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METHODS OF FORMING THE STUDENT'S CREATIVE THINKING IN TEACHING MATHEMATICS IN ELEMENTARY GRADES

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ABSTRACT: - Creativity plays an important role in mathematics learning, so teachers must provide students with appropriate learning opportunities. This means using tasks, in particular those with multiple solutions and/or multiple resolutions, that usually require creative thinking and it could be a possible way to promote creativity in students. In this paper, we identify some traits of creativity in elementary pre-service teachers through tasks productions used during math classes.

KEYWORDS: Profession, craft, professional games, interest, stage, new pedagogical technology, didactic games.

INTRODUCTION

Students' mathematical literacy is usually determined by how they use their knowledge, skills and attitudes to solve problems. It is therefore necessary to offer them diverse experiences in order to develop their abilities for problem solving, so they can take advantage of lifelong learning mathematics. In order to deepen students' understanding of mathematics, we need to recognize that the mastery of rules, algorithms, and strategies is not the end goal of mathematics education, instead they should use these procedural tools to explore, test and defend their solutions to meaningful problems. Creativity plays an important role in mathematics learning, however there is no single description of creativity, but it can be argued that it begins with curiosity and involves students in exploring and experimenting, raising their imagination and originality (e.g. Conway, 1999; Silver, 1997). Research has showed that what students learn is largely influenced by the tasks given to them (Doyle, 1988; Stein & Smith, 2009; Vale, 2009), in particular those

with multiple solutions and/or multiple resolutions that usually require creative thinking (e.g. Leikin, 2009; Leikin & Pitta-Pantazi, 2013). Research also has shown that problem posing and problem solving in mathematics are closely related to creativity and can be characterized by three dimensions: fluency, flexibility and originality (e.g. Conway, 1999; Leikin, 2009; Silver, 1997). Thus, learning environments, where tasks give students opportunities to use several strategies to solve and formulate their own problems, may involve them in rich mathematical explorations, increase their motivation and encourage them to investigate, make decisions, generalize, look for patterns and connections, communicate, discuss ideas and identify alternative paths. In this sense the initial training courses in education must propose tasks for future teachers to experience and deeply explore, so they can use them with their future students. Thus we developed an exploratory study with elementary pre-service teachers where our main question was: Does problem solving and posing tasks have the potential to identify the dimensions of creativity in future teachers through their written productions? Mathematics teaching Nowadays we are experiencing deep changes in different areas of society, in particular in mathematics education. So mathematics educators have a great challenge to face mainly in the development of higher order thinking skills in students, such as formulating and solving problems, reasoning and communication. We need as well to analyze what features of teaching and learning are associated with better performance in mathematics by improving the quality of the main agents of change: teachers. These factors justify innovative strategies to improve teaching and learning, in particular tasks and other instructional materials that call for independent and critical problem solvers. The teacher unquestionably affects students learning, either with his knowledge and conceptions on teaching and learning of mathematics, or with the choices he makes and the actions he develops in his practice (Vale, 2009). In the context of mathematics classrooms, teacher, students, and (mathematical) content are linked in a system, which several researchers called “the didactical triangle” (Sträβer, 1994) or the “instructional triangle” (Lampert & Ghousseini, 2012), where teaching depends on the coordination of students’ active engagement in meaningful mathematical work, and on the materials that are used to represent the content to be learned in teacher-student interaction. In particular, the teacher’s role in this instructional system is to assure that students are engaged with content in a productive way, where we can highlight the role of the tasks Many of the fragilities that students have in learning mathematics are due to teachers' conceptions and attitudes, which influence their actions in the classroom, and the interactions with the students, but also to the gaps in mathematical knowledge and in innovative teaching strategies. The tasks that teachers select for their classes are fundamental and characterize their work (Stein & Smith, 2009). The orientation of inquiry, discussion and reflection of ideas is critical to student learning and arises only when teachers have a good knowledge of the subject they teach, how they teach it and when to teach it. Thus, it is important that teachers develop certain skills, including creative ones, based on a deep mathematical knowledge and teaching of subjects, allowing them to build, adapt, and exploit good mathematical tasks for the classroom. On the one hand, teachers must propose tasks that

help motivate their students to learn and develop their creative thinking, on the other hand teachers should themselves formulate creative tasks and teaching strategies to offer their students. It is therefore crucial that teachers can take advantage of all the potential contained in a task and, for that, they need to have opportunities to explore and solve them in the same way they think to explore with their own students. Among all the different tasks that we use in mathematics classes, problem solving plays an important role in the learners' competences, involving rich discussions that are cognitively challenging and are the primary mechanism for promoting conceptual understanding of mathematics (Stein & Smith, 2009). Problem solving tasks must be also revisited through new approaches, encouraging students to be persistent and look for creative ideas in order to raise a flow of mathematical ideas, flexibility of thought and originality in the responses. An exploratory teaching in which the teacher promotes conditions for students to discover and construct their own knowledge is the key to achieve this objective. We pay special attention to the work in figurative contexts due to their importance in any mathematical activity, being a learning component with many possibilities and often neglected in the learning trajectory of all students. Such importance is due to the fact that the display is not only related with the mere illustration, but also recognized as a component of thinking, deeply involved in the conceptual and not just in the perceptual. Students without this visual capacity will have great difficulty in learning. Seeing is an important component to explore mainly the generalization ability and this can only be developed through experiences that require this type of thinking (e.g. Barbosa, 2011; Rivera & Becker, 2005; Stylianou & Silver, 2004; Vale & Pimentel, 2011). Recognizing the central role of tasks in the teaching and learning process, it is necessary to involve teachers in their selection and preparation in order to acquire a deeper awareness of their effectiveness and educational value. So it is important to have rich tasks to help teachers develop creativity skills with their students. Mathematics is naturally engaging, useful, and creative and challenging tasks usually require creative thinking. Challenge in mathematics requires prior knowledge and is related to solving high-level mathematical tasks where memorization is not enough, and among other things involves the use of procedures with connections. According to Liljedahl and Sriraman (2006) students' ability to present new ideas and/or (re)solutions to problems in mathematics is considered as an indicator of creativity. Defining mathematical creativity is a very complex task. It is argued that it begins with curiosity and engages students in exploration and experimentation, involving imagination and originality. Several authors (e.g. Conway, 1999; Leikin, 2009; Meissner, 2005; Silver, 1997; Vale et al., 2012), consider that creativity involves divergent thinking contributing to higher order reasoning, which highlights three main dimensions: fluency, flexibility and originality (novelty). Fluency is the ability to generate a large number of different solutions obtained by the student for the same task. The flexibility is the ability to produce a variety of different ideas about the same problem, organized in various categories. Originality is the ability to create ideas that have been identified as unique as compared to students in the same group. Environments where students have the opportunity to solve mathematical problems, using diverse strategies, and formulate their own problems, allows them to be engaged in their exploration, increasing motivation and

encouraging them to investigate, to make decisions, to look for patterns and connections, to generalize, to communicate, to discuss ideas and identify alternatives.

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