acquires knowledge?

What do you think about the claim that a computer does exactly what one wants it to do step by step?

Additional resources

Holmes, W., Bialik, M., & Fadel, C. (2019). Artificial intelligence in education. *Boston: Center for Curriculum Redesign*. Available at: https://curriculumredesign.org/wp-content/uploads/AIED-Book-Excerpt-CCR.pdf

Roll, I., & Wylie, R. (2016). Evolution and revolution in artificial intelligence in education. *International Journal of Artificial Intelligence in Education*, *26*(2), 582-599. Available at: https://link.springer.com/content/pdf/10.1007/s40593-016-0110-3.pdf

Video materials

What Is Artificial Intelligence: https://www.youtube.com/watch?v=oV74Najm6Nc

Knowledge Representation in AI: https://www.youtube.com/watch?v=V-O-RFSRe-E

4.3 Can Machines Be Creative?

In the following paragraphs, the theme of machine creativity is dealt with. The main questions underlying this topic are shortly introduced, reporting and discussing the views of authors involved in Artificial Intelligence and mind psychology research.

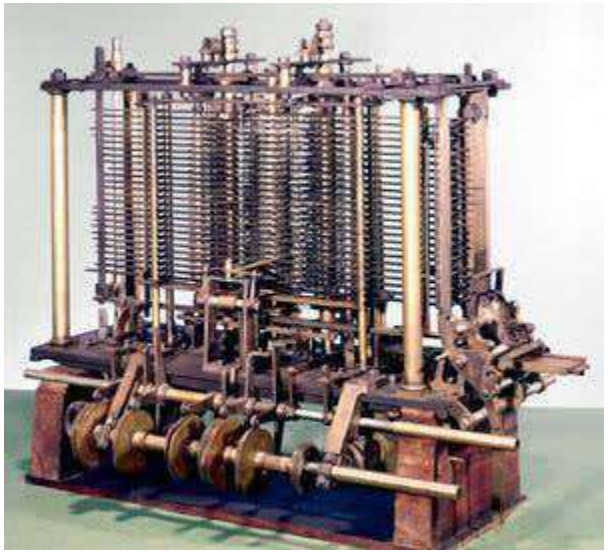
The main questions that emerged from the research on machine creativity concern machine autonomy and involved both technical and ethical problems. They are essentially related to machine control and interaction as well as solutions of full automation and machine' liability.

One can conclude that, in the past, Remington type-writers revolutionized the way people write. Today machine-content generators revolutionize the way to understand writing itself and, accordingly, the author's creativity.

3.1 The question of machine creativity

Ada Lovelace, the daughter of the famous poet Lord Byron, is counted as one of the first programmers on account of the algorithm she wrote for Babbage's *Analytical Engine* (Plant, 1997). In her honour, *ADA* a programming language developed at the end of the 1970s by the *U.S. Defense Department* was named after her. Ada Lovelace expressed her ideas about programmable machines in *Note G* to the English translation of Babbage's lectures transcribed by the Italian Luigi Menabrea:

"It is desirable to guard against the possibility of exaggerated ideas that might arise as to the powers of the Analytical Engine. In considering any new subject, there is frequently a tendency, first, to overrate what we find to be already interesting or remarkable; and, secondly, by a sort of natural reaction, to undervalue the true state of the case, when we do discover that our notions have surpassed those that were really tenable. The Analytical Engine has no pretensions whatever to originate anything. It can do whatever we know how to order it to perform. It can follow analysis, but it has no power of anticipating any analytical relations or truths. Its province is to assist us in making available what we are already acquainted with. This is calculated to effect primarily and chiefly of course, through its executive faculties; but it is likely to exert an indirect and reciprocal influence on science itself in another manner. For, in so distributing and combining the truths and the formula of analysis, that they may become most easily and rapidly amenable to the mechanical combinations of the engine, the relations and the nature of many subjects in that science are necessarily thrown into a new light, and more profoundly investigated" (Toole, 1991, p. 68).



The Babbage's Analytical engine

She sustained two broad principles that were, for a long time, generally accepted among engineers and computer programmers:

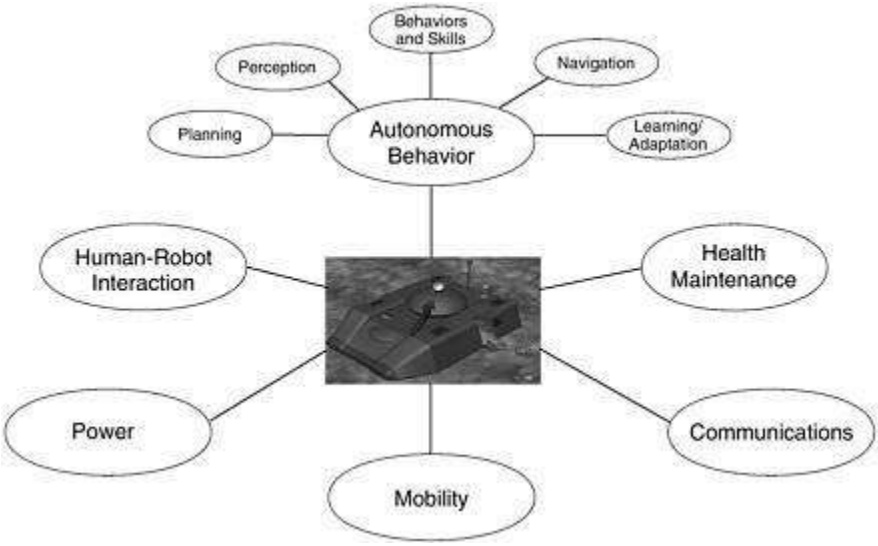
1. A machine can do whatever we know how to order it to perform.
2. A machine can follow the programmer's instructions but has no power to produce anything autonomously.

These two principles seem to reflect common sense: if a machine is programmed it is not autonomous and, accordingly, its behaviour necessarily depends on the programmer who writes the program. Times have changed, however, and with the progress made, such reasoning does not consider an increasingly relevant possibility: can a machine be programmed to have autonomous behaviour? To respond to this, clearly, one must define, in operational terms, what autonomous behaviour is. In other words, what necessarily identifies a behaviour as autonomous?

3.2 Autonomous behaviour

In psychology, autonomous behaviour refers to self-government and responsible control for actions. Autonomy includes behavioural, emotional, and cognitive self-government, and is essentially the capacity to make free choices.

Nowadays, autonomous vehicles are an example of machine autonomy (Schwarting, Alonso-Mora, & Rus, 2018; Wiseman, 2021). Nevertheless, can one consider an autonomous vehicle to be self-directed? And what about the responsibility of a machine? Does the line by Richard L. Gregory (1981, p. 74), that "Machines are seen as free of moral culpability as they are not self-directed, though they can, of course, be instruments for good or ill", still hold true?



This is indeed an intricate and still open question of social ethics (Bonnefon, Shariff, & Rahwan, 2016). What, for instance, should the ethical requirements be, for algorithms implemented into autonomous vehicles for supporting decision-making, in the event of a critical situation such as, in an extreme case, an impending accident in which either the car's occupants or one or more pedestrians must be sacrificed?

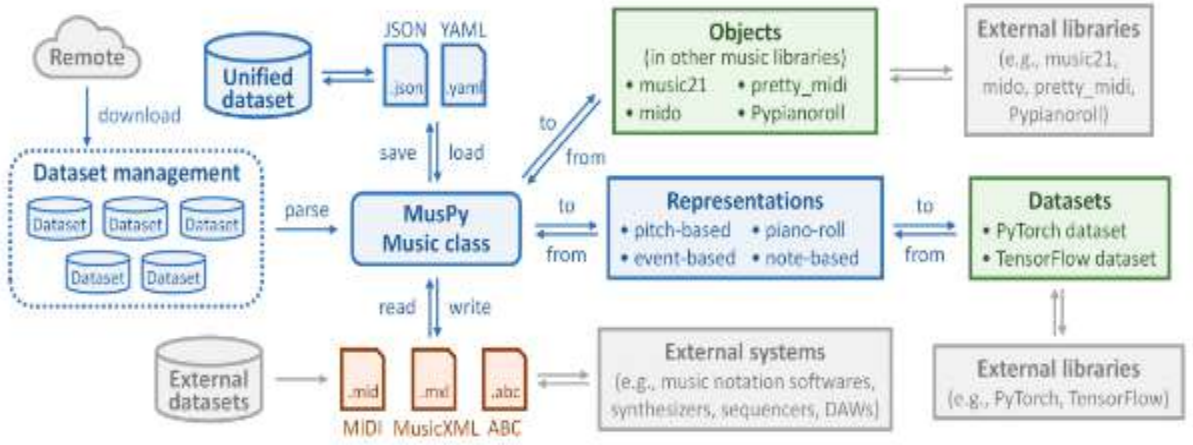
Although the question of whether a machine can be creative does not pose any similar ethical dilemmas, it is no less difficult to answer. As such, to consider the topic of machine creativity, it is useful to first address the old problem of machine intelligence. This is because, as the previous chapters have illustrated, psychologists generally consider creativity and intelligence to be strictly related. Moreover, it will also be necessary to tackle the problems of knowledge acquisition and knowledge representations. These problems are crucial in AI.

3.3 Machine creativity

Briefly taking note of some recent AI applications could be a helpful way to introduce machine creativity. Two of these, Magenta and MusPy, have been implemented in the music scope.

Magenta is an open-source research project exploring the role of machine learning in the process of creating art and music (https://magenta.tensorflow.org/). The primary aim of the Magenta project is to develop deep learning algorithms for generating songs, images, drawings, and other materials (Kayacik et al., 2019; Yu & Ding, 2020). It was also foreseen to provide artists and musicians with tools and interfaces to extend (not replace!) their processes using AI. Magenta was started by some researchers and engineers from the Google Brain team, but many others have since contributed significantly to the project. Magenta is based on TensorFlow, an open-source end-to-end platform that allows users to build and deploy machine learning applications.

MusPy is an open-source Python library for symbolic music generation. MusPy provides easy-to-use tools for essential components in a music generation system, including dataset management, data I/O, data pre-processing, and model evaluation (Dong, Chen, McAuley, & Berg-Kirkpatrick, 2020). The system diagram of the MusPy shows its complexity due to the several components involved.



The system diagram of MusPy (source: Dong, Chen, McAuley, & Berg-Kirkpatrick, 2020)

Research on computer-generated literature is another emergent field in which machine creativity is investigated. The idea of a machine producing poems deconstructs some of the most traditional understandings of poetry as an emotional expression that comes from inspiration (Pereira & Maciel, 2017). Literary text generated by computers is grounded in the assumption that language can be viewed as an algorithmic phenomenon, as Structural Linguistics, Generative Grammar, and Computational Linguistics propose. According to these approaches, a set of associative and restrictive principles (the grammar) provide the foundational setting for every language.

Tools for producing software-generated poems are not new (Manzhos, 2014). The most recent tools, however, allow users to interact with the system, as in Hitch Haiku and its developments (Tosa, Obara, & Minoh, 2008). Others use Word Associations Norms, such as Gaiku (Netzer, Gabay, Goldberg, & Elhadad, 2009). Haiku Generator is a system programmed in Flash that automatically generates Japanese *haiku* and *tanka* verses whenever a user clicks the refresh button. The system does so through a series of algorithms that rule the combination of words from those registered in its database. These words are categorized according to their respective parts of speech. The initial step, taken by the software after the user's click, is the random selection of a syntactic structure for each verse (of which there are 3 in a haiku and 5 in a tanka). Although the software initially works with a predefined set of basic sentence patterns, the user can also enrich them as long as they have some knowledge of Linguistics and Flash. The Haiku generator has been used to read blogs and illustrate them with sound and images (Rzepka & Araki, 2015).

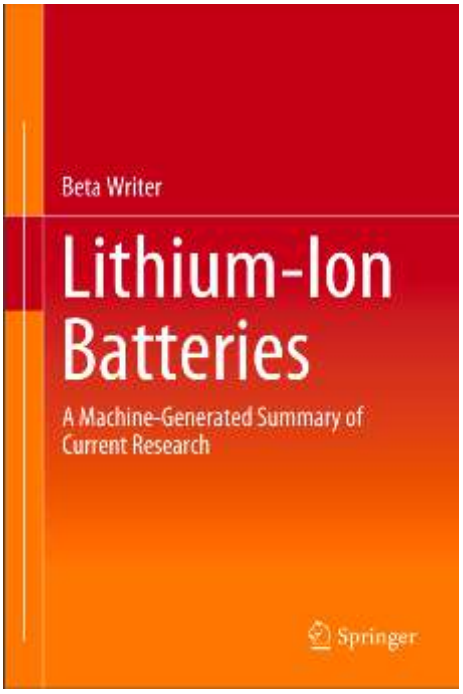
The most outstanding results in machine creativity, however, have been achieved in automatic text generation. Recently, *natural language generation* platforms have been revolutionizing journalism.

These platforms such as *Wordsmith* by Automated Insights and *Heliograf*, the AI writer of the Washington Post, can automatically generate journalistic content in an incredibly short time, but natural language generation platforms are not limited to generating journalistic content alone. One of them has been experimented with in scientific publishing.

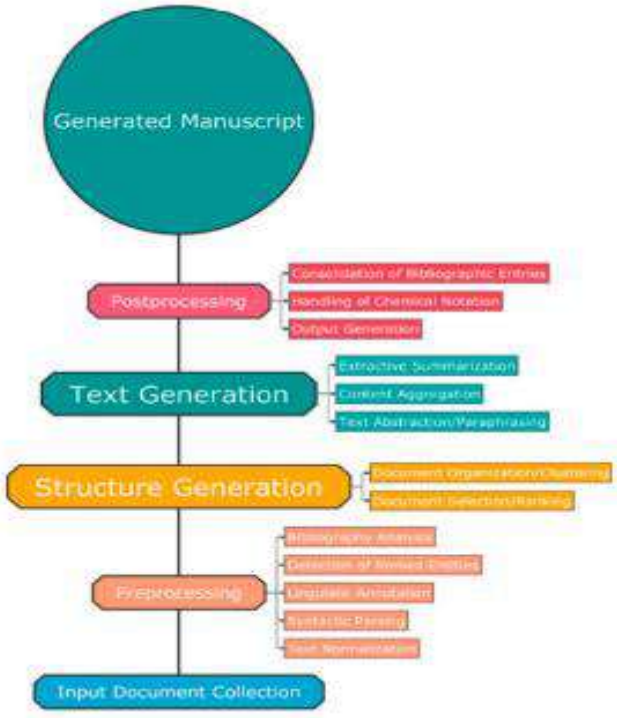
In 2019, the first machine-generated scientific book was published by Springer Nature. The *Lithium-Ion Batteries: A Machine-Generated Summary of Current Research* is a book of 278 pages produced by a non-human author named Beta Writer (Writer, 2019). It is the result of a collaboration between computer scientists and editorial subject-matter experts at Springer Nature and Goethe University Frankfurt in Germany. In the book's preface, Christian Chiarcos and Niko Schenk explain that Beta Writer combines two subfields of artificial intelligence: natural language processing and machine learning. They claim:

“This book about Lithium-Ion Batteries has the potential to start a new era in scientific publishing. With the exception of this preface, it has been created by an algorithm based on a re-combined accumulation and summarization of relevant content in the area of Chemistry and Materials Science. The book is a cross-corpora auto-summarization of current texts from Springer Nature’s content platform “SpringerLink”, organized using a similarity-based clustering routine in coherent chapters and sections. It automatically condenses a v large set of papers into a reasonably short book. This method allows readers to speed up the literature digestion process of a given field of research instead of reading through hundreds of published articles. At the same time, if needed, readers are always able to identify and click through to the underlying original source in order to dig deeper and further explore the subject. It can assist anyone who, for example, has to write a literature survey or requires a quick start on the topic. This book proposes one solution (out of many others) to the problem of managing information overload efficiently” (Writer, 2019, pp. v-vi).

Figures below show, respectively, the book’s cover and the book generation flow.



The cover of the Beta Writer book (own source)



Book generation system pipeline and Natural Language Processing components (source: Writer, 2019, p. xii).

In the above examples, can one recognize machine creativity? Can one assume that a machine behaves creatively if it generates music, poems, journalistic reports, and scientific reviews?

What is astonishing and fascinating is that computers cannot appreciate poetry and music, but they can produce artefacts. Moreover, they are able to evaluate the quality of artefacts based on criteria given by art experts or derived from analysing data available on the web.

One can conclude that, just as in the past, Remington typewriters revolutionized the way people write, today machine-content generators are revolutionizing the way of understanding writing itself.

Key concepts

Autonomous vehicles: self-guided vehicles that are expected to be able to circulate on the road without any intervention from a human driver.

Heliograf: The Washington Post developed Heliograf to enhance storytelling for large-scale, data-driven coverage of major news events. The technology was first introduced during the 2016 Rio Olympics to assist journalists with reporting the results of medal events (https://www.washingtonpost.com/pr/2020/10/13/washington-post-debut-ai-powered-audio-updates-2020-election-results/).

Open-source software: software that is freely distributed with its source code, making it available for use, modification, and distribution with its original copyright.

Reflection

What is your opinion about machine creativity?

What is the future of autonomous vehicles?

Additional resources

Fujita, M., Kuroki, Y., Ishida, T., & Doi, T. T. (2003, October). Autonomous behaviour control architecture of entertainment humanoid robot SDR-4X. In Proceedings 2003 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2003) (Cat. No. 03CH37453) (Vol. 1, pp. 960-967). IEEE. Available at: https://ieeexplore.ieee.org/abstract/document/1250752

Smakman, M., Vogt, P., & Konijn, E. A. (2021). Moral considerations on social robots in education: A multi-stakeholder perspective. Computers & Education, 174, 104317. Available at: https://www.sciencedirect.com/science/article/pii/S0360131521001949

Video materials

Machine Creativity: https://www.youtube.com/watch?v=QNsylEE34kM

Making Machines Creative: https://www.youtube.com/watch?v=LEIq_iXH9wI

4.4 Machines vs Humans: The Singularity

Turing predicted that by the year 2000, technological progress would produce a computer extraordinarily powerful enough that a program would be able to fool the average evaluator for 5 minutes on about 70% of occasions:

"I believe that in about fifty years it will be possible, to programme computers, with a storage capacity of about 10^9, to make them play the imitation game so well that an average interrogator will not have more than 70 per cent chance of making the right identification after five minutes of questioning. […] I believe that at the end of the century the use of words and general educated opinion will have altered so much that one will be able to speak of machines thinking without expecting to be contradicted" (Turing, 1950, p. 442).

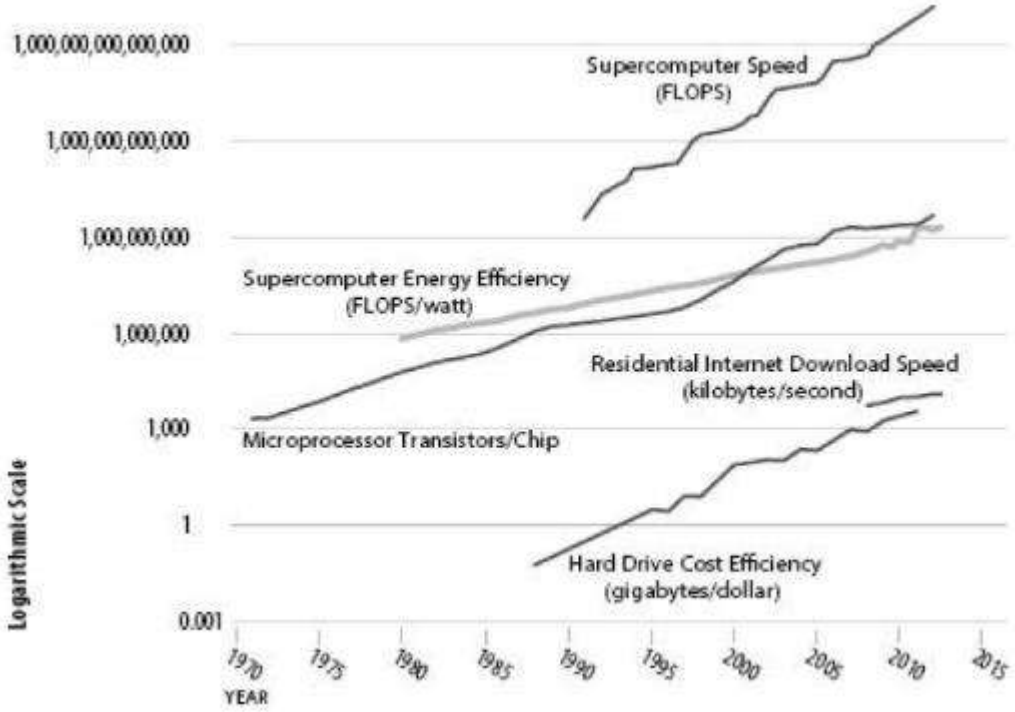
The year 2000 has come and gone but the questions remain: Can machines replicate human beings? and Will machines surpass human beings' capabilities?

In the last thirty years, information technology has opened new important fields of research and application, integrating different scientific domains and developing solutions in all sectors of human activity. Great advances have been made in biometrics, biosensors, the so-called cognitive prostheses, and the development of cyborgs, while great expectations are placed on the development of *immersive computing*, neural computing, and quantum computing. The pace of the development of digital technologies appears unprecedented and unstoppable, to such a degree that many authors have openly wondered about the possibility that human beings could end up losing control over the very technologies we ourselves are producing.

4.4.1 The Moore's law

Based on his observations of computer hardware development, in 1965 Gordon Moore, the director of the research and development centre of Fairchild Semiconductor, formulated an empirical law according to which the power of integrated circuits would double every year, while their cost, in the same period, would halve. His was a linear prediction with a positive derivative for computing power and a negative

derivative for cost. In subsequent years, Moore revised his law, referring it to a period of eighteen months rather than twelve. This law was confirmed until 2015.



Graphic representation of Moore's law for the period 1970-2015 (source: Brynjolfsson & McAfee, 2014, p. 16).

In recent years, some digital technology manufacturers have declared Moore's Law to be no longer valid, since the exponential progress of hardware would mean it ceased to be economically viable (Tibken, 2019). However, new formulas on the exponential development of digital technologies have been advanced, taking into account other parameters (Batra, Jacobson, Madhav, Queirolo, & Santhanam, 2018). Moore's law was used to support the so-called *technological singularity*, according to which the exponential development of digital technologies will lead humans to lose their control over them, with the idea that there is a definite point of no return in technological progress, also referred to in terms of the "overcoming of the other half of the chessboard". This expression draws on the famous story of the bored Indian prince and the reward he agreed to pay the inventor of the game of chess. The story goes that, in the beginning, the reward requested by the inventor appeared to the prince to be relatively modest:

- a grain of rice for the first square of the chessboard,
- two grains of rice for the second square,

- four grains of rice for the third, with a continuous doubling for the remaining 61 squares.

By the time the calculation for the amount of rice due reached the middle of the chessboard it had become clear that it would be impossible to obtain enough rice to satisfy the commitment (2^{64}), and the prince ordered the inventor's execution.

Vernor Vinge introduced the theory of technological singularity in 1993 on the occasion of *Vision-21 Interdisciplinary Science and Engineering in the Era of Cyberspace*. At this conference, Vinge claimed that a change was coming that was comparable to the birth of human life on Earth. This change would be brought about by the imminent creation of artificial entities with an intelligence superior to that of humans. The author defined this change as *a singularity*, or rather, *the Singularity*. He was confident that it would happen because there were numerous means by which science could achieve it:

- the development of super-intelligent computers;
- the presence of large and powerful computer networks;
- the existence of human-machine interfaces able to transform human beings into super-intelligent beings;
- advances in the field of biology that can increase human intellectual abilities.

Ray Kurzweil, an American inventor and futurologist, and author of *The Singularity Is Near: When Humans Transcend Biology*, is one of the best-known advocates of technological singularity. The author describes The Singularity as the result of a combination of three critical 21st-century technologies: genetics, nanotechnology, and robotics (which also includes artificial intelligence). In his book, he enunciated four postulates:

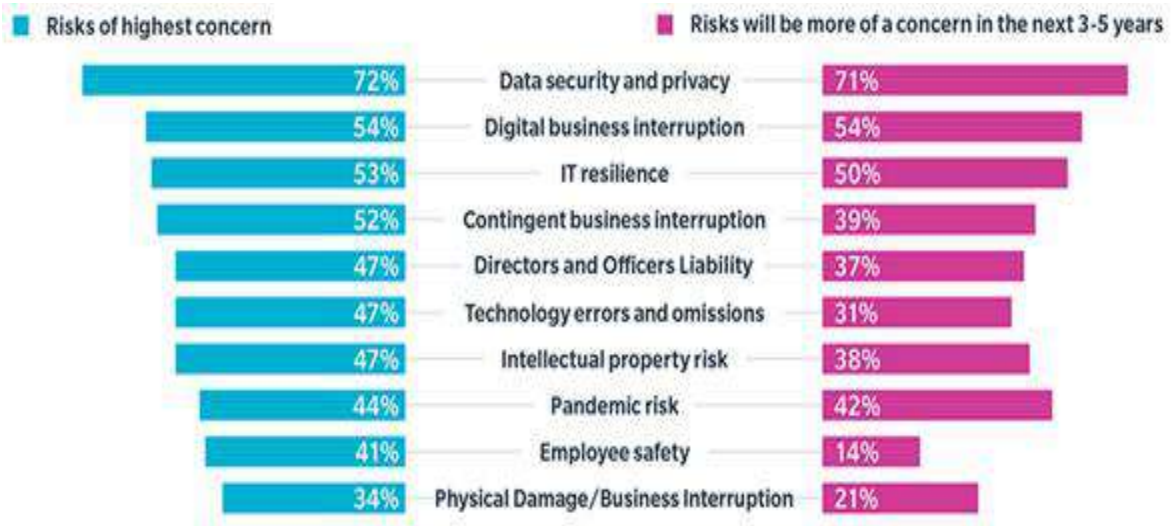
1. Singularity is a point/goal that humanity can reach.
2. Technology is progressing towards singularity according to an exponential trend.
3. The functionalities of the human brain are quantifiable in terms of technologies available in the near future.
4. Advances in medicine have lengthened human life by making possible the developments necessary to surpass the capabilities of their brains.

4.4.2 Social challenges of digital technology

The techno-pessimists argue that technological advances will have a critical impact on the labour market, at least in the short term. They underline that, over the last few years, automation processes have begun substituting the jobs of many manual workers, as well as those of bookkeepers, cashiers, and telephone operators. The techno-optimists, on the contrary, claim that technology will soon bring economic growth. Some economists talk about secular stagnation, a term coined by Alvin Hansen in

1938, forecasting a situation of persistent shortfalls in demand and wage squeezing (Krugman, 2014). They believe that new technology can lead to a temporary fall in productivity due to the reorganization of workers' competence. Brynjolfsson and McAfee (2014) emphasized that, to take advantage of the fourth industrial revolution's opportunity, it is necessary to understand the critical impact that this revolution will have on society. Accordingly, an effort is required to recognize and deal with new social challenges facing people and organizations, and investment must be made in analysing the seriousness of the risks that are intrinsic in the extended use of intelligent systems in the social sphere and industrial production processes (Marzano, Grewinsky, Kawa, & Lizut, 2020). From this perspective, the loss of traditional jobs and the reorganization of workers' competence, although crucial aspects in themselves, are only one part of the issue. A hugely critical issue concerns internet-based participation. This can hide the risks of new forms of tyranny developing based on the consensus obtained through social media. E-democracy, e-participation, and virtual decision-making (Hennen, Van Keulen, Korthagen, Aichholzer, Lindner, & Nielsen, 2020) open a question about responsibility. What is the responsibility of decision-makers in crowd-based participatory processes? They could shift blame by transferring responsibility for a problematic decision to the crowd. Taking inspiration from the famous book "Escape from freedom" by Fromm (1941), the problem could be reformulated as one of "escape from responsibility." Another problem arises with the drive towards full automation. It might not be wise to automate tasks just because it is possible to do so. Indeed, there are problems with machine control and interaction that are connected with full automation. Moreover, interactions of humans with machines and intelligent programs bring new, possibly unforeseen, social risks that research should urgently address.

Figure below shows the top 10 risks for technology companies in 2021:



Source: https://www.marsh.com/pr/en/migrated-articles/tech-risk-study.html

4.4.3 The irony of automation and the human-centred approach to automation

The irony of automation argues that, in an automated system, there are always some circumstances that are not expected. An automated system is designed to handle only things that have been predicted. Design constraints limit even intelligent systems based on a machine learning approach. Discussing how automation of industrial processes may expand rather than eliminate problems with the human operator, Bainbridge introduced the concept of the irony of automation: The important ironies of the classic approach to automation lie in the expectations of the system designers, and in the nature of the tasks left for the human operators to carry out. The designer's view of the human operator may be that the operator is unreliable and inefficient, so should be eliminated from the system. The above attitude of the automation designers is still diffused. They do not understand that automated systems should be designed to support human beings. Accordingly, they should reduce the human workload but not eliminate human intervention. However, if a designer is asked to design only some complex system's elementary functions, the designer task is completed when these functions work. Nevertheless, in a complex system, pieces of hardware and software are interconnected and depend on other hardware and software pieces. Consequently, integrated control and feedback are needed since unexpected events can occur in any complex system (Ladyman, Lambert, & Wiesner, 2013). Moreover, according to Sebok & Wickens (2017) many types of automation failures, including software bugs and hardware failures, lie in how automation performs as the designer intended but not as the user intended. Analysing and discussing the still unresolved ironies of automation, Strauch (2017) observes that to solve them, one must recognize them. In this regard, the author claims that the way to do it is necessary that system designers, trainers, managers, and regulators work together to address the potential adverse effects of automation.

Human-centred automation is automation whose purpose is not necessarily to automate all manual functions, but rather to enhance user effectiveness and reduce errors. In 1992, Sharidan identified 10 degrees of automation that should be considered in supervisory control. These degrees, which remain a landmark in current research on autonomous controlling, are shown in Table 1.

