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The effect of situated learning environment in enhancing mathematical reasoning and proof among tenth grade students

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Abstract

This study investigated the effect of situated learning environment in enhancing mathematical reasoning and proof among tenth grade students. To achieve the aim of the study, a pre-post-test of mathematical reasoning and proof was used, and its validity and reliability were verified. The sample of the study consisted of 50 female students who were distributed equally into two groups; the experimental who were taught the circle unit in geometry by situated learning environment, and the control group who were taught by the traditional method. The results indicate a significant improvement in the students' ability of reasoning and proof in favor of the experimental group. Moreover, a diversity of mathematical reasoning and proof strategies were used by the experimental group.

Keywords: situated learning environment, mathematical reasoning and proof, mathematics education

INTRODUCTION

Traditional teaching methods that depend on indoctrination and memorization without understanding and application in life are among the causes of difficulties in learning mathematics, and the weak ability to develop ways of thinking, as students' performance levels drop due to their lack of understanding, and their negative view of mathematics, because of its abstract teaching without real application and daily life situations.

Nemours studies (Kumar, 2021; Li & Schoenfeld, 2019; Malik & Rizvi, 2018; Melinda et al., 2019; Peng et al., 2022; Wenger, 1998) indicate that educational institutions consider learning an individual process separate from the students' implementation of activities, which leads to receiving knowledge, and focusing on abstract information outside of life contexts, and to go beyond that it is better to put learning in the context of real experience.

Zeitoun (2008) showed that many of the learning theories that emerged due to deviation from life contexts are concerned with learning that is related to real life, the most prominent of which is the situated learning. In this context, Voskoglou (2019) indicates that situated learning is a theory developed by Lave and Wenger (1991) based on the opinions of many scholars such as Vygotsky and Dewey who believe that students tend to learn through participation in activities. Moreover, Donaldson et al. (2020) argued that "situated learning pedagogy include field–based instruction and students within a community of practice, and it emphasizes legitimate peripheral participation in this community" (p. 722).

Learning is defined by various educationalists (Kumar, 2021; Lave & Wenger, 1991; Xin et al., 2021) as the process of assimilation of knowledge by the learner through discovery or interaction with experienced people, it also means the individual's ability to participate in new activities, perform new tasks, and master new concepts. Learning from the viewpoint of supporters of the situated learning theory takes place through an authentic context of life situations that depend on interaction with others (Illeris, 2009; Klein & Leikin, 2020; Koskinen & Pitkaniemi, 2022; Leonardo et al., 2021; Li & Schoenfeld, 2019; Xie & Cai, 2020). Mousley (2003) claims that the situation is presented in the form of an activity practiced by students, and they interact in it in an experimental or real practical way

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Contribution to the literature

- This study has a notable contribution in developing mathematics teaching and learning, because it is the first study investigates the effect of situated learning on students' mathematical performance in Jordan.
- This study explains to educational researchers the role of situated learning on improving reasoning and proof.
- The current study shows the role of teacher in developing mathematics learning environments using the situated learning.

through a social environment in which they interact actively, and they acquire knowledge through this interaction.

Mathematical knowledge acquired in the context of school mathematics is usable and applicable outside of school in real-world contexts, and in this context, Persky and Robinson (2017) and Watson (1998) claim that students learn when they participate in activities using tools and language of the situation and when they move from the novice level to the expert level, and from the secondary role to the main role in the work. Ling and Choo (2005) confirm that interaction arises between students through their ideas and discussions during the performance of the activity. Ozudogru and Ozudogru (2017) indicate that situated learning activities must be collaborative in order to support knowledge building, higher-order thinking skills and multiple solutions, as well as direct students to identify their problems and express their knowledge, provided they are given enough time.

The role of the teacher in the situated learning environment is determined in designing and preparing activities and their tools, and working as a facilitator of learning, and as a member of the learning community (Besar, 2018; Kumar, 2021; Kurniawan et al., 2020; Polizzi et al., 2021; Zeitoun, 2008). It is also assumed that if the learner acquires knowledge using a material in a specific context, it will be easier to retrieve knowledge in a similar context, but he may not be able to retrieve it in different contexts and may not retrieve it at all (Alzahrani, 2022; Anderson et al., 1996; Assefa & Eshetu, 2019; Csíkos & Hidayatullah, 2022).

