ELECTRONIC JOURNAL FOR RESEARCH
IN SCIENCE & MATHEMATICS EDUCATION
VOL. 28, NO. 2, 45-68

Preservice Mathematics Teachers' Dispositions Regarding Tasks in a Computer-mediated Learning Environment

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ABSTRACT

The aim of this research is to examine preservice mathematics teachers' dispositions toward drawing geometric patterns in tasks and find out their perspectives on using these tasks for their future students. Sixty preservice mathematics teachers who enrolled in a methods course for 14 weeks participated in the research. The responses to the written questionnaire were evaluated through document analysis. As a result, two perspectives — I as a learner position and I as a teacher position — were used to group the preservice teachers' dispositions. Under the headings of the socio-psychological approach, cognitive conditions of sensorimotor skill acquisition, and epistemological approach, the perspective of a learner was investigated. The perspective of being a future teacher was examined under the vocational and pragmatic approaches. From learner and teacher perspectives, the participants support GeoGebra's use in mathematics classes, even though they initially knew nothing about GeoGebra in the learning process. The participants mentioned that learning GeoGebra and the use of the application in the learning process, such as dragging, copying, easily rotating shapes, and getting their symmetries, contributed to learning geometry as well as developing positive feelings towards mathematics.

Keywords: tasks, geometric patterns, preservice mathematics teachers, computer-mediated learning environment, I-positions

Introduction

Technology has become indispensable in today's world. In the field of mathematics education, it not only serves a basic need but also acts as a catalyst for transformation. Such technologies are known as Information Communication Technologies (ICTs) and include a variety of tools such as calculators, virtual reality applications, computer algebra systems, and dynamic geometry software. However, the impact of technology on mathematics teaching and learning, as well as its integration, has long been the focus of mathematics education research. The existing literature presents findings indicating that technology use affects mathematics achievement positively (Özçakır & Çakıroğlu, 2019; Turk & Akyuz, 2016) and contributes to the development of a positive attitude towards geometry and the mitigation of anxiety (Wittman et al., 1998). Numerous studies have investigated the roles of students' and teachers in Computer-mediated Learning Environments (CLEs) (Bartolini Bussi & Mariotti, 2008; Drijvers & Trouche, 2008). These studies offer detailed insights into the learning process. Indeed, the integration of technology into mathematics lessons has the potential to improve achievement and disposition. However, the success of this integration largely depends on teachers' perspectives. Their views on using technologies, along with their own experiences in computer-mediated lessons, play a crucial role. Research has shown that teachers' attitudes toward a subject (in our case, employing technology to teach mathematics) and their personal educational experiences have an impact on how they manage the teaching and learning process (Baumert et al., 2010; Campbell et al., 2014). Therefore, it is important for preservice mathematics teachers (PTs) to participate in methods courses that incorporate technology. Computer-mediated courses also encourage PTs to reflect on their experiences and include a review of this reflection process. Teacher education programs are specifically designed to facilitate a transformative process in students, enabling them to adopt the perspective and role of a teacher. The courses offered within these programs play a crucial role in fostering the development of teacher identity among students. Examining the efficacy of computer-mediated courses is important for the professional identity growth of teachers and PTs (Lai & Jin, 2021; Ye & Wang, 2023). The aim is to prepare them to become future teachers who are adept at utilizing technology.

Dynamic geometry software such as Cabri, Sketchpad, and GeoGebra have become essential for mathematics education. They allow teachers to create specific tasks for instruction (Ndlovu et al., 2013). According to findings from research, teachers' development of computer-mediated tasks can enhance cognitive and affective gains for students (Aruvee & Vintere, 2023; Turk & Akyuz, 2016; Wangid et al., 2020; Wittman et al., 1998). Such studies present findings indicating that the use of ICTs in lessons decreases mathematics anxiety and develops a positive disposition. In their study, Turk and Akyuz (2016) emphasized that students in computer-mediated classes displayed higher levels of excitement and curiosity. These authors reported an enhanced enjoyment of learning geometry through GeoGebra tools, which contributed to a positive disposition towards geometry within the experimental group where GeoGebra was implemented.

Furner and Duffy (2002) emphasized the profound influence of mathematics anxiety on students' attitudes and dispositions towards the subject and highlight the essential role of teachers in shaping students' experiences. A teacher's level of knowledge, and the manner in which they employ such knowledge, influence students' disposition and achievement (Baumert et al., 2010; Campbell et al., 2014). Teacher's types of knowledge, particularly pedagogical content knowledge (PCK) and knowledge of integrating technology into the lessons (Technological Pedagogical Content Knowledge-TPACK), are crucial factors in helping them become successful instructors (Guerrero, 2010; Hill et al., 2008). Mathematics teachers should be supported regarding technology integration into lessons and thereby teach the efficient and effective use of technology.

Furthermore, it is imperative for PTs to participate in CLEs in mathematics teaching courses to acquire valuable learning and teaching experiences, as well as engage in computer-mediated tasks as learners. Consequently, PTs will acquire a deeper understanding of students' perspectives on computer-mediated tasks within their instructional settings, enabling them to proactively identify and resolve any potential challenges. Therefore, an investigation into PTs' thoughts and feelings regarding computer-mediated lessons is crucial for establishing their attitude and understanding towards conducting such lessons in the future. In this area, even though the early studies (e.g., Çakıroğlu et al., 2008) found negative beliefs regarding the use of technology while teaching mathematics, recent studies (Akkaya, 2016; Bingölbali et al., 2012) showed that PTs have positive opinions about employing technology in their upcoming mathematics teaching and they considered technology as a helpful tool, especially for geometry lessons when they are provided with CLE tasks.

Research indicates that mathematics in CLEs is more effective than traditional methods (Özçakır & Çakıroğlu, 2019; Sokolowski et al., 2015). This effectiveness is not limited to the cognitive domain but also extends to affective and psychomotor domains. Sokolowski et al. (2015) conducted a meta-analysis and found that CLEs produced a moderate effect size when compared to traditional instruction methods. The study conducted by Ndlovu et al. (2020) investigated the beliefs held by PTs regarding their intentions to incorporate technologies into their future mathematics classrooms. The feelings and thoughts of PTs about the utilization of technology constitute a determinant that will exert an impact on their future students. Therefore, the examination of PTs' present proficiency in technology utilization and their intentions towards integrating it into their future instructional methodologies are significant areas of investigation for the researchers.

The educational experiences of PTs have a significant impact on their future pedagogical approaches. It is crucial to examine students' learning experiences and their reflections on their learning (Ferguson, 2023). Therefore, PTs will gain practical knowledge not only in finding personalized ways to effectively integrate technology into educational settings, but also in crafting instructional tasks. PTs who lack hands-on training in CLE are bound to have their career paths affected by their orientations. As a result, this research aims to contribute to the field by offering insights into PTs' perspectives before they implement technology in their profession. In light of this information, the research questions are as follows:

- What are the experiences of the PTs in a methods course supported with tasks employed in CLEs?
- How do these experiences influence PTs' thoughts on teaching mathematics to their future students?

Theoretical Framework

Teacher education programs have a fundamental function in equipping PTs with essential professional knowledge and skills. Navigating the complexities inherent in their profession, PTs must concurrently develop a distinct professional identity. This identity involves a transformative journey from being a student to becoming a qualified teacher. To better understand and facilitate this transformation, our study employs two complementary theoretical frameworks aimed at enhancing the professional identity development of PTs: Wenger's (1998, 2010) sociocultural theory and Montaigne's insights with Herman's I-positions (Hermans, 2014). Wenger's framework provides a lens through which we can examine how the social environment shapes professional identity, while Herman's I-positions adds an introspective dimension to this discourse.

Wenger's Theory on Identity Development

Drawing on Wenger's (1998, 2010) theoretical framework on identity development, which emphasizes the importance of social interactions, one can derive valuable insights into the process by which individuals transition from being students to assuming the role of teachers. According to Wenger (1998), the formation of an individual's identity within a community is shaped by their actions and beliefs. More specifically, Wenger (2010) underscores the notion that one's identity is formed by a combination of past and future experiences, ultimately shaping one's present state. This process involves accumulating memories, skills, notable events, narratives, and social connections. Additionally, identity has a crucial role in shaping an individual's trajectory, as it establishes a framework for guidance, offering directions, aspirations, and self-images (Wenger, 2010, p. 185).