TABLE 1 SCALE OF DEGREES OF AUTOMATION (SOURCE: SHERIDAN, 1992, P. 358)

1.	The computer offers no assistance, human must do it all.
2.	The computer offers a complete set of action alternatives, and
3.	narrows the selection down to a few, or
4.	suggests one, and
5.	executes that suggestion if the human approves, or
6.	allows the human a restricted time to veto before automatic execution, or
7.	executes automatically, then necessarily informs the human, or
8.	informs him after execution only if the asks, or
9.	informs him after execution if it, the computer, decides to.
10.	The computer decides everything and acts autonomously, ignoring the human.

It has been underlined that one test of whether a proposed piece of automation is human-centred is to pose the question: "Does it enhance user effectiveness?" (Mitchell, 1996). Of course, if the answer is yes, the onus is on the designer to demonstrate how. The analysis of issues particularly relevant in urban operations and chemical/biological incident responses suggests that the effects of technological change should be previously understood before introducing robot systems into an existing workplace (Woods, Tittle, Feil, & Roesler, 2004). In this regard, Murphy's Law is often quoted, which states that: "any deployment of robotic systems will fall short of the target level of autonomy, creating or exacerbating a shortfall in mechanisms for coordination with human problem holders" (Woods, Tittle, Feil, & Roesler, 2004, p. 1). Accordingly, the human-centred automation design should consider that intelligent human and machine agents must be combined appropriately. One should not forget that machine agents are knowledge-based software objects with both strengths and weaknesses. They are expected to act in timely and consistent ways but have very fragile and domain-limited knowledge. They may be unable to behave reliably when an unpredicted or anomalous event occurs. Human agents should be responsible for identifying and compensating for the limitations of the machine agents. In designing an automated system, a way should always be provided to allow the user to intervene and take control of the system. It is also essential that automation design supports the operator's awareness of both the current system state as well as the states of the machine agents so as to ensure that the two sets of agents are operating in complementary mode. Coordinating and integrating the interaction between humans and machines is not a speculative philosophical question. It encompasses technical problems that lie in the realm of human-robot coordination, human-centred artificial intelligence, and Digital Social Innovation

(Karajz, 2021). A paradox has been recognized in designing human-centred automotive automation systems. It goes beyond the specific field of application: "Trust in and understanding automation can be a vicious cycle. On the one hand, humans may not be able to fully understand an automation system until they can develop a certain level of trust in the system to reach their goal. On the other hand, the more humans understand the automation system, the more they can develop an appropriate trust system." Muslim, H., & Itoh, M. (2019). Finally, according to Shneiderman, "an important research direction is to develop objective measures of the levels of control and autonomy, tied to diverse tasks. Such measures would stimulate more meaningful design discussions, which would lead to improved guidelines, evaluations, and theories" (Shneiderman, 2020, p. 499).

Key concepts

Turing test: it is a method of inquiry in artificial intelligence (AI) for determining whether or not a computer is capable of thinking like a human being (https://www.techtarget.com/searchenterpriseai/definition/Turing-test#:~:text=The%20Turing%20Test%20is%20a,thinking%20like%20a%20human%20being.&text=Turing%20proposed%20that%20a%20computer,human%20responses%20under%20specific%20conditions.)

Singularity: in technology, the singularity describes a hypothetical future where technology growth is out of control and irreversible. These intelligent and powerful technologies will radically and unpredictably transform our reality (https://www.techtarget.com/searchenterpriseai/definition/Singularity-the)

Reflection

Is the singularity coming?

What are the main risks of automation?

Additional resources

Bainbridge, L. (1983). Ironies of automation. In *Analysis, design and evaluation of man-machine systems* (pp. 129-135). Pergamon. Available at: https://maritimesafetyinnovationlab.org/wp-content/uploads/2020/06/Ironies-of-Automation-Bainbridge-1983.pdf

Chalmers, D. (2009). The singularity: A philosophical analysis. *Science fiction and philosophy: From time travel to superintelligence*, 171-224. Available at: https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.228.3745&rep=rep1&type=pdf

Video materials

The Path to The Singularity: https://www.youtube.com/watch?v=RFTGTUNiq1A

Impacts and risks of digital technology on society: https://www.youtube.com/watch?v=ZIrH1361n9w

4.5 Assessment

1) The standard definition of creativity states that:
   a) creativity consists in effectiveness and originality
   b) originality and novelty
   c) innovation and originality

2) Machine learning is
   a) the way to use machines to learn
   b) a branch of artificial intelligence
   c) a method of understanding automation

3) Computer-generated literature
   a) consists in the literature about computers and automation
   b) is an emergent field in which machine creativity is investigated
   c) is a form of human-centred automation

4) In psychology, autonomous behaviour refers to
   a) the capability of a machine to be creative
   b) the concept of Singularity
   c) self-government and responsible control for actions

5) The Analytical engine was invented by
   a) Steve Jobs
   b) Bill Gates
   c) Charles Babbage

6) Artificial Intelligence engineers claim that knowledge is:
   a) a human capability
   b) something related to common sense
   c) something that could be distilled by human experts

7) Who did introduce the concept of the irony of automation?
   a) Gordon Moore
   b) Bill Gates
   c) Lisanne Bainbridge

Module 5. Pedagogical use of the arts

Author: Helena AREVALO MARTINEZ

Learning Objectives

Upon completion of this Learning Unit, trainees will be able to:

- Identify the concept of creativity, as well as the types, techniques and applications, in order to provide theoretical and practical elements to develop creativity
- Recognize the characteristics of this concept
- Acquire techniques for the development of creative thinking skills
- Distinguish different types of digital art
- Apply the pedagogical use of the different types of digital art
- Learn about the importance of digitalization in social environments

Introduction

Arts education is an area of pedagogical intervention that must be considered as a general area of popular education. It is important to maintain this precision and identification for arts education because its defence and foundation contribute to the formation among education professionals of criteria for the arts as an educational value and as a field of pedagogical knowledge. This knowledge guarantees not only the possibility to carry out the intervention considering the conditions of formal, non-formal and informal processes, but also the possibility to create pedagogical facts and decisions and exercise the pedagogical function in a technoaxiological and mesoaxiological sense because we must build the arts as a field of education.

On the other hand, arts education as a field of experience is a field that is distinguished from other areas of experience by its specific cultural content and, like any other general field of education constructed in relation to another field of experience, can be treated not only as a field of general education but also as a field of vocational education and professional development. In this sense, just as we speak, for example, of physical education as an integral part of general education and as a unique form of vocational education leading to a professional career, we can also speak of music, dance, theatre, painting, film-the arts-as integral parts of general education and as unique forms of vocational and professional development.

The arts must be integrated into education in order for the meaning of "education" to fully develop. The holistic development of the educator requires providing "meaningful opportunities to experience and learn to use the arts in ways that lead to a life worth living" (Eisner, 1992, p. 33). From the perspective of constructing educational environments, developing the arts as an educational environment requires understanding and distinguishing three possible meanings for arts education, independent of artistic manifestation, and which make it significant in the relationship between arts and education, namely as an educational experience, as an artistic educational experience, and as a professional and vocational educational experience (Touriñán, 2011b):

1. The arts as a general field of education that, by virtue of experience and artistic expression, provides educational values like any other subject or content of experiential fields that realise the character and meaning inherent in the meaning of education (this is what art education has in common with the education of any other field of education).
2. Art as a field of general education, that is, as a field that belongs to the basic artistic education of students and develops the aesthetic and artistic sense through the content and forms of expression peculiar to it and the understanding of the development of artistic culture, so that it contributes to developing our aesthetic and artistic sense and our ability to be critical viewers and beginning realizers of artistic activities and objects (this is what is peculiar and specific to art education as part of the basic and general education of each student).
3. Art as a field of professional and vocational development that provides theoretical, technological and practical knowledge about the artistic experience that is knowable, teachable, explorable and realisable (this is the specific education that applies to artistic, vocational and professional education).

Source: https://teachonline.ca

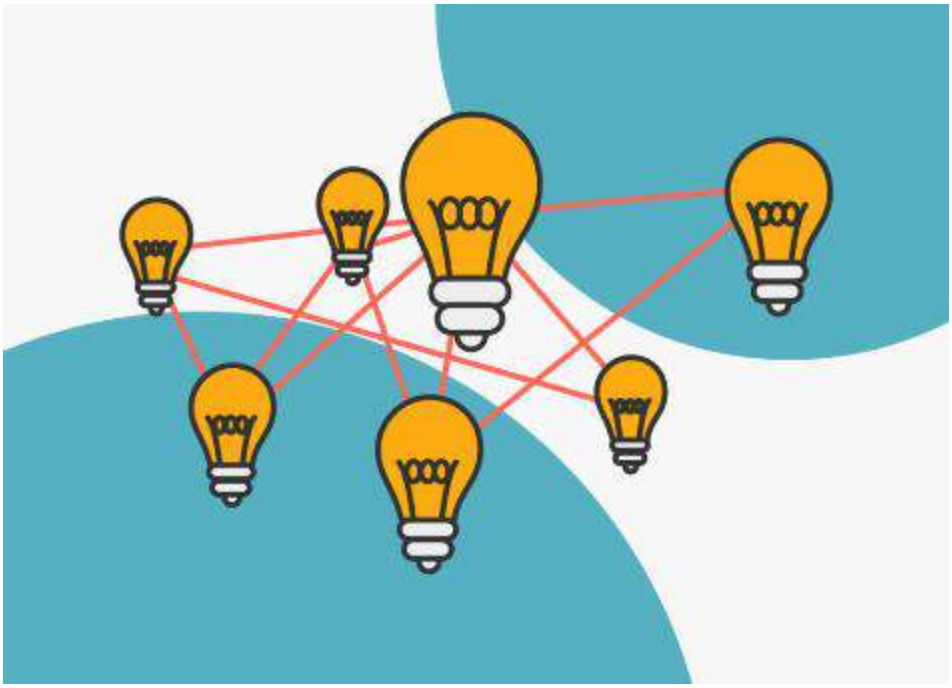
Educating with the arts, which are a cultural domain, is not a problem of exclusive knowledge of the arts, nor of didactics of the arts, or of cognitive pedagogy that allows us to improve our way of knowing. Educating with the arts means using the arts to develop them as a general field of education, a field of general education, and a field of professional education:

- To use the arts to create in students values associated with the character and meaning of education.
- To use the arts to develop in students skills, habits, attitudes, knowledge and competencies that enable them to decide and realise their personal life projects and to educate themselves,
- To use the arts to develop our aesthetic and artistic sense and our ability to be critical viewers and budding creators of artistic activities and objects.
- To use the arts as a theoretical-technological and practical domain, knowable, teachable, explorable and practicable, in which we can acquire the competence to create artistic objects, using the appropriate forms of expression and instruments, with professional sense and, if that were our work goal, with professional sense.

5.1 Creativity - Concept, characteristics and how to enhance it

The importance of creativity in society is undeniable. Some authors even claim that creativity is "essential for human progress" (López-Fernández, 2015, p. 40). Its importance lies, among other things, in the fact that it promotes adaptation to the context, facilitates the transition to action, avoids learned helplessness, is related to subjective well-being, etc. Therefore, knowledge of creativity and its properties will help us to promote it in different contexts (including educational) in order to optimize our students' learning. Admittedly, the construct is complex, and although there is still much to be clarified in this regard, steps are being taken toward a more concrete approach to its conceptualization.

We understand creativity as the ability of people to generate new, original, and innovative ideas depending on their context. This definition refers to the fact that in a creative atmosphere it is possible to create novel products of great social value and, in conveying them, to transcend for certain moments the historical and social context in which we live. For this reason, creativity requires the interaction of our abilities and our higher processes, as well as the environment in which it is exercised, which must be stimulating for its development (Castillo et al., 2017).



In addition to this definition, the main definitions in the scientific literature understand creativity as the ease of finding new solutions to individual problems, as well as the ability to discover something new, to think differently than before or in an unconventional way (Gonen-Yaacovi et al., 2016). As well as the ability of people to develop original ideas that propose new materials in a particular social context (Rodríguez-Muñoz, 2011, p.46) or show the ability to solve all kinds of problems (Vecina, 2006). Therefore, it is important to emphasise that creativity results from the interaction of a variety of skills, processes and contexts through which a product is created individually or in a group that is also useful and novel within a social context (Runco and Jaeguer, 2012).

Having said all that has been said so far, the complexity of the construct does not go unnoticed, which is not only related to the artistic, as there is no doubt that creativity extends to all facets of daily life, combining cognitive, emotional, social and motivational elements.

Characteristics

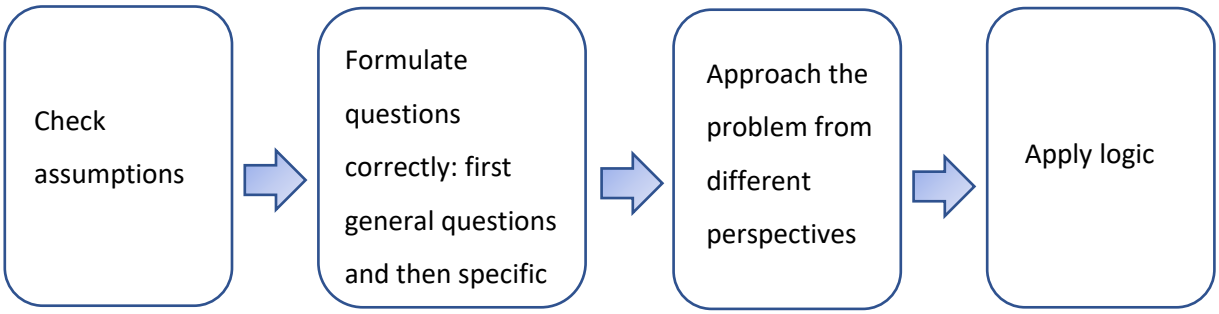
When we talk about the characteristics of creative thinking, there is a clear consensus among several experts in the field, who make it clear that creativity is related to the characteristics of fluency, flexibility, originality and elaboration.

López-Martínez and Navarro-Lozano (2015) define each characteristic as follows:

- Fluency (number of ideas).

- Elaboration (number of details contributed to the proposal).
- Originality (which evaluates the novelty of the proposal compared to the expected responses).
- Flexibility (referring to the variety of types of ideas or categories elaborated).

It is also important to point out that creativity, which can be learned and is so important in life, is also essential in education. Although we are all creative from birth, some more than others, creativity and creative thinking can be learned/trained to improve them, just as we learn other skills. To do this, it is necessary to keep an open mind and work on putting some basic elements of creative thinking into practice:



Techniques for the development of creative thinking skills

Below we highlight some relevant and effective keys and techniques used in various educational contexts for developing creative thinking skills and creativity:

Guilford argues that the best way to develop creativity is to improve all the functions that take place in the creative process and to optimize resources.

Nickerson, Perkins, and Smith point to the need to foster attitudes toward creativity and the cognitive styles characteristic of creativity, while teaching effective techniques and strategies to promote creativity.

Klausmeier advocates working on the following aspects:

- Context: a classroom atmosphere that stimulates creative thinking should be fostered.
- Obstacles or blockages: Working to remove blocks fosters fluency, flexibility, and originality.
- The characteristics and skills of creative people, developing interests in aesthetics and culture, exploring new places and activities, or developing unconscious creativity.
- To learn strategies and techniques that facilitate the emergence of the phases of the educational process by working on the same through activities; something to be realized especially in secondary education.

According to Muñoz (1994), an educational context for creativity must:

- Encourage curiosity.
- Encourage evaluation of one's own work and ideas.
- Promote autonomous learning.
- Promote a climate in which freedom is a prerequisite.
- Encourage communication.
- Encourage expression of feelings.
- Encourage flexible thinking.
- Encourage questioning.
- Encourage holistic thinking.
- Postpone snap judgments.

Klausmeier suggests that the teacher should ensure that:

- Klausmeier suggests that the teacher should ensure that: o Provide students with learning materials and forms of expression that take into account the fluidity, originality, and flexibility of creative thinking.
- Achieve a positive attitude toward creativity among their students.
- Make students open-minded and receptive to other ideas.
- Encourage students to express their creativity spontaneously.
- To encourage creative productivity.
- To offer support in problem-solving from a creative perspective and feedback in the form of constructive criticism.

In addition, the teacher must change his/her teaching style (Esquivias, 2004; Bravo, 2009; Menchén-Bellón, 2012) to:

- Generate more ideas about each situation.
- Provide more freedom to express ideas.
- Use all possible channels of communication.
- Educate in an atmosphere of love and respect.
- Consider the different abilities of your students.
- Look for unusual ideas.
- Tolerate more moments of silence and ambiguity and avoid routines.
- Avoid fear of ridicule in the classroom.
- Encourage responsibility.
- Encourage student interest in inquiry and discovery.
- Encourage participation in the classroom.
- Encourage teamwork.
- In which students listen to each other's opinions.
- Hetero-evaluation and self-evaluation are encouraged.
- In which all of the above is considered on a daily basis.

If we want to reach creative students, teachers must realize that the agent of change is the person, both the teacher and the students.

Bernabeu and Goldstein (2009), Huidobdro (2004), and Ladish (2008) add the following to these strategies:

- Avoid routine and encourage varied and dynamic activities.
- Encourage critical thinking.
- Encourage learning through play.
- Encourage students' emotions and feelings in the classroom.
- Encourage attitudes of overcoming difficulties and problems.
- Reward and/or appreciate creative work and do not penalize work that goes beyond the norm.
- Address conflict situations that require a different and original response.
- Teach to think in pictures.
- Use all senses in learning.
- Teach them to be willing to make mistakes and that they are allowed to make mistakes.
- Teach them to suspend assessment or evaluation of their creative process to prevent being blocked.
- Help parents understand and encourage their child's creativity.

Key Concepts

Learned helplessness: a condition in which a person suffers from a sense of powerlessness, arising from a traumatic event or persistent failure to succeed. It is thought to be one of the underlying causes of depression

Conceptualization: the representation of an abstract idea in a concept; it arises from the general knowledge one has on various subjects

Holistic thinking: refers to a big picture mentality in which a person recognizes the interconnectedness of various elements that form larger systems, patterns and objects. Thinking holistically is the opposite of analysing something, which involves breaking down a larger system into its details

Reflection

Do you encourage creative thinking in the classroom?

If the answer is no and you are interested in doing so, do you think you know how to use it with the information we have given you?

Additional resources

The Ultimate List of Visual Creative Thinking Techniques for Your Next Great Idea: https://creately.com/blog/diagrams/creative-thinking-techniques/

Creative thinking techniques: Stimulate the mind to be productive by Pierre Veyrat: https://www.heflo.com/blog/business-management/creative-thinking-techniques/

19 Creative Thinking Skills (and How to Use Them!): https://www.sessionlab.com/blog/creative-thinking/

Video materials

Critical Thinking: Why, How Examples: https://www.youtube.com/watch?v=eBAdfJye2QU

Using Brain Teasers to Build Critical Thinking Skills by GCFLearnFree.org: https://www.youtube.com/watch?v=m2eINI4WXkc

A Japanese Method to Develop Creativity in Kids: https://www.youtube.com/watch?v=kXnugJEcVE8

5.2 Creativity, arts and digital technologies

Art and technology are two faces of human creativity that are closely related despite the differences that may exist between them. What art does has often been achieved thanks to a certain technical development, a technology whose existence allows the artist to create or not to create certain work.

The impact that new technologies have on artistic productions is truly significant. The world of technology encompasses a wide range of artistic manifestations such as video art, transmission art, multimedia installations, interactive art, net.art, digital photomontages, virtual reality, media performances, augmented cinema, artificial intelligence, and telepresence, to name a few, i.e., those that use electronic or digital audio-visual support in the production or exhibition process.

Thus, technology and art arise from a need for expression, except that they go in different directions and express themselves in different dimensions, but "we must not lose sight of the fact that technology and art have a constant relationship, even in other times there was this awareness, the Renaissance, for example, used the camera obscura to capture realistic drawings through an optical effect, and this close relationship is still maintained today" (Palomino, 2019).

In general, both technology and art have an inherent relationship with humans, and both emerged from a human creative process (Heidegger, 2020).

Undoubtedly, this relationship is more evident today, as developments and the search for innovations also take place in a dizzying way in this interaction between the two to give meaning to proposals, and it is made even more evident by the levels of grandeur and majesty in which they are presented.

Nowadays it is difficult to speak of an artistic discipline that has not already explored this relationship, from painting, sculpture, music, dance and the derivative arts such as cinema and visual arts, which are clearly closer to this relationship since its birth.

Artistic products have managed to overcome the notion of the use of technology as a purely instrumental means to merge in an already finished work that intervenes in the whole, even specific developments are created exclusively to allow expressions. But there are also cases in which technology is the subject of the work, either as a critique or as a trend, that is, self-referential and expressive of a position or approach to the context of the time and its technological developments.

Digital Art & Pedagogical Uses

Digital art is a relatively new and evolving form of expression that is one of the developments of today's world. The development of computer technologies leads to a new creation of digital works of appropriate quality, leaving great results and changing the usual way of making art. The novelty of these digital media improves the aesthetics of the works and the criticism of artists and authors of digital culture, as well as companies that promote technologies that contribute to this purpose.

This art has not only undergone a great evolution, but because of its effectiveness and the context in which we live, it is an extremely important means of communication: a completely technological and visual environment. Through digital art we can express emotions while developing interactive and innovative digital applications in many fields that allow the user to coexist with technology.

It is important to emphasise that the teaching and learning process in art, as in any other field, should be an interactive and constructive process, where teachers and students are supported by ICT tools. The contributions of art in education and the way it can be related to technology to achieve meaningful learning outcomes, the use of free software and other applications as a technological didactic strategy, the importance of the ability that drives us beyond the creation of the artistic object to find new proposals, find innovative solutions to problems, test creativity and perform collaborative learning.

The first objective implies the promotion of the formation of holistic rather than fragmented beings, capable of shaping a diverse, critical and democratic society. For these reasons, it is important to take into account the immense motivation that lies in ICT and art as a cross-cutting area that generates all knowledge and activates students' knowledge.

Based on these premises, it is now proposed to suggest some guidelines that should be taken into account in initial and continuing education in the field of arts education. It is a compilation of ideas that

emerge from the review of the pedagogical literature (reports, research, experiences, courses) for correct pedagogical use, whether we are trainees or instructors:

1. Rational use of software.

Some arts and technology courses focus exclusively on the technical operation of one or two computer applications. The complexity of some of these applications may take up all of the programming time. This option does not seem coherent because software is the means, but never the end, of the educational process. The use of a software application should be done as part of an art project so that students do not lose interest. It is not essential that students learn and master all the functions of a computer program. If necessary, the teacher can limit himself to a brief introduction to the basic functions (which, incidentally, are included in most programs) and let the students discover other functions (either independently or by asking the teacher) if they are needed to solve a particular aspect of the task. It is also useful to teach them to search for technical solutions using the help function, some manuals available online or solutions given by other users in Internet forums, so that they can become more and more independent in using computer tools.

Resources such as Choice-Based Art Education[1] or Teaching for Artistic behaviour[2] are based on these approaches and can provide many ideas for designing work proposals.

2. Spend some time designing the project.

It is worthwhile to pause long enough in the so-called pre-production phase, that is, to think about what we want to do and how we will do it. Depending on the type of artistic product we want to work out, it is useful to make sketches, lists of ideas and elements to record, photograph or draw before we start, and so on.

3. Integrate traditional and digital materials.

Incorporating ICT into arts education does not mean that we must abandon many of the common practices in our teaching and learning contexts or displace work with "traditional" materials. There are numerous ways to integrate drawing, painting, instrumental play, dance, or creative writing into a digital project. To give just a few examples, consider how a drawing can be scanned and then combined with

[1] http://www.princetonol.com/groups/iad/lessons/middle/TABCHOICE.htm
[2] http://knowledgeloom.org/ tab/index.jsp

digital painting and special effects; or that "live" dance can be the basis for images captured by the camera to create a production called video dance.

4. Make decisions about when to use ICT in the teaching of different artistic areas and when not to use them.

In addition to the integration of traditional and digital practices and resources, there will be activities that will continue to be carried out without the use of any type of technology and others that will be carried out only with ICT. In this sense, it is important to find a balance and know when it makes sense to use ICT and when it does not. This is a point that we need to address in the training courses. One of the dangers in today's classroom is that there are usually two opposing attitudes towards the use of ICT. While some vehemently defend the use of technology in the classroom and tend to use it in situations that do not warrant it, others reject it outright. Neither position seems appropriate. Therefore, it is important to overcome technophilias and technophobias and strive for a more realistic attitude that grants technologies their appropriate value and does not see them as a magic solution to all educational problems or as culprits for all problems (Cabero, n.d., 16).

5. Ensure that a student-centred learning environment is taught before incorporating ICT into classroom work.

If classroom work remains teacher-centred, little can be accomplished with ICT. Therefore, in addition to technological training, other possible approaches to arts education need to be known. In in-service training, practising teachers can gradually begin to incorporate project-based work (Hernández and Ventura, 1992; Markham et al., 2003), problem-solving (Jensen, 2005), and interdisciplinary modalities (Torres Santomé, 1998; Giráldez, 2006), as well as cooperative learning (Ovejero Bernal, 1989; Pujolás Masset, 2009 2) into the classroom.

In initial training, the courses themselves should incorporate these modalities and explain their characteristics and functions.

6. Develop skills to search and find information.

The Internet opens a window to the world, making it possible to visit museums and virtual galleries, watch videos, virtually attend concerts that have been recorded and posted on the web, learn about the latest artistic trends, read articles, research papers, and other documents related to art and arts education, obtain digital materials (images, videos, sound files, etc.) that can be used for teaching and learning, access online didactic materials or lesson plans and experiences of other teachers, etc. With

more than 226 million websites indexed on the web (Netcraft, 2009), the offer is overwhelming. Obviously, we cannot keep up with all the news, but it is important to develop skills that allow us to search, find, and stay informed appropriately. Evidence shows that students and teachers do not know or use basic strategies to find information in search engines, nor do they use RSS feeds from blogs, newspapers, and other websites to stay informed. This low level of strategy results in them wasting a lot of time searching or surfing aimlessly. Searching and finding information should therefore be included in the training process.

Key concepts

Video art: an art form which relies on using video technology as a visual and audio medium. Video art emerged during the late 1960s as new consumer video technology such as videotape recorders became available outside corporate broadcasting

Net.art: art that uses the Internet as its medium and that cannot be experienced in any other way. Typically, net.art has the Internet and the specific socio-culture that it spawned as its subject matter but this is not required

Expanded cinema: used to describe a film, video, multi-media performance or an immersive environment that pushes the boundaries of cinema and rejects the traditional one-way relationship between the audience and the screen

Telepresence: the use of virtual reality technology, especially for remote control of machinery or for apparent participation in distant events

ICT: an extensional term for information technology (IT) that stresses the role of unified communications and the integration of telecommunications (telephone lines and wireless signals) and computers, as well as necessary enterprise software, middleware, storage and audio-visual, that enable users to access, store, transmit, understand and manipulate information

Cooperative learning: an educational approach which aims to organize classroom activities into academic and social learning experiences

Reflection

What do you think about digital art versus more traditional art?

Which is the most relevant current trend in your opinion?

Additional resources

Pedagogical Design of Digital Learning of Future Art Teachers in a Virtual Classroom by Kondratska Liudmyla Anatoliivna, Tsidylo Ivan Mykolaiovych and Kurach Mykola Stanislavovych (Ternopil Volodymyr Hnatiuk National Pedagogical University): http://ceur-ws.org/Vol-2740/20200232.pdf

The Implementation of Digital Technology for Automation of Teaching Processes by Stefan Svetsky and Oliver Moravcik (the Slovak University of Technology in Bratislava) December 2016: https://www.researchgate.net/publication/315662144

The Implementation of Digital Technology for Automation of Teaching Processes Choice-Based Art Education: http://www.princetonol.com/groups/iad/lessons/middle/TABCHOICE.htm

Teaching for Artistic behaviour: http://knowledgeloom.org/ tab/index.jsp

Video materials

The Importance of Art Education: https://www.youtube.com/watch?v=8-u6naFYWpg

The Importance of Art Education | StarTalk, National Geographic: https://www.youtube.com/watch?v=BQ4UwzRLVpQ

Integration of Technology in the Classroom: https://www.youtube.com/watch?v=4jLKL2VCZrA

Using digital tools to transform the classroom: https://www.youtube.com/watch?v=B99FXVamqMM

5.3 Pixel art and interactive art

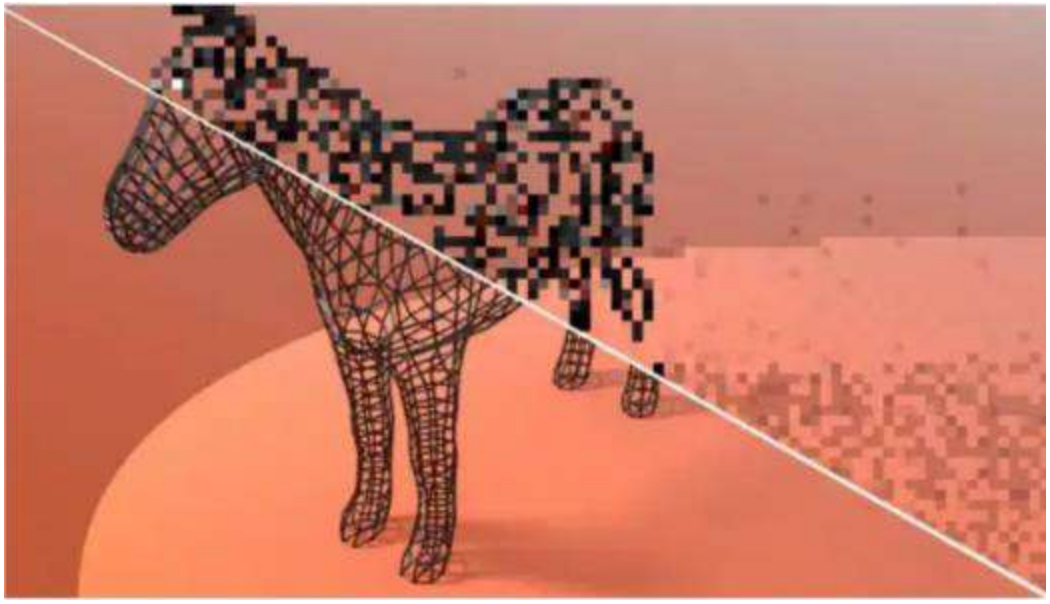
If we are truly interested in immersing ourselves in the world of art, creativity, and technology, we should look at examples of the most current digital art, such as pixel art or interactive art, in our education. Digital works are not only an example of what some artists are currently producing, but they are becoming an important source of ideas to develop new forms of expression from the knowledge of the works of those who preceded them.

