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THE TEACHER'S ROLE IN THE INTERACTION BETWEEN SOFTWARE AND MATHEMATICS EDUCATION THEORIES AND ITS EFFECT ON THE CREATIVITY OF SAMPAD STUDENTS

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Abstract. Mathematical Challenge is one of the main components in mathematics education, which aims to improve the ability of learners in the field of mathematics. Also, creativity is a personal and social characteristic that leads to the development of people at all levels and in all historical periods. In fact, applying information and knowledge and using creativity in solving problems is very important. In between, for a mathematics teacher, in addition to having good techniques and knowledge, the use of software and theories of mathematics education is also effective on the flourishing of students' talent and creativity and helps them to solve a higher-level problem. In geometric concepts, using Euclid's principles and mastering them gives the teacher a better perspective for the problem solving process. In this article, a geometrical problem suitable for the 8th and 9th grade level has been proposed for the 7th grade in Sampad school, and while expressing the importance of Euclid's principles, both the dynamic environment of mathematics and the paper-pencil environment have been used. By using the Van Hiele's Theory in mathematical education, by designing an educational scaffold and dialogue between the teacher and students and with the help of Variation Theory, the answer of the problem was guessed by several students and a creative student gave a complete answer. Finally, we stated the problem as if and only if. In the meantime, Dimensional Deconstruction of Shapes was also used in the dynamic environment and paper-pencil environment.

Keywords: theories of math education - scaffolding - creativity - math software - if and only if.

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1. Introduction

Undoubtedly, one of the most important pillars of mathematics is Euclid's axioms. Designing and solving many geometrical problems can be based on these axioms. In 1980, the National Council of Mathematics Teachers published a statement entitled "Agenda for Action" and in it, it was emphasized the need to revise school mathematics curricula and it was realized that the knowledge of teachers is a key element in education. In the training of teachers to teach mathematics in the framework of TPACK, content knowledge and technology are two important pillars, and the interaction of these two components with pedagogy has a strong effect on teaching design. Based on this framework, content knowledge of teachers is one of the most key factors in the developing students' creativity. Also, improving knowledge for teachers is one of the important recommendations of Karamzadeh in [23] and also Polya in the book "How to solve it?". On the one hand, researchers in the field of mathematics education have various theories that the teacher, while using them as a theoretical background for research, can apply these theories to solve problems and on the other hand, the use of technology in teaching and learning mathematics is useful in many mathematical fields at different educational levels, especially in fields which are based on Dynamic Geometry Software. It is somehow difficult for an elementary student to go from solving intuitive and experimental problems to abstract problems to achieve a deep understanding, and we believe that this is the transition from a Van Hiele level to its higher levels, makes it difficult especially the transition from level 3 to level 4. In Iran, students are introduced to the basic concepts of geometry in elementary school, and out of a large number of 6th grade students, a small number (about 60 to 100 people) of creative and intelligent students are accepted in a Sampad center. In order to allow these mathematically interested students to use their intelligence, we must pose challenging problems for them [22].

2. Discussion

In football, sometimes 1 minute from the referee is enough time to change the result, and in real-time math education, 1 minute is enough time for students to solve a problem. We believe that one of the proper ways to design a good math problem is to combine several simple and basic problems and design a challenging problem for students. Leikin used a similar idea and a stepped task as a math activity involving a complex math problem called the target problem, along with scaffolding paths that include steps of different levels of math challenge. In this research, in the geometry classroom, we have used stepped problems, such as bottom-up rich problems and its converse. From Karamzadeh's point of view, mathematics education consists of two important parts, teaching and learning, and all other components should be used to facilitate these two, for teachers and students. The application of mathematics education theories in teachers' classrooms and researchers' research shows that they care about the most important topics of mathematics education, namely teaching and learning. It is

