ИСПОЛЬЗОВАНИЕ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В ОБРАЗОВАНИИ. МЕЖДУНАРОДНЫЙ ОПЫТ

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Improving Tenth Graders' Geometrical Thinking Skills via an Islamic Patterns-Based Program: Active Learning and Dynamic Applications

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Islamic mathematicians developed several geometric forms that integrate mathematics and art. Arab mathematics educators and students are oblivious to this illustrious history. An engaging educational program is being created to address students' inadequacies in geometrical thinking. This study examines the geometrical reasoning abilities of tenth graders, active learning methodologies, and Islamic motifs. It seeks to establish an interactive educational atmosphere beyond the classroom by incorporating *Geogebra* and *MOODLE* as a Learning Management System. A quazi experimental design of two groups: experimental group 118 and control group 120. Pre-tests and post-tests were administered. A test of 20 items was developed. Validity and reliability (Cronbach's alpha 0.81) were assessed. The school's learning management system (LMS) was made accessible to students for the retrieval of course materials, assignments, training, and assessments beyond classroom hours. The results show the fewer levels in the experimental group significantly differ from those in the control group at $\alpha = 0.05$ on the geometrical thinking assessment. A statistically significant difference in geometrical thinking test means ($\alpha = 0.05$) exists among the four subgroups of the experimental group: poor, average, above average, and excellent, across visual, analytical, informal deduction, and formal deduction levels. The findings advocate for mathematics educators to implement the learning program and utilize its foundation to develop innovative teaching methodologies. Such studies are uncommon as they integrate active learning with Islamic culture, contemporary technology, geometric reasoning, and many educational ideas. This document facilitates integration for mathematics educators.

Keywords: geometrical thinking; Islamic patterns, dynamic applications; *GeoGebra*; *MOODLE*, active learning.

Introduction

Geometry is an essential component of mathematics that holds significant relevance in students' daily lives [*Jablonski, Ludwig*, 2023]. The study of geometry not only enhances students' problem-solving abilities but also serves as a tool for connecting various mathematical concepts [*Desai et al.*, 2021]. *TIMSS* (Trends in International Mathematics and Science Study) *2019* provides comprehensive data on student achievement in mathematics and science across various countries, including Jordan.

The focus here is on Jordan's performance in geometry, a key domain in mathematics. Jordan is a developing country in the MENA region and shows a decrease in its students' level in TIMSS. Jordan's average mathematics achievement at the eighth-grade level was below the TIMSS scale center point of 500, indicating challenges in overall mathematics proficiency, including geometry [*Murtiyasa et al.*, 2019]. The most important points raised in the report are: Geometry and Cognitive Development includes content domain analysis: Jordanian students demonstrated particular difficulty in the geometry content domain, with scores significantly lower compared to other mathematical domains such as algebra and data representation [*Kuzle*, 2023; *Andini et al.*, 2017]. This suggests the need for targeted interventions to enhance students' geometrical thinking skills. Also, for International Comparison: When compared to international benchmarks, Jordanian students' performance in geometry was consistently below the international average, highlighting a need for targeted interventions in this area [*Trimurtini et al.*, 2023]. The Contextual Factors includes the following: Teacher Preparation and Resources: Challenges in geometry achievement are partly attributed to inadequate teacher preparation and a lack of resources dedicated to teaching geometry effectively.

Teachers reported a need for more professional development in teaching geometry [*TIMSS 2019 Contextual Questionnaires*, 2019; *Haj-Yahya*, 2022]. Classroom Environment: Factors such as class size, availability of teaching materials, and instructional time also played a significant role in students' performance in geometry. Schools with better resources and more instructional time in geometry saw relatively higher achievement [*TIMSS 2019 Methods and Procedures*, 2019]. In summary, Jordanian students face significant challenges in geometry as reflected in the *TIMSS 2019* results. Addressing issues related to teacher preparation, resource availability, and instructional time could potentially improve performance in this critical area of mathematics. For more detailed information and specific data, you can refer to the *TIMSS 2019 International Results in Mathematics and Science* and the *TIMSS 2019 Methods and Procedures* [*I.S.C. Boston College*, 2023].