Pixel Art is the artistic creation that is digitally based on pixels using simple image editing tools. However, it is not a simple technique, as the colour palette and the use of colours are very important to properly implement what is desired.

The 80s and 90s were the years that gave the greatest impetus to Pixel Art, so much so that today the retro trend has revived it in an amazing way. In fact, Pixel Art has resurfaced stronger than ever, paradoxically competing with the prevailing realism in the video game industry, with proposals that combine nostalgia, sympathy, colour and colourfulness based on clearly identifiable pixels. Pixel Art, however, does not refer to all existing games, but to a very specific design style based on classic development art. It is a rasterization, pixel by pixel, that makes it possible to design all the elements of a video game with the help of small colour mosaics.

In the context of interactive art, this is any type of art that involves the viewer in the creative process. Interactive art seeks to transcend the traditional boundary between artist and "audience." It can use a physical medium, as in the case of installation art, or it can be purely digital and internet-based. Interactive art often uses computer power to drive responses to the viewer's actions.

The early 20th-century art movement in Europe and North America laid the foundation for the emergence of interactive art. People began to question the role of the artist, the work, and the viewer in art. French-American artist Marcel Duchamp may have created one of the earliest examples of interactive art with his 1900 Rotary Glass Plates device. His machine used a motor to rotate rectangular pieces of glass on which segments of circles were painted.



Technology often plays an important role in interactive art. For a work of art to be interactive, it must have a way to detect the actions of the viewer. This can take the form of physical sensors or, in the case of Internet-based art, computer input devices such as a mouse. Generally, the work must also respond in some way to the input. Often a large amount of output is possible, with much room for interpretation by the viewer.

Pixel Art & pedagogical uses

To learn to master this art, several factors must be considered (Tokyo, 2021):

First, a passion for video games and, more specifically, for video game design. The most appreciated creations in the history of this sector are made by professionals who are passionate about what they do. Working in a profession you like is synonymous with quality and good work.

Secondly, you need proper training. With the best training, the best and most innovative resources at your disposal, and a team of professionals dedicated to your learning, you'll have the guarantee of mastering pixel art and other styles.

Creativity at last! The video game designer can rely on programs with predefined functions and already invented design techniques, but in the end, the design of the elements depends on the creative contribution you can make to each character, figure or even pixel.

Starting with a new art style can be complicated. Therefore, it is advisable not to stop practising and not to concentrate on a single result, but to make many works until the technique is polished, since you'll discover it as you improve.

From this point, we will show you the basic guidelines you need to create your own pixel art designs and feel like a video game artist or maybe even start a promising art career.

Step 1: Select the program

The first step, of course, is to download and install a suitable program for creating pixel art. Paint is indeed a tool that can be used for this purpose, but in truth, it is even better if we can get an app that will make our work easier. To do this, we can look at some "apps to create pixel art":

GIMP:

GIMP is known as an alternative to Photoshop and is one of the best design apps for creating pixel art: https://www.gimp.org/

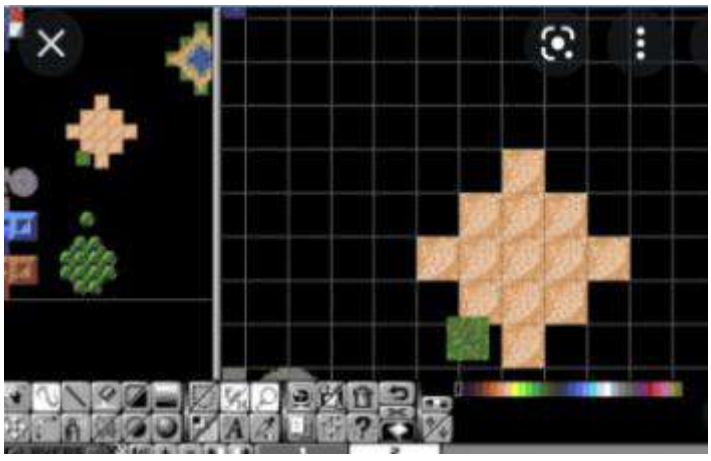
Paint.NET:

Paint. NET is not only an excellent image editor, but also a fabulous tool for creating pixel art, thanks to its simple but powerful features.

MOAI:

It is one of the most popular tools among artists dedicated to pixel art, since it offers many options and functions that let us edit our designs in the best quality: http://members.allegro.cc/sirocco/nav_mo.htm

Grafx2:



This tool stands out from the others mainly because it is an application specifically designed for creating Pixel Art with the tools from the golden age of this technique. However, it also offers support for more modern features such as layers and transparencies, so that our work can be done with the best possible comfort: http://pulkomandy.tk/projects/GrafX2

Step 2: Select the drawing tools

Although the mouse is a very useful tool to create our own pixel art, in truth any device that can help us in this task is welcome. One of these tools is a digitizing tablet, which can save us a lot of time. However, this device is not really necessary.

Step 3: Prepare the drawing program

Once we have installed the drawing program, we must first prepare it for the creation of our pixel art. In this case, it's advisable to use Photoshop for illustrations, but the procedure does not differ much from app to app.

The first thing you need to do is enable the grid view. This way we can easily see how the individual pixels are placed.

Step 4: First Pixel Art Practices

Once we have the grid set up, we still need to create a new image. It should be noted that pixel images do not need to be extremely large. With 72 x 72 pixels, we have enough to start with a simple figure. If we want to draw a larger scene, we must make sure that the dimensions do not exceed 250 pixels. At this point, we should note that the resolution for pixel art images must be 72 pixels. Once the image is created, we enlarge the screen using the Zoom tool to work more comfortably with the grid and pixels. A standard magnification percentage for this type of design is between 700 and 800 percent of the original image. The next step is to choose the appropriate drawing tool. This should be the "pencil", which should be only one pixel in size so that we can capture individual pixels in the drawing.

Interactive Art & pedagogical uses

The experience of art is always active and interactive in a fundamental sense, as it consists of the interaction between the environment, perception, and the creation of meaning in the mind of the audience. However, the advent of computer-based interactivity has created a new kind of art experience. In interactive computer artwork, the activity is not only psychological, but also consists of material exchange between a person and an object.

Source: Business Insider

A current form of interactive art is the "interactive digital artwork," as some call it. Both terms refer to artworks that are interactive and incorporate digital technology as an integral element in their creation.

Source: Archive EVE

Key concepts

Pixel: the smallest addressable element in a raster image, or the smallest addressable element in an all points addressable display device; so, it is the smallest controllable element of a picture represented on the screen

Rasterisation: the task of taking an image described in a vector graphics format (shapes) and converting it into a raster image (a series of pixels, dots or lines, which, when displayed together, create the image which was represented via shapes). The rasterized image may then be displayed on a computer display, video display or printer, or stored in a bitmap file format

Reflection

Do you believe in the statement that the best pixel art artists are those who are fans of video games?

What kind of pixel art would you choose?

Additional resources

GIMP: https://www.gimp.org/

MOAI: http://members.allegro.cc/sirocco/nav_mo.htm

Grafx2: http://pulkomandy.tk/projects/GrafX2

The 11 Best Pixel Art Tools to Create Pixel Perfect Artwork: https://www.makeuseof.com/tag/best-pixel-art-tools/

Video materials

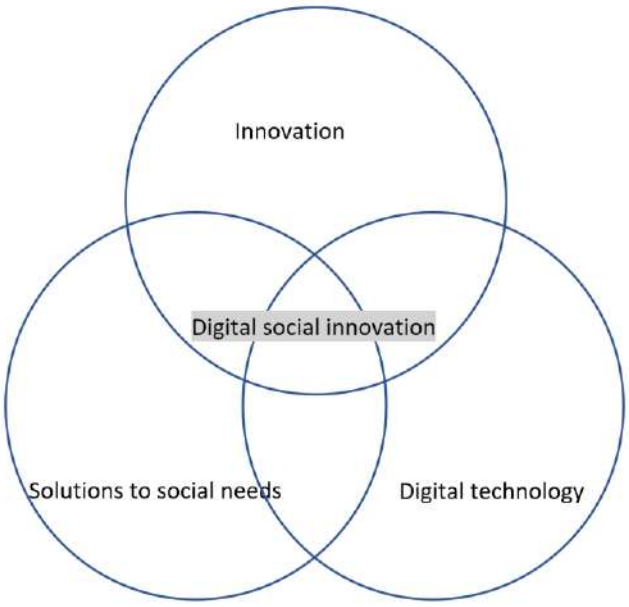
How to make a PIXEL Art using EXCEL: https://www.youtube.com/watch?v=UREbCMIwT9c

How to Create Excel Pixel Art: https://www.youtube.com/watch?v=HdKlxFIUvyg

Create Digital Mystery Pictures in Google Sheets | Fun Digital Pixels Activities for Students: https://www.youtube.com/watch?v=EKhaBNu0yAw

5.4 DSI examples and case studies

Digital social innovation (DSI) is a type of social and collaborative innovation in which innovators, users, and communities work together using digital technologies to co-create knowledge and solutions to a wide range of social needs, at a scale unimaginable before the advent of the Internet.



Examples

This analysis, led by Fab Lab Barcelona[3], highlights three main areas of DSI activity in skills and learning:

- Initiatives that use technology as a tool in the classroom to enhance learning (most comparable to mainstream edtech). Examples include CreaNova4 School and Liceu Politecnic5, both in Catalonia, which use heavily digital methods in teaching and learning. Outside the classroom, the UK-based Hegarty Maths6 has been very successful with students using the platform's videos to learn and practise math for free at home. In Italy, Book in Progress7 is taking advantage of a recent change in the law to create teacher-led, open, collaborative digital textbooks and learning resources that are now being used by dozens of schools.
- Initiatives aimed at reducing inequality in access to education and educational outcomes. These could include online mentoring for children from lower socioeconomic groups (e.g., TutorFair Foundation8, which focuses on math education in rural and coastal areas of the U.K.; The Access Project9, which works with secondary school students to increase university admissions among low-income groups; and Language Futures by Whole Education, which matches students with native speakers). They also offer free

[3] Fab Lab Barcelona: https://fablabbcn.org/
[4] CreaNova: https://www.collegicreanova.org/cat/
[5] Liceu Politecnic: https://www.liceupolitecnic.es/
[6] Hegarty Maths: https://hegartymaths.com/
[7] Book in Progress: https://www.bookinprogress.org/
[8] TutorFair Foundation: https://foundation.tutorfair.com/
[9] The Access Project: https://www.theaccessproject.org.uk/

courses to help digitally excluded groups get online (such as the UK's Good Things Foundation10 or Poland's FRSI11, which work to reduce digital exclusion).

- Initiatives that support digital skills development, not only for employment purposes but also to empower individuals in a digital world. These initiatives aim to democratise access to digital and physical tools to empower individuals to take control of and influence their lives and communities. At the same time, they disrupt existing models and empower people to become change agents themselves.

DSI initiatives leverage a range of technologies, including online platforms, digital fabrication technologies, low-cost computing, and open-source hardware. There are hundreds of projects ranging from introducing maker technologies to youth and adults, teaching programming skills, promoting digital social entrepreneurship, and supporting the coordination, promotion, and communication of these technologies through events, conferences, challenges, and campaigns. In addition to teaching digital skills, most projects aim to promote a range of cognitive and non-cognitive skills, benefit society at large, reduce inequality, and work with underserved groups.

Case Studies

- Fab Academy: Fab Academy uses a decentralized education model to help students around the world make (almost) anything. Founded in 2009, the company disseminates the principles, applications and possibilities of digital fabrication and is based on the popular rapid-prototyping course How to Make (almost) Anything from MIT. Fab Academy takes a blended online-offline approach, with students learning and working with peers and mentors on-site at the Fablab and around the world through content sharing, video conferencing, and interactive classes. Individual Fab Labs are supported and overseen regionally by expert nodes with advanced skills, expertise, and inventory. The course began in 2010 with 12 Fab Labs and 30 students and grew to 73 Fab and 285 students in 2017. More recently, it has been joined by other programs, including Fab Academy X, Bio Academy, Fabricademy, and Fab Academy Thesis, all part of a platform called Academy, which ultimately aims to spread education in a decentralized way.
- FixEd: FixEd's mission is to inspire creative, resourceful, and generous problem solvers and equip them with the skills they need for the 21st century by helping educators and organisations around the world engage and motivate learners through learning programmes for schools and universities. FixEd's flagship programme is Fixperts, a learning programme that challenges young people to use their imaginations and skills to find ingenious solutions to everyday problems faced by a real person. In the process, they develop a variety of valuable, transferable skills, from prototyping to collaboration. Fixperts offers a range of

[10] Good Things Foundation: https://www.goodthingsfoundation.org/
[11] FRSI: https://frsi.org.pl/

teaching resources and formats for schools and universities, from one-hour workshops to a semester-long project relevant to all creative design, engineering and STEM /STEAM degree programmes. The course is now offered at over 30 universities worldwide and is recognised in the general English education system. The Fixperts course is based on six key areas: Learning to solve problems; Building social relationships; Connecting imagination and skills; Award-winning, ready-to-teach teaching tools; Effectiveness in design, engineering, STEM and STEAM; and Creating new formats and options in response to changing needs. In addition to the Fixperts course, FixEd recently launched FixCamp, a summer activity camp in London supported by the Royal Academy of Engineering that is expected to reach 200 students in summer 2018.

- Barcelona Open Data Challenge: The Barcelona Open Data Challenge aims to promote the use of open data by engaging secondary school students in hands-on projects. Open Data BCN, the city's main portal, has 420 datasets on topics such as housing, population, trees, public transportation, bike lanes, accidents or incidents reported by citizens. The contest asks students to analyse, review and use open data available through the city's portal to design proposals for how the City Council can think differently about the city. The competition takes place throughout the school year and includes phases for analysing challenges, identifying and analysing data, developing proposals and presenting them at a public event, and evaluating the process. Throughout, teachers receive training in open data methods, data analysis, video editing, and design, which in turn can support students. Winning proposals will be evaluated by city officials. Teams also receive additional training and the opportunity to visit data and technology companies in the city.

Key concepts

Edtech: Educational technology is the combined use of computer hardware, software, and educational theory and practice to facilitate learning. When referred to with its abbreviation, EdTech, it is often referring to the industry of companies that create educational technology.

Digital exclusion: where a section of the population have continuing unequal access and capacity to use Information and Communications Technologies (ICT) that are essential to fully participate in society.

STEM / STEAM: Science, Technology, Engineering, and Mathematics / Science, Technology, Engineering, Arts and Mathematics.

Open Data: data that can be freely used, re-used and redistributed by anyone - subject only, at most, to the requirement to attribute and share alike.

Reflection

How could we incorporate our digital skills to create timely solutions for our environment?

How would you make things better socially with a project where technology and collaboration go hand in hand?

Additional resources

Digital Social Innovation in the heart of Europe by Silvia Bertolotti for Digicult:
http://digicult.it/news/digital-social-innovation-in-the-heart-of-europe/

Digital social innovation Network | Social Innovation Community:
https://www.siceurope.eu/network/digital-social-innovation/digital-social-innovation

What is next for Digital Social Innovation? Realising the potential of people and technology to tackle social challenges by Matt Stokes, Peter Baeck and Toby Baker. May 2017.
https://media.nesta.org.uk/documents/dsi_report.pdf

Video materials

Digital Social Innovation by Nesta - The UK's Innovation Agency:
https://www.youtube.com/watch?v=DSijSS7MKN4

5.5 Assessment

1) What defines creative thinking according to López-Martínez and Navarro-Lozano (2015)?
   a) Fluency, Elaboration, Originality and Flexibility
   b) Fluency, Passivity, Originality and Flexibility
   c) Fluency, Passivity, Imitation, and Flexibility

2) According to Guilford's approach, what is the best way to develop creativity?
   a) changing the perspective by inverting the problem allows us to open a new way of thinking about aspects we did not contemplate before
   b) observing and taking into account structural features and requirements
   c) by improving all the functions involved in the creative process and optimizing resources

3) The teaching-learning process in art, as in any other area, should be a … process.
   a) unidirectional and constructive
   b) interactive and exemplary
   c) interactive and constructive

4) What technique did the French-American artist Marcel Duchamp use with his 1900 Rotary Glass Plates device for his interactive art creations?
   a) The machine used a motor to rotate rectangular pieces of glass that had segments of painted circles
   b) The machine used a presser to press rectangular pieces of glass that had segments of painted circles
   c) The machine used a propeller to break the glass pieces into pieces and then paint them

5) What is rasterization?
   a) an algorithm for image synthesis that calculates the path of light as pixels in an image plane and simulates its effects on the virtual surfaces on which it strikes
   b) the process of generating photorealistic or non-photorealistic images from a 2D or 3D model by means of computer programs.
   c) the process by which an image described in a vector graphic format is converted into a set of pixels or dots for display on a digital output medium, such as a computer screen, electronic printer, or bitmap images

6) What does the acronym DSI stand for in this module?
   a) Digital Social Inclusion
   b) Digial Social Innovation
   c) Digital Service Innovation

7) What are some of the initiatives that can emerge from ISDs?
   a) Initiatives which seek to reduce access to digital tools
   b) Initiatives which seek to reduce digital platforms in the educational field
   c) Initiatives which seek to reduce inequality of access and outcomes for education

Module 6. Creativity and the Arts at School

Authors: Nida AKCEVİZ OVA, Mehmet Necmeddin DİNÇ

Learning Objectives

On completion of this Learning Unit, trainees will be able to:

- Define creativity and key elements of creative teaching
- Classify the conceptual framework for creative teaching
- Comprehend on creative teaching instructional cycle
- Develop a comprehensive model for measuring creativity
- Define "What is Creativity in Education"?
- Recognize and Implementing Creative Teaching Approaches
- Explain Art Integration in Schools
- Differentiate types of art education
- Develop ways to integrate art into the classroom
- Organize arts integration checklist
- Explain digital art education and its importance
- Classify new digital art forms

Introduction

The concept of "creativity" as a desirable attribute within education is long-standing. The fields of education and creativity have developed, and periodically intersected with, government reports, policies, commentaries, and advice. The world of education is now committed to creativity which is central to policy and curriculum documents in education systems.

Source: shutterstock

Early studies of creativity focused primarily on creative thinking. However, it has become increasingly apparent that children only display creativity when they *want* to and when they *feel able to.* In addition, children need appropriate skills and abilities, such as the capacity to recognize inconsistencies and to get ideas. The way creativity is understood, nurtured, and linked with real-world problems for emerging workforces is significantly changing the ways contemporary scholars and educators are now approaching creativity in schools.

Creativity is an essential aspect of teaching and learning that is influencing worldwide educational policy and teacher practice and is shaping the possibilities of 21st-century learners. Creativity discourses commonly attend to creative ability, influence, and assessment along three broad themes: the physical environment, pedagogical practices and learner traits, and the role of partnerships in and beyond the school. The Robinson Report (1999) suggested that, while there were strong links between the expressive arts and creativity, viewing creativity as solely or mainly the province of the arts was unhelpful because it could lead to a denial of the role of creativity in other areas, such as science, mathematics and business. Art Education is a primary pathway to learning, a journey of discovery of the meaning of teaching for aesthetic experience. Creative expression in the arts is as natural and developmentally necessary for people as fresh air and sunshine are. Through the arts, one can learn the fundamental process of discovering and imagining, originating and problem-solving, thinking and creating. The association between the arts and creativity has given rise to much debate. This module is suitable for social educators and teaching staff who want to improve themselves in creativity and arts education at school and will provide competency about the creativity education to be applied in schools and the approaches related to this field, as well as the mutual interaction of art and creativity.

6.1 Nurturing Creativity at Schools

The Essential Elements of Creative Teaching

It has been widely acknowledged that creativity is a complex concept for which there is no one particular definition. We can see many definitions of creativity (Prentice, 2000). These are:

- “a state of mind in which all our intelligences are working together” (Lucas, 2001, p. 38) ;
- “the ability to solve problems and fashion products and to raise new questions” (Gardner, 1993, p. 48);
- “getting away from the main track, breaking out of the mould, being open to experience, and permitting one thing to lead to another” (Bartlett, 1958, p.103).

Source: commons.wikimedia.org

These definitions show us that creativity is a very crucial and special characteristic of human life. Creativity is a phenomenon that might help us not only in particular issues but also in every area of life. In other words, it is a kind of behaviour that helps individuals in adapting to new forms, in converting life to a regular structure, in coping with difficult situations.

Much of the scholarly work on creativity has focused on defining its nature and setting out the contours of the field. Yet, terms such as 'creativity' and 'innovation' are still not well defined in education policies. In the EU and beyond, there is little guidance on how to integrate new approaches in teaching and assessment or on the impact of different approaches on learners' creative capacities (Cachia et al., 2010; Craft, 2001; Ryhammer & Brolin, 1999).

The Conceptual Framework:

- Creative Individuals

Early research on creativity in education focused on identifying learners with high creative potential. It was assumed that creativity was a fixed trait — a sign of giftedness and it was hoped that its characteristics could be assessed easily so that exceptional talent could be nurtured from an early age. The focus was very firmly on big 'C' creativity, and little thought was given to teachers' roles in nurturing everyday creativity beyond gifted programmes or arts classes. Various commentators have criticised these early approaches, noting, for example, that the number of ideas a person generates and how unique or uncommon they are do not reveal their value or usefulness. Rather, the most creative people seem to be those who are able to arrive at the 'best' solution in the shortest period or with the greatest simplicity. Researchers still consider that personal traits, or dispositions, are correlated with creativity. But they also believe that all individuals can develop capacity for everyday creativity (small 'c' creativity),

including divergent thinking and the ability to generate new ideas or develop skills for creative problem-solving over time. Teachers and parents have an important role to play in nurturing. Active participation in lessons has been identified as important to enhance the creative potential in studies drawing on educational data mining techniques and self-reported creativity scores (Dawson, Tan & McWilliam, 2011).

- Creative Processes

Research on creative processes overlaps, to some extent, with research on creative dispositions. But it is also concerned with identifying specific behaviours of creative individuals (e.g. exploratory behaviours, analysis, evaluation, synthesis) and approaches to problem finding and problem-solving in different domains and at different stages of development. Disequilibrium may spur creative processes. For example, Timperley and colleagues (2007) found that learners (including teachers) were most likely to benefit from creative processes that addressed significant problems or when confronted with new information that challenged their previous conceptions. This requires that the learner thinks in new ways and makes new connections with prior knowledge and beliefs. Learners also need to develop the capacity to tolerate ambiguity and frustration. (Albert, 1996).

- Creative Products

Among experts on creativity, there is fairly wide agreement that creative work — whether of the big 'C' or small 'c' variety — is novel, appropriate to the task at hand, and of high quality as compared to some reference groups. In the arts, creativity may be found in something that is both original and aesthetically pleasing (Sternberg, Kaufman & Pretz, 2002) For a variety of reasons, relatively little attention has been given to the quality of creative products in schools. learners receive little guidance on how they might improve or deepen their work. Neither teachers nor learners are encouraged to develop their own sense of what counts as high-quality creative work. The promotion of creative potential brings benefits to the individual in terms of better learning(e.g., Schubert, 1973) and improved mental health (e.g., Cropley, 1990), as well as benefits to society.

- Creative Partnerships

The Creative Partnerships programme places artists in the classroom to assist teachers in developing their pedagogical practice. While the artists have had some training to take on their partnership roles, they do not function as teachers in the classroom. Rather, they encourage teachers to adapt creative methods and processes in their classrooms. They also play an important role as outside observers,

asking teachers why they made certain choices, why learners may have responded as they did to different exercises, and generally provoking deeper questioning and new ways of thinking about what is happening and what could happen differently in the teaching and learning process. Teachers are encouraged to move beyond their typical roles and routines. We highlight these particular approaches, as they support open and closed learning for teachers, learners and the creative professionals themselves. The fundamentally collaborative nature of creative partnerships is vital. Creative professionals can infuse new energy and insights and bring new approaches and tools to support teaching and learning. They also bring very different points of view and tend to be curious (an important creative disposition, as noted above), asking many questions which may seem naïve to educators, but are nevertheless important. Teachers bring domain-specific knowledge, a good understanding of how to structure content and scaffold learning so that it is at the appropriate level of challenge for their students.

Creative Teaching Initiatives

- Generate Multiple Ideas

The skill of generating multiple ideas or possibilities in response to a problem is necessary for innovation. When we ask students to generate new ideas, we are by design creating space for novel solutions and alternate realities. We are asking students to imagine “What If…?” and “What other possibilities exist?”

Using creative teaching strategies to help students select which idea is most useful to solve a specific problem takes this idea generation a step further. Requiring students to generate ideas and choose which one is best is the same process an entrepreneur uses to develop a new product and a child uses to imagine a future that breaks a cycle of poverty or abuse. We should highlight both the social/contextual component of creativity and learning (Lave and Wenger, 1991) as well as the technical and craft aspects (Berger, 2003, Ericsson et al., 1993)

- Make Creative Choices

Throughout creative instruction, teachers select cognitive tasks that allow students to make creative choices to process and express their learning. While such tasks are often targeted, they are also open-ended and provide development opportunities. For example, a teacher may ask a student to create a statue representing justice in connection to a series of events and outcomes from a novel study. This task is targeted because it requires students to compare their prior knowledge of justice with the concept as presented in the novel, but it is open-ended in that there are multiple ways for the student

to process and express this point of view. As the student embodies this term as a statue, she often moves through several mental and physical iterations of justice, tweaking and revising each one to improve upon the other before finalizing her statue for display.

- Make Mental or Physical Models

Model-making is one of the most defining characteristics of creative learning, and it occurs in multiple formats. In some creative teaching tasks, the teacher asks students to create mental models of ideas or concepts; in other tasks, he/she ask students to create physical models with their bodies or three-dimensional models with media. In both kinds of model-making, mental and physical, they're helping students build schema and make learning more lasting.

- Analyse and Synthesize

The cognitive actions of analysing and synthesizing are central in learning. Teachers search for instructional tasks that encourage these processes. Creative teaching strategies can help students zoom in and pan out to understand different perspectives.

Source: shutterstock.com

By design, creative teaching strategies help students confront the complexity of their curricula to decipher existing and new meanings from it. Equally important, students must make creative choices about how to accurately represent their analysis and synthesis. These representations, which make thinking visible, require a depth of understanding that only rigorous analysis and synthesis tasks can produce.

- Translate and Transfer

Creative teaching strategies require students to translate information from one symbol system into another, such as from image to text or text to image. Such cognitive tasks ask students to reorganize data in new ways. This reorganization, or translation of ideas, results in students connecting and grappling with information in different ways. This translation process deepens comprehension and

allows new information to be expressed. Research shows transferring ideas from one context to another offers multiple learning benefits as well. Students must deeply examine what they know about a topic in order to transfer ideas into new domains. In near transfer of learning, students transfer knowledge between similar contexts, such as learning to write with a pencil and then transferring hat understanding to painting with a brush.

Creative Teaching Instructional Cycle

Source: Photograph courtesy of Kaie Kellough

1. Identify Curricular Goals and Objectives

Identifying curricular goals and objectives is a common instructional task for teachers. Teachers must dive deep into curricular topics to determine which goals and objectives are best suited for creative teaching strategies. Identifying these teaching goals and objectives is the first step when choosing a creative teaching strategy.

2. Identify Strategy & Design Creative Teaching Lesson

Choosing a strategy requires teachers to understand what a strategy does well, with whom, and when to use it within a lesson cycle. If creativity is indeed a necessary component of 21st-century learning (Collard & Looney, 2014), teachers need fresh ideas to enhance creativity within the general education classroom. Teachers often think through multiple strategy frameworks and the choices involved within each to determine what serves the classroom's unique considerations and what misses the mark. This helps teachers envision the strategy play by play to ensure that the creative lesson:

- Meets instructional goals and objectives;

- Works with the teacher's instructional style and fine arts experience; and
- Supports student learning styles, personalities, and interests.

3. Facilitate Creative Teaching

After identifying goals, matching creative teaching strategies with classroom considerations, and designing lessons, teachers focus on positive learning impacts during instructional time. This includes:

- Seamless integration of strategy into the flow of instruction
- Student-led inquiry
- Clear instructions and expectations
- Equitable student participation
- Strong scaffolding and differentiation
- Questions that lead to metacognition

4. Evaluate Impact using Student Data

Teachers evaluate the impact of their creative instruction during and after facilitating creative teaching strategies using informal and formal methods. Meaningful student reflection is often the hardest part of creative teaching – and in fact, of all teaching. At other times, teachers are gathering formative assessments through examples of student work. Teachers also evaluate the impact of their creative teaching using paper assessments generated by the teacher, the district, and the state.

5. Reflect and Redesign Creative Teaching

During the final stage of the Creative Instruction Lesson Cycle, teachers reflect on and redesign their creative teaching. Often, teachers know their strengths and areas for improvement. These teachers are constantly adjusting creative instructional choices for a greater impact on student learning. Teachers revise their instructional objectives and pair them with the most appropriate creative teaching strategy based on curricular, instructional, teacher, and student considerations. Teachers then use this creative teaching strategy to design a meaningful task with the greatest possible impact for all learners, which is evaluated through formative and summative assessment. Teachers will naturally inquire how to build skills in the domains where their reflection shows them there are opportunities for professional growth.

How Can Creativity be measured in schools?

Measuring creativity inspires the development of better curricula and teaching practices and provides formative feedback so that students can continue to develop their creative strengths over their lifespans. By measuring creativity, the fundamental importance of creativity as a key part of schooling is underscored. Given assessment often determines the priorities of education (NACCCE, 1999), it is

important that teachers are encouraged to utilize different methods of assessment throughout the whole educational process, from informal judgment to written assignments. A comprehensive model that incorporates the competencies of both creativity and critical thinking has been developed and adapted as a tool for creativity measurement suitable for the school context. The model describes five creative habits of mind and 15 sub-habits. This tool provides a formative assessment of creative thinking that can be used by teachers and by students to assess their own creative habits. Below are both the five habits (in bold) and the three sub-habits associated with each habit:

- **INQUISITIVE** (wondering and questioning, exploring and investigating, challenging assumptions)
- **PERSISTENT** (sticking with difficulty, daring to be different, tolerating uncertainty)
- **IMAGINATIVE** (playing with possibilities, making connections, using intuition)
- **COLLABORATIVE** (sharing the product, giving and sharing feedback, cooperating appropriately)
- **DISCIPLINED** (developing techniques, reflecting critically, crafting and improving)

Another approach is to measure the conditions for creativity within schools. The emphasis is not on the "outputs"—that is, the creative products created by individual students, but rather, on the "inputs"—namely, the situations in which students might be called upon to think and act creatively. Examples of creative inputs would include fine and performing arts classes, scientific investigations, theatre and dance performances, debating clubs, independent research opportunities, entrepreneurial projects, school-community partnerships, and integrated curricula.