In Wenger's (2010) conceptualization, the process of establishing an identity is grounded in the *identification* and *negotiation* of meaning processes. Identification can be facilitated by three key factors: *engagement, imagination*, and *alignment*. Engagement refers to active participation within a community of practice, where individuals become involved and immersed in shared activities and goals. Imagination involves the ability to connect oneself to the broader world outside of the immediate community of practice, allowing for a broader perspective and understanding. Lastly, alignment pertains to the process of aligning one's own practices and actions with the established norms and values of the community of practice, ensuring coherence and integration within the collective endeavor. This process involves not only the construction of an identity but also the negotiation of meanings and practices. To examine the aspect of *identification* within the identity formation process, we have adopted the perspective of "being a learner," while the perspective of "being a future teacher" is employed to observe the *negotiation* aspect. In this current research, identification of the meaning process connects to the learner position through the aforementioned factors (engagement, imagination, and alignment) from the following perspective. For engagement, PTs were immersed in a method course where the CLE was introduced. Within this course, PTs actively participated in various tasks, both individually and as a class. In terms of imagination, during tasks, PTs envisioned themselves as students, either imagining current mathematical and educational scenarios, or hypothesizing potential challenges and reflecting on how such situations might pose problems for them as students. For alignment, the PTs, while performing their tasks, underwent a process of ensuring consistency and integration of their practices and actions, aligning them with a student's perspective in a collective endeavor.

According to Wenger (1998), it is also posited that *negotiations* have a crucial role in determining the level of active participation and influence individuals have in the practices they engage in. In the current research, PTs negotiate their future teacher's perspective to develop appropriate CLE tasks and employ these tasks by considering their prospective students. Hence, the development of one's identity is a continuous and dynamic process influenced not just by personal actions and thoughts, but also by the larger societal community in which the individual is situated. For example, in their study, Nguyen and Yang (2018) investigated the acquisition of teaching skills by PTs during their practicum and the subsequent impact of this educational experience on their professional identities as educators. The researchers drew upon Wenger's (1998, 2010) theory to gain insights into this process. Their research revealed that the formation of PTs' identities is an ongoing and evolving process, significantly influenced by collective activities stemming from their interactions with coordinating teachers, mentors, and students. Drawing from this understanding, Wenger's theoretical framework pertaining to identity formation provides a useful perspective for analyzing the evolution of teacher identity throughout the initial phases of their professional trajectory, particularly in the context of a methods course that integrates the notion of CLE.

Montaigne's Insights and Herman's I-positions

Transitioning to another theoretical insight, Montaigne's comprehensive exploration of self (as cited in Hermans, 2014) reveals the dual facets of "being a learner" and "being a future teacher." By employing Hermans' (2014) *I-position* technique, PTs can explore various facets of their identities, specifically those pertaining to their roles as teachers and learners. This exploration enables them to gain a deeper comprehension of these components. PTs can utilize this technique to actively engage in dialogue regarding their opinions and personal characteristics (Hermans & Herman-Konopka, 2010). For instance, Assen et al. (2018) conducted a study utilizing *I-positions* to investigate the growth of teachers' professional identities. Their findings indicated that engaging in dialogues in which teachers share boundary experiences and *I-positions* enables them to critically evaluate their teaching practices from a meta-position. Concurrently, these dialogues assist them in reconciling their myriad *I-positions*. Thus, it serves as a catalyst for educators to enhance their teaching practices and cultivate a stronger professional identity. Stenberg et al. (2014) performed a study to investigate the concept of *I-position* among first-year PTs, with the aim of gaining a deeper understanding of teacher identity. This study revealed that the majority of PTs' initial teaching responsibilities involved inspiring and encouraging students to engage in studying and acquiring knowledge. The identities of first-year PTs sometimes lacked consideration for contextual aspects pertaining to the classroom, society, and curriculum-related issues. These results highlight the crucial importance of teacher education in enhancing the process of teacher identity development. The *I-position* technique provides a scaffold for teachers and preservice teachers in crystallizing their identities.

By enrolling in holistic programs, spanning theoretical lectures to hands-on practicums, PTs carve their identities. The orientation of PTs towards the teaching-learning continuum plays a crucial role in the process of integrating knowledge and experiences throughout their educational journey. Therefore, the current research aims to investigate the self-perceptions of PTs about their professional potential as students and future teachers. This research seeks to gain a deeper understanding of PTs' professional identities and their engagement with the process of CLE, which encompasses both theoretical and practical aspects.

Method

The current research is characterized as a qualitative study, utilizing a case study approach to provide a comprehensive analysis of the topic at hand. Within the scope of a case study, which requires extensive investigation and analysis of a specific group or instance (Merriam, 2009), this research design enables an in-depth exploration of the complex dynamics affecting PTs in CLEs that employ task-based approaches. The primary goal of this research is to gain a deeper understanding of the experiences of PTs attending CLEs that employ task-based approaches in the methods course. In alignment with this primary aim, this research explores PTs' dispositions regarding the use of tasks within a CLE, aiming to foster critical reflection on their identities as both learners and teachers in future.

Participants

This research was conducted at a prominent Turkish university during the autumn semester of the academic year 2019-2020. A total of sixty PTs, consisting of thirty-one sophomores and twenty-nine seniors, who were enrolled in the mathematics education program, willingly participated in the research. These volunteers were primarily selected because they were enrolled in a course that utilized computers for mathematics instruction. None of the volunteers had previous experience with GeoGebra or any other type of computer-assisted learning environment. This research exclusively examined the utilization of GeoGebra, which was chosen for its dual advantages: being a publicly accessible dynamic geometry software and providing support for the Turkish language. The particularity of GeoGebra has permitted its integration into a higher education methodological course offered in the Turkish language, while simultaneously constraining the focus of the research to exclusively encompass experiences related to GeoGebra. In the educational environment, PTs in their sophomore year completed courses in mathematics, yet they did not engage in any formal pedagogical training. In contrast, senior PTs undertook a comprehensive curriculum that not only encompassed advanced mathematics courses but also included courses with a pedagogical focus. To maintain confidentiality, the participants were assigned numbers ranging from 1 to 60.

Data Collection Tools

The research employed a written questionnaire comprising four open-ended questions to ascertain the thoughts of PTs about the tasks employed in CLE for the teaching of mathematics. Additionally, a decision was made to verify the claims of the PTs by examining the drawings created using GeoGebra and the tasks assigned by the PTs. The participants were presented with the following series of open-ended questions:

(1) What did you gain as a learner while studying with CLE tasks? Please explain.
(2) What do you think about using tasks in mathematics teaching?
(3) If you think that these tasks are useful for students in mathematics teaching, in what way could the students benefit from them?
(4) If you think that these tasks are not useful for students in mathematics teaching, could you please explain why you think so?

The initial question delves into the perceptions of PTs regarding their own experiences with drawing-based learning as learners. The second question focuses on the perspective of PTs about the usage of tasks within mathematics teaching settings, considering both the perspectives of teachers and students. The third question is to ascertain the intentions of the PTs who replied positively to the previous question regarding their utilization of this instructional setting in their teaching career. The fourth question specifically targeted the PTs who gave unfavorable responses to the second question. It seeks to understand the reasons behind PTs' beliefs that engaging in such tasks would not be advantageous in their future careers as teachers.

Procedures and Data Collection

During a 14-week math teaching course in CLE, PTs received weekly in-person training sessions lasting three hours each, focused on the utilization of the GeoGebra software, which is freely available and can be used offline. During this procedure, the primary author ran instructional applications on the main computer, whilst the PTs typically operated the applications on their assigned computers. The PTs were provided with comprehensive information regarding the objectives and structure of the tasks, considering both the viewpoints of the teacher and student. Additionally, they were made aware of the potential outcomes, practical application, and instructional strategies for incorporating these tasks into the classroom setting. Initially, PTs were provided with a comprehensive introduction to GeoGebra and its significance within the educational setting. Next, PTs acquired proficiency in utilizing the toolbars of GeoGebra to manipulate and represent a diverse range of mathematical items, concepts, principles, and prepositions. Finally, PTs actively participated in tasks aimed at determining the most effective ways of representing those ideas, including algebraic, verbal, symbolic, and graphical approaches. When designing the tasks, the instructor considered two factors: 1) The development of certain classroom tasks was initiated by utilizing GeoGebra toolbars. As a teacher identity, PTs were asked to think about the GeoGebra toolbar that would be most advantageous for the present instructional task; 2) The PTs in the class were assigned tasks that required them to engage in critical thinking, considering situations where concepts and topics were presented from the perspectives of both a teacher and a learner.