The objective of this study is to construct an instructional program that incorporates technology, specifically *Geogebra* and *MOODLE* as a Learning Management System, in order to establish an immersive learning environment outside the traditional classroom setting. Implementing active learning strategies can perhaps mitigate the issue of low academic performance in geometry.

The elaborate and repeated geometric forms of Islamic patterns offer a comprehensive framework for strengthening geometric thinking. These patterns frequently employ basic geometric shapes such as equilateral triangles, squares, and hexagons, which are carefully organized to form intricate and visually appealing designs. A profound comprehension of geometric principles, such as symmetry, tessellation, and spatial reasoning, is essential for studying and creating Islamic patterns. The use of tools such as *GeoGebra* greatly improves the learning process by providing a dynamic and interactive platform where students can visualize and modify geometric forms [*Gladys*, 2023]. *GeoGebra* enables learners to investigate the connections between angles and sides, engage in experimentation with various geometric transformations, and experience the direct effects of their manipulations on the overall pattern. This practical method not only reinforces their comprehension of geometric principles but also enhances their imaginative and analytical thinking abilities, cultivating a deeper admiration for the aesthetic and mathematical elegance of Islamic designs.

The Van Hiele levels of geometric thinking, as examined in the study of Mahlaba and Mudaly (n. d.), provide a sequential framework for comprehending geometry. The theory, formulated by Pierre and Dina van Hiele during the 1950s, delineates five discrete stages: identification, examination, arrangement, inference, and precision. At the perceptual level, learners categorize shapes by their holistic visual characteristics. The analysis stage entails comprehending shapes based on their inherent features. At the level of ordering, learners can systematically arrange these qualities and comprehend the connections between distinct forms. The deduction level is defined by the capacity to employ axioms, definitions, and previously established theorems to infer new properties and demonstrate theorems. Ultimately, the rigour level encompasses comprehending the abstract essence of geometry and its fundamental frameworks, enabling logical thinking within and extending beyond Euclidean geometry. Advancement through these stages necessitates a transition from following set rituals to engaging in exploratory discussions, wherein learners progress from mimicking answers to autonomously investigating and substantiating geometric principles.

Table 1. The levels of geometric thinking distributed according to geometric skills

Level skill	Recognition	Analysis	Deduction
Visual	Recognize geometric shapes by its' picture without knowing the shapes prosperities	Recognize the relationship between different kinds of geometric shapes	Uses information about a geometric shape to deduce more information
Descriptive	Naming a geometric shape. Explain statements that describe geometric shape	Describes the relationships between geometric shapes. Defines geometric concepts clearly.	Understand the difference between the definition, postulate and theorem
Logical	Understand the meaning of shape reservation in different situations	Uses the prosperities of geometric shapes to identify the subset relation	Uses logic to prove and being able to deduce new knowledge from given facts

This study is focused only on four stages of geometric thinking: Visual, Analytic, Informal deduction, and Formal deduction. The four levels were obtained from table1. In this work, the term "Visual level" refers to the ability to identify geometric shapes only based on their visual representation, without any knowledge of their specific properties. Analytic refers to the process of describing the relationships that exist between different geometric shapes. Provides precise definitions of geometric topics. Informal deduction refers to the process of using available information about a geometric shape to draw further conclusions.

Formal deduction refers to the process of utilizing logical reasoning to establish proof and derive new knowledge based on existing facts.

Problem Statement

Although Islamic mathematicians have a rich history of creating complex geometrical designs that combine mathematics and art, a considerable number of Arab mathematics educators and students are still unaware of this important heritage. The pupils' inadequate awareness of this topic leads to a deficiency in their ability to reason geometrically, which is a vital talent in the field of mathematics education. Conventional instructional techniques frequently fall short in captivating students and cultivating profound comprehension of geometrical principles. Thus, there is a requirement for inventive educational programs that not only integrate the cultural history of Islamic geometrical patterns but also utilize contemporary technical tools to improve students' geometrical thinking abilities.