In light of the above, situated learning takes place through a real-life situation within the culture of the community and the needs of the students, where the students and the teacher build a community that consists of them as individuals, and the place where the experience or activity that represents the situation will be applied in a practical way, with all the necessary tools provided. And during the implementation of the activity or the experiment, knowledge and experiences are exchanged, which makes the students more knowledgeable through discussion, expression and clarification of different ideas and opinions, and through the implementation of the activity and its real application in order to acquire the required knowledge, and apply this knowledge through similar contexts.

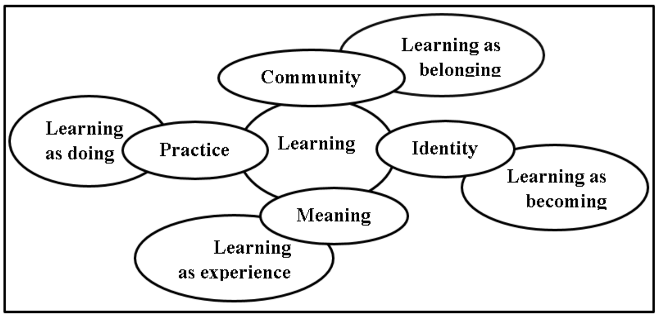

Figure 1. Components of a social theory of learning (Wenger, 1998, p. 5)

Wenger (1998) mentions that the theory of situated learning consists of the following components, illustrated in **Figure 1**:

1. **Meaning:** Learning occurs through activity or experience.
2. **Practice:** This indicates that learning takes place through mutual participation in action and application of knowledge in a social environment.
3. **Community:** This indicates that learning through the social environment of a situation and includes place, tools, people, and social interaction.
4. **Identity:** This underlines that learning takes place through changing thinking and knowledge in the context of society.

The assumptions of situated social learning theory include learning depends on everyday situations; knowledge is acquired through situations, and is passed on to similar situations; learning is the result of a social process that includes ways of thinking, understanding, problem solving, interaction, conceptual and procedural knowledge; learning is inseparable from the real world but takes place in social environments that consist of individuals and the situation (Northern Illinois University Center for Innovative Teaching and Learning, 2012; Stein, 1998).

Herrington and Oliver (1995) summarize the characteristics of a situated learning environment as: authentic contexts, authentic activities, access to the expert level, as well as multiple roles and perspectives, collaborative work, reflection, articulation, as well as teacher coaching and scaffolding, and assessment.

From the above, the role of learning through situations in developing students' skills in mathematics is clear, as through group work and discussion, students' skills develop in interpretation and giving evidence, which may lead to the development of their skills in mathematical reasoning and proof. In this context, Kumar (2021) claims that

> "abstract concepts such as mathematics can be more easily mastered when taught in real context than in formal context of the classroom, and classroom situated learning is implicitly based on school culture" (p. 2).

Mathematical reasoning is a process performed to obtain a conclusion based on mathematical premises and relevant facts and sources that have been assumed to be true (Besar, 2018; Hasanah et al., 2019; Kadioglu et al., 2020). The principles and standards for school mathematics curriculum document, issued by the National Council of Teachers of Mathematics (NCTM, 2000), states that reasoning is essential to understanding mathematics, because it leads to the development and discovery of ideas, interpretation of results, and the use of conjecture. Therefore, mathematical reasoning is an essential part of students' mathematical experience, and that students need to work with each other to formulate and explore their conjectures and to listen for and understand different interpretations, giving them the opportunity to discuss and to modify or strengthen their arguments and ideas. Stefanowicz (2014) claims that a proof, as a high level of reasoning, is a series of logical statements, one referring to the other, which gives an explanation as to why a particular statement is true.