Throughout the duration of the course, a total of 40 distinct tasks were carried out by the PTs over a span of 14 weeks. The primary focus of the 40 distinct tasks was to educate students on K-12 subjects, with a specific emphasis on the manipulation of geometrical transformations in an educational context. To explore the practical applications of geometric transformations, specific examples of geometric patterns were created on the coordinate plane, illustrating their relevance in real-world contexts. During instruction, PTs worked individually on their computers but also used collaborative classroom settings with groups of two to three PTs depending on the specific content and characteristics of certain activities.

After the 14 weeks of training, PTs were given two tasks to complete. The first of these was for the PTs to design a task involving GeoGebra that matches a learning goal they selected from the mathematics teaching curriculum (Ministry of National Education [MoNE], 2018). The second task was to employ GeoGebra to create a geometric pattern inspired by Bourgoin (1879). Throughout the

14-week instruction period, every PT completed two pattern drawings: one self-designed pattern and another pattern assigned by the instructor. This opportunity afforded researchers the ability to gain insights into the perspectives and dispositions of future teachers.

The primary data source for this research consists of the responses provided to the four open-ended questions mentioned previously. In light of these four questions, PTs were requested to meticulously write down their thoughts with the greatest detail. PTs were also asked to provide their names on the written questionnaire paper, as their GeoGebra drawings will be assessed in accordance with their responses.

Data Analysis

Hermans et al.'s (1992) framework of how a teacher's identity develops from a "multi-voiced", or "dialectic" self was used to analyze the qualitative data in this research. Using the *I-positions* points of view, such as "I as a teacher" and "I as a learner" (Hermans, 1996), a document analysis was conducted to address research questions about the experiences and dispositions of PTs who engage in task-based CLEs (Cornett, 1990). The researchers separately conducted a thorough analysis of the written responses provided by the PTs within the established framework. This analysis was performed multiple times, and the perspectives of both the teacher and learner identities were subsequently incorporated into the coding process using open coding, as outlined by Patton (2002). The researchers then proceeded to research and interpret the encoded texts while also engaging in the process of refining the codes during two distinct 2-hour video conferences conducted online. Themes were developed to classify the codes into coherent and meaningful units. The primary focus of the analysis was on the words used by the PTs to express their feelings and experiences regarding the utilization of CLE-related tasks in their own instructional practices and in their professional development as future teachers. The themes and codes are detailed in Table 1.

Table 1

Themes and Codes Clarifications in the Light of PTs' Role

The Role of PTs	Themes	Codes	Clarifications of the codes
I as a learner	Cognitive conditions of acquisition of sensorimotor skills	The context of using GeoGebra	-Being capable of mastering GeoGebra -Being aware of the practical use of GeoGebra -Being able to draw with GeoGebra
		The context of creating patterns	-Knowing specifications on how to make a pattern -Being able to draw easily
		The context of drawing	-Learning to draw better -Having ability to easily draw a pattern -Knowing the distinction between digital and hand-drawn techniques
	Epistemological approach	The context of technology and geometry relation	-Discovering GeoGebra's many facets -Being capable of using GeoGebra for geometric analysis
		The context of topics	-Learning to recognize shapes conceptually -Using GeoGebra to improve algebra and numbers -Using GeoGebra to improve geometry
		The context of thinking skills	-Having spatial thinking -Having geometrical thinking -Having analytical thinking -Having reasoning ability -Encouraging thinking differently

The Role of PTs	Themes	Codes	Clarifications of the codes
		The context of learning geometry	-Competence in identifying geometrical relations -Being able to use mathematical language -Being aware of different perspectives of mathematics -Learning during drawing
	Socio-psychological approach	Interest and curiosity	-Inciting interest and curiosity
		Motivation	-Providing motivation
		Enjoyable lesson	-Learning to enjoy the process of learning
		Struggle	-Having hard time
		Being patient	-Learning to wait patiently
		Overcome mathematics anxiety	-Getting over learner's fear of math
		Attention	-Improving learner's ability to focus
		Admirance / Respect	-Having a sense of admiration and respect
		Positive attitude	-Enhancing positive attitude
I as a teacher	Vocational approach	Learning environment	-Pondering interactive, individualized learning environments with the aid of CLE-related tasks
		Measurement and evaluation	-Having thoughts on utilizing CLE-related tasks to provide instant feedback, prevent misconceptions, and comprehend students' conceptions during and after instruction
		Teaching methods	-Pondering many instructional strategies to facilitate student learning
		Skill acquisition	-Considering the impact of CLE-related tasks in enhancing learners' skill acquisition
		Teaching process	-Considering about the contribution of CLE-related tasks to the teaching process
	Pragmatic approach	Technological perspective	-Highlighting concerns related to hardware and software
		Social interaction perspective	-Emphasizing concerns about the social development
		Professional perspective	-Highlighting issues regarding operating the task, managing time, and using GeoGebra as a manipulative
		Learning acquisition perspective	-Emphasizing concerns about the gains and losses in cognitive, affective domains

The analysis yielded five prominent themes that were evident in the perspectives of both the teacher and student identities. The cognitive conditions of the acquisition of sensorimotor skills, the epistemological approach, and the socio-psychological approach were assessed by analyzing the statements of PTs in their roles as students or learners. The issues of drawing, pattern creation using GeoGebra, and cognitive gains are all topics of interest that reflect the perspective of PTs when they perform the roles of typical learners and students in various tasks. To exemplify the cognitive conditions of the acquisition of sensorimotor skills, this research examined the improvements in the coordination between mental processes and physical actions, as reported by PTs or directly observed. The PTs addressed this procedure by considering the aspects of drawing, pattern construction, and the utilization of GeoGebra. The epistemological approach also elucidates the enhancement of cognitive abilities, such as thinking, learning, analytical proficiency, and similar skills. PTs reported that they noticed improvements in areas such as values, personality, and aesthetics; however, these transformations are not easily observable. This is where the socio-psychological approach comes in.

In contrast, both the vocational approach and the pragmatic approach were used to discuss the inner perspectives of PTs in their role as teachers. These overarching themes illustrate the perspectives of the PTs as teachers about CLE-related tasks. As an illustrative example, the pragmatic approach brings together the explanations provided by PTs on the advantages and disadvantages associated with technology within the educational setting. Additionally, it encompasses their concerns pertaining to classroom management and the challenges encountered with hardware and software.

The vocational approach represents the benefits of the PTs and could support their efforts in enhancing their mathematics instruction. Consequently, PTs participated in discussions regarding their perspectives on professional competence pertaining to teaching processes, classroom dynamics, assessment, skill acquisition, and instructional strategies.

The validity and reliability of the research were assessed by several methods. The researchers' long-term interactions with the PTs, their collection of data in the PTs' natural context, and their use of various data sources all improved the research's validity and reliability. Furthermore, the entirety of the data was subjected to independent analysis by two researchers, resulting in a 95 percent concurrence between their respective analyses. After a period of three weeks, a collaborative endeavor led to the achievement of complete synchronization with the agreed-upon protocols (Miles & Huberman, 1994). After a period of one month, the codes and themes that were obtained were reviewed and modified. The intent was to achieve reliability by considering the time gap and conducting a subsequent re-evaluation of the codes. To ensure the validity of the research, a comprehensive explanation of all stages was provided, as recommended by Maxwell (1992). The codes and themes that emerged were introduced using direct quotations from the remarks made by the PTs.

Ethical Considerations

Various strategies were implemented to address a power disparity between the course instructor and the research PTs. Initially, PTs were informed that their participation in the research was voluntary and that they had the freedom to leave at any point without incurring any negative repercussions. The PTs received a description of the research's objectives and assurances that their participation wouldn't have an impact on their academic performance. Researchers assured the PTs that confidentiality would be maintained in all written reports from the research, acknowledging the significance of these aspects in relation to the power issue.

Results

The findings are provided in the result section using two primary lenses: *I as a learner* and *I as a teacher*. The present research provides a comprehensive analysis of the findings, organized according to thematic categories (cognitive conditions of the acquisition of sensorimotor skills, the epistemological approach, the socio-psychological approach, vocational approach, and pragmatic approach) and incorporating direct statements from the participants.

