



CHAPTER 3: CREATIVE AND CRITICAL THINKING SKILLS

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MSTEM

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Introduction

In a constantly changing world, developing creativity and critical thinking is an educational priority so that everyone can analyse and act with discernment. Far from being a skill reserved for adults, critical thinking begins to be developed from early childhood, when the child explores, questions and tries to understand the world around them.

This process of intellectual awakening, guided by appropriate interactions, is essential for the development of autonomous individuals, capable of discernment and able to act on the world. At different levels, these two skills are synonymous with well-being for the individual: 'One of the main attractions and interests of creativity lies in the feeling of anchoring and well-being it provides, according to positive psychology. (OECD p22). Critical thinking also plays a role in individual well-being, but is more often seen as one of the main pillars of a well-functioning modern democracy.' (OECD, p22)

Creativity is often associated with the arts, and critical thinking with the analysis of discourse or media output. Yet all areas of thought require creativity and critical thinking. Similarly, one might think that creativity is a gift and critical thinking a particularly strong personality trait. Yet both skills are present very early on and naturally in all individuals. 'Like other skills (at least most of them), creativity is not binary, but a continuum that can operate at different levels of mastery. It is not only artists or 'visionaries' or those presented as such who are capable of it.' (OECD, Similarly, critical thinking, given the biases in reasoning induced by the functioning of the human brain and the variety of situations in which it must be exercised also requires different levels of mastery.

It is therefore possible to develop levels of mastery in creativity and critical thinking. Most societies also believe (survey conducted by the OECD, chapter 2, p52) that it is important for these two skills to be taught at school.



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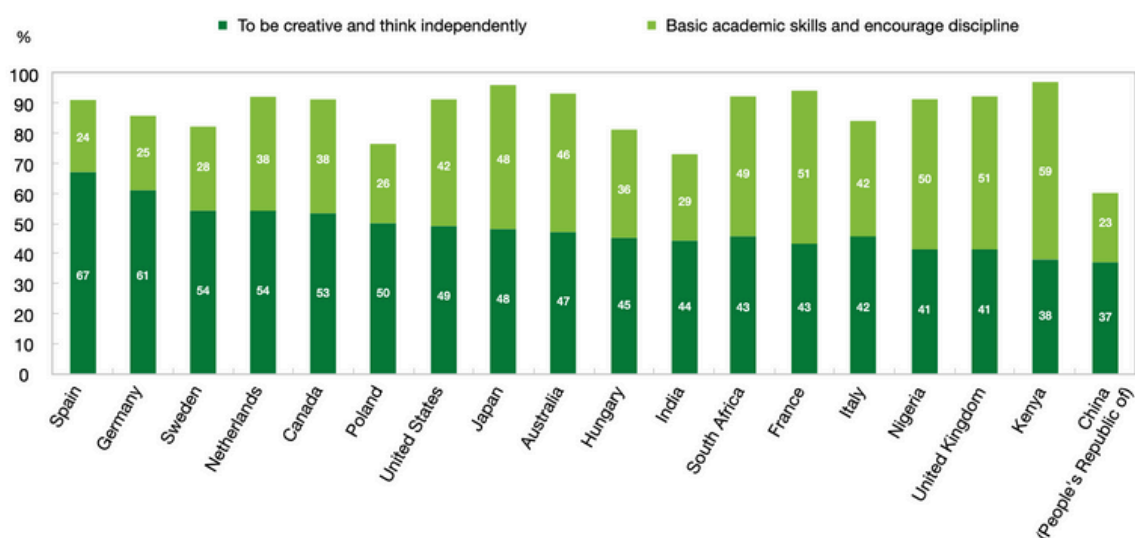


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It is therefore possible to develop levels of mastery in creativity and critical thinking. Moreover, most societies believe (survey conducted by the OECD, chapter 2, p52) that it is important for these two skills to be taught at school.

Figure 2.2. Most societies support the fostering of creativity and critical thinking in education
It is more important that schools in our country teach...



Source: Pew Research Centre, Spring 2016 Global Attitudes Survey.



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Learning models and education in creativity and critical thinking

Creativity and critical thinking cannot be developed without a certain amount of knowledge. But the reverse is also true. It is in this tension between the contribution of knowledge and creativity on the one hand and knowledge and critical thinking on the other that the learning situations devised by teachers must take place.

Creativity can be defined as the ability to ‘come up with new ideas and solutions’ (OECD, p32). Critical thinking as the ability to ‘question and evaluate ideas and solutions’ (OECD, p32).

In view of these definitions, it is clear that not all learning situations are equal when it comes to fostering creativity and critical thinking. Learning models that leave room for students to represent their everyday lives, in which they can try, make mistakes and start over are conducive to the development of creativity and critical thinking. Learning through research and problem solving and project-based learning are conducive to the development of creativity and critical thinking in pupils. These two teaching methods, which are inspired by the scientific approach of researchers, are therefore easily practicable with pupils in the context of MSTEM learning.