Process standards in the principles and standards for school mathematics curriculum document (NCTM, 2000) refer to the standard of mathematical reasoning and proof, which emphasizes a set of sub-standards: inferring connections between mathematical ideas, and giving explanations for them; testing the validity of mathematical statements and thus accepting or rejecting them; building mathematical arguments and judging their validity, which includes developing proofs and evaluating their validity; the use of different methods of reasoning, including mathematical proof; discovering patterns and generalizing through inductive reasoning. And through the sub-standards, the skills of analysis, interpretation and reflection are employed to understand and acquire knowledge in the primary level and develop with access to the secondary level.

Based on the foregoing, involvement in situated learning, whether inside or outside the classroom, may be an environment for developing the requirements of the reasoning and proof standard for students, as the situated learning environment stimulates thinking and gives convincing reasoning for solutions.

LITERATURE REVIEW

Previous studies examined situated learning and its impact on enhancing many variables, in different subject areas including mathematics, such as the acquisition of knowledge and the transfer of its impact to other situations, as in the study of Cabral et al. (1997), which aimed to reveal the effect of situated learning in promoting effective learning, where 59 male and female students were involved in planned activities within the contexts of civil engineering, and at the end of the semester they were subjected to a test, in addition to the use of observation and questionnaire to collect data. The results showed that the activities planned to place the students in the context of civil engineering had a positive impact on their awareness of the importance of the acquired knowledge for their future profession, and there was a significant improvement in the students' ability to transfer the acquired knowledge to other situations.

In a longitudinal study conducted by Boaler (1999) in order to reveal the benefits of situated learning in students' learning of mathematics, whether their conceptual understanding, procedural fluency, or their attitudes towards mathematics. The study was conducted on students from the age of 13 to 16 years who are enrolled in two schools: in one of them, students were taught in the traditional method, and in the second, students were given complete freedom to create their own educational environment, and to practice activities that link learning with the real world, and to form the idea that math classes are a community to practice what has been learned. The results showed that the students to whom situated learning was applied were able to solve most of the conceptual and procedural questions in the national test, and considered that mathematics is a science related to life situations. As for the students who learned in the traditional method, they had many conceptual errors, and they were not able to solve many questions, and they considered that mathematics does not exceed the content of the book, and is applied only in the classroom.

In the context of technology-assisted situated learning, Ling and Choo (2005) designed a simulation-based learning environment, where students were trained to install and maintain electrical wiring for buildings and industrial facilities according to the code of practice for electrical installation, in addition to the use of CP5 software, which provides interactive activities and demonstrates real-world applications for a real task that the trainee will encounter in the real field of work. The results of the study showed that the students interacted with this application and their knowledge gained in the situation-based environment was transferred to the real application in life.

Moreover, in the context of robotics, Wang et al. (2021) conducted a study that aimed at empowering undergraduate and graduate computing students in robotics through situated learning. Multi-model collaborative robot was employed in the classroom based learning community for one semester; the proposed situated learning pedagogy was effective in learning robotics.

Since the teacher is an individual who represents the expert in the community of practice and in the situated learning environment, in addition to the students who all represent the members of this community, Hodgen (2007) showed that mathematics teachers' activation of their knowledge based on situations and practices in the classroom, good relationship with students, and collaborative work, whether in the classroom with students or in collaboration with other teachers through the social environment, and the exchange of learning resources, led to an increase in students' ability to better acquire knowledge and apply it in real contexts.

In the same context, Malcolm (2010) showed that communities of practice through situated learning within the school context improved students' assimilation and acquisition of knowledge, which leads to the transfer of skills and knowledge from school to daily life and in the future to the labor market. Also, the study of Widjaja (2013) and through the application of four problems in mathematics with life contexts for the fourth, fifth, and sixth grades, and activating the discussions in which teachers and students participate, and giving different explanations and reasoning, showed that learning through the life context leads to meaningful learning when students take an active part in the discussion, by asking questions, explaining and giving reasoning.

In the field of the role of learning based on life contexts and teamwork in enriching the interaction of secondary school students in learning mathematics, Brown and Redmond (2017) showed that learning through life contexts develops students' understanding of different mathematical concepts, links daily life with mathematics, and enhances students' participation in mathematics.