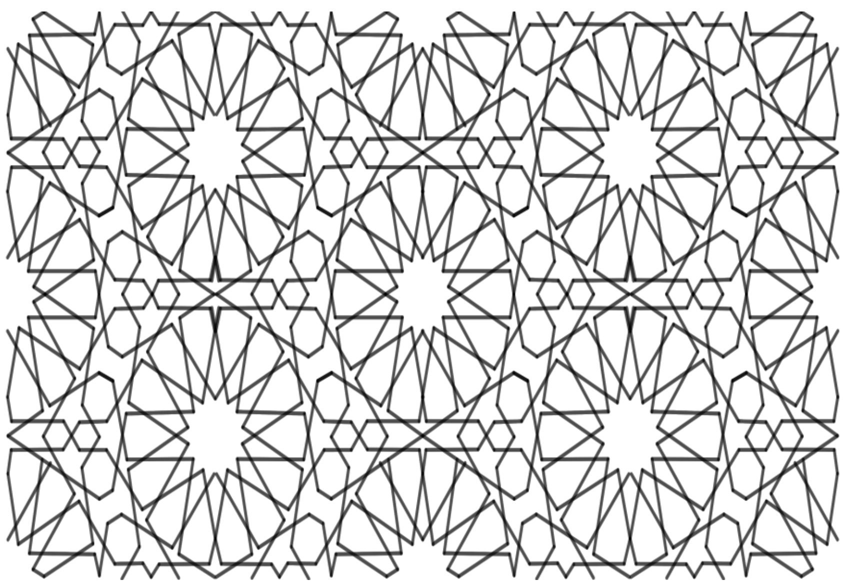
I as a Learner

Cognitive Conditions of Acquisition of Sensory-motor Skills

Through the lens of *I as a learner*, PTs discussed the impact of CLE on the growth of their sensory-motor abilities. Within this setting, it was seen that the PTs had a progressive improvement in their ability to execute drawings that were initially challenging. As the process unfolded, their drawing skills exhibited noticeable enhancement. PTs pointed out the differences between technological and manual drawings. PT16 provided a concise overview of the PTs' approach at the commencement and culmination of the academic term, stating, "...I gained an in-depth understanding that the act of drawing was not as hard as I had initially perceived." Several PTs remarked that they found it to be a straightforward task to create 2D and 3D figures as well as curved graphics, which are typically considered challenging to create. For instance, PT55 reported that the utilization of a program to facilitate the creation of accurate and comprehensible 3D figures would be beneficial for students, as it can alleviate the inherent challenges associated with manual drawing. Despite drawing in a CLE, several PTs reported an enhancement in their dexterity skills. PTs also emphasized the differentiation between technological and hand-drawn drawings, as exemplified by PT4's statement: "Drawing geometric patterns using GeoGebra software versus manually drawing them on paper are fundamentally dissimilar activities. GeoGebra enables us to examine certain attributes of a cube which are not readily observable on a surface such as paper." Initially, PTs experienced apprehension about the idea of drawing geometric patterns. However, they discovered that the task was not as challenging as anticipated. Figure 1 displays the pattern developed by PT27 who had no prior experience with GeoGebra, by the end of the semester.

Figure 1

The Pattern Constructed by PT27



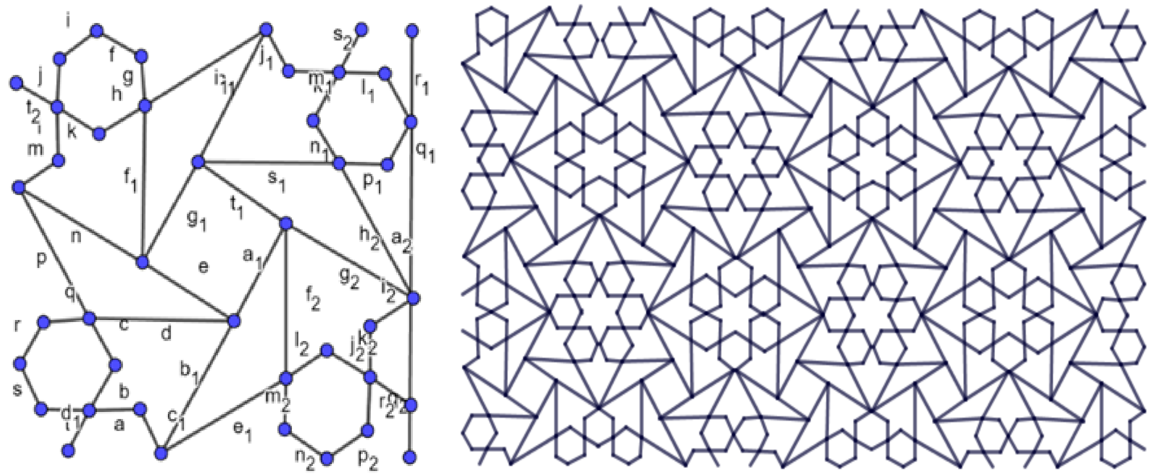
Aside from the convenience of drawing, PTs shared information regarding the process of generating a pattern based on the techniques they acquired or devised throughout their professional journey. In this regard, they performed pattern analysis utilizing the concept of ratio, and enhanced practicality by attempting to discern the unit pattern during the construction of geometric patterns. For instance, PT20 emphasized the importance of conducting pattern analysis before commencing the drawing process, stating, "I acquired the skill of pattern analysis. I gained expertise in the initial steps involved in drawing a pattern." PT37 indicated that they primarily considered which geometric transformation to employ, stating, "I've discovered that utilizing procedures such as reflection and translation when designing patterns allows me to complete the task even more quickly." The objective of the analysis was to partition recurrent patterns into sub-components and formulate the requisite procedures for their construction. However, PT26 highlighted the significance of ratio in the creation of geometric patterns by acknowledging that "I saw how important the ratio is between figures while constructing our patterns."

In contrast, PT58 elucidated their approach to speeding up sketching geometric patterns by identifying the unit pattern: "I gained practicality in visualizing the pattern as a result of drawing geometric patterns with GeoGebra. When I see a pattern, it becomes more convenient to identify its unit pattern and which procedures were used." Figure 2 displays the unit and geometric pattern that PT32 made in 3480 steps.

Figure 2

The Unit Pattern and Completed One by PT32

Unit Pattern Geometric Pattern



Additionally, PTs emphasized that they gained proficiency in utilizing GeoGebra as they were acquiring the skill of drawing with this software. This provided PTs with practical exposure to the utilization of GeoGebra in real-world scenarios. Several participants indicated that engaging in the task of drawing geometric patterns facilitated their familiarity with the toolbars in GeoGebra. Conversely, other PTs expressed the belief that acquiring proficiency in GeoGebra would enhance their performance in the given task. PT3 and PT21 expressed their opinions on these situations. PT3 stated that it would be more beneficial to teach, like in their lesson, with toolbars. PT21 mentioned that they became more familiar with the toolbars while constructing patterns.

Epistemological Approach

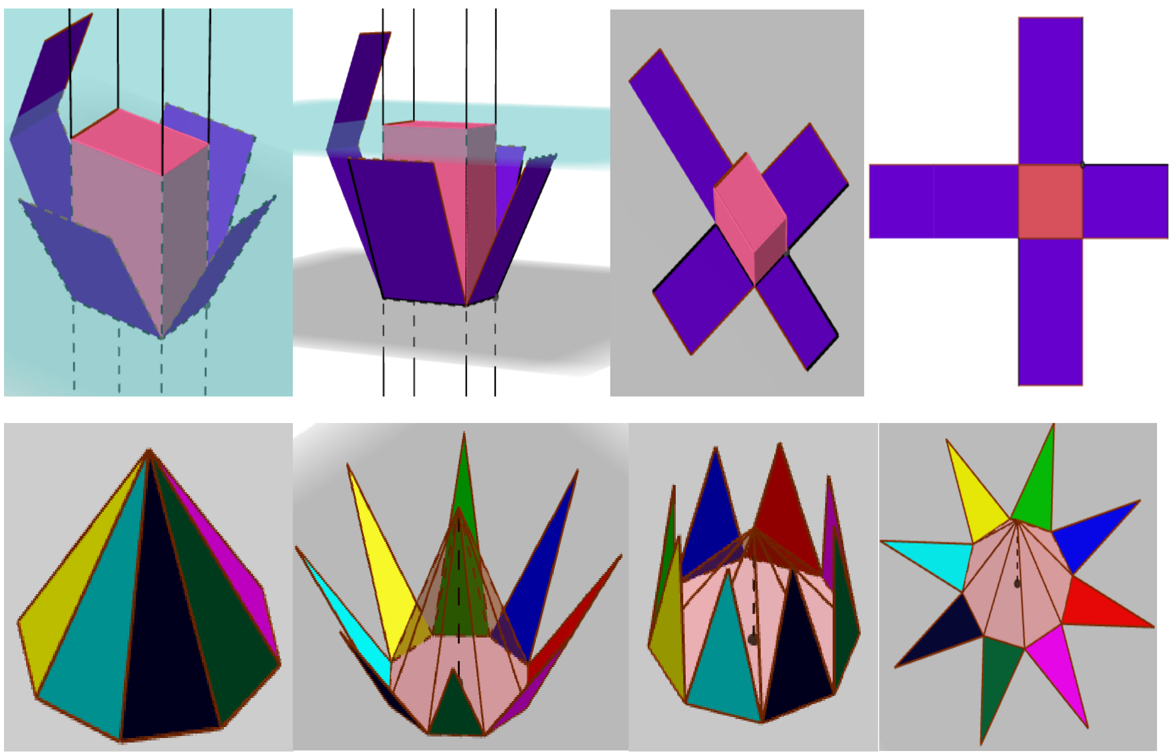
Using the *I as a learner* point of view, PTs discussed their knowledge regarding the relationship between technology and geometry. PTs deliberated on the areas in which they could employ these tasks, the thinking skills they acquired, and their personal learning experiences. Within this setting, PTs expressed statements indicating that predominantly geometry topics and concepts, ultimately connecting to algebra and numbers, could potentially be acquired and that the understanding of shapes could be achieved through the utilization of various tasks. For instance, PT44 posited that students could potentially benefit from intuiting concepts on their own. According to PT44, students' comprehension could be enhanced by visually demonstrating the infinite extension of both sides of a line through drawing. This approach is not limited to a single concept; rather, it encompasses multiple concepts such as line segments, rays, and reflections.