One of the main advantages of evaluating creativity in schools is that it underscores the importance of creativity to the school experience. Measuring creativity also provides critical feedback, guiding students in their creative development and guiding schools toward optimal conditions for fostering creativity. For all of these reasons, creativity must be included in measures of student and school success.

Key concepts

Big C creativity is the breakthrough kind of thinking that most people are familiar with, but it's relatively rare.

Small c creativity describes the small ideas and "a-ha's" that enhance and enrich our lives — like creating a new recipe

Creative teaching: The act of teaching in a novel and useful way that promotes student growth related to the development of original thought and action.

Reflection

Do you apply any methods while evaluating creativity? If yes, which tools? If not, why not?

Are you able to use “Creative Teaching Initiatives”? How?

What methods do you use to foster creativity in curriculum?

Additional resources

BESEMER, S. P. (1998) Creative product analysis matrix: testing the model structure and comparison among products — three novel chairs, Creativity Research Journal

OECD (2009) Creating Effective Teaching and Learning Environments: First Results from TALIS (Paris, OECD).

DAWSON, S., TAN, J. P. L. & MCWILLIAM, E. (2011) Measuring creative potential: using social network analysis to monitor a learners’ creative capacity, Australasian Journal of Educational Technology

PARKER, D. (2013) Creative Partnerships in Practice: developing creative learners (London, Bloomsbury).

Video materials

Creativity In School: https://www.youtube.com/watch?v=wyibbybVoEs

How to use creativity in the classroom: https://www.youtube.com/watch?v=qV7DiTFdtvw

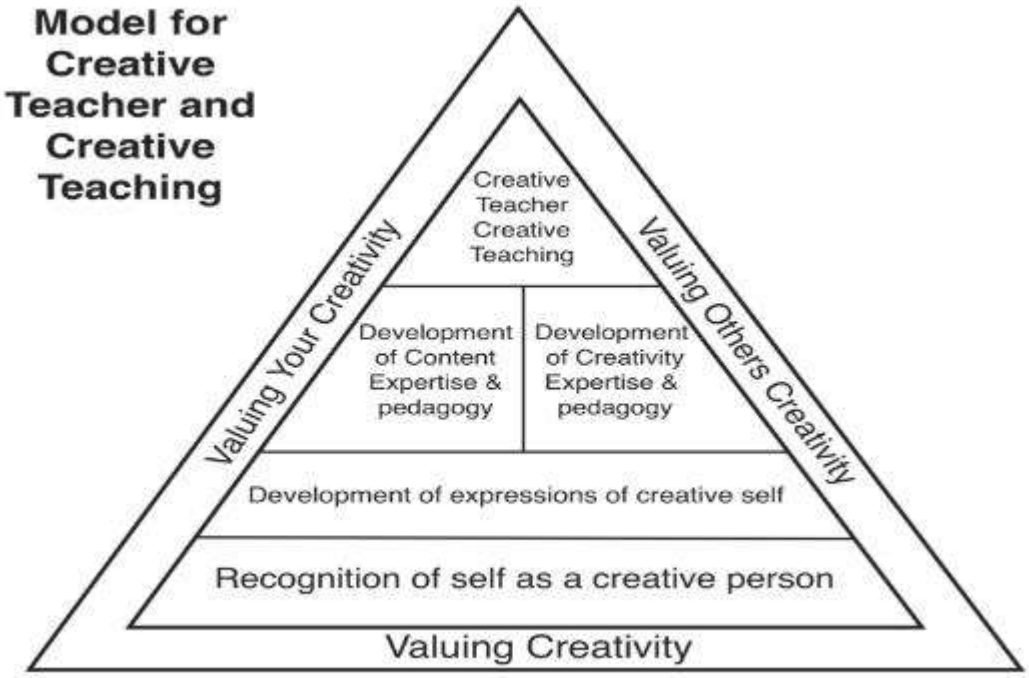
How to Develop Student Creativity-Creativity for All: https://www.youtube.com/watch?v=mUIPlGRY_LE

6.2 Creative Education at School

What is Creativity in Education?

Creativity is a human characteristic like thinking. Creativity consists of actions that are related to consciousness, thought, forming and imagination. Creativity that means breeding, forming and producing can appear in different ways. It shows itself in all areas of life, in an original manner, in finding new solutions for problems. It is defined as the ability that is displaying reveal new experiences, new thoughts (ideas) and new products in a new thinking scheme by establishing relationships that previously haven’t been established (Karayağmurlar, 1993, p. 384). Teachers have an important role in this issue. To do this task, all teachers should know how much important is creativity in education. Teachers who know that can help their students and can plan the curriculum. Sak (2011) says Creativity is an ability which is innate and special to humans among living things; Even if the development of

creativity ability is prevented for several reasons, development of creative ability, life experiences can be regained, stimulated and developed with special programs.



Source: https://crearla.weebly.com

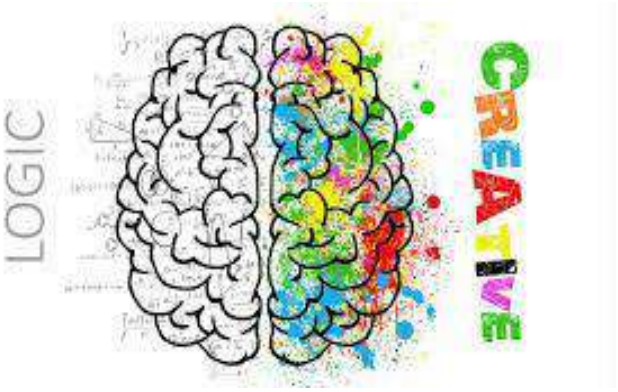
Torrance described four components by which creativity could be assessed:

- fluency: the ability to produce a large number of ideas
- flexibility: the ability to produce a large variety of ideas
- elaboration: the ability to develop, embellish, or fill out an idea
- originality: the ability to produce ideas that are unusual, statistically infrequent, not banal or obvious. (Torrance, 1966, 1974).

Teaching outside the box while still ensuring students have grasped the necessary skills and knowledge they need can be a tricky balance to master. Creative teaching is an approach where limitations become possibilities; it is a means of empowerment. It is an interaction of many intellectual concepts such as imagination, analytical inquiries, sound reasoning, participation and reflection, field study, object study, modelling etc., by which students prepare themselves for an emerging World. Creative teaching is becoming essential in designing empowering learning experiences. From games and apps to songs and hands-on activities, educators are finding innovative ways to creatively teach and engage their students.

The development of creativity in education

There is very little recent research, it seems, investigating the development of creativity in education, although some commentators suggest that creativity can be developed. Seltzer & Bentley (1999), for example, suggest in their recommendations on knowledge and skills for the new economy, that 'creativity can be learned' and that the school curriculum should be restructured 'to reflect forms of learning which develop creative ability' (page 10). There is, it seems, a dearth of conclusive research evidence suggesting that creativity can be developed or that progression can be identified in creativity.



Source: shutterstock.com

An overview of findings from such studies as exist is given below, using five categories;

- Comprehensive approaches

Stein (1974, 1975) has summarised studies up until the mid-1970s, in which researchers evaluated attempts to stimulate adult creativity at the individual and group level, using a range of techniques, including role play, brainstorming, psychotherapy and hypnosis. His review of the literature up to that point suggests that attempts to train people to become more creative are not particularly effective, although some studies did indicate short-term effects.

- Educational approaches

Various kinds of training programmes have been advocated to develop creative thought processes. Creative thinking is often equated with originality, the generation of ideas, and a range of problem-solving strategies (sometimes referred to as 'creative production'). Although there have been attempts to do this within a school context, Vernon (1989) concludes that the results of such studies suggest they are much less successful than is sometimes maintained. For although specific skills, such as problem-solving, can generally be trained and improved upon, there is rarely a

transfer to more complex activities such as creative production.

- Psychodynamic approaches

Both psychodynamic approaches and humanist approaches emphasise the development of personality traits. Underpinning psychodynamic approaches is the belief that thinking can be explained through the way that various motives, conflicts, emotions, processes and structures in the psychic system interact. Openness to the so-called preconscious processes is considered to be important for creativity. The methodological approach to research in the psychodynamic tradition is through case studies and there are those which appear to demonstrate increased creativity following psychodynamic input/training. However, it is clearly problematic to generalise from such investigations. In addition, it is not possible to compare the creativity of equivalent individuals who did not have the input.

- Humanistic approaches

These approaches concentrate on growth within the individual agent. Creativity is understood as self-creation, ie the generation of personal identity and agency. Humanistic studies have also been undertaken using the case study approach and again suggest that humanistic training can influence the individual's effectiveness in creating their own life plan.

- Behaviourist approaches

Behaviourism as a branch of psychology has not taken creativity to be a major focus of work. However, Rhyammer & Brolin (1999) suggest that some educational programmes contain within them behaviourist assumptions. Broadly speaking, behaviourists place emphasis on the significance of the environment in influencing the behaviour of the individual. Implicit within behaviourist programmes is the assumption that creativity is learned and that it can be fostered through stimulus, reinforcement and response and that individuals learn to be creative at different rates, although all can be taught, through this method, to become more creative.

Creative Teaching Methods for every 21st-century teachers

- Flipped Classroom

One of the modern methodologies that have gained more popularity in recent years is the Flipped Classroom. It is a pedagogical model in which the traditional elements of the lesson taught by the teacher are reversed: the primary educational materials are studied by the students at home and then they are worked on in the classroom. The main objective of this methodology is to optimize class time

by dedicating it, for example, to meeting the special needs of each student, developing cooperative projects or working on projects. Flipped classroom activities allow students to demonstrate creativity and ingenuity, increasing the worth and uniqueness of work.

Source: https://shutterstock.com

Furthermore, flipped learning can enhance the artistic value of work and let students perceive and compare the advantages and shortcomings of their own work and that of others' work. Students can sum up the characteristics of creative works and thus strengthen their critical thinking and creativity. Hsieh (2003) found that peer assessment may provide students with opportunities to enhance critical thinking and the ability to express appreciation.

- Project-Based Learning:

Project-based learning (PBL) creates a learning environment that fosters creativity and teamwork, and teaches children to use the tools at their disposal to find innovative solutions to problems that are always changing. With the influx of innovative methodologies in schools, both new teaching techniques and new forms of existing teaching approaches have emerged, now revised for digital generations.

One of the most used in class today is Project-Based Learning (PBL). At its core, the PBL enables students to acquire knowledge and key competencies through the development of projects that respond to real-life problems. Starting from concrete and real problems rather than traditional theoretical and abstract models, opportunities to develop complex skills such as critical thinking, communication and collaboration seem obvious, as well as increased students 'ability to remember information. or problem-solving.

- Problem-based learning:

Source: iStock

Problem-based learning is a cyclical learning process consisting of many different stages, starting with asking questions and acquiring knowledge, leading to more questions in one cycle of increasing complexity. Putting this methodology into practice does not only involve the exercise of inquiry by the students, but also converting it into useful data and information. According to multiple pedagogues, the four great advantages observed with the use of this methodology are:

a. The development of critical thinking and creative skills

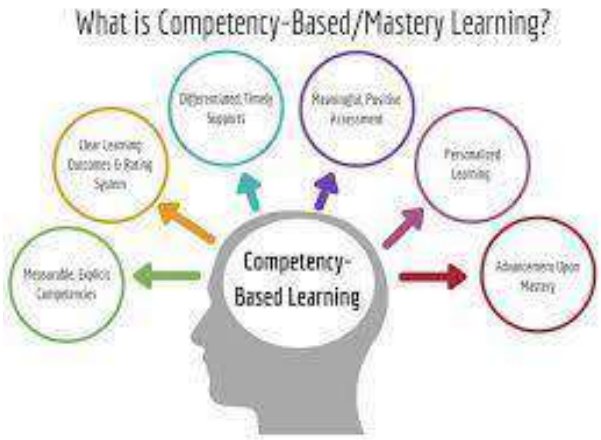
b. Improving problem-solving skills

c. Increased student motivation

d. The best ability to transfer knowledge to new situations

- Competency-based learning model

In a competency-based learning model, the instructor is required to identify specific learning outcomes in terms of behaviour and performance, including the appropriate criterion level to be used in evaluating achievement. Experiential learning is also an underpinning concept competency-based learning is learner-focused and often learner-directed.



Source: iStock

The methodology of competency-based learning recognizes that learners tend to find some individual skills or competencies more difficult than others. For this reason, Gervais asserted that the learning process generally allows different students to move at varying paces within a course. Additionally, where many traditional learning methods use summative testing, competency-based learning focuses on student mastery of individual learning outcomes. Students and instructors can dynamically revise instruction strategies and based on student performance in specific competencies.

- Cooperative learning

Source: https://innovationtraining.org

Cooperative learning is often defined as a pedagogical strategy where small, heterogeneous groups of students are requested to work together for a given period to accomplish shared learning goals, fulfilled

if all group members are committed to their assignments (Johnson, Johnson,& Smith, 2014). Cooperative learning is a teaching and learning method that aims to achieve a common goal through collaboration with group members (Johnson, & Johnson, 2014). Students encourage and support each other, assume responsibility for their own and each other's learning, employ group related social skills, and evaluate the group's progress. Working together also promotes the students' skills for their learning autonomy. It is an effective teaching method for students to acquire problem-solving skills, critical thinking skills and creativity instead of fragmentary knowledge acquisition.

- Design Thinking

Design Thinking is an iterative process in which we seek to understand the user, challenge assumptions, and redefine problems in an attempt to identify alternative strategies and solutions that might not be instantly apparent with our initial level of understanding. At the same time, design thinking provides a solution-based approach to solving problems. Design thinking is a non-linear, iterative process that teams use to understand users, challenge assumptions, redefine problems and create innovative solutions to prototype and test. Involving five phases—Empathize, Define, Ideate, Prototype and Test—it is most useful to tackle problems that are ill-defined or unknown.

Source: innovationtraining.org

Education has always been a space par excellence for innovation. Teachers around the world are constantly bringing new ideas and methodologies to the classroom by making the best use of the tools at their disposal. Design Thinking (DT) - or "Design Thinking" - was born with designers and their method of solving problems and thus meeting the needs of their clients. Applied to education, this model makes it possible to more accurately identify the individual problems of each student and generate in their educational experience creation and innovation towards the satisfaction of others, which later becomes symbiotic.

Key concepts

Design thinking: is a process for creative problem-solving. Design thinking has a human-centred core

Creativity: is a phenomenon whereby something new and valuable is formed

Flipped classroom: a flipped classroom is an instructional strategy and a type of blended learning, which aims to increase student engagement and learning by having pupils complete readings at home and work on live problem-solving during class time.

Reflection

Are you familiar with creative teaching approaches? Do you use any? If yes, which one?

For creativity which components does someone need?

Additional resources

Winner, E., & Cooper, M. (2000). Mute those claims: No evidence (yet) for a causal link between arts study and academic achievement. Journal of Aesthetic Education, 34, 11–75. doi:10.2307/3333637

The National Art Education Association. (2002). Authentic connections: Interdisciplinary work in the arts (ED470397). Reston, VA: Author. Retrieved from https://arteducatorsprod.s3.amazonaws.com/documents/449/4f945f19-b16a-4b5d-9f35

Video Materials

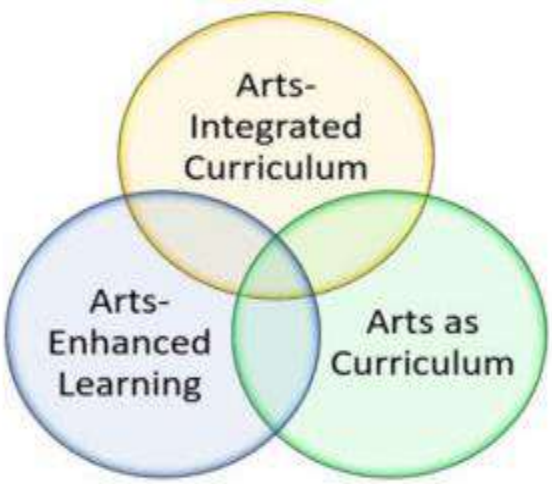
The importance of creativity -https://www.youtube.com/watch?v=-Qi0MN0tJIk

What is Creative Learning- https://www.youtube.com/watch?v=fJaAVX1hbak

6.3 Art Integration in Schools

Art is important because it is an essential component of human culture, heritage and creativity, summing up ways to know, present, represent, interpret and symbolize human experience. Growing recognition of a link between arts learning and achievement creates an emergent, critical question for research, one that presses beyond questions of whether the arts impact student learning and moves into deeper explorations of how the arts might facilitate student growth. If learning with and through the arts is correlated with higher achievement and other evidence of learning, what special qualities or processes of arts education might be supporting students' growth?

What is the difference?



Source: https://artsintegration.org

A. **Arts as Curriculum** are the arts programs that many schools offer: music, drama, dance, theatre and are offered for students to develop knowledge and skills in a particular art form guided by national, state, or local standards for each of the art forms.
B. **Arts-Enhanced Curriculum** is when the arts are used as a device or strategy to support other curriculum areas, but there are not objectives in the art form explicitly being taught. For example, using music to teach letter names and sequence in the alphabet is an arts enhancement. Music is used as a means to other ends, but students are not usually expected to learn about melody, musical concepts, or singing skills. Arts-enhanced curriculum acts as a "hook" to engage students in learning other content and educators need little or no training in the art form.
C. ***Arts-Integrated Curriculum***, the arts become the approach to teaching and the vehicle for learning. Students are engaged in dual learning objectives as they engage in the creative process to explore connections between art forms and other subject areas to gain greater cross-cutting understandings. The experience is mutually reinforcing and results in deeper meaning-making in both the arts and other curricular areas. Arts-Integration requires that educators engage in professional learning about arts standards and how to authentically connect the arts to the curriculum they teach.

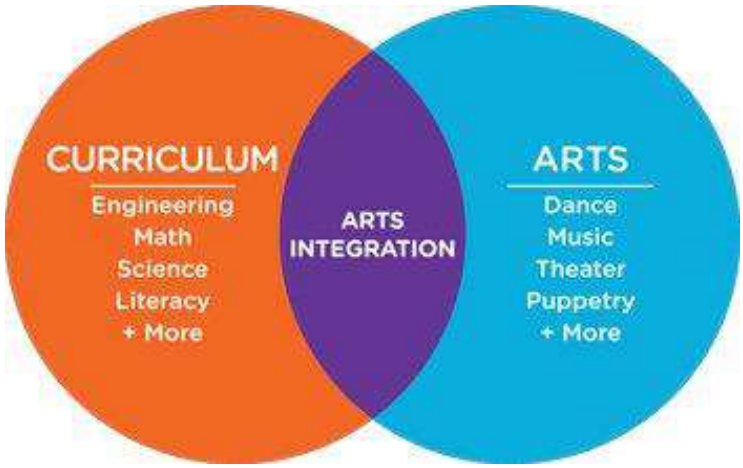
What is an Art-Integrated Curriculum? And Why Art Integration Is Important?

Arts Integrated Learning is an innovative approach to teaching and learning which ensures effective and joyful classroom transactions in order to secure the attention of students, motivate learners, support the active participation of students in the classroom process and enable them to develop their thinking abilities. Robinson (2013) defined arts integration in three categories**: arts integration as learning through and with the arts, arts integration as a curricular connection process, and arts integration as a**

collaborative engagement. Arts integration basically deals with the integration of various art forms with the curriculum in order to make learning meaningful and effective. AIL incorporates skills of planning and organising age-appropriate art experiences to make the learning of different subjects appealing and interesting, provides creative space for every learner to explore, experience and express and also cater to individual needs and preferences.

Arts Integrated Learning (AIL);

- is the process of teaching through artistic mediums, such as dance, music, visual arts, theatre, and many more.) is an innovative and cross-curricular approach to teaching and learning, which integrates different art forms with school subjects.
- is not giving students an art project to supplement a lesson. Rather, it is using the medium to teach the lesson in innovative ways.



Source: maxpixel.net

This definition emphasizes the dual process of learning through arts and traditional subjects. In line with a constructivist view of teaching, arts integration emphasizes in-depth knowledge, meaningful and relevant concepts, and connections that are linked between numerous subjects and with elements of life outside of school. Constructivist practices that align with arts integration practices include:

- Drawing on students' prior knowledge,
- Providing active hands-on learning with authentic problems for students to solve in divergent ways,
- Arranging opportunities for students to learn from each other to enrich their understandings,
- Engaging students in reflection about what they learned, how they learned it, and what it means to them,
- Using student assessment of their own and peers' work as part of the learning experience,
- Providing opportunities for students to revise and improve their work,

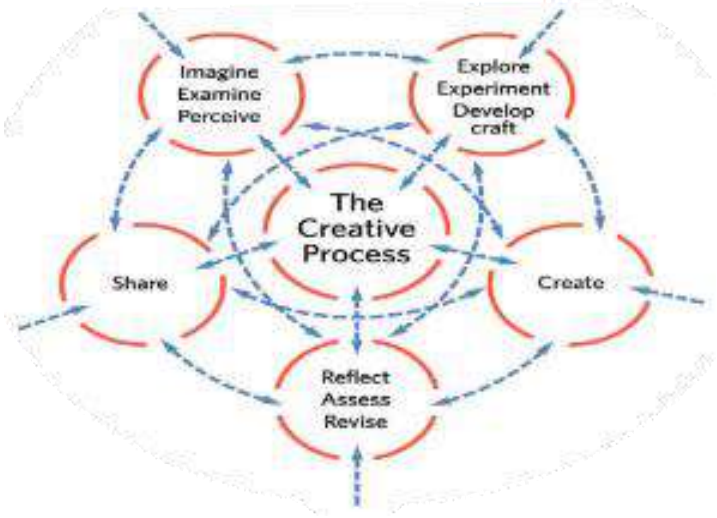
- Building a positive classroom environment where students are encouraged and supported to take risks, explore possibilities, and where a social, cooperative learning community is created and nurtured.

Stevenson and Dewey claimed that "In the arts, students have central and active roles as meaning makers. This role demands that they not only acquire knowledge but they develop the capacity to reflect on what they are learning and to use it as they interpret and create works of art." Students' visible demonstrations of learning serve as both formative assessments to guide instruction and summative assessments to determine what students have learned. For example, when students are challenged to work as choreographers to create a dance that demonstrates how the seasons change, they must build their understanding of the vocabulary and concepts shared by science and dance (such as rotate, revolve, cycles, patterns, and change). Their dance will reflect their understandings and provide teachers with a quick, effective means to determine whether individual students know the difference between rotate and revolve, if a group understood the cyclical nature of the seasons, or if the class has mastered how to demonstrate the concept of change through physical movement.

Source: https://pxhere.com

Why the Arts? Reasons for Developing an Arts-integrated Curriculum

The creative process in the arts is a process not a single event. It includes many interacting phases and each phase is related to every other. There are many descriptions of the creative process. The one provided here is a synthesis of ideas from many different sources. In this diagram, the process is made visible as five open circles.



Source: https://commons.wikimedia.org/

1) Students imagine, examine, and perceive.

2) They explore, experiment, and develop crafts.

3) They create.

4) They reflect, assess, and revise, and share their products with others.

Arrows indicate the ways one can enter the process and the myriad ways the phases interact.

The Consortium of National Arts Education Organization (1994) defines art integration as “the use of two or more disciplines in ways that are mutually reinforcing, often demonstrating an underlying unity”. A key concern here is to utilize the arts as a bridge in identifying shared concepts, contents, and skills across the disciplines, and in searching for appropriate methods to acquire inter-disciplinary knowledge (Russell and Zembylas, 2007). This is usually achieved by proposing themes or projects that would include common ideas.

The pedagogy contained in the art-based process accommodates space for varying paces of individual children. The learning and developmental needs of all children including children with special needs, weaker socioeconomic backgrounds and diverse cultures benefit from performance and expression through the medium of art. Art encourages, promotes and implements learning and living to be part of the natural process. Arts integration advocates claimed the arts offered unique, innovative, and engaging ways to approach teaching and support learning. Studies confirm the arts can be used as a way to transfer knowledge. The concept of —transfer in which —learning in one context assists learning in a different context has intrigued cognitive psychologists for at least a century (Catterall, 2002, p. 151).

Using this approach, the arts are a facilitator of learning. Rabkin and Redmond (2004) stated that integrated arts education is not arts education as we generally think of it. It is designed to promote a transfer of learning between the arts and other subjects, between the arts and the capacities students need to become successful adults.

Arts integration requires teachers to set objectives in both the art form and the other subject area. The dual objectives are balanced; students are accountable for significant learning in both the art form and the other subject. Second, just as objectives evolve and challenge students to deepen their understandings in science, math, or language arts, objectives in the art form must also evolve if students are to remain challenged.

For example

A student does not learn to express ideas through dance in one session. Objectives evolve and unfold over time as students' experiences and understandings develop. As students master each objective, they are ready to take on the next, more challenging ones. Teachers monitor student progress and adjust objectives to keep students challenged and interested within a unit or across a year. As students' mastery grows, so do their feelings of self-efficacy—the belief in oneself and one's ability to achieve.

Here is an example in dance:

- The objective is for students to create and perform a movement phrase set to a piece of music. This objective can begin with small groups of students choosing their movement phrase from a limited set of options and where the teacher counts the beat aloud.
- Once mastered, the objective evolves as students create their own movement phrase without pre-set options and can recall and repeat it. The objective further evolves as students are able to count the beat on their own. The objective evolves again as students are challenged to refine the quality of their movements.
- The evolution of objectives can pertain to one specific experience with a dance or can evolve as students have multiple experiences with dance across a school year.

Ways to Integrate Art in the Classroom

1. Encourage the use of art-related vocabulary.

Teach students words that are related to art and encourage their use on a daily basis in conversation and presentations.

2. Integrate art into other subject areas.

Show how art can relate to other subjects, like science (for example, observing the change in state or colour of a living thing or plant), math (geometric shapes, measuring), social studies (history told through paintings and photographs, acting out historical events through drama), and writing (write a critique of a famous work of art).

3. Allow students to explain their thoughts, ideas, and feelings through drawing and labelling.

Some students have a difficult time expressing themselves through writing. Children, especially those learning English or with special needs, might find that drawing helps them explain themselves and communicate better. Vocabulary, grammar, and writing can then be developed based on their art. In addition, visuals help students better understand written words by providing more context, thus helping them connect meaningful input to a particular topic or text.

4. Delve deeper into units of study.

Students can create dioramas, models, sculptures, illustrations, or other relevant artefacts to better understand concepts in history as well as other subject areas.

5. Allow students the opportunity to role-play.

Understanding a story, character, or event is easier for some students to understand if given the opportunity to act it out. Whether students act out just a part of a text or conduct a “readers’ theatre” activity where each student acts out a part of a text, role-play will help students develop confidence and understanding in a much more meaningful way.

6. Allow students to move and perform.

Get students moving and up out of their seats by incorporating dance movements. Students can pose and act like historical figures, move their bodies to the sounds of music played during a particular time in history, or pretend to be particular objects learned about in science class. Anytime students can move around, engagement will increase as learning becomes fun and meaningful.

7. Learn through song.

Songs and music help students understand and retain information. They also develop listening skills and learn musical elements, such as tone, beat, and rhythm. In addition, songs can help students learning English understand grammar and vocabulary in a way that they can remember. Art is essential in schools as a way of addressing the physical, social, emotional, and cognitive needs of children. It also allows children to use and develop many important skills, including problem-solving, predicting, design,

vocabulary development, abstract thinking, and cause and effect, to name a few. The arts also offer children the opportunity to explore and investigate.

Arts Integration Checklist

Many teachers confuse any inclusion of the arts in the classroom with arts integration. While all types of arts-based instruction are encouraged, it is helpful for teachers to know if they are engaged in arts integration. To clarify its distinctive nature, an Arts Integration Checklist is provided. Teachers answering yes to the items can be assured that their approach to teaching is indeed integrated.

ARTS INTEGRATION CHECKLIST		
APPROACH TO TEACHING		
1. Are learning principles of Constructivism (actively built, experiential, evolving, collaborative, problem-solving, and reflective) evident in my lesson?	Yes	No
UNDERSTANDING		
2. Are the students engaged in constructing and demonstrating understanding as opposed to just memorizing and reciting knowledge?	Yes	No
ART FORM		
3. Are the students constructing and demonstrating their understandings through an art form?	Yes	No
CREATIVE PROCESS		
4. Are the students engaged in a process of creating something original as opposed to copying or parroting? 5. Will the students revise their products? 6. Will the students share their products?	Yes Yes Yes	No No No
CONNECTS		

7. Does the art form connect to another part of the curriculum or a concern/need? 8. Is the connection mutually reinforcing?	Yes Yes	No No
EVOLVING OBJECTIVES		
9. Are there objectives in both the art form and another part of the curriculum or a concern/need? 10. Have the objectives evolved since the last time the students engaged with this subject matter?	Yes Yes	No No

Key Concepts

Art Integrated Learning (AIL): is a teaching-learning model which is based on learning 'through the arts' and 'with the arts'

Art: is a highly diverse range of human activities engaged in creating visual, auditory, or performed artefacts— artworks—that express the author's imaginative or technical skill, and are intended to be appreciated for their beauty or emotional power.

Reflection

Do you use Art Integrated Curriculum? If yes, how?

Do you find yourself sufficient to use the education program integrated with art?

Additional resources

Use Arts Integration to Enhance Common Core: https://www.edutopia.org/blog/core-practices-arts-integration-susan-riley

Peppler, K. A., Powell, C. W., Thompson, N., & Catterall, J. (2014). Positive impact of arts integration on student academic achievement in English language arts. The Educational Forum, 78, 364- 377. doi:10.1080/00131725.2014.941124

Hardiman, M. M. (2012). The Brain-Targeted Teaching Model for 21st-Century Schools. Thousand Oaks, CA: Corwin Press.

