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Thinking classrooms: Promoting Critical Thinking and Creativity Through Problem Solving

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Abstract. In the context of enhancing 21st-century skills, this work seeks to evaluate the relevance of the Thinking Classrooms methodology for fostering creativity and critical thinking in the initial training of teachers. This methodology is based on problem-solving and a specific configuration of tasks and classroom management, using vertical surfaces and group work. To assess the potential of this methodology, two rubrics from the OECD were used to evaluate classes for the development of creativity and critical thinking. As a result, it was found that the methodology has the potential to develop creativity and critical thinking by effectively managing the classroom and presenting open-ended problems with high levels of cognitive demand, as suggested by the literature. As a future line of research, the aim is to validate the methodology by expanding the sample size and analyzing teaching situations in greater depth.

Keywords: Teacher training, Didactic, Creativity, Critical Thinking, Mathematics

1 Introduction

In the context of enhancing 21st-century skills as proposed by the Ministry of Education, this work aims to evaluate the appropriateness of the Thinking Classrooms methodology (Liljedahl, 2020) for fostering creativity and critical thinking in the initial training of elementary school teachers. This methodology is based on problem solving and a specific configuration of tasks and classroom management.

2 Theoretical Framework

First, the Thinking Classroom approach, proposed by Liljedahl (2020), is considered. This approach focuses on teaching mathematics through problem solving, with an emphasis on group work and a spatial arrangement of the classroom that facilitates discussion and the joint generation of new knowledge. We understand problem-solving as engaging in a mathematical task that has the potential to provide an intellectual challenge since its solution procedure is not known in advance (Cai and Lester, 2010). According to the literature, problems with higher potential for learning development are

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those with high levels of cognitive demand, such as open-ended problems (Olivares et al., 2020).

Secondly, the concepts of creativity and critical thinking are considered. According to the OECD (Vincent-Lancrin et al., 2019), these are fundamental skills for innovation and civic life in a democratic society, taking into account the current advancements in artificial intelligence and other technologies that are gradually replacing humans in more automated tasks.

3 Methods

An exploratory scoping study was carried out with an interpretive approach. 5 lessons implemented with the Thinking classroom methodology in the Mathematics Didactics subject were evaluated with 36 first-year students of Pedagogy in Basic General Education. Table 1 shows the problems worked on in each class.

Table 1. Problems addressed with the Thinking Classroom methodology.

Lesson	Problem	Tipe of problem	Cognitive demand level (from 1 to 4)
1	Decomposition of 25.	Closed	3
2	Boiling eggs	Open	4
3	Stressed people bar	Open	3
4	Exploding dots	Closed	3
5	Field trip	Open	2

Two rubrics were applied, one for creativity and another for critical thinking, assigning scores from 0 to 2, depending on whether the criterion was achieved, partially achieved, or not achieved during the class implementation. Table 2 summarizes the general guidelines of each rubric.

Table 2. Rubrics on creativity and critical thinking from the OECD.

Dimension	Creativity	Critical thinking
Inquiry	Making connections with other concepts, integrating other disciplinary perspectives.	Identifying and questioning assumptions and commonly accepted ways of solving a problem.
Imagination	Experimenting with multiple approaches to solving a problem.	Considering multiple perspectives to approach a problem.
Doing	Posing and envisioning how to meaningfully solve a problem in a novel way.	Explaining the strengths and limitations of different problem solving approaches based on logical criteria.
Reflecting	Reflecting on the steps taken to solve a problem.	Reflecting on the chosen approach and solution in relation to possible alternatives.

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4 Results

Table 3 presents the results of applying the rubric to the dimensions of the creativity (C) and critical thinking (CT) domains, where 0 points indicate not achieved, 1 point indicates partial achievement, and 2 points indicate fully achieved.

Table 3. Results in the dimensions of creativity and critical thinking.

Lesson	Inquiry		Imagination		Doing		Reflecting		Total	
	C	CT	C	CT	C	CT	C	CT	C	CT
Decomposition of 25.	1	1	1	2	1	1	2	1	5	5
Boiling eggs	2	2	2	2	2	2	2	2	8	8
Stressed people bar	1	2	2	2	2	2	1	1	6	7
Exploding dots	0	0	1	1	1	1	0	1	2	3
Field trip	2	2	1	1	2	2	2	2	7	7

5 Discussion

According to the results of the rubric, certain problems and classroom management characteristics contribute more to creativity and critical thinking. We agree with the literature that open-ended problems with higher cognitive demand are the most beneficial. This indicates that Mathematics classes provide a great opportunity for the development of higher-level skills.

6 Conclusions

The Thinking Classroom methodology has the potential to work on creativity and critical thinking in initial teacher training, depending on how it is implemented. An essential element is the type of problem that is proposed for solving. It is suggested to intentionally address these two aspects in classes explicitly, leveraging the advantages offered by the methodology.

7 Limitations and Future Research

The limitations of this work are related to the sample size and the lack of methods for obtaining reliability indicators. In the future, there are plans to expand the sample, the number of classes, and validate the rubric.

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