Several PTs indicated that it is possible to acquire knowledge in transformation geometry, encompassing concepts, and subjects pertaining to reflection, rotation, and translation. Nevertheless, proficiency in these areas is essential for accurately drawing geometric patterns. PT37 highlighted the importance of reflection and translation, stating that these tasks can be accomplished by performing procedures, such as reflection and translation, while drawing. PT29 emphasized the significance of reflection and rotation, stating that individuals possess the ability to comprehend and use these cognitive processes.

The PTs additionally reported that the tasks have educational value in the study of solid geometric shapes such as prisms and pyramids, with their corresponding nets, spatial perspectives from various angles, surface areas, volumes, and related concepts. For instance, PT6 placed a strong emphasis on the acquisition of knowledge pertaining to nets of solids. However, PT9 highlighted the potential usefulness of the tasks' advantage that it would enable the observation of 3D objects from several perspectives. This capability could yield significant conceptual advantages. Likewise, PT27 noted the potential to learn objects' surface areas, and volumes of things, stating that it offers a practical means of elucidating these properties. Figure 3 shows the tasks performed by the participants in the CLE.

Figure 3

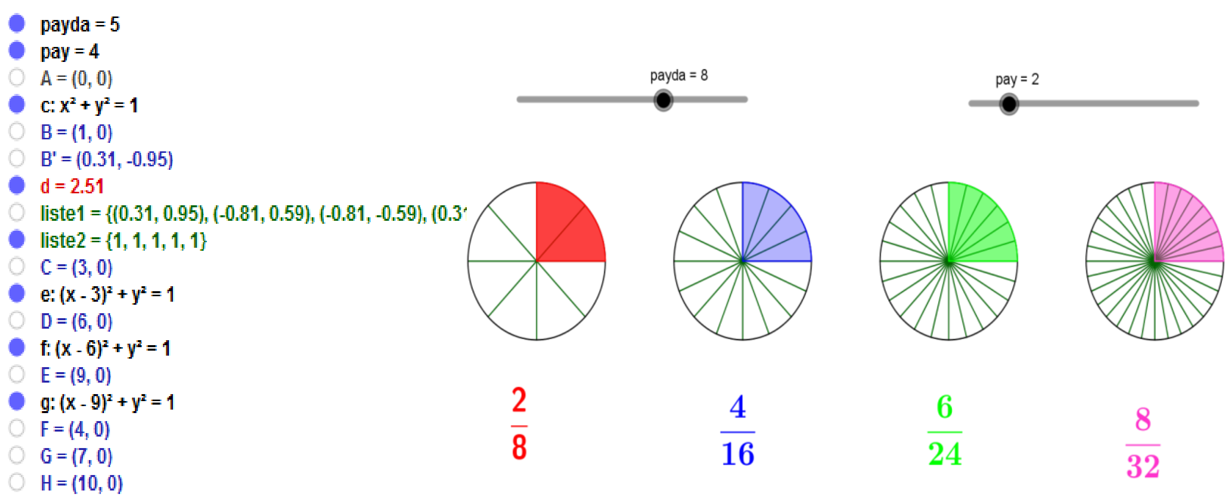
Construction of Prisms and Their Nets



The PTs who placed importance on the analysis of shapes and the acquisition of concepts argued that by focusing on conceptual understanding, students would develop a more enduring grasp of these concepts, thereby discouraging rote memorization. This approach was supported by PT22, which suggested that through this program, students can internalize the definitions of geometric concepts in a deep and lasting manner. The PTs also deliberated on the topic of algebra and numbers, discussing potential learning of various concepts including algebraic patterns, operations, equations, the coordinate system, ellipses, parabolas, hyperbolas, and the perception of infinity. PT10 provided an illustration of their ability to monitor algebraic operations by utilizing the various stages incorporated within the algebra window of GeoGebra. As depicted in Figure 4, students were able to visually comprehend the mathematical operations and sequential procedures involved in the construction of geometrical shapes.

Figure 4

A Task on Fractions

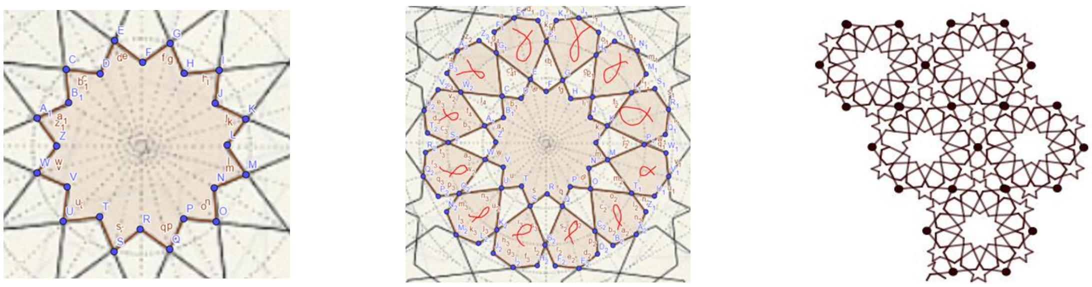


The PTs asserted that the tasks had a positive impact on individuals' thinking skills, specifically enhancing their reasoning, analytical thinking, geometric thinking, and spatial thinking capabilities, while also promoting divergent thinking. For instance, PT21 articulated their opinion on the cognitive ability of reasoning by stating, "It facilitates the adoption of a cognitive approach similar to that of a mathematician, enabling the formulation of mathematical conclusions, generalizations, and the cultivation of a distinct cognitive framework." Only PT49 mentioned the task's ability to improve analytical thinking skills. With respect to spatial thinking skills, the PTs stated that students encountered challenges in perceiving geometric patterns and successfully surmounted this issue through engagement in tasks that incorporated GeoGebra. The participants clarified that the tasks fostered divergent thinking by the utilization of the terms "creative thinking," "multi-dimensional thinking," and "improved imagination." In this respect, the PTs indicated that individuals' perspectives would be improved. PT41 argued that there was no single way of drawing a geometric pattern, emphasizing the need for alternative approaches. PTs highlighted the usefulness of employing GeoGebra to explore geometric shapes from various perspectives. This approach involved analyzing patterns and determining the appropriate geometric procedure and additional toolbars required to construct a given shape.

The PTs emphasized the use of GeoGebra as a tool for learning geometry. They observed that the tasks facilitated the recognition of geometrical relationships, the exploration of various facets of mathematics, the acquisition of mathematical knowledge through drawing, and the development of proficiency in employing mathematical language. PT3 expressed that they now possess the capacity to comprehend the constituent elements of a drawing, thus greatly benefiting from this newfound knowledge. Additionally, PT23 emphasized that this understanding of geometrical relations aids in facilitating the comprehension of mathematical connections for students. As depicted in Figure 5, PT43 who placed significant emphasis on the relationship between mathematics and art, incorporated the mathematical underpinnings of the patterns into their independent task. Furthermore, PT43 expounded upon the relationship between mathematics and art, highlighting the step-by-step construction process involved. Through this approach, PT43 gained a fresh perspective on mathematics, recognizing its role in the aesthetic realm of artistic expression.