Null Hypotheses

1. There is no significant difference in the geometrical thinking skills between tenth graders who participate in the *Islamic patterns-based program* and those who receive traditional geometry instruction.

2. The use of active learning strategies in conjunction with Islamic patterns-based geometry instruction does not result in significant improvements in students' post-test scores according to their level of achievement.

Operational Definitions

1. Geometrical Thinking Skills: The capacity to comprehend, analyses, and utilize geometric ideas and principles, assessed using a 20-question examination created exclusively for this research, guaranteeing accuracy and consistency with a Cronbach's alpha coefficient of 0.81.

2. The *Islamic patterns-based program* is an educational program that integrates the examination and utilization of historical Islamic geometric designs into geometry lectures. This is achieved through the use of dynamic apps like *GeoGebra* and is administered using the *MOODLE* learning management system.

3. Active learning refers to instructional techniques that involve students in the learning process through interactive activities, conversations, and hands-on exercises. This is in contrast to passive learning, where students simply absorb knowledge from the teacher without actively participating.

4. *GeoGebra*: A versatile mathematical software that combines geometry, algebra, and calculus, serving as a tool to enhance interactive learning and investigation of geometric principles.

5. *MOODLE* is an open-source learning management system that allows for the delivery of course materials, exercises, training, and assessments. It provides students with the

ability to access and interact with educational content outside of the traditional classroom environment.

6. Previous achievement level: the participants were categorized into two groups based on their academic performance in ninth grade. The threshold was set at 80 out of 100. If a student's grade exceeds 80, they are considered above average; otherwise, they are considered average or below.

Methodology

A quazi experimental design was employed, with two groups (Exp 118 and control 120). A pre- and post-test was administered. A 20-item exam was developed. Consideration was given to validity and reliability (Cronbach 0.81). So that students may engage with the program even when class was not in session, the school's learning management system (LMS) was made public, including all course materials, exercises, training, and exams.

The first step was creating a teaching framework. The researcher has constructed the subsequent framework to direct the process of lesson preparation. The initial component is the explanation, which involves the teacher providing a thorough and comprehensive explanation of the topic during class. This ensures that students understand the fundamental principles. Additionally, video explanations are available for students to access outside of class, allowing them to review and enhance their understanding at their own pace.

The second component is training, which emphasizes individual practice. Students engage in individualized training to hone their skills and deepen their understanding of the subject area. In addition, the option of group training is being taken into consideration. Interactive exercises that foster collaboration among students to collectively solve obstacles, hence enhancing their problem-solving skills.

The final element is sharing. Students present their work to the teacher. Teacher Feedback provides students with essential instructions, offering feedback on how to improve their work and highlighting their areas of expertise. Furthermore, the practice of providing feedback from peers is strongly promoted. Students participate in the evaluation and constructive critique of their peers' work, offering useful insights and suggestions to help improve their peers' work. Furthermore, a *Knowledge Assessment* was conducted. Periodic assessments are conducted to assess students' understanding and retention of the material, ensuring their advancement towards their educational goals. Finally, *Direct Teacher Assistance* occurred. The teacher offers personalized assistance to address specific requirements and respond to queries from students. This framework ensures a comprehensive approach to teaching by incorporating clear instruction, practical training, and continuous feedback to support student learning and development.

The second step was developing lessons based on *Dynamic Instructional Design* (DID) to deliver the activities [*Y. An*, 2021]. The following is an example of a lesson prepared for the experimental group. The same content was used the control group with a main difference represented with using the usual geometric tools and grid papers instead of using *Geogebra* in creating the Islamic pattern.