In the same context, the study of Reyes et al. (2019) revealed that teachers' use of life contexts for their classroom activities in the community of practice while teaching geometry to seventh and ninth grade students has achieved a better understanding of geometry concepts for students. In the context of developing reasoning in geometry among students, Đokić (2015) conducted a quasi-experimental study that used life contexts within collaborative groups and the results through testing and classroom observation showed the development of geometric reasoning among students. Also, regarding using life contexts and the community of practice within the classroom, it was found that this pedagogy enhances students' ability of mathematical reasoning in general and geometric reasoning in particular (Ginting et al., 2018; Habsah, 2017; Kennedy & Dunn, 2018; Koskinen & Pitkaniemi, 2022; Mohamed et al., 2020).

Investigating the effect of situated learning on students' mathematical performance (Rocha, 2020) designed a game based on the principles of situated learning, and an empirical evaluation of the game was performed through five-week experiment, the results revealed significant improvement of students' mathematics performance. In the meanwhile, creating situated mathematics tasks, Yaro et al. (2020) conducted a study to illustrate, for math teachers, the possibility of creating math tasks using environmental, cultural and societal issues of certain local community.

In the sense of globalization, Chang (2021) conducted a study abroad in different fields including education to investigate how foreign sites programs function as learning context. By interviewing 12 participants, the qualitative analysis of the data showed that foreign sites were effective in enhancing students' learning.

By reviewing previous studies, it was found that there were few studies that dealt with the impact of situated learning in the field of mathematics, in addition to the scarcity of studies that dealt with the impact of situated learning on improving reasoning and proof in geometry of circle. Hence, this study came to confirm the findings of previous studies, and to research the impact of situated learning on improving students' ability in mathematical reasoning and proof, as previous studies did not directly address this issue.

STUDY PROBLEM AND QUESTIONS

Through experience in teaching mathematics, the most prominent problem that leads to students' lack of understanding of mathematics is separating mathematics from life situations and dealing with it as an abstract science, which leads to the lack of application of knowledge and its lack of development and consequently forgetting it, and this is evident through the students' inability to reason and prove correctly.

Adolphus (2011) points out that one of the most prominent areas of mathematics related to life, in which students' lack of understanding and their weak ability to reason and prove is the field of geometry and its various applications, where students face difficulties in applying theories and linking them with different definitions and relationships, inferring new relationships and characteristics, and proving them individually or collectively in collaboration with students and teachers.

Hence, the trend to teaching mathematics based on situated learning came in order to move students from the novice level to the expert level, and the impact of this in enhancing their ability to reason and prove in the geometry of the circle. Specifically, the study answers the following two questions:

1. What is the effect of situated learning on improving mathematical reasoning and proof ability in geometry among tenth grade students?
2. Do the strategies of mathematical reasoning and proof used by students differ according to the method of teaching?

Study Sample

The study sample consisted of 50 tenth grade students enrolled in a public school for girls in Jordan for the first semester of the academic year 2020/2021. The study sample was divided equally into two groups, one experimental and the other control. The experimental group studied the unit of the circle using situated learning, and the control group studied the same educational unit using the traditional method.

Situated Learning Environment

After determining the learning outcomes for the unit of the circle from the tenth-grade book, five lesson plans were designed, with 15 class sessions, to suit the principles of situated learning and its elements and components. Learning takes place through real life situations within the environment and the culture of the school, and its application in the form of an activity or a practical experience through the formation of an integrated social environment in which the application and the exchange of experiences and knowledge between the members of this community, namely the students and the teacher. This environment, according to Oliver and Herrington (2014), includes providing a real context that reflects the way knowledge is used in real life, providing authentic activities, accessing expert performance, providing multiple perspectives, supporting the collaborative construction of knowledge, promoting reflection to reach abstraction, enhancing articulation to clarify knowledge, and the teacher's assistance to students in training, practice, providing scaffoldings, and providing an integrated assessment of learning within the tasks. All of this is accompanied by collaborative group work forms, worksheets, various assessment tools, and an explanatory table of the geometrical unit concepts.