Figure 5

The Construction for Representing an Artwork of PT43

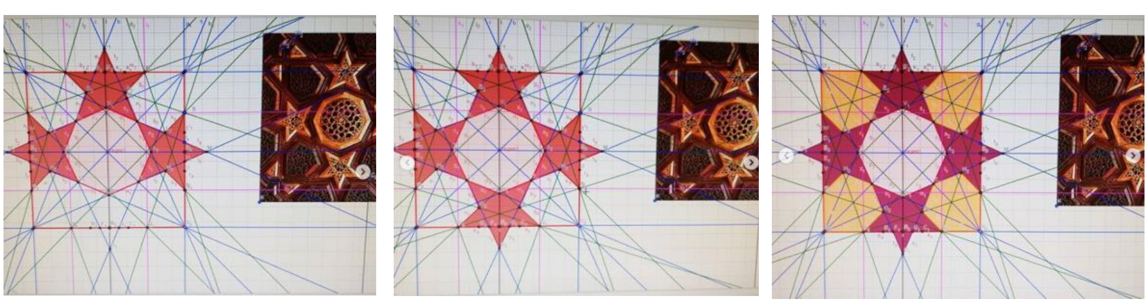


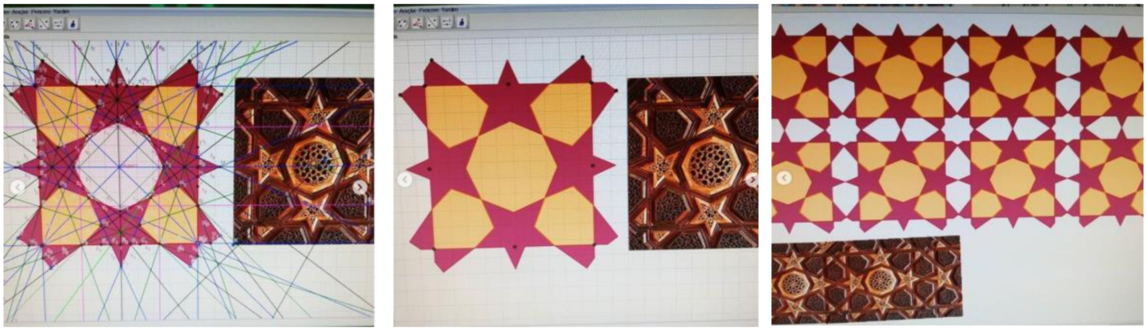
Socio-psychological Approach

Through the prism of *I as a learner,* the PTs engaged in an explanation of the social and psychological advantages they had experienced from performing CLE-related tasks. Within this context, the PTs asserted that incorporating tasks into the class would facilitate an enjoyable learning experience, with a particular focus on the pleasant qualities of these tasks. PT12's observation indicated that conducting a lesson in a traditional manner on a board can be monotonous. PT12 proposed that utilizing this program could potentially inject an element of enjoyment into the learning process. The PTs indicated that tasks had a motivating effect on students. Additionally, the PTs emphasized that tasks elicited qualities such as interest, curiosity, and attention, aiding individuals in fostering positive attitudes. The PTs appreciated the task of recreating the geometric pattern on the minbar of İzmir Birgi Grand Mosque (Ödemiş) in the class. This was accomplished by transferring the real-life pattern onto a coordinate plane using the stages outlined in Figure 6.

Figure 6

The Steps of Constructing a Pattern





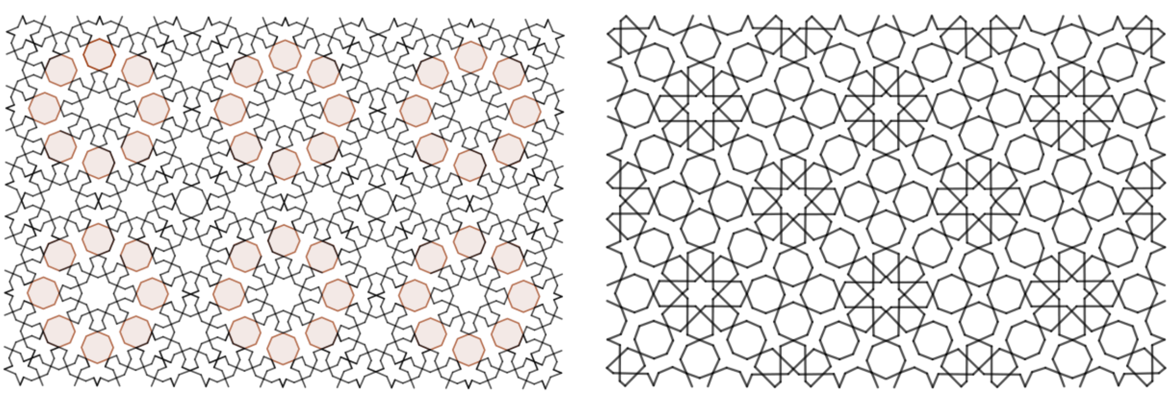
PTs recognized that engaging in the process of drawing geometric patterns fostered a deeper respect for everyday works of art and a greater understanding of the role mathematics plays in daily life, particularly in the effortless creation of intricate patterns. PT15 expressed their appreciation for the use of mathematics in everyday life and highlighted how the tool effortlessly identifies patterns. PT15 further remarked, "Actually, my perspective on historical ceramic art has undergone a transformation. The patterns exhibit a high level of complexity and necessitate diligent effort."

Another benefit indicated by the PTs was the ability to overcome math anxiety. According to PT7, it was possible to effectively challenge students' preconceived notions that mathematics is excessively abstract and beyond their ability to comprehend. Furthermore, the PTs stated that the tasks they experienced in CLEs provided them with valuable skills in problem-solving and cultivating patience.

The PTs asserted that they obtained these two important benefits by creating patterns during class. The construction procedures, particularly those pertaining to the formation of geometric patterns by the participants, were regarded as the decisive component. Figure 7 displays the geometric patterns of PT3 and PT47, which were constructed using 7421 and 2811 steps, respectively.

Figure 7

Patterns Constructed by PT3 and PT47



PT3 discovered the virtue of patience through drawing geometric patterns using GeoGebra, as they mentioned that it was the most significant benefit, and a prominent level of patience was required. PT59 also mentioned that tasks helped the development of the ability to struggle; "...students can learn to cultivate patience and confront the challenges they encounter."

I as a Teacher

Vocational Approach

Through the lens of *I as a teacher,* the PTs recognized that CLE-related tasks offered certain advantages. These advantages include the ability to introduce a fresh perspective to teaching, optimize time utilization, give comprehensive and explanatory demonstrations, facilitate teaching, deliver long-lasting, effective, and relevant instruction, and ensure continuity in the teaching process. The PTs stated that the incorporation of tasks altered their perspective on mathematics instruction. This was attributed to the tasks' ability to communicate lesson content in diverse formats, hence catering to multiple senses and appealing to a wider range of students. For example, PT52 asserted that "It helps the learning process by engaging multiple senses." Several PTs, for instance PT42, contended that the inclusion of such tasks in CLEs facilitated the efficient utilization of teaching time. They posited that by eliminating the need for teachers to manually draw on the board, more time could be allocated to instructional tasks." In contrast, comprehensive and explanatory demonstrations focused on providing real-world examples of mathematical applications in daily life, presenting comprehensible and proper drawings, and offering in-depth explanations of relevant concepts. For example, PT15 stated, "When students ask where they would use [mathematics], we might show them it is in works of art."

The PTs underlined that tasks in CLEs were effective in promoting comprehension of mathematical subjects, enhancing teachers' instructional methods, and ultimately improving students' understanding of the lesson. PT44's perspective on this issue was that by using GeoGebra to create patterns, they realized the potential to teach their students more effectively in the future. PT44 also noted that this application could facilitate the explanation of geometry terms. The PTs who voiced their opinions on the instructional process contended that tasks also provided permanent and effective teaching, therefore enhancing the comprehension of geometric shapes. For example, PT49 hinted at more effective teaching. In particular, PT49 proposed that a shape that a teacher drew on a plane at random might not coincide with a child's imaginary schemes but might share a common geometric basis. Consequently, they advised that teachers should implement strategies that minimize the child's exposure to such discrepancies. Certain PTs stressed that including tasks in the teaching process directs meaningful learning experiences for students.