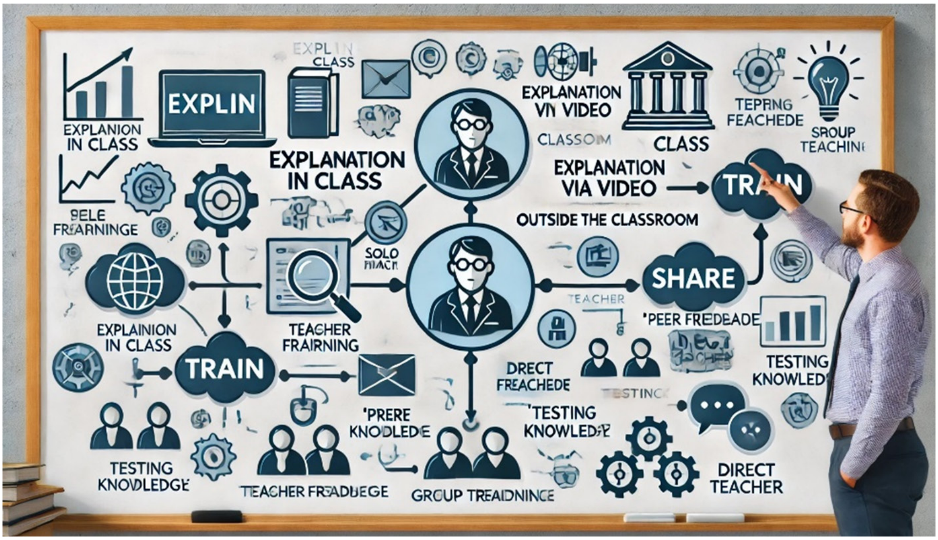

Fig. 1. Elements of the Teaching Framework[1]

Lesson Plan (DID Model) Dynamic Instructional Design

Title: Islamic Pattern Using Equilateral Triangles. Subject: Geometry and the process of using logical thinking to solve geometric problems.

Summary: Students can create Islamic patterns using *Geogebra*. At first, students manipulate the activity by moving the points using a dragging motion. Afterwards, they watch an educational film. Subsequently, students proceed to create a similar pattern and subsequently analyze the arrangement they have constructed in order to develop an innovative design. Additionally, they are driven to investigate new relationships between angles or sides.

Step 1: Understand The Learner

— Tenth grade students: Individuals aged 15-16, undergoing simultaneous growth in their academic and social-emotional domains. Transition to high school: Involves experiencing increased autonomy and accountability, as well as undergoing hormonal and physiological transformations. Academic challenges: Overcoming heightened expectations and heavy workloads, effectively navigating social dynamics in a more expansive educational setting [12].

Step 2: Define Objectives

Learning outcomes:

— comprehend the constituent elements of an Islamic pattern employing Equilateral Triangles;

— utilize *Geogebra* software to generate an Islamic pattern composed of equilateral triangles;

— generate a novel Islamic motif by incorporating various polygons;

— examine the correlation between the lengths of the sides and the measures of the angles;

[1] The picture was generated via *ChatGPT*.

Skills to acquire:

— proficiency in creating geometric forms using *Geogebra*;

— creating a geometric design inspired by Islamic art;

— engaging in the exchange of ideas with colleagues;

Geometric reasoning abilities:

— enhancing spatial visualization skills;

— analysis of patterns;

— uncovering novel connections.

Step 3: Establish The Learning Environment

Physical Environment:

— classroom Arrangement: Organize the desks into clusters to promote collaborative work and facilitate group discussions. Make sure that every cluster is equipped with a computer or tablet that has *Geogebra* software installed;

— required materials: Computers or tablets, internet connectivity, projector, instructional videos;

Emotional Environment:

— cultivate a nurturing and cooperative ambiance that promotes students' willingness to openly express their thoughts and seek clarification;

— promote the appreciation of different viewpoints and innovative methods in the design of patterns.

Distance learning Environment: *MOODLE* learning management system (LMS) was used to publish the learning material and to create online environment for students to share ideas.