Burnaford, G., Brown, S., Doherty, J., & McLaughlin, H. J. (2007). Arts integration frameworks research and practice: A literature review. Washington, DC: Arts Education Partnership.

Video materials

The Art of Learning Integration Through the Arts: https://www.youtube.com/watch?v=1CdwDDFrg7s

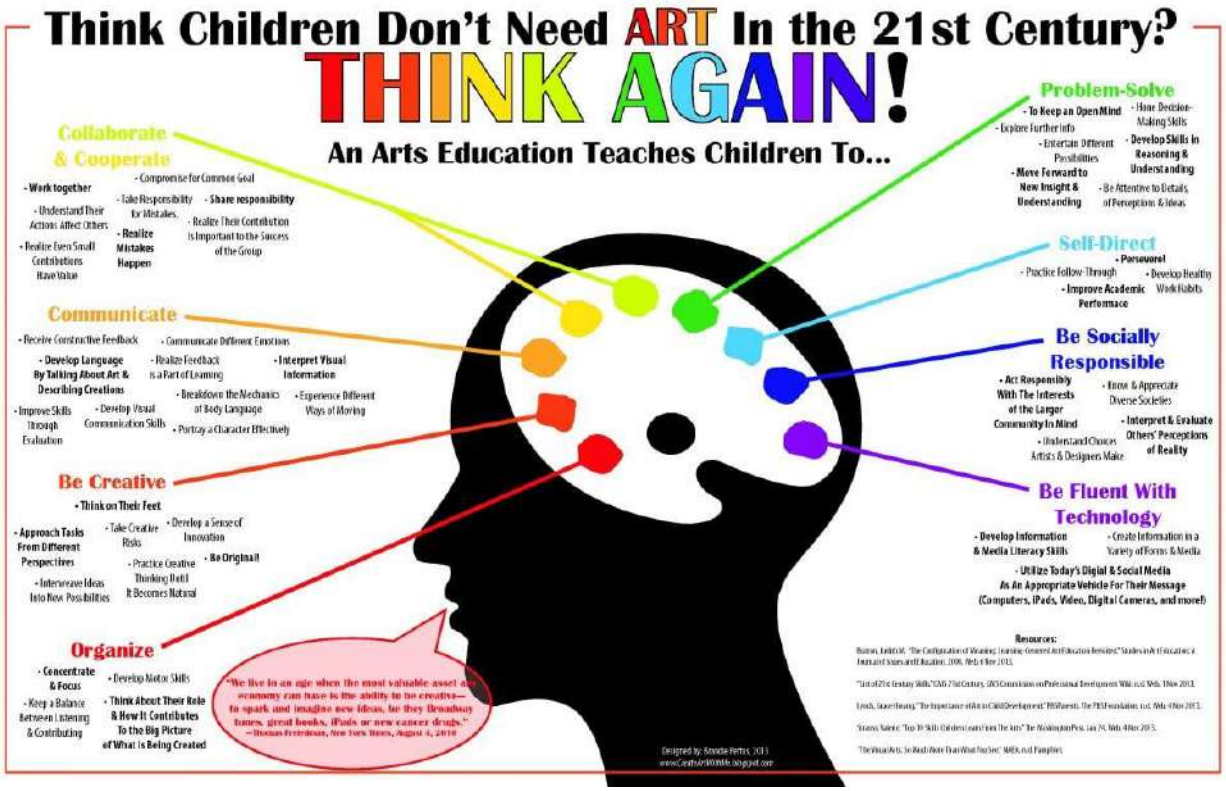
Arts Education versus Arts Integration: https://www.youtube.com/watch?v=O6mtls3Opaw

6.4 Transforming Art Education in Digital Age

Art is a notion as old as human history. Art existed in every place where humans lived. Every society owned its unique art throughout the universal history of art. If there is a community of people where there is a life that required material life, intuition, subconscious mind, art has shown itself as an effect of instinct and continues to show.

Art is a form of expression which is based on the concept of aesthetics. It is a tool to understand and interpret objects and events. Art is also a communication tool that uses a variety of ways. Art is the most comprehensive and singular area of people's cultural life and personal experience. In this context, there is not any other lesson, experience or field that can provide as much value as art. Ever since ancient times, philosophers have made different definitions of art and each of these definitions has assigned responsibilities according to their perceptions of the world. Over time many of the definitions focused more on what art is good for rather than what it is. Eventually, all of these definitions have referred to its importance and necessity in human life. In antiquity, Aristotle interpreted art as " Art does not reflect

reality but what it should be" (Artun, 2009: 20).



Source: http://createartwithme.blogspot.com/

In the 21st century, the rapid development of modern science and technology, this new digital art, is a gradual deepening of our lives, and aroused widespread concern and attention. The formation of a new art form independent aesthetic value of works of art after Broadly speaking, digital art refers to the use of digital technology and information technology, image, video, text, and voice to be digitized and integrated design and use of, it is interactive and online media to use the basic features, including online games, computer illustration, video effects, digital imaging, virtual reality, digital music. Can also say that all computer technology produced by the media culture can be attributed to the category of digital art, digital art computer technology, the need to involve the knowledge of culture, art and design, computer and information technology and other fields.

The arts, particularly the new digital arts, play a central role in empowering society—how they see themselves, how they learn about the world, and how their work can impact the broader socio-political landscape. This perspective is especially important in an age where social networks and online communities provide widespread distribution of new perspectives (Jenkins et al., 2009; Shirky, 2008). Digital art is an artistic work or practise that uses digital technology as an essential part of the creative

or presentation process. Since the 1970s, various names have been used to describe the process including computer art and multimedia art, and digital art is itself placed under the larger umbrella term new media art.

How to transform?

An integrated arts and technology curriculum requires teachers with strong conceptual understandings (Gouzouasis, 2006). Accompanying changes in technology and digital media is the growing need for professional development for art teachers in the area of digital technology. Change in the digital technology field is so rapid that art educators are challenged to keep abreast of changes and to incorporate them into their programs (Sabol, 2006)

Source: https://theartofeducation.edu

- Strengthen the Innovation and Improvement of Curriculum and Teaching Mode

The emergence of digital media technology has provided a new way for artistic design and creation, and art design works also become diversified because of the integration of digital media technology. From the depth of artistic content to the display of artistic achievements, the innovation of educational curricula must be scientific, flexible and characteristic. Adjust the proportion of teaching and practice to cultivate students' comprehensive ability in art design. For example, the proportion of courses is arranged at 60%, and the proportion of digital media technology is arranged at 40%.

Teachers teach through the use of digital media techniques for artistic expression, put digital media technology and art throughout the teaching of art design in order to make students deeply understand that in the continuous development of the information age, excellent artistic creation works cannot do without the support of technology, and the performance of technology and art will also impact students'

innovative thinking concepts and thinking patterns. In the actual digital media art design teaching, teachers should integrate the language of art design into digital media design, which can not only enable students to use computer technology to achieve a high level of creativity but also enable students to design artworks with high aesthetic value. In addition, in the process of learning art design software, students must master the skills and rules of learning digital media art design.

- Strengthen the Construction of Strength and Comprehensive Quality Training of Teachers

The creative thinking in digital media art design education should be built in the teachers' team construction and the reasonable content of teachers' curricula. Under the pressure of the new curriculum reform, teachers, as the soul of teaching, should not only broaden their horizons but also enhance their own technical level and artistic aesthetic ability. The teaching contents and forms have a direct impact on students' interest in and degree of mastering knowledge. At present, with the rapid development of information technology and the full coverage of the Internet, digital media art design is one of the new professional disciplines in the field of art education, its teaching content not only needs to be synchronized with the current demand for art, but also needs to be synchronized with the market economy.

Source: http://www.ijea.org/v15n6/

- Strengthen the Practicality of Digital Media Art Design Education

The digital media art design is scientific and practical. The birth of design work must be built on the basis of professional technology to achieve the perfect combination of technology and art. An excellent art design work needs not only the innovation of cultural creativity, but also the combination of the practical application of digital media technology and artistic creation ideas. An artistic design work

should be targeted, technical and practical. In addition, art colleges and universities can work with design projects from all walks of life to create training bases for practical practice, innovation and entrepreneurship, so that students can improve their digital media art design skills from these projects. Adapting to the needs of contemporary society and innovating the teaching curriculum system and form can make the whole digital media art design education better to promote the production of art and culture. The digital media art field not only realizes cultural innovation, but also impacts students' innovative thoughts (Jiang & Zhang, 2018).

The New Digital Arts:

- Visual Arts

Digital visual art consists of either 2D visual information displayed on an electronic visual display or information mathematically translated into 3D information, viewed through perspective projection on an electronic visual display. The simplest is 2D computer graphics which reflect how you might draw using a pencil and a piece of paper. In this case, however, the image is on the computer screen and the instrument you draw with might be a tablet stylus or a mouse. The second kind is 3D computer graphics, where the screen becomes a window into a virtual environment, where you arrange objects to be "photographed" by the computer. The visual art tools such as Painter7 and iPad/iPhone/Android apps, the Nintendo DS Art Academy enables players to use traditional tools in a virtual environment, learning the basics of drawing, mixing colours, and shading. Browser-based tools that allow for image production and manipulation are often available without any licensing fees.

- Comics and Manga

Many new technologies are dedicated exclusively to aiding designers in creating manga-style illustrations (such as Web tools on www.toondoo.com and http://www.pixton.com, or mobile apps such as ComicBook! by 3DTOPO), while several widely available image manipulation platforms (such as Photoshop and iPhoto) include built-in filters to apply the look and feel of comics to digital photos.

- Digital Photography

The widespread availability and affordability of new digital cameras is rapidly lowering the barriers to entering the field of photography, as well as changing the landscape of this art form (Ito et al., 2010). Making and posting digital photographs is one of the primary pathways into digital art-making. Students can use popular software such as the Adobe Photoshop Series, Adobe Elements, iPhoto, and freeware

such as Gimp and Fotoflexer. In addition to sharing photos through social network sites, teachers frequently join Flickr, Photo.net, Fotki, Myshutterspace, Eyefetch, and other online communities.

- Dance

Like other artistic disciplines, dance now intertwines technological elements in teaching, performance and choreography. The integration of modern dance and technology began with the post-modern dance movement when teachers and choreographers used video and film to catalogue, critique, and promote existing dances (Birringer 2002). (Channels such as YouTube, BoogieZone, dancejam.com, dance.net, and MTV.)

- Digital Music

A flood of new mobile apps, such as Beatwave, Sonorasaurus, Pattern Music, and Looptastic, is expanding the opportunities for music creation. As these programs redefine what it means to be a 21st-century music education, new technologies are expanding the channels through which people perform and learn about music. The music education community has long lamented that many students fail to connect the repertoire, instruments, and skills embodied in informal music activities (e.g., rock music, garage bands, songwriting and the cultural capital that comes with those activities) to formal music education.

- Drama

Using drama as a teaching tool integrates social, emotional, and cognitive development while meeting academic benchmarks. . Common tools that are used for drama education such as iMovie; recording software such as Screenium, iChat, and iDVD; video cameras; cellphones; and computers; as well as Web-based tools such as Xtranormal, GoAnimate, Animasher, Toondoo, and Masher. Some teens are using video game consoles like the PS3, Xbox, and Wii for their productions, particularly of machinima (described in further depth below). Media education studies have slowly been acknowledging the importance of video to identity development and the broader media education curriculum (Buckingham, 2003; Halverson, 2010; Goodman, 2003; Fisherkeller, 2002).

- Integrated Art / Mixed Media and Hybrid Painting

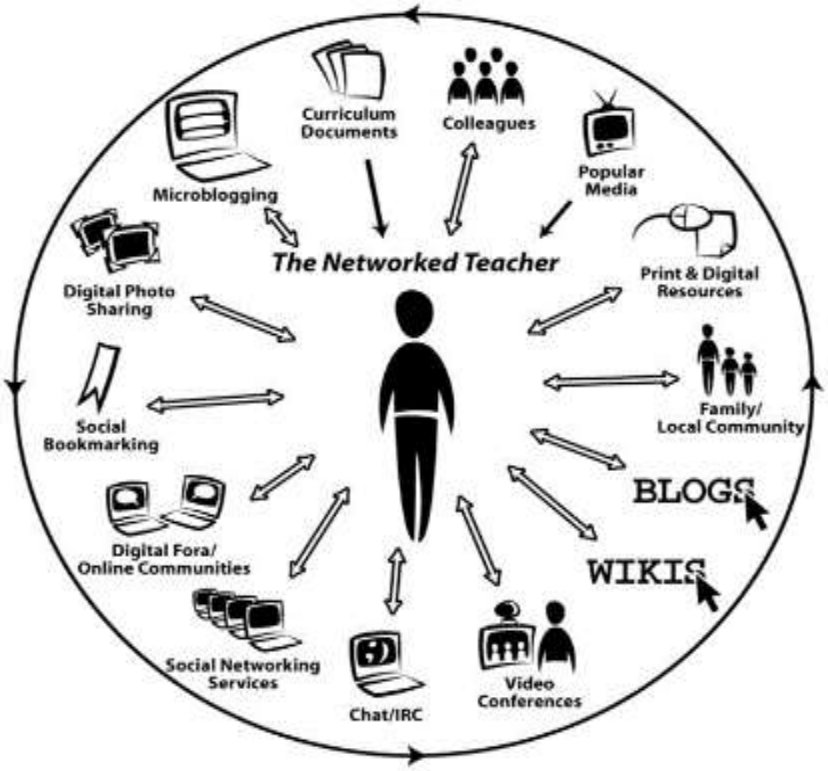
The original meaning of this term is a combination of more than one form of art, also known as “interdisciplinary art”, that is mostly used in learning environments to help the audience grasp a concept better, or can also be for the sole purpose of entertainment. In this type of art, there is a lesser influence

of restrictions when it comes to the digital environment rather than conventional mediums. The artist has immense control over how he/she wants the outcome to look like.

Why transforming? : The Importance of Digital Arts Education

Teaching art by digital means is a big challenge for the majority of teachers of art and design in primary schools, yet it allows relationships between art, technology and creativity to be clearly identified. There is no magic to digital tools. The magic comes from how we teach our students to foster their creativity. Generations before us have been using new technologies in different forms. Using chalk on chalkboards and pencils on paper were once novel ideas.

A look at research into the use of digital tools tells us that appropriate and effective tools are needed to allow the student to be in control, opening the world of technology to his/her perceptions and abilities and allowing him/ her to think creatively. The teacher has a significant role to play in helping pupils to understand how the process of creativity can be developed through the use of digital tools, and in promoting awareness of how and when they can be used in the digital art classroom.



Source: https://www.flickr.com

- Technology gives students a new way to create art.

Technology in the art studio is a great way to get your students to use a different type of medium. There are several apps with which students can create their own art as well as manipulate the traditional art they have made.

- Apps like these Aviary, Paper 53, Doodle Art, Green Screen, KaleidaCam, PicsArt, Procreate show students that there are other forms of art out there like animation, green screen, and iMotion videos.
- Technology offers many apps that allow for the transformation of traditional art.

Students have the opportunity to transform the art they have created with a variety of apps. There is also a term called "app smashing" in which students can use two or more apps to transform their artwork. For example, students can take a photo of a drawing and edit it with Aviary. From there, the student could take it into another app, such as PicsArt, to add different edits.

- Technology allows for flipped learning.

Flipped learning can be a great way to share information with your students without continuously repeating yourself. If a student is late or absent, they can watch video demonstrations created using technology such as Chromebooks or iPads. Many art teachers have begun to use the flipped model to cut down on time spent reteaching concepts, when they are absent, or for student-directed learning. Flipped learning works in all types of art rooms and can be very helpful.

- Technology can transform your teaching strategies.

Resources like projectors, document cameras, iPads, Chromebooks, and SMART boards can take teaching to the next level. We are past the times of "sit and get" where students are following a book word for word or listening to lectures. Technology allows educators to transform education and present information in new, effective ways. There are even websites available to take students on virtual tours of museums like the Louvre.

- Technology provides ways to easily track student progress.

Digital portfolios have become popular in many art rooms. They are effective ways to see what your students are working on as well as a place for them to organize their work—and they don't take up any space. A few popular apps for digital portfolios include Creatubbles, SeeSaw, and Artsonia. Some art teachers even use Google Classroom as a way for older students to document their work.

- Technology offers a variety of opportunities to integrate formative assessments.

Assessment in the art room can be overwhelming depending on the number of students you have in your class. Technology can help ease this burden by creating fun, easy, effective ways to conduct organized formative assessments in your class. Depending on the app or platform you choose, you can cut down on paper and consolidate data in one easily accessible place.

- Technology promotes engagement.

A key concern in classrooms is student engagement. In order to reach your students, the learning activities should be engaging. Technology is a great way to get your students engaged and interested in discussion topics. Whether it is viewing a Google Slide presentation of famous art or being assessed using Plickers, both can grab students' attention easily. They are interactive ways of learning that promote student engagement. Whether you use loads of technology or are just getting started, the fact that you are implementing forms of technology in your class is a step in the right direction.

- Technology gives instant shareability

Because digital art creation is already stored on a digital device, it is easier for artists to share their work in its highest form. Work can be shared digitally on websites and through social media instantly. Sure, a photograph of a painting doesn't usually do the physical features of the painting justice, but it can communicate the overall idea.

Key concepts

Digital art: is an artistic work or practise that uses digital technology as part of the creative or presentation process

Digital media: means any communication media that operate with the use of any of various encoded machine-readable data formats.

Technology: is the sum of any techniques, skills, methods, and processes used in the production of goods or services or in the accomplishment of objectives, such as scientific investigation.

Reflection

How can we improve art integrated lessons?

How are the art integrated lessons in your country? What is similar or different compared to other countries?

Additional resources

British Educational Communications and Technology Agency (Becta). 2003. What the Research Says about Barriers to the Use of ICT in Teaching. https://mirandanet.ac.uk/wp-content/uploads/2019/06/wtrs_11_ict_teaching.pdf

Wilks, J., A. Cuthcer, and S. Wilks. 2012. "Digital Technology in the Visual Arts Classroom: An [Un] easy Partnership." Studies in Art Education 54 (1): 54–65. doi:10.1080/00393541.2012.11518879.

Tusiime, W. E., M. Johannesen, and G. B. Gudmundsdottir. 2019a. "Developing Teachers' Digital Competence: Approaches for Art and Design Teacher Educators in Uganda." International Journal of Education and Development Using Information and Communication Technology (IJEDICT) 15

Video materials

How artists transform everyday objects: https://www.youtube.com/watch?v=DCgWn8fFKAQ&t=44s

What is Digital Art? https://www.youtube.com/watch?v=2RWop0Gln24

6.5 Assessment

1) Which is not correct about creativity?
   a) Is the ability to solve problems and raise new questions.
   b) Is a phenomenon that might help us not only in particular issues but also in our whole life.
   c) Is a rare gift and happens in the right hemisphere of the brain.

2) Which one is among the Creative Instructional Cycle process?
   a) Teach the lesson in line with the curriculum.
   b) Identify a strategy and design a creative teaching lesson.
   c) Present information to the students who are passively receiving it.

3) According to the comprehensive model which is not subhabit?
   a) Inquisitive
   b) Unquisitive
   c) Imaginative

4) As a teacher, which creative teaching methods can you use;

a) Lecture method
b) Inductive method
c) Project-based methods

5) “The arts become the approach to the teaching and the vehicle for learning”. Which of the following is the definition of this statement?
   a) Arts-enhanced curriculum
   b) Arts-integrated curriculum
   c) Arts as curriculum

6) Which is not true about art?
   a) Art is reserved only for the talented.
   b) Art existed in every place where humans lived.
   c) Art is a form of expression which is based on the concept of aesthetics.

7) “It is a non-linear, iterative process that teams use to understand users, challenge assumptions, redefine problems and create innovative solutions to prototype and test.” Which of the following creative teaching methods does the above definition belong to?
   a) Problem-based teaching
   b) Design thinking
   c) Brainstorming

Module 7. Creative Thinking

Authors: Roxana Elena ANDREI, Ovidiu ACOMI

Learning Objectives

On completion of this Learning Unit, trainees will be capable of (Bloom taxonomy):

- Comprehending the characteristics of a creative person;
- Applying activities to stimulate creative thinking;
- Defining thinking styles;
- Classifying types of thinking styles;
- Classifying thinking styles due to people's behaviour;
- Analysing a problem due to critical thinking;
- Generating ideas for solving a problem;
- Conducting a problem-solving activity;
- Explaining what critical thinking is;
- Explain the steps of SCAMPER method;
- Apply the SCAMPER method during the lessons;
- Developing modern pedagogy methods.

Introduction

People associate creativity with arts like writing novels, painting, music, crafts, etc., they are all creative endeavours. Not all artists are creative thinkers. There are plenty of jobs that require creative thinking, in spite of having nothing to do with art and crafts. Creative thinking is a part of being creative which results in creativity.

Boden (2001) stated that creative thinking is the ability to bring new ideas that are surprising and valuable in many ways. Creative thinking is related to novelty, to the ability to create something, to implement new forms, to generate a lot of imaginative skills or to make something that already exists into something new (Greenstein, 2012). Furthermore, Abraham (2016) stated that creative thinking is a form of expressing oneself in a unique way.

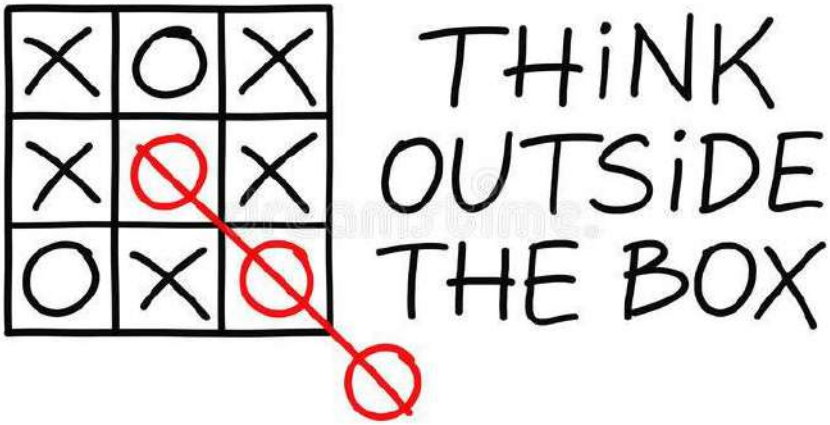
Creative thinking can be incorporated into learning by instructors, so they should be able to carry out the mandate of developing students' creative thinking skills. This is in accordance with the opinions of Wheeler, Bromfield, and Waite (2002), who stated that the teacher's task is to provide the best conditions for students to acquire relevant thinking skills. Creative thinking skills are considered to be very important for students (Baker & Rudd, 2001). Seyihoglu and Kartal (2010) stated that in order to

face the challenges of modern life which is dynamic and full of uncertainty, it is necessary to develop creative thinking skills in learning.

According to Treffinger, Young, and Selby (2002) there are five indicators of creative thinking:

1) fluency, the ability to generate ideas, ways, suggestions, questions, and alternative answers smoothly within a certain time;
2) flexibility, the ability to generate various ideas, answers, or question, where the ideas or answers are obtained from different viewpoints by changing the ways of thinking and the approaches used;
3) originality, the ability to generate phrases, ways, or ideas to solve a problem or make a combination of parts or elements unusually and uniquely that was unthinkable by others;
4) elaboration, the ability to enrich, develop, increase, describe or specify details of the object, idea, product, or situation to make it more interesting;
5) metaphorical thinking, the ability to use a comparison or analogy to make a new connection.

A commonly used phrase "Thinking out of the box" or "thinking outside the box" or "thinking beyond the box" stands for unconventional or different thinking. This metaphor also often refers to creative thinking. Creative thinking means thinking differently or thinking in a different perspective or horizon. Creative people find different ways to solve problems, task and meet challenges. Such people bring unorthodox and fresh perspective to work. Animation film making requires people to have different thinking. It requires different solutions for the same problem. Along with different solutions animation, at times, also requires creativity to add humour to solution and make it interesting and enjoyable. Some people are naturally creative but creative thinking can also be achieved and strengthened by practice.[12]



Source: Dreamstime

[12] Jain A., Jain, N., & Singh (2018). A peek into creative thinking Retrieved from https://www.academia.edu

This module is suitable for every instructor who wants to be a modern one and teach the students skills that are a must in 21st century. The module offers information about complex process that is happening in our lives – creativity. This module has answers to questions such as: Can creativity be learnt? What is thinking? How am I thinking? How are they thinking? How can I resolve a problem? How can I help my students gaining necessary skills?

What is more important is that every aspect has a practical part in which there are presented some recommendations about how to apply the concepts in the classroom. So, there is no difficulty in creating a creative classroom with motivated and curious students.

7.1 Creativity tools

Creativity is an essential skill in the 21st century. Creativity is a necessity for all spheres of life. From the day it was merely related with the field of arts to the day it gained a broader meaning in the sense of creating new and innovative solutions to problems of any kind, creativity is no longer conceived as including only the spectrum of arts, but also all sciences and even daily life.

Today's society therefore has to meet the challenge of satisfying the growing need for creativity and innovation. Creativity needs to be fostered in training and education, in order to produce a creative workforce that is both flexible and competent when tackling complex tasks.

The questions is: Can creativity be taught?

The results of a study (Çubucu & Dündar,2008) benefits of visual analogy indicated that a novice student would be able to produce more creative products by studying former visual examples. Providing such visual examples did not cause fixation for simple design tasks, such as designing a composition to convey the expression of symmetrical balance or harmony. Even one of the greatest painters of all times, Van Gogh was inspired from others such as Eisen, Millet, Rembrandt etc.

Within the creativity community, researchers and practitioners have developed and studied various support tools. It is important to learn from these tools, identifying requirements for improving the future support of creativity in design. Creativity is complex and there are a lot of creativity tools that boost the creative proves. One thing to keep in mind is to choose the best creativity tool that fits for a someone or for a specific team.

Examples of creativity tools

Brainstorming

Brainstorming is known as an individual or group method for creating ideas, increasing creativity, and finding solutions (Wilson, 2013). Based on Osborn (1953), there are four rules for brainstorming. First and foremost, no evaluation should take place during the session, no matter how absurd the ideas may appear. Second, the team should generate as many ideas as possible. Third, wild and crazy ideas are welcome. And the last, creating new ideas on top of each other's ideas is important. One of the well-known brainstorming practices is to write ideas on sticky notes and collaboratively discuss and group them (Kumar, 2012).

During the brainstorming session, the participants have to follow the next four rules[13]:

1. express all the ideas (however wild or mad) related to the problem at hand that come to mind;
2. write all these ideas down;
3. reject self-censorship;
4. use different combinations of all the ideas expressed so far to find new.

Mind-mapping

According to Buzan (2019), mind mapping is one of the effective and creative ways to map and record information to make it stored properly in memory. The activity of making mind maps allows to express managing information by using colors, images and symbols, involving the right and left brains to work together so that information is organized, easy to remember, and easy to understand, so that the information belongs to the students themselves. It is also a a technique for visualizing relationships between concepts and a reflective tool.

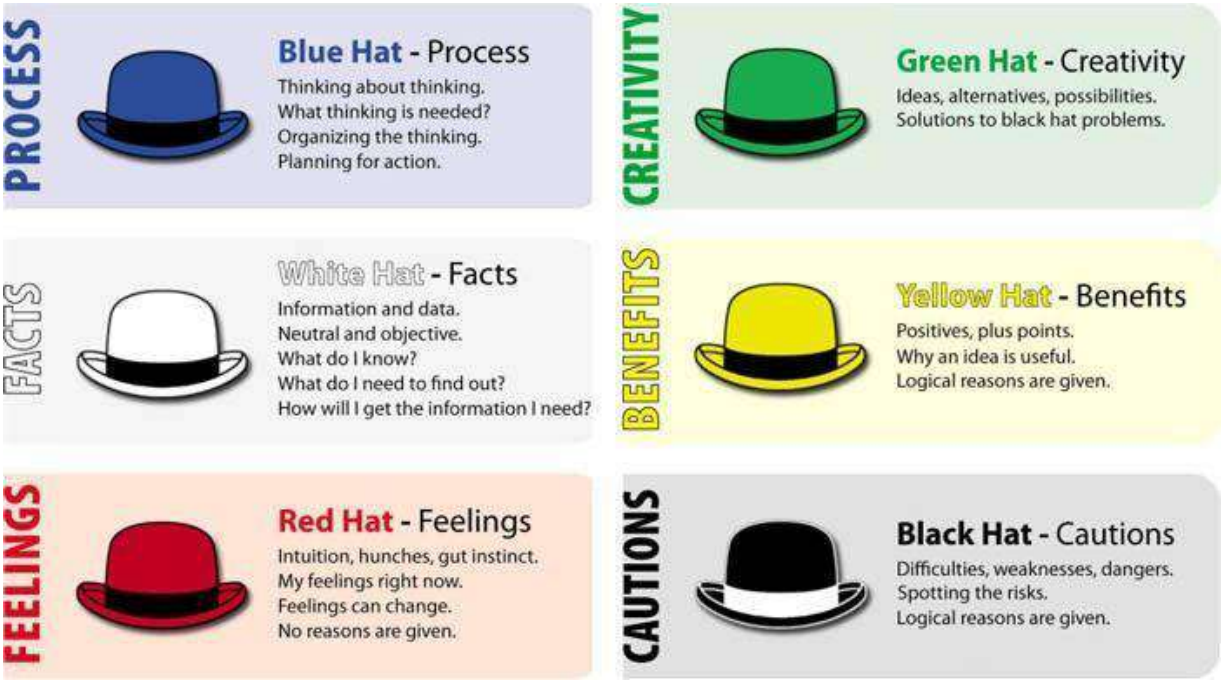
The mind map preparation begins by reading from various sources. Then students determine the main concepts and sub-concepts, described as branches of the main concepts. A good mind map can be in the form of drawings using paper and pencil, produced through student involvement in the processing of material information in depth, thereby adding to the learning experience, understanding of the material, and as an effort to build student's knowledge itself. For teachers, mind mapping can be used to map teaching resources to prepare and monitor lectures. The results show that mind mapping is a creative

[13] Nathalie Bonnardel, John Didier, Brainstorming variants to favor creative design, Applied Ergonomics, Volume 83, 2020, 102987, ISSN 0003-6870, https://doi.org/10.1016/j.apergo.2019.102987. (https://www.sciencedirect.com/science/article/pii/S0003687018305520)

way of guiding and directing students in learning to remember the main concepts and create a learning environment to help processing information.[14]

Six hats

The Six Thinking Hats technique is one of the most important educational techniques used to improve and teach thinking, making the teachers and learners more active and effective. De Bono used his Six Thinking Hats as a technique to look at the making of decisions using different points of view, but the technique is also applicable to other domains. The six hats have different colors, including the color white (information and facts), red (emotions and feelings), black (negative aspects), yellow (positive aspects), blue (assessing things and prioritizing), and green (new ideas).[15]



Source: Cooler insights

[14] Astriani, D., Susilo, H., Suwono, H., Lukiati, B., & Purnomo, A. R. (2020). Mind Mapping in Learning Models: A Tool to Improve Student Metacognitive Skills. *International Journal of Emerging Technologies in Learning (iJET)*, *15*(06), pp. 4–17. https://doi.org/10.3991/ijet.v15i06.12657

[15] Abdelkader M. A. E., Rasha E. S. A. (2021). The Effectiveness of De Bono's Six Thinking Hats Technique in the Development of Critical Thinking and Numerical Sense in Mathematics Education in Oman, pp. 4–17. Doi: 10.17051/ilkonline.2021.01.138

Online creativity tools

Souce: Freepik

Today, using more advanced digital tools and carefully selected programs, students can continue to actively create and communicate their interests, thinking, and understandings of the world around them, especially when they are supported by caregivers and teachers who thoughtfully arrange the tools and programs to support students' playful explorations. Some examples of online creativity tools are:

Apps	Type	Short description
Coogle	Brainstorming	Coggle claims to be the "simple way to share complex information." Its color-coded, intricate mind maps allow your team to enter deeply into ideas and discover new connections between your content. The free version includes real-time collaboration capability, and you can upgrade to the professional version for $8 to access more tools.
Eyewire Creativity Cards	Develop creative thinking	This website is made to boost your team's creativity. The short phrases and questions revealed on the cards are meant to provoke creative thinking to get team members out of a mental block.
GroupMap	Organizing ideas	GroupMap helps moderate and organize group decision-making by analyzing individual opinions and bringing them together logically on a diagram. They have their own templates for specific projects, or you can build your own. You

		can test the application through a 14-day free trial.
Mentimeter	Brainstorming Idea collection	Word Clouds are visual representations of words that give greater prominence to words that appear more frequently. It is useful for brainstorming and idea collection.
Popplet	Mind-mapping	It is a straightforward application that, as many other brainstorming tools online are, is mind mapping-based. It is targeted at students, educators, and businesses. Popplet is a mind mapping tool perfect for people who prefer maps than any other method.