Although multiple PTs emphasized using tasks in geometry classes from a teaching perspective, only a single PT mentioned skill acquisition. The PTs posited that the tasks may be employed as a pedagogical tool to facilitate comprehension of students' cognitive processes, offer immediate feedback, mitigate the occurrence of misconceptions, and serve as a means of assessment-evaluation during and following instruction. Furthermore, PT56 expressed their intention to incorporate the use of GeoGebra for the purpose of drawing shapes in upcoming examinations. PT56 said that it would be more beneficial for students to take geometry exams that are prepared using this application, rather than solely relying on training with the program. However, PT43 expressed the notion of eliminating misconceptions in the teaching process. They highlighted that conventional instructional approaches provide challenges in effectively conveying mathematical objects and avoiding misunderstandings. Consequently, PT43 asserted that the implementation of this application is indispensable and endorsed its utilization. PT25 briefly addressed the final component of the measurement-evaluation element, suggesting the possibility of assigning tasks to students and observing their performance and thought processes.

When asked regarding pedagogical approaches, the PTs acknowledged that the utilization of tasks can provide a framework for instructional guidance. In this respect, the participants believed that tasks facilitated student learning through active engagement, exploration, and visualization of mathematical ideas within the instructional context. PT4 stressed that GeoGebra has the power to promote learning through exploration, as it is an application designed to assist students in this process. Finally, the PTs indicated that engaging in these tasks could improve students' ability to visualize or embody mathematical concepts, with a focus on preparing them to teach these concepts to future students.

The PTs highlighted the utilization of technology in mathematics instruction, considering the unique characteristics of each student, and fostering an engaging and participatory educational setting. The participants mostly mentioned the instructional value of GeoGebra and the advantages it offers to students. For instance, PT28's emphasis was on an interactive learning environment, stating, "I think that students would learn in an interactive manner." PT2 mentioned an individualized learning environment where it is possible to offer an educational atmosphere that aligns with the students' specific level of learning.

Pragmatic Approach

Through the lens of *I as a teacher*, PTs focused on the advantages of the CLE-related tasks for their future professional careers. This professional perspective was commonly expressed when discussing the implementation of CLE-related tasks within the educational setting, as well as strategies for effective time management during these tasks. In these explanations, the PTs put forth the contention that tasks might potentially result in adverse professional consequences for teachers in terms of their instructional practices, time management, and lesson planning. As future teachers, the PTs indicated that students were unable to perform mathematical inquiries while utilizing the software, and the use of concrete materials yielded more favorable outcomes. For example, PT20 asserted that the utilization of concrete materials serves as a pedagogical instrument for facilitating inquiry-based instruction, hence fostering permanent learning outcomes:

> I believe that engaging in hands-on learning experiences with tangible tools such as a compass or ruler, as opposed to relying solely on computer-based methods, may provide more enduring educational outcomes. The act of adjusting on a computer automatically, compared to manually, implies that a student is inclined to take shortcuts rather than engage in the process of learning.

The inability to create appropriate tasks or manage them effectively was another professional perspective that the PTs highlighted, according to PT25. This PT emphasized that if tasks cannot be created and managed adequately, they may not yield favorable outcomes for the children. One of the primary considerations regarding the professional perspective was the inability to effectively utilize GeoGebra in practical situations. For example, PT56 underscored the importance of ensuring equal access to education, which necessitates the consideration of all educational institutions and students nationwide. In the assessment context, PT56 underscored the limitation that not all schools have incorporated GeoGebra into their curriculum, restricting the potential benefits of this tool to certain students or schools while excluding others.

The social interaction perspective was another way in which the PTs conveyed their opinions. They emphasized that CLE-related tasks may exert a detrimental impact on students' social development, particularly for younger children who may find these tasks excessively challenging. For instance, PT52 highlighted their apprehension over social development, claiming that it will intensify the challenges faced by students who are already experiencing setbacks in this way.

From the technological perspective, the PTs placed significant emphasis on the hardware and software concerns that align with the prevailing economic conditions. The PTs highlighted the insufficiency of hardware in schools and classrooms, asserting that CLE-related tasks would be unsuccessful without the establishment of appropriate technical and technological infrastructure. The PTs clarified that these hardships give rise to psychological aspects in students, such as a sense of inadequacy and the erosion of their enthusiasm. One example of a challenge highlighted by PT13 was the difficulties encountered by students in transferring 3D drawings observed on GeoGebra onto their notebooks. The potential disparity between visual perception and visual representation might lead individuals to experience feelings of inadequacy. The learning acquisition perspective encompasses PTs' thoughts on psychomotor, physiological, and cognitive gains and losses, as elucidated by these types of explanations. Finally, the PTs addressed the cognitive aspects and posited that the acquisition of application proficiency posed significant challenges and consumed substantial amounts of time for students.

Conclusion and Discussion

Results of the research profoundly explored the comprehension of PTs' dispositions with respect to the utilization of tasks within a CLE. By drawing from Wenger's (1998, 2010) and Herman's (2014) theoretical framework, the research emphasized the dynamic process of PTs' development of identity as they navigated the realms of *I as a learner* and *I as a teacher*. The utilization of tasks derived from CLEs inside the methods course played a crucial role in shaping the experiences of the PTs, consequently impacting their future perceptions of the pedagogy of mathematics instruction. As PTs transition from their roles as students to future educators, comprehending their experiences and viewpoints becomes crucial. Thus, the present investigation contributes valuable insights into the ongoing discourse on teacher education, highlighting the potential of tasks within CLEs to shape future educational practices in the domain of mathematics.

In addition, this research offers evidence demonstrating the substantial influence of GeoGebra on the psychomotor, cognitive, affective, and pedagogical development of PTs, emphasizing its innovative potential in mathematics instruction when positioned at the core of the learner's experience (*I as a learner*). In contrast to conventional wisdom that minimizes the essential role of psychomotor skills in the educational impact of digital technology, our research emphasizes the transformative effect of GeoGebra on visual representation and understanding of mathematical concepts. This highlights the importance of psychomotor skills in CLEs. Initially, the PTs perceived the task of manually creating geometric patterns as challenging, but eventually recognized the capabilities of GeoGebra and highlighted the advantages it provided. This phenomenon reflects a more extensive change in the mindset enabled by digital tools, like GeoGebra, which transforms the way PTs perceive and interact with mathematical subjects. In particular, the integration of cultural aspects into geometric patterns, enabled by the use of GeoGebra, has a significant role in promoting cognitive and psychomotor development in PTs. In addition to its practical applications, GeoGebra enhances individuals' intellectual frameworks, fosters deeper comprehension, and refines pedagogical approaches (Drijvers & Trouche, 2008; Trouche, 2004).

Although the natural attraction of a manual geometric drawing cannot be disregarded, the capabilities of GeoGebra present a strong argument for its inclusion in the classroom as a dynamic alternative to the traditional pencil and paper environment (Kokol-Voljc, 2007). This study also emphasizes the benefits gained from attaining practicality in psychomotor action, which are closely interconnected with cognitive processes. Illustrative instances of such tasks encompass the acquisition of fundamental technical terminology associated with GeoGebra, a widely employed tool. Students derive advantages from acquiring familiarity with visual aids such as graphics, drawings, and technical plans. Furthermore, it is advisable for individuals to actively participate in tasks that include the analysis of structures and the acquisition of practical knowledge, such as the ability to associate an element with its corresponding function. Additionally, it is imperative for students to cultivate the ability to utilize tools and hardware in a logical and systematic manner. This viewpoint is consistent with the research results of Trouche (2005) and Vérillon (2000).

The power of technology in educational settings extends beyond the facilitation of work, as it engenders a more profound comprehension and interrelation of concepts. This research emphasizes the cognitive processes that are routinely engaged in the scrutiny of the patterns employed during the act of drawing. These methods also include evaluating the mathematics involved in the drawing. The PTs who effectively leveraged technological advantages were able to uncover the relationships between the unit pattern, and the completed pattern, by identifying specific mathematical characteristics inherent in those patterns. In this process, the PTs endeavored to choose appropriate geometric components and concepts from GeoGebra. The PTs applied these elements proficiently and efficiently while constructing a geometrical structure. As a result, the PTs acquired a comprehensive understanding of these concepts, encompassing both their definition and visual representation. The findings of this study support the assertion made by Escuder and Furner (2012), Çağlayan (2015), and Azizah and Kumala (2023) that learners demonstrated the ability to make connections between visual representations, mathematical concepts, and symbolic representations through the utilization of GeoGebra as a technology.

As we navigate the future of mathematics education, understanding the intersection of technology, pedagogy, and student disposition is vital. Examining PTs' dispositions and experiences with GeoGebra during a task is an important assessment for future research and computer-mediated programs, especially with the increasing active and effective use of technology in mathematics classrooms. One of the most intriguing discoveries of this research pertains to the acquisition of patience and challenges encountered by PTs during their engagement with tasks in CLEs. In the *I as a learner* position, the PTs exhibited a strong interest and curiosity towards challenging tasks, demonstrating high motivation and perseverance in their efforts to successfully complete them. In this context, the inclinations of motivation, curiosity, and persistence can be seen as a mechanism for maximizing the utilization of GeoGebra.