Examples of situations that were used in the "chords, diameters and tangents of a circle" lesson include circular decorations, metal cutters, wooden bases, and gymnastics rings in the school gymnasium. Another situation in the lesson "arcs and sectors" is the identification of a circular part in the school garden, dividing it into four circular sectors, and planting each part with a type of plant. Another example of situations for the lesson "equation of a circle" is displaying a turntable on one of the walls of the school theater using data show with a fan installed on the wall, in addition to other situations. Due to the conditions of COVID-19, two consecutive class sessions per day were given at a rate of 45 minutes for each session during the first month of the semester, after that, switching to distance learning was made. The control group was subjected to studying the same unit according to the textbook and in the traditional method without exposure to situations. The quasi-experimental pre-post two groups design was used, one experimental and the other control.

Data Collection Instrument

After reviewing the previous literature, the National Council of Teachers of Mathematics (NCTM, 2000) principles and standards document, and the general and specific outcomes of the circle unit in the tenth grade mathematics textbook for the academic year 2020/2021, the mathematical reasoning and proof test was prepared with the aim of revealing the effect of situated learning in enhancing mathematical reasoning and proof.

The test consisted of 12 opened tasks, and the tasks were constructed based on three areas: inferring connections between mathematical ideas with an explanation (four items), testing the validity of mathematical statements and thus accepting or rejecting them (four items), and building mathematical arguments (four items).

A rubric has been designed within performance indicators grading (below the novice, novice, trainee, expert) with numerical scale: 0, 1, 2, and 3, respectively, for each of its four indicators, so that the minimum score is zero and the maximum score is 36. The test was presented in its initial form to specialized referees, and in light of their comments, few tasks were reformulated to achieve the desired objectives of the test in line with the standard of mathematical reasoning and proof.

In order to verify the reliability of the test, it was applied to an empirical sample from outside the study sample consisting of 12 female students of the eleventh grade, as they had studied the circle unit previously, using the test-retest method, and calculating the Pearson correlation coefficient between the performance in both times, as it reached 0.78. Also, the tasks' correlation coefficients with the total score of performance on the test, and with the score performance with their areas were calculated to verify the validity of the internal consistency of the test, and they were within the intervals 0.540-0.955, 0.757-0.965, respectively, which are statistically significant and appropriate for the purposes of this study (Odeh, 2010).

FINDINGS OF THE STUDY

The findings of the study are presented in two parts based on the study questions.

Part One

This presents data analysis related to the following question: "what is the effect of situated learning on

Table 1. Means, standard deviations, and adjusted means of the sample performance in the reasoning and proof test, according to the group (experimental and control)

		Pre-test		Post-test			
Group	Number	Mean	SD	Mean	SD	AM	SE
Experimental	25	6.56	1.87	23.00	7.35	22.72	1.17
Control	25	5.72	2.23	14.20	3.96	14.48	1.17

Note. Max score=36; SD: Standard deviation; AM: Adjusted mean; SE: Standard error

Table 2. One-way ANCOVA for the post-test of mathematical reasoning and proof according to the teaching method (situated learning, the traditional method)

Source	SS	DoF	MS	F	S	ES
Pre (covariate)	88.89	1	88.89	2.64	0.11	
Teaching method	814.28	1	814.28	24.18	0.00	0.34
Error	1,583.11	47	33.68			
Total	2,640.00	49				

Note. SS: Sum of squares; DoF: Degrees of freedom; MS: Mean square; S: Significance; ES: Eta square

Table 3. One-way ANCOVA at the level of each area of the post-mathematical reasoning and proof test according to teaching method

Source	Area	SS	DoF	MS	F	S	ES
Teaching method	Inferring mathematical connections	128.00	1	128.00	28.78	0	0.38
	Testing the validity of mathematical statements	92.48	1	92.48	14.62	0	0.23
	Building mathematical arguments	103.68	1	103.68	18.91	0	0.28

Note. SS: Sum of squares; DoF: Degrees of freedom; MS: Mean square; S: Significance; ES: Eta square

improving mathematical reasoning and proof ability in geometry among tenth grade students?" To answer this question, the means and standard deviations of the sample performance on the pre- and post-test of mathematical reasoning and proof were calculated as a whole, and the adjusted means for them according to the group, as shown in **Table 1**.