What is more, as a tip and trick, when students can see each other's screens, most children enjoy keeping an eye on classmates' actions. This allows them to discover program tools and functions, and it fosters interaction between students. Children are able to build off each other's ideas while learning to use digital tools and more effectively make creations meaningful to themselves and their peers.

Become a better instructor using creativity tools

Teachers, through their creativity, provide students with learning treatment in the form of changing instructional materials, behaviours, personality, discipline, and exemplary behaviour. The more skilled and imaginative the teacher is in providing learning treatment, the better the results will be. On the other hand, the less professional and creative the teacher is, the worse the results will be.[16]

A creative teacher holds the following qualities (Jeffrey & Craft, 2004):

- Fluency – the capacity to produce many thoughts, answers, and problem-solving solutions from one's mind, as well as provide multiple suggestions for doing different things.
- Adaptability – i.e., the ability to address problems using various methods, consider multiple solutions, and adjust one's way of thinking.
- Originality – the ability to give birth to new and creative expressions, think of unusual ways to convey oneself and combine parts or components

[16] Tamsah H., Ilyas J. B. & Yusriadi Y. (2021). *Create Teaching Creativity through Training Management, Effectiveness Training, and Teacher Quality in the Covid-19 Pandemic* , DOI: 10.29333/ejecs/800

- Elaboration – the ability to create an idea or product and detail an object, idea, or circumstance to make it enjoyable

Source: EFL Magazine

Teachers who are innovative in their teaching practices are more than likely to meet competency standards than those who are not innovative. Three conditions affect the development of teacher creativity in teaching (Gustina & Sweet, 2014). The first is professionalism. Professionalism means that teachers have teaching experience, master numerous teaching and learning techniques and models, are wise and innovative in discovering ways. They can handle learning activities individually and in groups, emphasize high expectations of achievement for any opportunity, and master techniques and study models. Second, they have a distinct personality. These characteristics include being open to new experiences, being sensitive to children's growth, having broad concerns, being attentive, having tolerance, high imagination, and being curious. Third, they develop social relationships, which involves being fond of and successful in associating with gifted students with all their anxieties, knowing these students, being adaptable, easy to get along with, and quickly understanding others' actions.

Creativity arises because of the many factors influencing it. In general, the development of different talents, behaviours, and a strong positive interest around work occupied, and the desire to carry out tasks affect creativity (Simonton, 2012). Several factors affect teacher creativity production, such as:

- The job environment helps teachers expand their experience and expertise in completing assignments.
- Effective collaboration among educational personnel in resolving problems.
- Recognizing and encouraging any positive effort made by teachers to increase student achievement.
- Providing teachers with the confidence to develop themselves and demonstrate innovative work and ideas.

- Delegating significant authority to teachers to carry out tasks and solve problems that arise when carrying out tasks.
- Allowing teachers to create policies regulating educational practices in schools, especially those about learning achievement. In essence, if the task is prepared ahead of time, the goal will be guided and efficient.

A teacher must be creative to plan lessons. A teacher should design teaching programs and make teaching plans before starting to teach. Learning preparation is the practice of scheduling content, media, teaching approaches, or methods in advance for use in the following semester to achieve predetermined goals (Livingston, 2010; Tamsah et al., 2020). Learning preparation requires techniques that identify the objectives that a teaching activity will accomplish, the strategies it will use to measure the achievement of these goals, the material to be provided, how it will be delivered, and the media necessary.[17]

Key concepts

Brainstorming: individual or group method for creating ideas, increasing creativity, and finding solutions

Creativity: the ability to produce or use original and unusual ideas or to make something new or imaginative:

Mind-map: a type of diagram (=simple plan) with lines and circles for organizing information so that it is easier to use or remember

Reflection

Do you apply creativity tool while teaching? If yes, what tools? If no, why not?

Do you use online creativity tool while teaching? If yes, what tools? If no, why not?

Additional resources

Identify methods of teaching and learning to create interest, self-study and creativity of students: https://doi.org/10.18510/hssr.2020.8369

The Oxford Handbook of Group Creativity and Innovation: https://books.google.ro/books?hl=en&lr=&id=YiSQDwAAQBAJ&oi=fnd&pg=PA287&dq=effective+brains

[17] Tamsah H., Ilyas J. B. & Yusriadi Y. (2019). *Create Teaching Creativity through Training Management, Effectiveness Training, and Teacher Quality in the Covid-19 Pandemic* , DOI: 10.29333/ejecs/800

torming&ots=h0br_DmxS0&sig=fKWBZUyO69QTfegdDw3tBX_CyEQ&redir_esc=y#v=onepage&q=effective%20brainstorming&f=false

Video materials

Creative thinking skills techniques – The Five Whys: https://youtu.be/dbN-66Iwtgk

Creative thinking: how to increase the to connect: https://youtu.be/cYhgIlTy4yY

Six creative ways to brainstorm ideas: https://youtu.be/yAidvTKX6xM

7.2 Thinking styles

Behind your practical, everyday thinking there lies the most complex thing in the known universe: the human mind. Nobody hires and pays you nowadays for your physical strength. You are employed because you have a mind and you can use it effectively.

Thinking is the ultimate cognitive activity, consciously using our brains to make sense of the world around us and decide how to respond to it. Unconsciously our brains are still 'thinking' and this is a part of the cognitive process. Our ability to think develops naturally in early life. When we interact with others, it becomes directed, for example when we learn values from our parents and knowledge from our teachers. We learn that it is good to think in certain ways and bad to think in other ways. Indeed, to be accepted into a social group, we are expected to think and act in ways that are harmonious with the group culture. At its most basic level, thinking answers the question 'What's that?'.

A style is a way of thinking. It is not an ability, but rather, a preferred way of using the abilities one has. The distinction between style and ability is a crucial one. An ability refers to how well someone can do something. A style refers how someone likes to do something (Sternberg R. , 2006). It involves how one acquires knowledge, organizes thoughts, forms views and opinions, applies personal values, solves problems, makes decisions, plans, and expresses oneself to others.

Thinking styles refers to the preference a person displays during cognitive processing, or as Sternberg puts it, “The process used to solve a problem or to devise an answer.” A style of thinking is therefore, a preferred way of thinking. It is not ability but rather a preferred way of expressing one or more abilities. How do people think about things?" (Agarwal N., Rani P., 2020).

Types of thinking styles

According to Bramson, the five thinking styles are (Golian, 1999):

I. **Synthesists**

A dimension of thinking associated with concentrating on underlying assumptions and abstract ideas. The orientation of synthesist thinkers is focused on integration while their behaviour is often viewed as challenging.

Behavioural clues:

- bounces from topic to topic in a conversation
- asks “what if” questions
- argues theoretical points
- talks a lot speculates about new ideas and concepts

II. Idealists

A dimension of thinking associated with focusing on process, aspirations, and values. The orientation of idealist thinkers is focused on assimilation while their behaviour is often viewed as receptive.

Behavioural clues:

- is a good and interested listener
- talks about long range goals, values and ideals
- wants to please you so you won’t be upset
- often sounds disappointed in others

III. Pragmatist Thinkers

A dimension of thinking associated with examining problems within their situational context. The orientation of pragmatist thinkers is focused on payoff while their behaviour is often viewed as adaptive and incremental.

Behavioural clues:

- interested in a quick payoff
- quick-witted and quick on their feet
- playful and cheerful
- interested in a short time frame

IV. Analyst Thinkers

A dimension of thinking associated with abstracting facts into theories and problem solving approaches. The orientation is focused on method while behaviour is often viewed as prescriptive and logical.

Behavioural clues:

- insists on technical data
- generally appears neat and orderly
- asks detailed and concrete questions
- is reluctant to change from the tried-and-true

V. Realist Thinkers

A dimension of thinking associated with emphasizing available resources and apprehendable facts. The orientation of realist thinkers is focused on the task at hand while their behaviour is often viewed as empirical and objective

Behavioural clues:

- is direct and frank
- seems impatient and restless and interrupts a lot
- says “If you look at the facts ... Do we really need it?”
- states opinions as if they were facts
- is quick to provide solutions to issues

For identifying easier others’ thinking styles, there are even more clues about their behaviours:

Table 3: Thinking Style Behavioral Clues

Behavioral Clues	Synthesist	Idealist	Pragmatist	Analyst	Realist
Apt to appear	Challenging, skeptical, amused.	Attentive, receptive, supportive.	Open, sociable, humorous.	Cool, studious, hard to read.	Direct, forceful, quick, non-verbal expression.
Apt to say	On the other hand...	It seems to me...	I'll buy that...	Logically...	It's obvious to me...
	No, not necessarily...	Don't you think...	That's one sure way...	It stands to reason...	Everybody knows that...
Apt to express	Concepts, opposite points of view.	Feelings, Ideas about values. What's good.	Non-complex ideas, Personal anecdotes.	General rules, supporting data.	Opinions, factual anecdotes.
Tone	May sound argumentative, sardonic.	May sound tentative, hopeful, and resentful.	May sound insincere, enthusiastic.	May sound stubborn, careful, dry.	May sound dogmatic, forthright, and positive.
Enjoys	Intellectual, philosophical arguments.	Feeling-level, discussions.	Brainstorming, Lively give-and-take.	Rational examination of issues.	Short, direct, factual discussions.
Apt to use	Parenthetical expressions, qualifying phrases, adjectives.	Indirect questions, Aids to agreement.	Case examples, illustrations, and popular opinions.	Long, discursive, well-formulated sentences.	Direct, pithy, descriptive statements.
Dislikes	Talk that seems too simplistic, superficial, mundane.	Talk that seems too factual, conflictive, dehumanizing.	Talk that seems too dry, dull, humorless, "nit-picking."	Talk that seems too irrational, aimless, "far-out."	Talk that seems too sentimental, impractical.
Under stess	Pokes fun.	Looks hurt.	Looks bored.	Withdraws. agitated.	Becomes

Source: InQ Educational Materials, Inc. 1994. *Workbook for modifying your thinking profile.* Berkeley, Calif.: Holland Parlette Associates.

A better overview of thinking styles

A style is a preferred way of thinking. It is not an ability, but rather how we use the abilities we have. We do not have a style, but rather a profile of styles.

A fact that must be kept in mind is that while one or two styles predominates for most people, about fifteen percent use all five styles equally. People do not exhibit just one style or another, but they do have preferences across various kinds of tasks and situations (Agarwal N. , Rani P. , 2020).

According to Sternberg (1997) there are some general points were need to understand about thinking styles. These are given below:-

- Styles are preference in the use of abilities, not abilities themselves.
- A match between styles and abilities creates a synergy that is more than the sum of its parts.
- Life choices need to fit styles as well as abilities.

- People have profiles of styles, not just a single style.
- Styles are variable across tasks and situations.
- People differ in their strength of their preferences.
- People differ in their stylistic flexibility.
- Styles are socialized.
- Styles can vary across the life span.
- Styles are measurable.
- Styles are teachable.
- Styles valued at one time may not be valued at another.
- Styles valued in one place may not be valued in another.

Source: Discovery in Action

Be an open-minded instructor

When Susan (Sternberg R., 2006) was in her third grade, her teacher had a neat idea. The children were studying the planets and the teacher wanted her students to learn actively, not just passively. Because of that, she decided to have the children to pretend to be astronauts and stimulate going on Mars. The idea was a good one for promoting learning. What better way is to learn about a place than to stimulate being there? Here, the children would have to think about the air supply, the gravity, the terrain and anything else that a visitor to Mars would have to consider. Of course, the children could learn all these things by reading about them, but their learning and their retention would certainly be enhanced by pretending to deal with them at first hand. However, they would have to know enough about Mars to be able to imagine being there.

As the children were preparing to be astronauts, Susan had an idea. How about if she dressed up as a Martian and met the astronauts when they arrive on Mars? The teacher's idea was good, but perhaps Susan's idea was even better. When Susan told her idea to the teacher, the teacher immediately nixed it. Flustered, and perhaps needing a reason for her immediate no, the teacher patiently told Susan that we knew from space probes that there are no inhabitants on Mars and so, it would not be realistic to

have Susan pretend to be a Martian. The teacher pointed out that she was doing a science lesson and science lesson can't have non-existent Martian in them.

The teacher's excuse was lame. For one thing, astronauts aren't going to Mars either. For another thing, space probes can't really assure us that there is no life on Mars: maybe the Martians live in the interior of the planet or maybe they exist as some life form that probes cannot recognize yet.

Just wonder: how many more times, when Susan had a creative idea, would she bother to express it, either to the teacher or anyone else? Just ask yourself how many times this same incident repeated itself, not only in Susan's classroom or in the classroom of that teacher, but in countless classroom at all grade levels and all around the world. Many families and many organizations play by the same rules.

As it can be seen, schools and other institutions, from households to business to cultures, value certain ways of thinking more than others. People whose ways of thinking do not match those valued by the institution are usually penalized. In school, children who are viewed as bad often suffer from nothing more than a style that mismatches that of their teachers. What is more, the style of thinking, and even the thinking abilities needed to succeed in the class, have little or nothing to do with the styles and abilities needed to succeed in the career.

As an instructor, there is a huge need to recognize the variety of thinking and learning styles the students bring to the classroom and teaching them in ways that fit well. Instead of favouring a group who enjoys instructor's thinking style and exclude the groups who doesn't fit in it, let's embrace and accept all of them. Different thinking styles affect learning preferences and how individual abilities to learn should be recognized and respected.

Source: Prezi

Key concepts

Ability: the mental or physical power or skill needed to do something.

Open-minded: willing to consider ideas and opinions that are new or different to your own.

Thinking style: the process used to solve a problem or to devise an answer, a preferred way of thinking

To think: to use the brain to decide to do or plan something, solve a problem, understand a situation etc.

Reflection

What is your thinking style?

How is it influencing your teaching technique?

Additional resources

Long-term meditation: the relationship between cognitive processes, thinking styles and mindfulness: https://www.researchgate.net/profile/Rosa-Fabio/publication/320466746_Long-term_meditation_The_relationship_between_cognitive_processes_thinking_styles_and_mindfulness/links/5c2b9335458515a4c7058621/Long-term-meditation-The-relationship-between-cognitive-processes-thinking-styles-and-mindfulness.pdf

Unhelpful thinking styles: https://www.psychologytools.com/resource/unhelpful-thinking-styles/

What's your thinking style? This logic test can identify your mental strengths and weaknesses: https://www.clearerthinking.org/post/2016/11/08/whats-your-thinking-style-this-logic-test-can-identify-your-mental-strengths-and-weakness

Video materials

Identify your thinking style: https://youtu.be/zdaWFQyM_c0

Thinking styles: https://youtu.be/dJMST4dWcbs

7.3 Inventive problem solving

Creative thinking is valuable in many situations, not just traditionally creative industries. Whether you're solving a problem, organizing your calendar, or at an impasse with your team, creative thinking can come in handy. One way creative thinking is valuable is for identifying the right problem.

When a doctor is trying to diagnose the cause of someone's weak left, that is problem solving. Indeed, decision making and problem solving are so bound up with particular kinds of information or knowledge – areas of professional competence – that we find it hard to think of them in the abstract.

Problem solving can be described as a 21st century skill. Problem solving is an activity in which a learner perceives a discrepancy between a current state and a desired goal state, recognises that this discrepancy does not have an obvious or routine solution, and subsequently tries to act upon the given situation in order to achieve that goal state. It is accompanied by a number of mental and behavioural processes. (P. Griffin, E. Care, 2015)

Creativity is a way to find problem-solving. Many problems can be solved by creating new ideas or strategies. Strategy and model of learning that encourage the development of problem-solving skills is very useful for students on aspects of cognitive, psychomotor, and affective.

Problem-based learning

Problem-based learning (PBL) is a pedagogical approach that enables students to learn while engaging actively with meaningful problems. It is an active learning based on the use of ill-structured problems as a stimulus for learning. The essence of PBL is to present an authentic and meaningful problematic

situation to students and can be used as a springboard for investigation. The purpose of PBL is to learn content, process skills, problem-solving skills, and learn in the wider life of the future.[18]

Problem based-learning has huge advantages, such as improving:

- the quality of learning;
- the students' skills in putting the mind map of the level well enough in all aspects to good level;
- cognitive, affective, and psychomotor;
- the ability of mathematical problem solving;
- aspects of science literacy attitudes.

The learning stages of the PBL include: (1) Integrating students to the problem (2) Organizing students to learn (3) Guiding the investigation (4) Developing and presenting the work, and (5) Analysing and evaluating the problem-solving process.

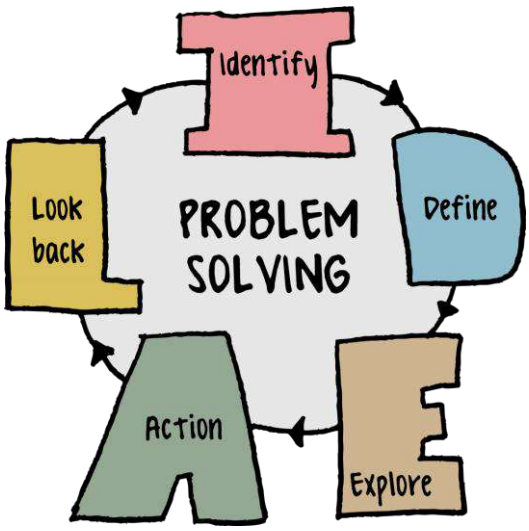
In a typical PBL setting, learning is triggered by a problem which needs resolution. Dewey explains the cognitive element of learner engagement by describing how the origin of thinking is some “perplexity, confusion, or doubt” that is triggered by “something specific which occasions and evokes it.” Students make connections to this “perplexity, confusion, or doubt” by activating their individual and collective prior knowledge and finding resources to make sense of the phenomenon; they also engage in peer learning through small-group discussions and consolidate their learning through reflective writing. Beyond enabling students to make sense of the concepts and subject matter, this learning experience is also likely to help students develop understandings of themselves and their contexts, and the ways and situations in which they learn effectively.[19]

That being said, PBL is an effective teaching and learning approach, particularly when it is evaluated for long-term knowledge retention and applications. Students are given the opportunities to problem-solve in a collaborative setting, create mental models for learning, and form self-directed learning habits through practice and reflection

---

[18] Anna Jarrotul Khoiriyah1* and Husamah (2018). *Problem-based learning: creative thinking skills, problem-solving skills, and learning outcome of seventh grade students*. Retrieved from http://ejournal.umm.ac.id/index.php/jpbi

[19] Abdelkader M. A. E., Rasha E. S. A. (2016). Problem-Based Learning: An Overview of its Process and Impact on Learning, pp. 76. Doi: https://doi.org/10.1016/j.hpe.2016.01.004



Source: Transport Futures Institute

Project-based learning

Project-based learning as a form of instruction has clear connections with other pedagogical approaches, such as problem-based learning among others. The main difference between the two is that, whereas students in problem-based learning are primarily focused on the process of learning, project-based learning needs to culminate in an end product.

Project-based learning is a student-centred form of instruction which is based on three constructivist principles: learning is context-specific, learners are involved actively in the learning process and they achieve their goals through social interactions and the sharing of knowledge and understanding. It is considered to be a particular type of inquiry-based learning where the context of learning is provided through authentic questions and problems within real-world practices that lead to meaningful learning experiences[20].

When applying the project-based learning, the instructor must follow the next 7 steps: start with the essential question, design a plan for the project, create a schedule, monitor the students and the progress of the project, assess the outcome, evaluate.

[20] Kokotsaki, D. and Menzies, V. and Wiggins, A. (2016) 'Project-based learning : a review of the literature.', Improving schools., 19 (3). pp. 267-277.

Source: Defined Learning Educators

The planning and implementation of a project is a highly time-consuming activity and requires great attention to detail. There are numerous aspects which call for careful consideration:[21]

Firstly, choosing a topic and a title that is to the point is very important. Involving students in the decision-making process is beneficial because they will feel more involved in the project on the whole.

Secondly, planning involves assigning roles and activities, organizing groups, and establishing venues and financial and time requirements. During the planning stage, teachers should consider the features of the venue and ensure that groups have sufficient workspace without distracting each other. Moreover, all participants should be able to accomplish the task, and the necessary tools should be available to everyone.

In addition, the project should ensure that students carry out research and work cooperatively in order to enhance their problem-solving skills, motivation and creativity. Data collection may take place within or outside the classroom. The topic can be discussed during regular lessons, or separate days can be allocated exclusively to the project.

[21] Habók, A., Nagy, J. In-service teachers' perceptions of project-based learning. *SpringerPlus* **5,** 83 (2016). https://doi.org/10.1186/s40064-016-1725-4

Finally, evaluation focuses on the presentation of the final product, which can take various forms, such as a school presentation, a short film, a diary entry or any other form which helps students summarize the work process. The final presentation also necessitates planning, as students need to agree on the roles and tasks of each participant prior to the presentation. Evaluation may take various forms; besides teacher evaluation, more fitting evaluation methods include peer evaluation, self-evaluation, oral presentation and a practical exam.

Some ideas for project-based learning are:

1. Analysing the five most popular social media platforms for teens, then predict and design a new platform based on existing trends and past trajectory of change.
2. Designing a new form of government (or democracy, specifically) that addresses some perceived shortcoming of existing democratic forms (partisanship, non-functioning checks-and-balances, etc.)
3. Imagining a dating app in 2050 considering anticipated shifts in technology (e.g., biotechnology) and social norms (e.g., gender, sexuality, class, etc.)

There can be unlimited ideas about project-based learning. Just let your ideas flow and apply one of them with your students!

Critical thinking

Creative thinking is considered the ability to produce original ideas or answers and to perceive new and unsuspected relationships or unrelated factors stated that creativity is finding new ways regard unusual correlations or solutions. Identifying and defining problems is an important influence on creative performance.[22]

Critical thinking is the art of analysing and evaluating thought process with a view to improving them. Critical thinking is self-directed, self-discipline, self-monitored and self-corrective thinking. It requires rigorous standards of excellence and mindful command of their use. It entails effective communication and problem-solving abilities, as well as commitment to overcoming our native egocentrism and

[22] Düşünme Ö. Y., İlişki E. D. (2016). The Relationship between Creative Thinking and Critical Thinking Skills of Students, pp. 696. Doi: 10.16986/HUJE.2016018493

sociocentrism. It advances the character and ethical sensitivities of the dedicated person through the explicit cultivation of intellectual virtues (Elder & Paul, 2020).

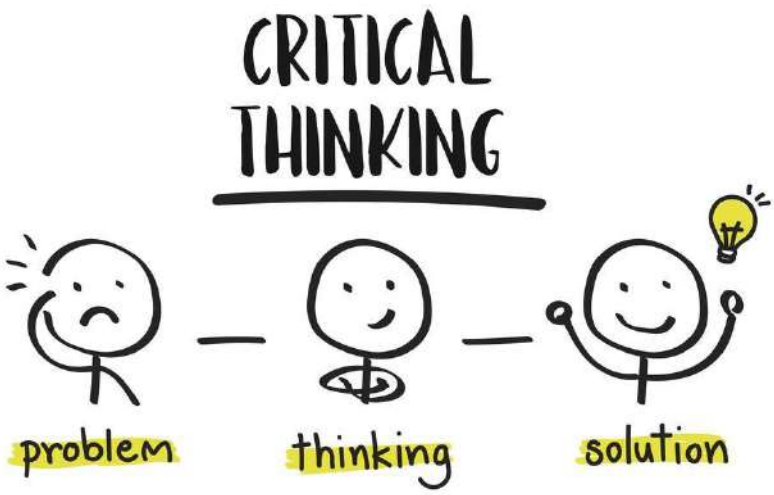
The profile of a well-cultivated thinker:

- Raises vital questions and problems, formulating them clearly and precisely;
- Gathers and assesses relevant information, using abstract ideas to interpret it effectively;
- Comes to well-reasoned conclusion and solution, testing them against relevant criteria and standards;
- Think open-mindedly within alternatives system of thought, recognizing and assessing, as need be, their assumption, implications and practical consequences;
- Communicate effectively with others in figuring out solutions to complex problems;
- Is scrupulously careful not to misrepresent or distort information in developing an argument or position and sees through false information and fake news. (Elder & Paul, 2020)

Critical thinkers have an abiding interest in the problematic aspects of their own thinking and they seek out these problems areas, target them and change something about their thinking in order to reason more rationally, logically and justifiably. Embracing critical thinking means learning to take command of the thoughts that control you, thereby experiencing a happier, more satisfied inner sense of self (Elder & Paul, 2020).

The major characteristics of creativity were the imagination, openness to experience, inquisitiveness / curiosity, intuition, idea-finding, tolerance for ambiguity, independence, innovation, insight, internal / external openness, illumination / insight, problem-finding, and imagery. Creative thinking and critical thinking no doubt involve many traits. The analysis, assessment, decision-making and logical problem solving are necessary traits for critical thinking. For creative thinking; imaginative, produce original ideas and finding new solutions to problems are necessary traits. Creative thinking tends to produce original ideas, views and perspectives for solving problems, and critical thinking tends to produce logical ideas, views and perspectives for solving problems. [23]

[23] Düşünme Ö. Y., İlişki E. D. (2016). The Relationship between Creative Thinking and Critical Thinking Skills of Students, pp. 696. Doi: 10.16986/HUJE.2016018493



Source: eSchool News

There is a need for effective methods to teach critical thinking. One instructional method that seems promising is comparing correct and erroneous worked examples (i.e., contrasting examples).[24] Also, exercises such as: asking questions, encouraging decision-making, working in groups, incorporating different points of view, connecting different ideas, inspiring creativity, brainstorming; all of them improve the critical thinking.

Using the strategy of considering factors that would block people with the ability to think critically from doing so, we can identify as initiating dispositions for thinking critically attentiveness, a habit of inquiry, self-confidence, courage, open-mindedness, willingness to suspend judgment, trust in reason, wanting evidence for one's beliefs, and seeking the truth.[13]

Key concepts

Problem: a situation, person, or thing that needs attention and needs to be dealt with or solved; something that causes difficulty or that is hard to deal with

Project-based learning: opportunities for students to construct knowledge by solving real problems through asking and refining questions, designing and conducting investigations, gathering, analysing, and interpreting information and data, drawing conclusions, and reporting findings

[24] van Peppen, L.M., Verkoeijen, P.P.J.L., Heijltjes, A.E.G. *et al.* Enhancing students' critical thinking skills: is comparing correct and erroneous examples beneficial?. *Instr Sci* **49,** 747–777 (2021). https://doi.org/10.1007/s11251-021-09559-0

Critical thinking: the process of thinking carefully about a subject or idea, without allowing feelings or opinions to affect you

Reflection

Is critical thinking a must nowadays?

Do you train your students' critical thinking? If yes, how? If no, why not?

Additional resources

Setting the standards for project based learning: https://books.google.ro/books?hl=en&lr=&id=10XwCQAAQBAJ&oi=fnd&pg=PP1&dq=project+based+learning&ots=ME59e-tcEG&sig=gdjJCLoSQavNk4As3Rfnhh28cUg&redir_esc=y#v=onepage&q=project%20based%20learning&f=false

Critical thinking and education: https://books.google.ro/books?id=E1IPDQAAQBAJ&lpg=PT8&ots=88iSp9CUNA&dq=critical%20thinking&lr&pg=PP1#v=onepage&q=critical%20thinking&f=false

12 Solid Strategies for Teaching Critical Thinking Skills: http://blog.futurefocusedlearning.net/teaching-critical-thinking-skills

Video materials

5 tips to improve your critical thinking - Samantha Agoos: https://youtu.be/dItUGF8GdTw

How to become a problem solever | Brian Tracy: https://youtu.be/C1XABm6OUQs

7.4 The SCAMPER method

Creativity literature has so many studies about creative thinking strategies. The creative process is also related with some techniques which are believed to enhance creativity. For example, the SCAMPER method which is a commonly used creative thinking technique in both studies and practices.