However, achieving this was not straightforward. PTs faced unexpected challenges such as instability and interruption of the application, which hindered the advancement of the PTs during their utilization of different methods and specific tools within GeoGebra. In such cases, it is imperative for instructors and learners to create a conducive atmosphere. Instructors should aim to cultivate and internalize effective pedagogical and instructional strategies. As Rivera (2007) suggests, the efficacy and significance of such tools are contingent upon the presence of favorable social conditions that facilitate the development of appropriate representations, applications, and language. PTs will enhance their capacity to serve as mentors to their students by acquiring a comprehensive understanding of effective strategies to assist students in navigating and surmounting classroom problems with persistence and reasonableness. This is consistent with our initial focus on the crucial interaction of technology, pedagogy, and student disposition in the future context of mathematics education. The influence of emotions on students' classroom experiences was noteworthy, particularly when engaging with geometric patterns in the CLE. The tasks involving the creation of geometric patterns elicited different emotions among PTs. Engaging in the assigned tasks evoked a profound sense of worth, appreciation, and esteem that mathematics teachers aspire to instill in their students. This was achieved through the examination of manually crafted geometric patterns from the Seljuk and Ottoman periods, devoid of technological aids. The presence of positive tendencies in teaching and learning processes is likely to have a significant impact on the success of students in mathematics lessons.

The presence of math anxiety is a significant barrier to the acquisition of mathematical knowledge, presenting a formidable challenge to overcome. According to the Organisation for Economic Co-operation and Development (2016, p.117), students' positive opinions towards mathematics are linked to increasing their motivation, reducing their anxiety and prompting them to invest time and effort, consequently resulting in academic success. From the viewpoint of PTs as learners, research suggests that specific tasks can serve as a potential strategy for overcoming anxiety connected to mathematics (Horzum & Ünlü, 2017). The integration of historical patterns with contemporary instruments in these tasks serves to enhance comprehension and establish a connection between the past and the present. The implementation of this integrated methodology has the potential to effectively mitigate math anxiety through enhancing the subject's relevance and fostering active participation. Research has indicated that mathematics anxiety tends to be more prevalent in mathematics classes that employ traditional teaching methods, whereas it is comparatively lower in classes which encourage active student participation, incorporate enjoyable tasks, and value the opinions of the students (Hackworth, 1992; National Council of Teachers of Mathematics, 2000).

The integration of cultural history with modern technological tools offers a unique avenue for pedagogical innovation. This integration not only enhances the educational encounter but also holds the capacity to mitigate mathematical anxiety by establishing a stronger connection between mathematics and real-life situations, thereby fostering greater interest and involvement. Building on existing research, several methods can foster a positive disposition towards mathematics lessons (Furner & Duffy, 2002), one of which is the focus of this research. Specifically, one method that can be employed to foster interdisciplinary learning is the utilization of geometric patterns, which serve as a means to connect individuals with their history and culture. This is exemplified in the present research through the cultural motif generated by GeoGebra. The advancement of technical tools such as GeoGebra not only presents a novel instructional approach but also signifies a fundamental shift in the comprehension of geometric patterns. Implementing this technological advancement is notably advantageous for mitigating math anxiety. Moreover, it not only facilitates a more participatory and experiential pedagogical approach but also fosters heightened student engagement while alleviating sentiments of fear or dissatisfaction. In line with Tennant's (2004) observations, geometric patterns serve as stimulating, captivating, motivating, and multifaceted educational tools for students.

The initial experiences acquired by PTs during their educational trajectory, concomitant with their roles as future teachers, play a pivotal role in shaping and nurturing their prospective professional identities. In the *I as a teacher* position, the PTs who were enthusiastic about mathematics teaching in the CLE showed a tendency for collaboratively creating practical CLE tasks that would be beneficial to their teaching careers. Thurm and Barzel (2020) emphasize that a teachers' beliefs and epistemological stance about how mathematics should be taught and learned, significantly influence their teaching skills. In alignment with the findings of Ndlovu et al. (2020), our research discovered that PTs commonly demonstrated positive dispositions towards incorporating technology in mathematics education. Similarly, Bingölbali et al. (2012) remarked that teachers effortlessly integrated technological tools and displayed a positive disposition towards the use of technology when they interacted with those tools they intended to employ. Through the CLE process, PTs, as learners who become aware of this situation shaped their learning perspective to take on instructional responsibilities from the outset. This aligns with Stenberg et al.'s (2014) findings, with a primary focus on inspiring and motivating students to engage in study and knowledge acquisition.

Although technology holds the potential to significantly revolutionize mathematics education, its pragmatic limitations and ensuing pedagogical challenges underscore the intricate interplay between tool, teacher, and task. For the PTs in the *I as a teacher* position, tasks in the CLE presented certain limitations. These limitations highlighted the pragmatic and functional roles of technology. In this respect, Cellerier (1979, as cited in Verillon & Rabardel, 1995) argues that identification and resolution of problems that arise during the interaction of the tool with the environment are part of the pragmatic approach. Accordingly, in the current research, certain problems were identified regarding the interaction of the technological materials with users and the environment during lessons. It was determined that some of these problems were caused by users and that these might lead to pedagogical problems in the teaching process. According to Ndlovu et al. (2020), the significance of a teacher's adaptability in pedagogy is emphasized. Therefore, the projections made by the PTs could potentially be interpreted as tasks conducted in the CLE with the intention of facilitating the incorporation of technology into mathematics lessons. Consistent with the research conducted by Akkaya (2016) and Ndlovu et al. (2020), the current research highlights the perspective of the PTs occupying the *I as a* *teacher* position regarding the challenges they faced in conducting tasks due to hardware limitations. Specifically, the lack of technological infrastructure for learning tools in educational settings hindered the efficient execution of these tasks. PTs are aware that these interruptions could make it challenging for the teacher to properly complete the lesson. Managing the computer-mediated mathematics classroom is one of the components of TPACK (Guerrero, 2010), which requires the ability to manage technical infrastructure. According to Mishra and Kohler (2006), a teacher who uses technology effectively should have knowledge distinct from that of a disciplinary expert (such as a mathematician), a technology expert (such as a computer scientist), and a pedagogical expert (an experienced educator).

The aspiration to seamlessly weave technology into the fabric of mathematics education confronts a sobering reality: the teacher's proficiency in utilizing hardware can significantly impact the intricate equilibrium of TPACK. In this research, the user-related problems stem from the PTs' insufficient prior knowledge of hardware. This suggests that the effective incorporation of technology, content knowledge, and pedagogy requires a strong foundation in TPACK (Mishra & Koehler, 2006). Ultimately, proficiency in information communication technologies (ICT) has a crucial role in shaping the intentions of both teachers' and PTs' intentions to integrate ICT into mathematics classes (Ndlovu et al., 2020; Thurm & Barzel 2020).

The cornerstone of mathematical education relies not solely on the teacher's subject-matter expertise but also on their refined pedagogical abilities, enhanced by the use of digital resources. The research findings illuminate the complex relationship between these factors and their potential impact on the evolution of mathematics instruction. Therefore, it is imperative for PTs to comfortably navigate these stages if they have aspirations of teaching mathematics in the future. The influence of teachers' knowledge and its implementation on students' dispositions and success has been well-documented (Baumert et al., 2010; Campbell et al., 2014). Additionally, research has shown that the use of digital tools in mathematics education has a positive impact on students' learning and achievement (Turk & Akyuz, 2016). Insufficient proficiency in the practical use of programs may cause complications for teachers while engaging in mathematical inquiries and formulating suitable tasks. Researchers can gain insights into PTs' awareness of and expectations for PCK by observing their responses while they are in the *I as a teacher* position. This underscores the recurring importance of teacher education. The present research seeks to validate this importance by examining the perspectives of PT's regarding tasks, both as learners and as future teachers.

The digital transformation of the classroom goes beyond a simple adoption of digital tools; it necessitates a reassessment of educational methodologies. The present research illuminates crucial factors that practitioners must take into account in the vanguard of this educational paradigm shift. Based on the findings, specific recommendations may be posited to researchers and teachers utilizing tasks within the CLE. Researchers and teachers involved in CLEs might benefit from exploring these proposed approaches. Conducting research on the influence of pedagogical approaches on technology utilization may provide valuable insights that can help educational practitioners cultivate a more positive disposition towards implementing tasks in future educational settings.

The authors received no financial support for the research, authorship, and/or publication of this manuscript.

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