It is clear from **Table 1** that there are apparent differences between the post mean of the scores of the study sample in the test of mathematical reasoning and proof, according to the group (control and experimental), and to find out whether these apparent differences are statistically significant, (one-way ANCOVA) was used for the post-measurement of the test of mathematical reasoning and proof according to the teaching method, as shown in **Table 2**.

Table 2 shows that there are statistically significant differences ($p<0.05$) between the two means of the scores of the two groups in the test of mathematical reasoning and proof attributed to the teaching method. The results also indicate that the differences are in favor of the experimental group, through the results of the adjusted means in **Table 1**. In addition, **Table 2** shows that the effect size is 0.34, meaning that the effect size of the teaching method was large, as the effect size is large and strong as it is more than 15% as indicated by Cohen referred to in Al-Kilani and Al-Sharifin (2016), which means that 34% of the explained variance in the students' performance in the reasoning test is attributed to the situated learning environment.

In order to show which area of mathematical reasoning and proof test was the cause of this effect, ANCOVA was performed on the combined areas of the test, where the value of Hotlling's is 0.674, and F was statistically significant ($p<0.05$), then followed by one-way ANCOVA at the level of each area of the mathematical reasoning and proof test according to the teaching method, as shown in **Table 3**.

Table 3 shows that there are statistically significant differences ($p<0.05$) in the means according to the teaching method in all areas of mathematical reasoning and proof, which indicates the effectiveness of the teaching method in enhancing mathematical reasoning and proof in each of its areas. The effect size was 0.38, 0.23, and 0.28 for each of the conclusion of inferring mathematical connections, testing the validity of mathematical statements and thus acceptance or rejection, and building mathematical arguments, respectively, which means that 38%, 23%, and 28% of the explained variance in the performance of the students in those areas of reasoning and proof process is due was to situated learning environment.

Part Two

This part of the findings of the study presents the data analysis related to the following question: "Do the strategies of mathematical reasoning and proof used by students differ according to the teaching method?" To answer this question, the responses of the students were analyzed qualitatively using the inductive–deductive approach, as the students' written answers to each question were extrapolated, and for each student, and the strategies used were organized within the three areas of reasoning and proof according to which the test was

Table 4. Frequencies and percentages of reasoning strategies used by students on the test as a whole according to the teaching method

Group	Experimental								Control							
Reasoning form	Symbolic		Words		S&W		F&W		Symbolic		Words		S&W		F&W	
Reasoning strategy	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Deductive reasoning	25	100	18	72	21	84	18	72	12	48	9	36	8	32	5	20
Direct proof	4	16	10	40	13	52	7	28	1	4	0	0	1	4	1	4
Indirect proof (reasoning by contradiction)	3	12	0	0	7	28	0	0	1	4	0	0	0	0	0	0
Reasoning by conjecture	11	44	20	80	8	32	5	20	8	32	25	100	8	32	3	12

Note. S&W: Symbolic and words; F&W: Figure and words

built, and the most prominent strategies of mathematical reasoning and proof that were used were categorized according to the teaching method (situated learning, traditional), and then determining the frequencies and percentages of these strategies at the level of each task according to the three areas set out previously. After that, the strategies used by the two groups and their frequencies and percentages on the test of total mathematical reasoning and proof were summarized as shown in **Table 4**.

Through the solutions of the students in the experimental and control groups, it was found that the methods of reasoning and proof were varied among the students of the experimental group in the three areas of reasoning and proof; they were more flexible and in depth, and the answers were more correct among the experimental group, where the students used all kinds of reasoning and proof mentioned in **Table 4**, and the methods of reasoning and proof were less diverse in the control group, where few students used the methods of reasoning and proof mentioned in **Table 4**; as many of its members relied on the three areas of reasoning and proof on conjecture without explanation, incomplete solution, failure to give explanations and reasoning for the followed solution steps, or inability to use concepts and theories correctly. This indicates that the situated learning gave the students flexibility and ability to think, analyze and link better than the traditional method that restricted the students' thinking in very limited ways and strategies, which led to the experimental group gaining a better ability to mathematically reason and proof.