SCAMPER has been used for brainstorming by teachers in elementary technology classes (Myrmel2003), utilized in innovation training at interdisciplinary conferences (Ennovity2015) and embraced by companies such as McDonald's. SCAMPER's application in the business setting has been credited with

helping companies retain their competitive edge, the introduction of drive-throughs by McDonald's and the addition of McCafe serving as examples of SCAMPER's utility in product and service innovation. [25]

SCAMPER basically aims to create numerous ideas. At the same time students are encouraged to gain new and various perspectives. This technique enables the person to develop their creative potential by themselves, it allows autonomy and it is life-long learning.[26]

How SCAMPER method works

SCAMPER is in essence a collection of seven simple techniques contained in one approach. This is what makes it different from other creativity-building techniques, which usually offer a single suggestion for expanding creative thinking.

SCAMPER is anacronym for seven "mini" techniques/stimuli that force the students to combine ideas from different domains of knowledge, explore random combinations between ideas in the same domain and reduce mental blocks:

Each letter represents the steps that must be taken in order to apply the SCAMPER method:

Step No.	Name	Instructions[27]
1.	***Substitution***	→ *Students are asked to think about: what part of the process/existing solution could be substituted for something else?* → Thinking out alternative ideas/objects instead of the existing idea/object.
2.	***Combine***	→ *Can two separate processes be integrated?* → Forming novel ideas by combining various and connected-disconnected ideas.

[25] Elizabeth Radziszewski (2017) *SCAMPER and Creative Problem Solving in Political Science: Insights from Classroom Observation*, Journal of Political Science Education, 13:3, 308-316, DOI: 10.1080/15512169.2017.1334562

[26] Malodi Özyaprak & Marilena Z. Leana-Taşcılar (2019). The effectiveness of self-regulated learning on teaching SCAMPER technique of creativity. Retrieved from https://dergipark.org.tr/en/download/article-file/1476185

[27] Malodi Özyaprak & Marilena Z. Leana-Taşcılar (2019). The effectiveness of self-regulated learning on teaching SCAMPER technique of creativity. Retrieved from https://dergipark.org.tr/en/download/article-file/1476185

3.	***Adapt***	→ *Has a similar problem been encountered in a different field? Can their insights be adapted to our problem?* → Modifying existing object for the purpose of adapting to a situation or environment.
4.	***Modify***	→ *Can an existing process or part of it be enlarged/simplified?* → Changing the present object by magnifying, minifying, modifying it.
5.	***Put to other use***	→ *Can an existing solution or part of it be put to another use?* → Using an object in a different concept/situation/place.
6.	***Eliminate***	→ *What part of the process can be removed/omitted?* → Improving the existing material by eliminating a part of it or figuring out the consequences of elimination of something.
7.	***Reverse***	→ *What would happen if the process were reversed?* → Rearranging or reversing present status/situations/orders/patterns with the aim of considering alternative ends, practices, ideas.

How to apply the SCAMPER method

While an instructor could choose from a wide menu of creativity-building techniques, SCAMPER is one of the best because it is the most comprehensive one, making it useful for generating numerous ideas and enhancing students' creative potential.

This process can be organized and adapted according to the learning environment. Even one use of a creativity-building technique can improve the originality of ideas. Incorporating creativity-building exercises a few times during the course of a full semester would likely strengthen this effect even more.

Instructors should note that SCAMPER offers limited improvement in the area of idea appropriateness, the second dimension of creativity thinking. Thus, instructors should ensure that students have some knowledge about the subject before they use SCAMPER. They should also allocate sufficient time during the semester to help students evaluate the ideas they generate. Combining the benefits of SCAMPER in

the area of novel idea development with critical thinking to assess the relevance of ideas is likely to enhance students' capacity to generate both novel and appropriate ideas. [28]

Firstly, the teacher must be sure that all the students were exposed to general ideas related to the topic before investigating it in greater depth. The goal is to ensure that the students had some knowledge of the subject. Next, the teacher identifies a challenge that would be solved collectively:

There are presented some examples of how to apply the SCAMPER method in the class:

For the instructor:

Total time: 70 minutes

Step 1 – *Explain of the SCAMPER method* (20 minutes)

Suggestions: Instructors could utilize a number of videos available on YouTube that demonstrate the technique's basic premise. Also, it can be used a PowerPoint presentation to exemplify from a variety of disciplines and to demonstrate how the application of SCAMPER's techniques is evident in policy, product, and service innovation.

While explaining there must be examples of ideas for each step. For example:

- Adapt: Show a picture of U.S. soldiers using remotely controlled robots to disable improvised explosive devices (IEDs) next to a smaller but somewhat similar robot used by biologists to gather data on penguin populations. While at first the two contexts seem disconnected, I explained that U.S. soldiers and biologists shared the same problem: How to minimize the presence of humans in a difficult terrain. For the soldiers, it was to reduce the casualties from IEDs while for the biologists it was to access data on shy animals.
- Modify: The biologists incorporated the army's solution into their own challenge by applying some modifications—redesigning a robot so it resembles a penguin—they arrived at a novel solution to collecting data when human presence was not possible.

After giving the explanations, the students received a handout that explained for what each letter in SCAMPER stood.

Step 2 – *Apply the SCAMPER method* (35 minutes)

[28] Elizabeth Radziszewski (2017) *SCAMPER and Creative Problem Solving in Political Science: Insights from Classroom Observation*, Journal of Political Science Education, 13:3, 308-316, DOI: 10.1080/15512169.2017.1334562

Suggestion: The trainer/teacher write all the ideas on the board or the students can be divided in groups.

Step 3 – *Evaluation* (15 minutes)

The students use their critical-thinking skills to examine the ideas' relevance to the problem.

Suggestion: the students are asked if the ideas listed on the board were related to the challenge, and, if not, what connection was missing.

What is more, for the next session, the instructor could, for example, divide students into groups and ask each group to work on an idea from the earlier session, encouraging groups to socialize with each other to further enhance the creative process and ultimately to deliver an innovative research project.

For the student:

Purpose – promoting a peanut butter product

Steps	Ideas
1.Substitution	→ Replacing peanuts with almonds
2. Combine	→ Peanut butter + jelly = food mashups
3. Adapt	→ Powdered peanut butter for people who prefer a healthier low-fat product
4. Modify	→ Increase the size of the containers for large families or minimize the container for peanut butter on the go
5. Put to other use	→ Bake cookies with peanut butter → Spicy sauce
6. Eliminate	→ Eliminate the traditional method of spreading peanut butter on bread and eat it directly with a fork Or → Eliminate the product itself and use the jar for storing.
7. Reverse	→ Instead of spreading the peanut butter on the bread, it can be used toasted bread and dip it directly in the jar.

SCAMPER method and its efficiency

SCAMPER offers an immediate boost in the quantity of ideas and, with regular application over a more extended period of time, it could also improve the quality of ideas. SCAMPER provides an enjoyable environment for practicing creative thinking for students. Also, the leading questions in the technique present a concrete system to think in a flexible and fluent manner. The systematic thinking in SCAMPER helps students to overcome their mental blocks. Thinking alternative uses of an object or various strategies instead of one single and ordinary strategy help children to go beyond the generalizations and axioms. [29]

The mini SCAMPER techniques could help students achieve a moderate level of originality by pushing them to make connections between concepts in the same knowledge domain while others, such as "Put to Other Use," encourage connection making between concepts from unrelated fields there by increasing the potential for achieving high-level originality.

With SCAMPER, a student who exhausts one technique can easily transition into another. Not only SCAMPER increases the potential for delivering more ideas, but it also gives students the flexibility to move on to the next technique without feeling the pressure to stay with one because there is no other tool upon which to rely. Creative ideas flow when pressure is minimized, and a collection of "mini" techniques embedded in one overarching technique allows students to skip one technique completely or to return to it later without forcing an idea to emerge. [30]

[29] Malodi Özyaprak & Marilena Z. Leana-Taşcılar (2019). The effectiveness of self-regulated learning on teaching SCAMPER technique of creativity. Retrieved from https://dergipark.org.tr/en/download/article-file/1476185

[30] Elizabeth Radziszewski (2017) *SCAMPER and Creative Problem Solving in Political Science: Insights from Classroom Observation*, Journal of Political Science Education, 13:3, 308-316, DOI: 10.1080/15512169.2017.1334562

Source: Pngitem

Key concepts

SCAMPER – a creative brainstorming technique that helps teams explore ideas from seven different perspectives.

SCAMPER – stands for Substitute, Combine, Adapt, Modify, Put to another use, Eliminate, Reverse.

Reflection

As an instructor, what do you need to take into consideration while applying the SCAMPER method?

Additional resources

SCAMPER method and McDonald's: https://sivhansen.no/2020/09/03/scamper-method-and-mcdonalds/

The effectiveness of SCAMPER technique on creative thinking skills: https://dergipark.org.tr/en/download/article-file/483637

Video materials

Application of SCAMPER: https://youtu.be/ru9-74qLXAo

The SCAMPER technique explained: https://youtu.be/u4hKqgEeWRg

7.5 Assessment

1) SCAMPER stands for …
   a) Summary, Combine, Adapt, Modify, Put to other use, Eliminate, Reverse;
   b) Substitution, Combine, Adapt, Modify, Put to other use, Eliminate, Reverse;
   c) Substitution, Combine, Adapt, Modify, Put to other use, Eliminate, Recap;

2) How would you describe a critical thinker?
   a) Reluctant, superficial, sceptical;
   b) Curious, innovative, open-minded;
   c) Emotional, affective, supportive;

3) The analyst thinker:
   a) Needs technical data, asks details and concrete questions;
   b) Needs facts, provide solutions quickly, is direct;
   c) Needs goals, values and ideals, is a pleaser and a good lister.

4) As a teacher, one of the good practices of brainstorming is:
   a) Evaluate your students` ideas while they are expressing them;
   b) Set a limit for ideas;
   c) Accept all the ideas, no matter how unusual and numerous they are.

5) All the people have:
   a) Just one thinking style;
   b) A profile of thinking styles;
   c) No thinking style, just thinking.

6) What is problem-based solving?
   a) A pedagogical approach that enables students to learn while engaging actively with meaningful problems – being primarily focused on the process of learning

b) opportunities for students to construct knowledge by solving real problems through asking and refining questions, investigations, analysing, and interpreting information, drawing conclusions – culminate an end product

c) A thinking style that allows you to solve a problem easier.

7) What is the thinking style?

a) A favourite ability

b) A favourite style

c) A favourite way of using an ability

Recommendations for course delivery with target groups

In analysing the common challenges faced by social educators and teachers, as well as the needs in their own countries, our consortium found not only that their internal capabilities needed to be improved to address the newly identified challenges, but also that the needs had not been adequately defined previously. The global need for social educators and teachers is to use creativity, art, and digital technology to design and implement innovative solutions for social inclusion and also to develop DSI initiatives. These educators also need to consider various problems of social inclusion of marginalised and disadvantaged people and the use of digital opportunities (distance education, distance help) and the dissemination of new practices to support disadvantaged people online based on creative and innovative thinking. These were the main reasons for developing a training package that thoroughly considered the needs and challenges. In this way, we ensured that the course modules and scenarios we will develop during the project are fit for purpose.

The proposed plan for the "Course Modules for Educators, Facilitators and Volunteers" are:

Course duration: 40 - 60 hours

Methods: active learning, active engagement of learners with course material through discussions, problem solving, case studies, and role plays; CLIL (use of English to teach technical concepts to increase learners' English vocabulary), assessment and evaluation, community-based learning, MOOC, collaborative learning, active learning.

Resources: videos, articles, PPTs, learning diary, assessment forms (quizzes), activity templates, action plan templates, written resources (PDF, PPT, etc.)

Facilitation Guide and Worksheets:

- Theories and models of creativity: an overview of creativity, creativity and genius, creative problem solving, innovation and creativity.
- Individual and social creativity: the nature of creativity, types of creativity and how to improve them, progress in social creativity, deep analysis of creativity.
- Creative teaching and teaching creativity: Pedagogical purpose of creativity education, The context of creativity and education, Creativity is as important as literacy, Introduction to Stem Education.
- Machine creativity: definitions of creativity, Intelligent machines, Can machines be creative? Machines vs. Humans: The Singularity.

- Educational use of the arts: creativity - concept, characteristics and how to foster it, creativity, art and digital technologies, pixel art and interactive art, DSI examples and case studies.
- Creativity and the arts in schools: fostering creativity in schools, creative education in schools, arts integration in schools, transforming arts education in the digital age.
- Creative thinking: creativity tools, thinking styles, inventive problem solving, The SCAMPER method.

Transferability

The methodology for creating the course can be replicated for other categories of educators, and the use of the remote modality of interacting with learners and their online collaboration will have a positive impact on future teaching and learning activities. The training package is transferable to a wide range of educational practices. The course can be used by adult education organizations that want to provide attractive and relevant courses for educators working with seniors.

- The 7 course modules can be used by social educators and faculty when teaching DSI.
- The assessment tools can be used for skills recognition. Once the educators' resumes are available, they will transfer the results, which can then be used further.
- The educational materials can be used by organizations working with social educators and teachers to enhance their course portfolios.

The course modules are publicly available at https://academy.crearterasmus.eu/ and will be transmitted to organizations working with social educators and teachers. It is expected that leaders of organizations teaching arts, creativity, and education in the digital age will have a broader understanding and deeper knowledge and skills to work with their students and promote digital social innovation (DSI). Key elements of the course modules are usability and transferability of outcomes. From this perspective, organizations where educators, education students, adult educators work and social services, NGOs, He institutions, Vet institutions can use the course to ensure a deeper understanding of the process required for the competencies to design, develop and manage innovative social initiatives using digital technologies to properly work with students and acquire competencies and skills in DSI. The use of remote modality of interaction with learners and their online collaboration will have a positive impact on future teaching-learning activities and can be transferred to the wide range of educational practice.

About the authors

Ovidiu ACOMI holds an MBA at Robert Gordon University UK and is author of one book and 20+ academic articles. Ovidiu is a trainer and the National Institute of Administration in the areas of public

communication and operations management, Member of the Naval Supervisory Board within the Competition Council for a 5-year term, member of the Engineering Commission of ARACIS (public body for the accreditation of technical universities) for a 4-year term, EFQM trainer and international evaluator for the Global EFQM Awards, manager of European projects and management consultant, expert evaluator of the European Commission for research and innovation projects, chartered engineer of the Institute of Marine Engineering Science and Technology UK, chartered manager of the Chartered Management Institute UK and Project Management Professional (PMP)® Credential Holder.

Nida AKCEVİZ OVA has a degree in American Culture and Literature and MA in Women's Studies. She is responsible for Eramus projects in her institution's research and development department. Through her participation in the preparation, writing, development, and evaluation phases, she leads many national and international school projects.

Alpaslan AKILLI is the manager of Sarıçam HEM. He has extensive knowledge and experience in project management and implementation for EU-funded projects. He has more than 25 years of professional experience in 'Education, Management, Inspection Planning'' as well as assessment and evaluation studies.

Roxana Elena ANDREI has a bachelor degree in Pedagogy of Primary and Preschool Education. Currently she is doing her masters in Train the Trainers and Mentoring in Education. Her area of expertise is communication, tutoring, formal and nonformal education.

Helena AREVALO MARTINEZ studied Translation and Interpretation of German and English. She has lived in the UK where she worked as a teacher's assistant and in the hospitality industry. She has experience as an English teacher and has worked with children, teenagers and adults. She is currently working on the coordination and development of Erasmus projects and pursuing a bachelor's degree in Art History in the Open University of Catalonia.

Mehmet Necmeddin DİNÇ graduated from Ankara University, Department of Theology. He has a Master's degree in occupational health and safety. He has been teaching for 22 years, has been an administrator for 8 years, and is currently working as the Yenişehir District Director of National Education. He crowns his expertise in local projects in the field of Erasmus.

Gilberto MARZANO, Dr. in Phil., President of Ecoistituto. Member of the professors' board at PhD of the University of Udine on Economy, Ecology, Landscape and Territory and Professor at the Janusz Korzac University in Warsaw (Poland).Vice president of IPSAPA (Interregional Society for Participation in

Agribusiness Landscape and Environmental Management). Visiting professor at many European Universities.He is an author of numerous scientific and technical publications; for many years he was professor at the University of Trieste and at the University of Udine (computer science); he worked as an executive manager in private ICT companies, and was the director of an R&D software laboratory and project leader of many important projects. He is an expert in EU projects and participates in many international projects as a coordinator. He is conducting research on Digital Social Innovation as well as crowdsourcing, crowdsensing, and crowdfunding in social sectors.

Yeliz NUR AKARÇAY has a bachelor's degree in international relations as well as a diploma in English Language Teaching. Yeliz is an English teacher and trainer with rich experience in non-formal education and the development of creative and innovative educational methodologies and activities. She is a fully qualified project leader with over 15 years of experience in designing and coordinating international projects, as well as providing a wide range of adult learning trainings on topics such as New Technologies and Digital Skills which are designed to be adapted to all levels and needs, as well as trainings for educators focusing on developing digital and ICT skills and how to use digital tools in learning environments. She also implements activities for low-skilled/low-qualified adults and has gained expertise in social innovation and inclusion through collaboration with adult education institutions across Europe.

Hüseyin PARS worked as an administrator at the Public Education Center Directorate since 2011. He has done many local projects and then he got involved in the project to improve himself in the field of Erasmus.

Özcan YÜKSEL is a project manager with more than 10 years of experience and has a degree in Human Resource Management from the University of Çukurova. Since 2012, he has been working as a coordinator of trainings which predominantly focus on migrant integration, social inclusion, democracy, promotion of dialogue, youth engagement, media literacy and global education.

About the partner organisations

Sarıçam Halk Eğitimi Merkezi (Saricam Public Education Center) is a public institution founded in 2009 in Adana, Turkiye and affiliated with the Ministry of National Education's Directorate General for Lifelong Learning. Saricam HEM, which provides training services all year, including weekends and evenings, performs tasks in accordance with the principles and objectives of non-formal education. Since 2010, Sarıçam HEM has been in charge of the execution and planning of adult education services in the areas of education, training, guidance, information access, counselling, culture, arts, and sports. Sarıçam HEM provides non-formal educational activities in collaboration with various governmental and private institutions, as well as volunteer organisations. Its main responsibilities include implementing training activities, as well as assisting and monitoring training activities. Sarıçam HEM also conducts activities aimed at ensuring the adaptation of adults who have not completed formal education to the constantly changing technological, social, and cultural conditions.

Mesleki Girişimciler ve Toplum Gönüllüleri Dernegi (MEGIDER): is a non-profit governmental organization founded in 2010. It aims to create a structure for the support and development of voluntary organisations working in the areas of social inclusion, social innovation and social entrepreneurship, solidarity, promoting employment, poverty alleviation, cultural development, lifelong learning and eco-development. MEGIDER is an organisation which implements training courses particularly in the fields of social inclusion, special education, employment, migrant integration and ICT. MEGIDER provides non-formal education to youth and adults aiming to help them acquire the skills they need to lead fulfilling and productive lives.

Karataş Halk Eğitimi Merkezi (KHEM): is a non-formal governmental institution which is located in Karataş, Adana in the south of Turkey. Karataş is a small town but it has a high rank of population migrated from Syria. Our mission is to connect people together, to promote non-formal and life-long learning among our society and to support quality and innovative projects that match the needs of adult people. We promote: Adult people's creativity and artistic potential, Integration and inclusion of vulnerable groups

in society, including people with disabilities, mental and physical impairments, ethnic minorities, disadvantaged groups, unemployed people, youngsters from rural areas, migrants and etc., Active participation of disadvantaged adult people in different trainings and activities, Supporting people in their personal development through participation in European education programs and projects in the field of education, sport, science, culture, Healthy lifestyle, sport, activism and young people's initiative, Create a proactive attitude toward education.

Ecoistituto del Friuli Venezia Giulia: was established in 1989 and is located in Udine. It is a research non-profit organization specialized in sustainable development. Its main research scopes are:

1) Digital Social Innovation.
2) Innovative teaching-learning methodologies.
3) Special needs education.
4) Social robotics.

DomSpain SLU: Training and Consulting Company active on a national and international level. It offers a variety of services to the public and private sector of Spain and actively participates in international schemes through a well-established network of partners abroad. DomSpain is engaged in the EU Pact for Skills. The Training department of DomSpain develops educational programmes in four main directions: courses/workshops for adult learners, including foreign languages, ICT, and personal growth classes; VET: ICT, foreign languages, employability, work-based learning; trainings for educators focusing on improving foreign language competences, use of digital tools and new teaching methods, blended learning; and extracurricular activities for school children and parents, including foreign languages, robotics, coding, and internet safety. The courses and trainings are implemented in our own premises as well as at 10 civic centres and 5 primary and secondary schools of the Tarragona province. We employ 40 educators and count around 1400 students each academic year. In the ICT field, DomSpain has acquired experience through many years of protection of informatics infrastructures to offer to organisations, businesses, public bodies and other entities integral solutions, which help them guarantee cybernetic security. DomSpain provides guidance and support to entities such as educational centres, public bodies, social enterprises, and NGOs in digitalising of their internal working processes. Also, DomSpain has a highly qualified team of information technology that has implemented various national and international projects, which included the development of educational platforms.

DomSpain is a member of the International E-Learning Association, an international network of e-learning professionals, researchers, and students

Yenişehir İlçe Milli Eğitim Müdürlüğü: was officially established in 2008 and is located in Mersin. YIMEM is a public authority and is responsible for planning and coordinating all types of education and training activities. YIMEM is tasked with supervising all types of formal and informal educational institutions. The administrative structure within the Directorate consists of elementary school, secondary schools, vocational schools and non-formal education institutions. The Directorate's mission is to oversee the Turkish national education system, to ensure that educational institutions operate in accordance with legislation, to meet their needs, and to supervise them. YIMEM carries out educational and training activities in accordance with contemporary principles and developments and aims to educate people who are creative, respect human rights and the environment, in accordance with EU standards, in accordance with the requirements of the digital age, by raising the quality of education in light of secular, free, democratic principles. YIMEM trains teachers in internships every year and organizes trainings for teachers in the region.

TEAM4Excellence (T4E): is a Romanian youth association aiming to improve the quality of life through education, research and consulting activities. To address societal challenges, T4E provide learning opportunities and career advice for social inclusion, development and employability of youth and adults, and equip trainers with key competences and skills to foster personal as well as professional development. Within 50+ EU funded projects, the association produces and transfers innovation, experience and know-how through cooperation with domestic and international partners. By hosting events, training courses and conferences, T4E strengthens collaboration between people, supports organisations and bridges gaps between generations. The wide expertise in management enables T4E staff to provide consultancy to large companies and SMEs using the EFQM Model and Business Model Canvas.

Bibliography

30 Things You Can Do To Promote Creativity by Miriam Clifford: https://www.opencolleges.edu.au/informed/creativity/promote-creativity-in-your-classroom/

A. Abraham, The neuroscience of creativity. Cambridge University Press, 2018.

Abdelkader M. A. E., Rasha E. S. A. (2021). The Effectiveness of De Bono's Six Thinking Hats Technique in the Development of Critical Thinking and Numerical Sense in Mathematics Education in Oman, pp. 4–17, 76. Doi: 10.17051/ilkonline.2021.01.138

Abraham, A. (2016). Gender and creativity: An overview of psychological and neuroscientific literature. Brain Imaging and Behaviour, 10(2), 609-618.

Aguilar D and Pifarre Turmo M (2019) Promoting Social Creativity in Science Education With Digital Technology to Overcome Inequalities: A Scoping Review. Front. Psychol. 10:1474

ALBERT,R.S.(1996) Some Reasons why childhood creativity often fails to make it past puberty into the real World.In M.A. RUNCO(Ed.)

Amabile, T. M. (1996). Creativity in Context: Update to the Social Psychology of Creativity. Boulder, CO, Westview Press.

Amabile, T. M., Conti, R., Coon, H., Lazenby, J., & Herron, M. (1996). Assessing the work environment for creativity. Academy of Management Journal, 39(5), 1154-1185.
Cook, P. (19998). The Creativity Advantage—Is Your Organization the Leader of the Pack?

Amabile, T. M., Conti, R., Coon, H., Lazenby, J., & Herron, M. (1996). Assessing the work environment for creativity. Academy of Management Journal, 39(5), 1154–1184. https://doi.org/10.2307/256995

An Interactive Approach to Learning and Teaching in Visual Arts Education by Zlata Tomljenović, University of Rijeka (2015)

Anderson, N., De Dreu, C. K., & Nijstad, B. A. (2004). The routinization of innovation research: A constructively critical review of the state-of-the-science. Journal of organizational behaviour, 25(2), 147-173.

Andrews, E., (original:18.12.2012, updated:18.02.2021), 11 Innovations That Changed History, retrieved from: https://www.history.com/news/11-innovations-that-changed-history

Anna Jarrotul Khoiriyah1* and Husamah (2018). Problem-based learning: creative thinking skills, problem-solving skills, and learning outcome of seventh grade students. Retrieved from http://ejournal.umm.ac.id/index.php/jpbi

Arias, E. G., Eden, H., Fischer, G., Gorman, A., & Scharff, E. (2001). Transcending the individual human mind: Creating shared understanding through collaborative design. In J. M. Carroll (Ed.), Human-computer interaction in the new millennium (pp. 347–372). New York: ACM Press

Artes y educación. Fundamentos de pedagogía mesoaxiológica. Revista Española de Pedagogía: https://revistadepedagogia.org/informaciones/artes-y-educacion-fundamentos-de-pedagogia-mesoaxiologica/

Artun, Kazım.2009. Art Education Theories and Methods, Ankara: Anı Published

Astriani, D., Susilo, H., Suwono, H., Lukiati, B., & Purnomo, A. R. (2020). Mind Mapping in Learning Models: A Tool to Improve Student Metacognitive Skills. International Journal of Emerging Technologies in Learning (iJET), 15(06), pp. 4–17. https://doi.org/10.3991/ijet.v15i06.12657

B. A. Hennessey. & T. M. Amabile. "Creativity". Annual Review of Psychology, 2010, 61, p. 572.

Baker, M. & Rudd, R. (2001). Relationships between critical and creative thinking. Journal of Southern Agricultural Education Research, 51(1), 173-188.

Beghetto, R. A., & Karwowski, M. (2017). Toward untangling creative self-beliefs. In M. Karwowski & J. C. Kaufman (Eds.)

Bender W. N. (2015). 20 strategies for STEM instructions. Blairsville, PA: Learning Sciences International.

Bernabeu, N. y Goldstein, A. (2009). Pedagógica. Creatividad: Ediciones Narcea.

Black, P., (17.10.2020), The F Word – Monroe Journal, August 11, 2016, retrieved from: https://petesperspective.com/the-f-word-monroe-journal-august-11-2016/

Boden, M. (2001). Creativity in education. London: Continuum.

Boden, M. A. (1992). Understanding creativity. The Journal of Creative behaviour, 26(3), 213–217. https://doi.org/10.1002/j.2162-6057.1992.tb01178.x

Boone, L.W. and Hollingsworth, A.T. (1990). "Creative thinking in business organizations". Review of Business, Fall Issue:1-6.

Campbell, D. T. (1969). Reforms as experiments. American Psychologist, 24, 409-429. doi: 10.1037/h0027982

Bozkurt Altan, & Hacıoğlu. (2018). STEM Education program for science teachers: perceptions and competencies. Journal of Turkish Science Education, 13

Braskamp, L. A., & Ory, J. C. (1994). Assessing faculty work. San Francisco: Jossey-Bass.

Bratskeir, K., (29.12.2021), 21 inspiring creativity quotes that'll get your ideas flowing, retrieved from: https://www.wework.com/ideas/professional-development/creativity-culture/creativity-quotes

Brynjolfsson, E., & McAfee, A. (2014). The second machine age: Work, progress, and prosperity in a time of brilliant technologies. WW Norton & Company.

Buckingham, D. (2003). Media education: Literacy, learning and contemporary culture. Polity.

Burnaford, G., Brown, S., Doherty, J., & McLaughlin, H. J. (2007). Arts integration frameworks research and practice: A literature review. Washington, DC: Arts Education Partnership

Buzan, T. 2009. Buku Pintar Mind Mapping. Gramedia. Jakarta

Martindale, "Personality, Situation, and Creativity". In J. A. Glover, R. R. Ronning, C. R. Reynolds, (Eds.), Handbook of creativity. Springer Science Business Media, 2013, p. 211.

Cachia, R., & Ferrari, A. (2010). Creativity in Schools: A Survey of Teachers in Europe. Seville: European Commission - Joint Research Centre -Institute for Prospective Technological Studies.

CACHIA, R., FERRARI, A., ALA-MUTKA K. & PUNIE, Y. (2010) Creative Learning and Innovative Teaching: final report on the study on creativity and innovation in education in the EU member states (Seville, Institute for Prospective Technological Studies, EUR 24675 EN

Carlile, P.R. (2002). A Pragmatic view of knowledge and boundaries: Boundary objects in new product development. Organization Science

Carson S.H., Peterson J.B., Higgins D.M. Reliability, validity, and factor structure of the creative achievement questionnaire. Creativity Research Journal. 2005;17:37–50

Catterall, J. S. (2002). The Arts and the Transfer of Learning. Critical Links: Learning in the Arts and Student Academic and Social Development (pp. 151-157). Washington DC: Arts Education Partnership.

Clear, J., For a More Creative Brain Follow These 5 Steps, retrieved from: https://jamesclear.com/five-step-creative-process

Clifford (2012). https://www.opencolleges.edu.au/informed/creativity/promote-creativity-in-your-classroom/ Stein, M. 1953. Creativity and culture. Journal of Psychology, 36:311–322.

Collard Paul, Looney Janet.(2014) Nurturing Creativity in EducationVol.49.No.3. DOI: 10.1111/ejed.12090

Collins, A. & Halverson, R. (2009). Rethinking Education in the Age of Technology: The Digital Revolution and the Schools. New York: Teachers College Press.