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important for teachers to understand how these theories can be used to improve teaching using an example as a case study. Marton and Lo call such an approach (case study) a learning study [20]. When we can choose several theories of mathematics education for a research, usually none of them is the best choice, because each one has its own strengths and weaknesses. And we believe that the teacher should apply the theories of mathematics education to solve the problems. In this research, we use Van Hiele's theory and the Variation theory. Every object or phenomenon has several aspects such as shape, size and function. The way in which a person experiences a phenomenon can be according to certain aspects of that phenomenon, which the person simultaneously focuses on and recognizes. We commonly use the term scaffolding when describing teaching and learning interactions in mathematics classrooms. Wood et al. [1] defined scaffolding as: an interactive system in which the teacher acts according to the actions of the learner to gain his attention. Due to how the teacher focuses on the nature of what is to be learned, it engages the students in interactions and discourse in the classroom. And for this reason, one of the key mechanisms that can make scaffolding constructive is dialogue. Stone also states that if we are to use the subject of richer discourse, we need to focus clearly on the dynamics of communication within a successful framework for children's learning. Creativity is a personal and social characteristic that nurtures human beings at all levels and in all historical periods. Karamzadeh suggests that individuals who possess creativity and can approach problem-solving with various methods tend to be more successful. In the context of school mathematics, students' creativity can be harnessed to generate novel ideas and solutions for unfamiliar mathematical problems or to devise alternative solutions for problems they have already learned. This approach, as highlighted by Leikin and Pita-Pantazi [17, 18], allows students to develop their mathematical thinking and problem-solving skills. Additionally, Barbeau [4] argues that presenting challenging mathematical tasks in the classroom can equip students with valuable qualities such as patience, persistence, and resilience, which are essential for overcoming future challenges in life. According to Sheffield , it is crucial for teachers to push high-achieving students and support those who may be facing challenges, especially in gifted center classes. This article presents a theoretical research study utilizing a descriptive-analytical research approach. The study began with an extensive review of literature, including articles, Olympiad and geometry textbooks, authoritative journals, and other pertinent sources. The research commenced by introducing a geometric problem to Sampad students, with a focus on investigating creativity and the teacher's impact on stimulating students' creative abilities. In this research, the classical problem and the target problem are identified as two separate issues that students address independently. The classical problem, which involves geometry, presents a greater level of difficulty for seventh-grade students in their first year of secondary school compared to the target problem. Despite the delayed realization of solutions for the classical problem, Karamzadeh emphasizes the importance of establishing a connection between the two problems using an “if and only if” approach.

3. Conclusions

The research conducted revealed that utilizing scaffolding not only offers a clear direction but also establishes a suitable framework for the application of mathematics education theories in a given problem. The teacher’s role has transitioned from a mere demonstrator to a facilitator and guide, potentially influencing the development of students’ cognitive processes from their current abilities to their potential abilities in constructing mathematical concepts and knowledge, particularly in the context of constructing isosceles triangles. The analysis of this research underscores the significance of geometry teachers and mathematics education researchers having a firm grasp of Euclid’s axioms, the TPACK framework, the integration of mathematics education theories in problem-solving scenarios, and the adept handling of challenging problems for gifted students.

we believe that mathematical creativity should be developed in all students. The findings indicate that teachers play a crucial role in presenting students with challenging problems and encouraging them to think critically, thereby nurturing their imagination throughout their educational journey. The examples presented in Section 6 show that by incorporating various mathematical proofs of students and interaction between dynamic and pencil-paper learning environments [8], a teacher can modify the level of mathematical challenge and guide students through Van Hiele’s levels, especially from level 1 to level 3. Van Hiele’s theory adopts a restricted perspective on the significance of language in the progression of geometry concepts. In this study, the geometry instructor managed to enhance the influence of language to a certain degree by effectively employing problem-solving techniques and fostering meaningful exchanges between herself and the students. Since students have to mentally manipulate the images to identify similarities and differences, the teacher’s role is clear after Variation Theory is introduced and changes in students’ perspectives are made. and the students were able to understand more deeply the two geometric views, i.e. angle and side, in the definition of an isosceles triangle. One of the most important parts of our results was the importance of posing problems in the form of “if and only if” from Karamzadeh’s point of view (his lecture in Mashhad, September 2001). After stating the paper-pencil proof of the classical problem, Karamzadeh says that, like many theorems, if we express the challenging problems as “if and only if” (Theorem 1 (gc-theorem)), we change the nature of the problem and difficult and relatively complex solutions become comprehensible and expressible proofs in the first secondary level and even in the elementary level. In fact, if the teacher presents a challenging problem to the students as “P if and only if Q” instead of ”If P then Q“, one side of the problem and sometimes both sides will become obvious. And it conveys the truth and depth of the material to the student faster and easier [23].

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