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

The results of the first question showed the effect of situated learning in enhancing students' mathematical reasoning and proof. This result can be explained that situated learning prepares the learner to use knowledge in life, interact with students and the teacher while completing tasks, explore by providing authentic activities and collaborative work, and enhance understanding through the exchange of pre knowledge, discussion and articulation, expressing different points of view and defending opinions and various arguments. And that is through the teacher's provision of support and enhancing to collaborative groups when needed, continuous assessment during work, and giving students a greater role in work and access to results.

These results can also be interpreted in favor of the experimental group because of the elements and characteristics of the situated learning environment, which begins with providing the real context, the physical environment and the necessary tools, then carrying out an authentic activity within this environment through collaborative groups and reflection on the activity and students' work, encouraging and motivating students to exchange knowledge and experiences, link previous and later information and express different opinions, in addition to the teacher's collaboration with students and providing scaffoldings, enhancing and assessment for them to reach the level of experts.

From the foregoing, it is clear that the experimental group's superiority in the test of mathematical reasoning and proof in the circle unit over the control group indicates a clear role of situated learning in developing students' ability to appropriate mathematical reasoning and proof, and in different ways from one student to another without being restricted to one method. On the other hand, the control group relied mainly on the teacher, who relied on direct instruction and indoctrination, as knowledge remains theoretical that is forgotten over time.

The result of the current study agreed with the results of previous studies (Besar, 2018; Chang, 2021; Hodgen, 2007; Reyes et al., 2019; Roacha, 2020; Widjaja, 2013; Zahner et al., 2021), whose results indicated an effect of situated learning in improving students' abilities to learn mathematics, use acquired knowledge, and develop students' skills in mathematics.

What supports the previous result, is the existence of an impact of situated learning on the diversity in the methods of mathematical reasoning and proof, their validity and their diversity among the members of the experimental group, through their answers to the test of mathematical reasoning and proof compared to the control group. This result can be explained by the fact that the situated learning led to a suitable diversity of reasoning methods among the students, due to linking previous knowledge with new knowledge, employing acquired knowledge in different ways of solving, which led to the employment of concepts, relationships and theories in the solution and linking the necessary relationships to suit the tasks.

Accordingly, this shows the role of life contexts, authentic activities and collaborative groups in understanding the acquired knowledge better because it matches the student's environment and needs, and the support provided by the teacher when needed led to an increase in the students' ability to express their ideas and opinions and the diversity of ways of thinking due to mutual experiences and knowledge, which increased the students' ability to reason and prove mathematically in a variety of ways and not to memorize one method by the method of indoctrination, which in turn helped not to forget the information and helped to use it correctly and benefit from it in similar situations and problems.

Also, the weakness of reasoning and proof among the members of the control group compared to the members of the experimental group, and the lack of diversity in their methods in mathematical reasoning and proof, rather the similarity of their methods in mathematical reasoning and proof and their limitation to specific methods and the inability to implement these methods correctly, can be attributed to the teaching method, which led to memorizing limited methods of mathematical reasoning and proof, without thinking in various ways or trying to deduce new ways or benefit from the acquired information in solving problems, because the students relied on memorization and did not apply knowledge in a practical way or link it with life; This, in turn, led to the inability to use knowledge properly. In addition, the role of the students in the control group did not exceed the repetition of solutions and ideas of some problems that the teacher solved, and this is consistent with the results of previous studies such as studies of Donaldson et al. (2020), Malcolm (2010), and Peng et al. (2022).

Based on the foregoing, and in light of the results of the study, the researchers recommend that mathematics teachers should adopt teaching using situated learning in geometry subjects, enrich the curricula with situated learning activities in mathematics subjects, especially geometry, and provide opportunities for mathematics teachers to view and plan for situated learning. The researchers call for conducting more research that deals with the impact of situated learning on teaching different topics in mathematics, and for other educational levels, and new dependent variables.

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