Collins, M. A., & Amabile, T. M. (1999). Motivation and creativity. In R. J. Sternberg (Ed.), Handbook of creativity (pp. 297–312). Cambridge University Press

Creative Problem Solving and Decision Making (2022), published by www.firstselectbh.com, retrieved from: http://www.firstselectbh.com/courses_en.php?id=31&lang=en

Creatividad: Revisión del concepto por José Ramón Fernández Díaz (Universidad Internacional de la Rioja), Fátima Llamas Salguero (Universidad de Extremadura) y Mónica Gutiérrez Ortega (Universidad Internacional de la Rioja): https://www.ugr.es/~reidocrea/8-37.pdf

Csikszentmihalyi, M. (1999). Implications of a systems perspective for the study of creativity. In R. J. Sternberg (Ed.), Handbook of creativity (pp. 313–335). Cambridge University Press.

Csikszentmihalyi, Mihaly. Creativity: Flow and the Psychology of Discovery and Invention. New York: HarperCollinsPublishers, 1996. Print.

Cummings, A., & Oldham, G. R. (1997). Enhancing creativity: Managing work context for the high potential employee. California Management Review

Henriksen, C. Richardson, R. Mehta, “Design thinking: A creative approach to educational problems of practice”. Thinking skills and Creativity, 26, 2017, p. 141.

Dawson, S., Tan, J. P. L., & McWilliam, E. (2011). Measuring creative potential: Using social network analysis to monitor a learners’ creative capacity. Australasian Journal of Educational Technology, 27(6). https://doi.org/10.14742/ajet.921

De Bono, E. (1967). New think: The use of lateral thinking in the generation of new ideas. Basic Books.

Desarrollo Creativo: https://educrea.cl/desarrollo-creativo/

development’ in Scandinavian Journal of Educational Research, vol.43, no.3, 1999, pages 259-273

Drazin, Robert, et al. “Multilevel Theorizing about Creativity in Organizations: A Sensemaking Perspective.” The Academy of Management Review, vol. 24, no. 2, Academy of Management, 1999, pp. 286–307, https://doi.org/10.2307/259083.

Düşünme Ö. Y., İlişki E. D. (2016). The Relationship between Creative Thinking and Critical Thinking Skills of Students, pp. 696. Doi: 10.16986/HUJE.2016018493

Educación Artística: Sustantivamente "Educación" y Adjetivamente "Artística" por José Manuel Touriñán López: Educación XX1, vol. 19, núm. 2, 2016, pp. 45-76 Universidad Nacional de Educación a Distancia, Madrid, España

Elder & Paul (2020). Critical thinking. Learn the tools that best thinkers use. London: Rowman & Littlefild.

Elizabeth Radziszewski (2017) SCAMPER and Creative Problem Solving in Political Science: Insights from Classroom Observation, Journal of Political Science Education, 13:3, 308-316, DOI: 10.1080/15512169.2017.1334562

Engineering Education. Vol 1, No. 1. p. 238. Washington, DC: The American Society for Engineering Education.

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2016). Teacher technology change: how knowledge, beliefs, and culture intersect. Journal of Research on Technology in Education, 42

Esquivias-Serrano, M., T. (2004). Creatividad: Definiciones, antecedentes y aportaciones. Artículos. Repositorio universitario. Disponible en: http://www.ru.tic.unam.mx:8080/tic/handle/123456789/693

Farnworth, D., (08.01.2021), What Is Creativity? 21 Authentic Definitions You’ll Love [Free Poster], retrieved from: https://copyblogger.com/define-creativity/

Fischer, G. & Ostwald, J. (2001) "Knowledge Management — Problems, Promises, Realities, and Challenges," IEEE Intelligent Systems, January/February 2001, pp. 60-72.

Fischer, G. (2001) "User Modeling in Human-Computer Interaction," User Modeling and User-Adapted Interaction (UMUAI), 11(1)

Fischer, M.G., Heeger, S., Hacker, U., Lehner, C.F. (2004). The mitotic arrest in response to hypoxia and of polar bodies during early embryogenesis requires Drosophila Mps1

Foshay, R., Kirkley, J. (1998). Principles for Teaching Problem-solving .

Fromm, E. (1941). Escape from freedom, Rinehart inc.

FRYER, M. (1996) Creative Teaching and Learning (London, Paul Chapman Publishing Ltd)

Gehani, R. (2011). Individual creativity and the influence of mindful leaders on enterprise innovation. Journal of technology management & innovation, 6(3), 82-92.

Gervais, J. (2016). "The operational definition of competency-based education". The Journal of Competency-Based Education. 1 (2): 98–106. doi:10.1002/cbe2.1011.

Glăveanu, V. (2010a). Paradigms in the study of creativity: Introducing the perspective of cultural psychology. New Ideas in Psychology , 28, 79-93. doi: 10.1016/j.newideapsych.2009.07.007

Golian, L. M. (1999). Thinking style preferences among academic librarians: practical tips for effective work relationships.

Gordon, W. J. J. (1961). Synectics: The development of creative capacity. Harper.
Rickards, Tudor. “Designing for creativity: A state of the art review.” Design Studies 1 (1980): 262-272.

Gouzouasis, P. (2006). A/r/tography in music research: A reunification of musician, researcher, and teacher. Arts and Learning Research Journal, 22(1), 23–42.

Greenstein, L. (2012). Accessing 21 century skills: To guide to evaluating mastery and authentic learning. USA: Corwin.

Guilford J.P. McGraw-Hill; New York: 1959. Personality.

Guilford, J.P. (1950) Creativity. American Psychologist, 5, 444-454.
http://dx.doi.org/10.1037/h0063487 Industrial and Commercial Training

Gustina, C., & Sweet, R. (2014). Creatives teaching creativity. International Journal of Art & Design Education, 33(1), 46–54. https://doi.org/10.1111/j.1476-8070.2014.01778.x

Habók, A., Nagy, J. In-service teachers’ perceptions of project-based learning. SpringerPlus 5, 83 (2016). https://doi.org/10.1186/s40064-016-1725-4

Halliwell, S. (1993) Teacher creativity and teacher education, in D. Bridges & T. Kerry (Eds) Developing Teachers Professionally. London and New York: Routledge.

Hansen, Alvin H. (1938), Full Recovery or Stagnation, New York: W.W. Norton.

Hardiman, M. M. (2012). The Brain-Targeted Teaching Model for 21st-Century Schools. Thousand Oaks, CA: Corwin Press

Harris, J., Mishra, P. & Koehler, M. (2009). Teachers' technological pedagogical content knowledge and learning activity types: Curriculum-based technology integration reframed. Journal of Research on Technology in Education

Hayes, J.R. (1989). The Complete Problem Solver. 2nd Edition. Hillsdale, NJ: Lawrence Erlbaum Associates.

Hennen, L., Van Keulen, I., Korthagen, I., Aichholzer, G., Lindner, R., & Nielsen, R. Ø. (2020). European e-democracy in practice (p. 359). Springer Nature.

Hennessey B.A., Amabile T.M. Creativity. Annual Review of Psychology. 2010;61:569–598.

Henriksen, D., Hoelting, M., & the Deep-Play Research Group. (2016). Rethinking creativity and technology in the 21st century: Creativity in a YouTube World. TechTrends

Higgins, James M. and Craig M. McAllaster. "Want Innovation? Then Use Cultural Artefacts that Support It." Organizational Dynamics 31 (2002): 74-84

Holly Carrell Moore (2019). Look what I made! Open-ended apps that spark creativity. Retrieved from https://www.naeyc.org

How to be creative and innovative in the workplace? (31.01.2019), published by www.plopdo.com , retrieved from: https://plopdo.com/2019/01/31/how-to-be-creative-and-innovative-in-the-workplace/

Hsieh C. T. (2003). Integration Information Into Visual Arts Appreciation Instruction for Elementary Giftedness Class. Master's Thesis, Institute of Special Education, National Taiwan Normal University, Taipei.
[https://www.researchgate.net/publication/264563051_Nurturing_Creativity_in_Education/link/5d8b048aa6fdcc255496e30d/download

Huckin et al., (2012) Critical Discourse analysis and Rhetoric and Composition. Available on www.ncte.org

Hul, J.V. (04.08.2017), 18 Inspirational Creativity Quotes to Live By, from ULR address here: https://artfulparent.com/creativity-quotes/

Illustration by FierceAbin, (24.02.2014), Leonardo da Vinci – İllüstrasyon, Retrieved from: https://www.istockphoto.com/tr/vekt%C3%B6r/leonardo-da-vinci-gm474901855-35481160

Indeed Editorial Team, (29.04.2021), 7 Creativity and Innovation Examples, retrieved from: https://www.indeed.com/career-advice/career-development/creativity-and-innovation-examples

Interactive Visual Art Learning in the Development of Young Children's Creativity by Sylvia Stavridi, Bibliotheca Alexandrina, Alexandria, Egypt

Interactive Web Technology in the Ar echnology in the Art Classr t Classroom: Pr oom: Problems and oblems and Possibilities by Marie Lynne Aitken Oxborrow, Brigham Young University - Provo

Ito, Mizuko et al. 2009. Hanging Out, Messing Around, and Geeking Out: Kids Living and Learning with New Media. Cambridge, MA: MIT Press.

Jain A., Jain, N., & Singh (2018). A peek into creative thinking Retrieved from https://www.academia.edu

Jauk, E., Benedek, M., Dunst, B., & Neubauer, A. C. (2013). The relationship between intelligence and creativity: New support for the threshold hypothesis by means of empirical breakpoint detection. Intelligence, 41(4), 212–221. https://doi.org/10.1016/j.intell.2013.03.003

Jeffrey, B. & Woods, P. (2003), The Creative School. London: RoutledgeFalmer

Jeffrey, B., & Craft, A. (2004). Teaching creatively and teaching for creativity: Distinctions and relationships. Educational Studies, 30(1), 77–87. https://doi.org/10.1080/0305569032000159750

Jenkins, H. (2006). Convergence culture: Where old and new media collide. New York, NY: NYU Press.

Jiang, H. Y., & Zhang, Y. T. (2018). Research on the Reform of Art Design Education Based on “Internet +”. Home of Drama, 1, 1-3

Johnson, D. W., Johnson, R. T., & Smith, K. (2014). Cooperative learning: Improving university instruction by basing practice on validated theory. Journal on Excellence in College Teaching, 25(3), 85-118.

Junginger, John et al. “Effects of serious mental illness and substance abuse on criminal offenses.” Psychiatric services (Washington, D.C.) vol. 57,6 (2006): 879-82. doi:10.1176/ps.2006.57.6.879

K. Robinson, Out of our minds: Learning to be creative. John Wiley & Sons, 2011, p.198.

Kalb, C., (2017), What Makes a Genius?, retrieved from: https://www.nationalgeographic.com/magazine/article/genius-genetics-intelligence-neuroscience-creativity-einstein

Kanchanachaya, N. (2012). Development of a blended learning model based on creative problem-solving principles using lateral thinking to enhance creative problem-solving abilities for instructional media production of pre-service teachers. Bangkok, Thailand: Chulalongkorn University.

Kao, J. J. (1996). Jamming: Art and Discipline of Corporate Creativity. New York: Harper Collins.

Karajz, S. (2021). The impact of Industry 4.0 on the processes of social innovation. Theory Methodology Practice: Club of Economics in Miskolc, 17(SI), 3-10.

Karayağmurlar, B. (1990). Sanatta yaratıcılık ve eğitim. Yayınlanmamış Yüksek Lisans Tezi, Dokuz Eylül Üniversitesi, İzmir.

Kaufman, J. C., & Beghetto, R. A. (2009). Beyond big and little: The four c model of creativity. Review of general psychology, 13(1), 1-12.

Kokotsaki, D. and Menzies, V. and Wiggins, A. (2016) 'Project-based learning : a review of the literature.', Improving schools., 19 (3). pp. 267-277.

Kumar, V. (2012). 101 design methods: A structured approach for driving innovation in your organization. John Wiley & Sons.

La creatividad: concepto, técnicas y aplicaciones por Autor: Mtra. Claudia Vanessa Joachin Bolaños: https://programas.cuaed.unam.mx/repositorio/moodle/pluginfile.php/166/mod_resource/content/1/la-creatividad/index.html

La importancia de la educación artística en la escuela by Auca Projectes Educatius: https://www.auca.es/la-importancia-de-la-educacion-artistica-en-la-escuela/4

Lacey, D.L., Erdmann, J.M., Teitelbaum, S.L., Tan, H.-L., O'Hara, J., and Shioi, A. (1995). Interleukin 4, interferon-g, and prostaglandin E impact the osteoclastic cell-forming potential of murine bone marrow macrophages. Endocrinology

Ladyman, J., Lambert, J., & Wiesner, K. (2013). What is a complex system?. European Journal for Philosophy of Science, 3(1), 33-67.

Las 14 claves para potenciar la creatividad: https://psicologiaymente.com/inteligencia/claves-potenciar-creatividad

Lauren M. Stevenson and Richard Deasy, Third Space: When Learning Matters (Washington DC: Arts Education Partnership, 2005),

Lee, J. R. (2001). Theory and method for creative education. Paju: Education & Science Press.

Levy, Frank and Richard J. Murnane. “The New Division of Labor: How Computers Are Creating the Next Job Market.” (2003).

LOONEY, J. (2009) Assessment and innovation in education. OECD Education Working Papers, No. 24 (Paris, OECD). doi: 10.1787/222814543073

López-Fernández, V. (2015). Importancia de la valoración de la creatividad desde las bases neuropsicológicas (p. 140-162). En P. Martín-Lobo y E. Vergara–Moragues (coordinadora). Procesos e instrumentos de evaluación neuropsicológica educativa. Madrid: Ministerio de Educación y Ciencia.

Loveless, AM (1997). Working With Images, Developing Ideas in A. McFarlane (ed) Information Technology and Authentic Learning. London: Routledge

Low, G. R. & Nelson, D. B. (Spring 2005). Emotional intelligence: The role of transformative learning in acade-mic excellence. Texas Study of Secondary Education, 14(2). The Texas Association of Secondary School Principals.

M. A. Runco, “Creativity research: Originality, utility, and integration”. Creativity Research Journal, 1(1), 1988, p. 4.

M. I. Stein. “Creativity and culture”. Journal of Psychology: Interdisciplinary and Applied, 36(2), 1953, pp. 311–322.

Malodi Özyaprak & Marilena Z. Leana-Taşcılar (2019). The effectiveness of self-regulated learning on teaching SCAMPER technique of creativity. Retrieved from https://dergipark.org.tr/en/download/article-file/1476185

March, J. G. (1991). Exploration and exploitation in organizational learning. Organization science, 2(1), 71-87.

Marzano, G. Grewinsky, M., Kawa, M., & Lizut, J. (2020). Towards changes of the labor market skills and competence, Elipsa.

Miller HB, Sawyers JK. 1989. A comparison of self and teachers’ ratings of creativity in fifth grade children. Creat. Child Adult Q. 14:179–85, 229–38

Mitchell, C. M. (1996). Human-Centered Automation: A Philosophy, Some Design Tenets, and Related Research. In Human Interaction with Complex Systems (pp. 377-381). Springer, Boston, MA.

Mohta, A., Joongel : Mother of All Custom Search Engines, retrieved from: https://www.technospot.net/blogs/joongel-mother-of-all-custom-search-engines/

Morris, W. (2006). Creativity: Its Place in Education. jpb.com, Erps-Kwerps, Belgium. http://www.jpb.com/creative/Creativity_in_Education.pdf

Muslim, H., & Itoh, M. (2019). A theoretical framework for designing human-centered automotive automation systems. Cognition, Technology & Work, 21(4), 685-697.

Nathalie Bonnardel, John Didier, Brainstorming variants to favor creative design, Applied Ergonomics, Volume 83, 2020, 102987, ISSN 0003-6870, https://doi.org/10.1016/j.apergo.2019.102987. (https://www.sciencedirect.com/science/article/pii/S0003687018305520)

National Advisory Committee on Creative and Cultural Education. (1999). All our futures: Creativity, culture and education (p. 62). Suffolk: DfEE publications.

Navilon, G., (2019), The creative process: To improve your creativity, follow these 5 steps, retrieved from: https://ideapod.com/the-creative-process/

Nesta. The UK's innovation agency for social good: https://www.nesta.org.uk/

Nikogosyan, A., (16.12.2019), Framework to guide your creative problem solving process, retrieved from: https://medium.com/andranik/framework-to-guide-your-creative-problem-solving-process-46b83533adc

NONAKA, I. & KONNO, N. (1998) The concept of "ba": Building a foundation for knowledge creation. California Management Review, 4

Osborn, A. F. (1953). Applied imagination.

P. Griffi n, E. Care (eds.), Assessment and Teaching of 21st Century Skills, Educational Assessment in an Information Age, DOI 10.1007/978-94-017-9395-7_2

P. Krugman, P. (2014). Four observations on secular stagnation, Secular stagnation: Facts, causes and cures, 61-68.

Patrick, C. (1937). Creative thought in artists. Journal of Psychology, 4(1), pp. 35–73.

Patrick, C. (1937). Creative thought in poets. Journal of Psychology, 26(178), pp. 1-74.

Patrick, C. (1938). Scientific thought. The Journal of Psychology, 5(1), pp. 55-83.

Peek, S., (23.07.2021), Creativity Is Not Innovation (But You Need Both), retrieved from: https://www.businessnewsdaily.com/6848-creativity-vs-innovation.html

Piaget, J. (1932). The moral judgment of the child. Harcourt, Brace.

PLUCKER, J. A. & MAKEL, M. C. (2010) Assessment of creativity, in: J. C. KAUFMAN & R. J. STERNBERG (Eds) The Cambridge Handbook of Creativity (New York, Cambridge University Press).

Plunkett, D. (1990). The creative organization: An empirical investigation of the importance of participation in decision-making. The Journal of Creative behaviour, 24(2), 140–148. https://doi.org/10.1002/j.2162-6057.1990.tb00535.x

PORTFOLIO H 5 CREATIVITY, the presentation can be found here: https://slidetodoc.com/portfolio-h-5-creativity-thoughts-for-all-of/

Prentice, R. (2000). Creativity A Reaffirmation of Its Place in Early Childhood Education. Curriculum Journal

Prompan, I. (2007). A development of a WEB-based instructional model based on Brain-based learning process in design course to enhance creative thinking of undergraduate students. Bangkok, Thailand: Chulalongkorn University.

Pryanka Rani & Nidhi Agarwal (2020). Thinking styles: an overview, 1, DOI: 10.5281/zenodo.3837701

Punya Mishra & Rohit Mehta (2017) What We Educators Get Wrong About 21st-Century Learning: Results of a Survey, Journal of Digital Learning in Teacher Education,

Rabkin, N., & Redmond, R. (2004). Putting the Arts in the Picture: Reframing Education in the 21st Century. Chicago, IL: Columbia College

Raudsepp, E., V. (1983). How to Create New Idea.

Reggio Emilia: An Essential Tool to Develop Critical Thinking in Early Childhood: https://naerjournal.ua.es/article/view/v6n1-6

Rickards, Tudor. “Designing for creativity: A state of the art review.” Design Studies 1 (1980): 262-272.

Ricker, J., (updated on 23.01.2022), The Relationship Between Intelligence & Creativity, retrieved from: https://study.com/academy/lesson/the-relationship-between-intelligence-creativity.html

Rinaldi, J. (03.12.2017), 15 Quotes to Awaken the Creative Inside of You [SlideShare], retrieved from: https://www.impactplus.com/blog/quotes-to-awaken-creativity-slideshare

Robinson, H. R. (2013). Arts integration and the success of disadvantaged students: A research evaluation. Arts Education Policy Review, 114, 191-204. doi:10.1080/10632913.2013.826050

Rodríguez-Muñoz, F., J. (2011). Contribuciones de la neurociencia al entendimiento de la creatividad humana. Arte, Individuo y Sociedad, 23 (2), 45-54.

Runco, M. A., & Jaeger, G. J. (2012). The standard definition of creativity. Creativity research journal, 24(1), 92-96.

Russell, J., & Zembylas, M. (2007). Arts Integration in the Curriculum: A Review of Research and Implications for Teaching and Learning. In L. Bresler (Ed.), International Handbook of Research in Arts Education (pp. 287-302). Dordrecht: Springer.

Ryhammar, L. & Brolin, C, 'Creativity research: historical considerations and main lines of

Sabol, F. R. (2006). Professional development in art education: A study of needs, issues, and concerns of art educators. Reston, VA: National Art Education Association

Sak U., San, İ., Ören, M. Üstindağ & the others (2011). Okulöncesinde Yaratıcılık. Eskişehir: Açık Öğretim Fakültesi.

Sarooghi, H., Libaers, D., & Burkemper, A. (2015). Examining the relationship between creativity and innovation: A meta-analysis of organizational, cultural, and environmental factors. Journal of business venturing, 30(5), 714-731.

Scott, W. A. (1965). Values and organizations: A study of fraternities and sororities. Chicago: Rand McNally

Sebok, A., & Wickens, C. D. (2017). Implementing lumberjacks and black swans into model-based tools to support human–automation interaction. Human factors, 59(2), 189-203.

Seltzer, K. & Bentley, T, The creative age: knowledge and skills for the new economy, Demos, London, 1999

Seyihoglu, A. & Kartal, A. (2010). The views of teaching about mind mapping technique in elementary life science and social science lesson based constructivist method. Educational Science: Theory & Practice, 10(3), 1637-1656.

Shneiderman, B. (2020). Human-centered artificial intelligence: Reliable, safe & trustworthy. International Journal of Human–Computer Interaction, 36(6), 495-504.

Simonton, D. K. (2008). Creativity and genius. In O. P. John, R. W. Robins, & L. A. Pervin (Eds.), Handbook of personality: Theory and research (pp. 679–698). The Guilford Press.

Simonton, D. K. (2012). Teaching Creativity: Current Findings, Trends, and Controversies in the Psychology of Creativity. Journal of Psychology, 39(3), 217–222. https://doi.org/10.1177/0098628312450444

Singh B. (1985). Chance in some characteristics of teacher behaviour and its effect on pupil creativity. Indian Journal of AppliedPsychology.

Sintapanon, S. (2009). Educational Innovation to develop youth's quality (3rd ed.). Bangkok, Thailand: 9119 Technic Printing.

Spivack, G., & Shure, M. B. (1974). Social adjustment of young children: A congitive approach to solving real-life problems. Jossey-Bass.

Stein, M.I, Stimulating creativity, Vol. 1, Individual procedures, Academic Press, New York, NY,1974

Stein, M.I. (1953). Creativity and culture. Journal of Psychology, 36(2), pp. 31–322.

Sternberg R.J., Lubart T.I. The concept of creativity: Prospects and paradigms. In: Sternberg R.J., editor. Handbook of creativity. Cambridge University Press; Cambridge: 1999. pp. 3–15.

Sternberg, R. J. (2003) Thinking styles. Cambridge: Cambridge University Press

Sternberg, R. J. (2010). Teach creativity, not memorization. Chronicle of Higher Education, 57(8), 1-4. Chicago

Sternberg, R. J., & Williams, W. M. (1996). How to develop student creativity. Alexandria, VA: Association of Supervision and Curriculum Development

Sternberg, R. J., Kaufman, J. C., & Pretz, J. E. (2002). The creativity conundrum: A propulsion model of kinds of creative contributions.

Strauch, B. (2017). Ironies of automation: Still unresolved after all these years. IEEE Transactions on Human-Machine Systems, 48(5), 419-433.

Sugimoto, M., Hosoi, K., & Hashizume, H. (2004) "Caretta: A System for Supporting Face-to-Face Collaboration by Integrating Personal and Shared Spaces." In Proceedings of CHI2004, Vienna, Austria.

Tamsah H., Ilyas J. B. & Yusriadi Y. (2021). Create Teaching Creativity through Training Management, Effectiveness Training, and Teacher Quality in the Covid-19 Pandemic , DOI: 10.29333/ejecs/800

Tatiana de Cassia Nakano, Walquiria de Jesus Ribeiro, Angela Magda Rodrigues Virgolim, (2021), Relationship between creativity and intelligence in regular students and giftedness students, retrieved from: https://www.scielo.br/j/pusf/a/mmsVpJTwvPSZst3t4LTqJ5j/

Teacher training: technology helping to develop an innovative and reflective professional profile: https://rusc.uoc.edu/rusc/ca/index.php/rusc/article/view/v12n2-hepp-prats-holgado/2606.html

Teachers' Pedagogical Knowledge and the Teaching Profession. Background Report and Project Objectives by Sonia Guerriero: https://www.oecd.org/education/ceri/Background_document_to_Symposium_ITEL-FINAL.pdf

Text by Oxbridge Team, What Makes a genius? Definition, Characteristics, and Qualities Explained, retrieved from: https://oxbridgehomelearning.uk/blog/characteristics-of-a-genius/

Text By Team Click Americana, (20.04.2020), About Albert Einstein: The life & work of the genius scientist, and why he mattered, retrieved from: https://clickamericana.com/topics/science-technology/about-albert-einstein

Text by the Mind Tools Content Team, (2016), Creative Problem Solving: Finding Innovative Solutions to Challenges, retrieved from: https://www.mindtools.com/pages/article/creative-problem-solving.htm#:~:text=Creative%20problem%20solving%20(CPS)%20is,obstacles%20and%20reach%20your%20goals

Torrance E.P. Personnel Press; Princeton: 1966. Torrance tests of creative thinking: Directions manual and scoring

Torrance, E.P, Torrance tests of creativity, Personnel Press, Princeton, 1966

Treffinger, D. J. (1995). Creative problem-solving : Overview and educational implications. Educational Psychology Review, 7(3), 301-312.

Umut, Y., (09.02.2021), Sanatta Işık ve Gölge Tekniği: Chiaroscuro, retrieved from: https://umutium.com/blog/sanat-ve-tasarim/sanatta-isik-ve-golge-teknigi-chiaroscuro/

University of Waterloo, Teaching problem-solving skills, retrieved from: https://uwaterloo.ca/centre-for-teaching-excellence/teaching-resources/teaching-tips/developing-assignments/cross-discipline-skills/teaching-problem-solving-skills

van Peppen, L.M., Verkoeijen, P.P.J.L., Heijltjes, A.E.G. et al. Enhancing students' critical thinking skills: is comparing correct and erroneous examples beneficial?. Instr Sci 49, 747–777 (2021). https://doi.org/10.1007/s11251-021-09559-0

Vincent, A.S., Decker, B.P., and Mumford, M.D. (2002).Divergent thinking, intelligence, and expertise: A test of alternative modes. Creativity ResearchJournal, 14,163-178. [Links]

Voogt, J. & Roblin, N. P. (2010). 21st century skills.http://opite.pbworks.com/w/file/fetch/61995295/White%20Paper%2021stCS_Final_ENG_def2.pdf

Wallach M.A., Kogan N. Holt, Rinehart and Winston; New York: 1965. Modes of thinking in young children: A study of the creativity-intelligence distinction.

Weisberg, R.W. (1999). Creativity and Intelligence. In R. J. Sternberg (Ed.), The Nature of Creativity. New York: Cambridge University Press.

What is creativity? The ultimate guide to understanding today's most important ability by Kelly Morr: https://99designs.es/blog/creative-thinking/what-is-creativity/

Whattananarong, K. (2011). Innovation and technical education technology. Bangkok, Thailand: King Mongkut's University of Technology North Bangkok.

Wheeler, S., Bromfield, C. & Waite, S. J. (2002). Promoting creative thinking through the use of ICT. Journal of Computer Assisted Learning, 18(1), 367-378

Wilson R.C., Guilford J.P., Christensen P.R. The measurement of individual differences in originality. Psychological Bulletin. 1953;50:362–370

Wilson, C. (2013). Brainstorming and beyond: a user-centered design method. Newnes.

Woodman, Richard W., et al. "Toward a Theory of Organizational Creativity." The Academy of Management Review, vol. 18, no. 2, Academy of Management, 1993, pp. 293–321, https://doi.org/10.2307/258761.

Woods, D. D., Tittle, J., Feil, M., & Roesler, A. (2004). Envisioning human-robot coordination in future operations. IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews), 34(2), 210-218.

Woods, D.R., Wright, J.D., Hoffman, T.W., Swartman, R.K., Doig, I.D. (1975). Teaching Problem-solving Skills.

Wycoff, Joyce.1995. Transformation thinking : tools and techniques that open the door to powerful new thinking for every member of your organization. New York:Berkley Books

Junginger, John et al. “Effects of serious mental illness and substance abuse on criminal offenses.” Psychiatric services (Washington, D.C.) vol. 57,6 (2006): 879-82. doi:10.1176/ps.2006.57.6.879

Yang, D. & Baldwin, S.J. (2020). Using technology to support student learning in an integrated STEM learning environment. International Journal of Technology in Education and Science (IJTES)

Yeates, K. O., & Selman, R. L. (1989). Social competence in the schools: Toward an integrative developmental model for intervention. Developmental Review, 9

Yıldırım, B., & Altun, Y. (2015). STEM Eğitim ve Mühendislik Uygulamalarının Fen Bilgisi Laboratuar Dersindeki Etkilerinin İncelenmesi. El-Cezerî Fen ve Mühendislik Dergisi

Yusnaeni, Corebima, A.D., Susilo, H., & Zubaidah, S. (2017). Creative thinking of low academic student undergoing search solve create and share learning integrated with metacognitive strategy. International Journal of Instruction, 10(2), 245-262.

Appendix. Evaluation quiz check sheets

Evaluation quiz no.1 check sheet – correct answers

1c	3b	5b	7a
2c	4c	6c	

Evaluation quiz no.2 check sheet – correct answers

1c	3b	5a	7c
2a	4c	6a	

Evaluation quiz no.3 check sheet – correct answers

1b	3b	5a	7b
2c	4a	6c	

Evaluation quiz no.4 check sheet – correct answers

1a	3b	5c	7c
2b	4c	6c	

Evaluation quiz no.5 check sheet – correct answers

1a	3c	5c	7c
2c	4a	6b	

Evaluation quiz no.6 check sheet – correct answers

1c	3b	5b	7b
2c	4c	6a	

Evaluation quiz no.7 check sheet – correct answers

1b	3a	5b	7c
2b	4c	6a	