On the other hand, ‘When education is seen as the simple transmission of socially accepted knowledge, there is little room for creativity and critical thinking. On the other hand, like most skills, creativity and critical thinking should only be exercised at certain times: assuming it is really possible, a world where people are creative or critical all the time would be unbearable.’ (OECD, p53)



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In 'Defining and Educating Critical Thinking', Pasquinelli et al emphasise that the learning times for critical thinking must be explicit for the pupils. The teacher and the pupils must know that in this situation, each will improve their creative and critical skills. It is therefore important to define and explain the criteria that correspond to these two skills and to specify the levels of mastery. In their OECD report (p32), the teachers who took part in the study propose these evaluation criteria for pupils.

Easily transferable to the classroom, these criteria are a guide for evaluation.

Table 1.2. OECD rubric on creativity and critical thinking (domain-general, class-friendly)

	CREATIVITY Coming up with new ideas and solutions	CRITICAL THINKING Questioning and evaluating ideas and solutions
INQUIRING	Make connections to other concepts and knowledge from the same or from other disciplines	Identify and question assumptions and generally accepted ideas or practices
IMAGINING	Generate and play with unusual and radical ideas	Consider several perspectives on a problem based on different assumptions
DOING	Produce, perform or envision a meaningful output that is personally novel	Explain both strengths and limitations of a product, a solution or a theory justified on logical, ethical or aesthetic criteria
REFLECTING	Reflect on the novelty of the solution and of its possible consequences	Reflect on the chosen solution/position relative to possible alternatives

Note: This rubric is meant for teachers/faculty to identify the student skills related to creativity and to critical thinking that they have to foster in their teaching and learning, not for assessment.

We will use the 4 actions: research, imagine, do and reflect to identify the added value of the metaverse for educating creativity and critical thinking in the context of STEM.



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Contributions of the metaverse to education in creativity and critical thinking with MSTEM

The metaverse enables people who are physically distant to meet and interact, and provides access to a very wide variety of content, both interactive and non-interactive.

The metaverse is therefore suitable for the collective resolution of problems or scientific questions or for the realisation of collective projects. The virtual laboratory also makes it possible to carry out manipulations that are impossible in real life due to lack of equipment or because they are too dangerous.

Drawing inspiration from the work of colleagues who wrote the OECD report, here are a few examples of scientific activities that are suitable for developing creativity and critical thinking skills. These activities have in common that they are open-ended, related to the pupils' daily lives and linked to MSTEM content.

- Explaining a phenomenon
 - Evaporation cooling
 - Gas exchange between the chlorophyll plant and its environment
- Solving an environmental problem
 - Reducing the heat in the playground
 - Promoting biodiversity in the school
 - Reducing traffic in a street to avoid traffic jams
- Designing a production
 - Designing a structure to provide shelter from the sun and collect rainwater for the garden or to feed a pond.
 - Building a pontoon to facilitate the observation of life in the pond
- Imagine hypothetical scientific scenarios
 - What would the Earth be like if plate tectonics did not exist?
 - If photosynthesis did not exist, what would ecosystems be like?



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For each area of creativity and critical thinking assessment, we present some of the possibilities offered by the metaverse

<u>Rubrics</u>	<u>Examples of activities available in the metaverse for education in creativity and critical thinking</u>
INQUIRING	<ul style="list-style-type: none"> - explore immersive virtual environments to find information, data or resources relevant to a given project or issue. - use data <u>visualisation</u> tools in the metaverse to <u>analyse</u> complex problems from different angles, identify gaps in knowledge and challenge existing hypotheses
IMAGINING	<ul style="list-style-type: none"> - collaborative brainstorming sessions where students can freely generate and share ideas in an immersive virtual space - create simulations or virtual models to explore different scenarios and alternatives, and anticipate the consequences of different ideas and solutions
DOING	<ul style="list-style-type: none"> - use 3D modelling tools to design and prototype virtual objects, environments or systems. - use the virtual lab to experiment - collaborate on the creation of digital artworks, virtual performances and interactive installations in the metaverse
REFLECTING	<ul style="list-style-type: none"> - take part in virtual discussions or debates in the metaverse to critically evaluate ideas, solutions or arguments - use virtual diaries or digital portfolios in the metaverse to reflect on their own learning process, their strengths and weaknesses, and how they can improve their creativity and critical thinking skills



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CONCLUSION

To conclude, the metaverse is a useful resource for working on creativity and critical thinking, provided that the pedagogical situation proposed by the teacher is a sufficiently open situation in which the pupils have a problem to solve. They will be able to compare their ideas with those of pupils who are not in the class and produce together or in parallel productions that can be discussed.

The use of AI present in the metaverse will also be an opportunity for students to exercise their critical thinking in the face of the proposed results, which are only the result of a statistical use of the data to which the AI has access.



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