Step 4: Identify Teaching and Learning Strategies

Educational Approaches:

In Class:

— Explanation: Commence the session with a concise discourse on Islamic patterns and the utilization of equilateral triangles, accompanied by visual illustrations;

— Demonstration: Illustrate the process of utilizing *Geogebra* to generate patterns. Enable students to engage in hands-on practice by manipulating points and observing the instructive film;

— Training and Sharing via Collaborative Learning: Facilitate students to engage in small group activities where they can collectively develop their patterns, promoting peer interaction and receiving feedback;

— Training Independent Practice: Instruct students to individually build a new pattern using different polygons, promoting creativity and the application of previously learnt ideas;

Learning Activities:

— Manipulative Exercise: Students manipulate points by dragging them in *Geogebra*;

At home:

— Educational Video at home: Watch a Video at home that provides an explanation of the process behind the production of Islamic patterns;

— Pattern Creation: Students generate a comparable pattern and analyses its structure in order to develop an original design;

— Exploration: Foster students' curiosity and urge them to investigate novel relationships between angles and sides.

Step 5 involves the identification and selection of support technologies.

— *Geogebra*: Principal instrument for generating and manipulating geometric patterns;
— Instructional Videos: Visual resources designed to assist comprehension of geometric principles and the process of pattern formation;
— Online Resources: Gain access to supplementary tutorials and exemplars of Islamic patterns (https://www.geogebra.org/f/svqqd6bcdz);
— Projector: Used to exhibit demonstrations and educational movies to the entire class;
— Tablets / Computers: To facilitate students' usage of *Geogebra* and enable their access to online resources.

Step 6: Assessment Strategy

Formative Assessment:

Observation: Continuously observe students' participation and advancement in activities, offering prompt feedback and support.

— Group Feedback: Facilitate collective conversations to evaluate comprehension and promote peer evaluation.

Summative Assessment:

— Pattern Submission: Assess students' final patterns made in *Geogebra* based on their inventiveness, correctness, and utilization of geometric principles. The students submit their pattern via the lesson link created by the researcher (https://www.geogebra.org/classroom/t6hxvrec).
— Reflective Essay: Instruct students to compose a concise essay in which they contemplate their process of learning, the obstacles they encountered, and the novel connections they uncovered between angles and sides.

Step 7: Reflection, Evaluate, and Revise the Design

— Self-Reflection: Prompt students to introspect on their learning experience and evaluate the efficacy of the instructional tactics employed;
— Teacher Reflection: Evaluate the efficacy of the lesson, the level of student involvement, and the attainment of learning objectives.

Evaluation:

— Gather feedback from students regarding the lessonls comprehensibility, level of involvement, and the practicality of *Geogebra*;
— Evaluate assessment outcomes to identify areas of achievement and areas requiring enhancement.

Revision:

— Modify the lesson plan after carefully considering feedback and assessments to rectify any highlighted shortcomings;
— Please consider implementing supplementary assistance for students who are encountering difficulties with geometric concepts or the utilization of technology;
— Revise educational materials and resources as necessary to improve clarity and increase engagement.

The third step involved the creation of *Geogebra* applets and the production of instructional videos. The fourth step entailed the creation of the geometric thinking assessment. The test was verified by referees. Furthermore, the Cronbach alpha coefficient was employed to validate the recallability, yielding a value of 0.81. Two teachers were trained on the lesson plans as the final phase. The initial instructor, a female with a decade of expertise, is employed at a private educational institution in Amman. Previously, she instructed four sections consisting of tenth-grade students, totaling 118 individuals. The second individual is a female who has accumulated eleven years of experience working at another private school in Amman. She formerly instructed four sections of tenth grade, including a total of 120 students. Both schools are situated in the eastern part of Amman and share numerous similarities. The allocation of the experimental and control group was randomized. Both teachers receive identical materials; the sole distinction is in the manner in which students generate and cultivate Islamic Patterns. The experimental group utilizes *Geogebra* software, while the control group employs traditional geometry instruments such as a protector, ruler, compass, and grid papers. The lessons were a weekly enrichment activity. These activities have a duration of six months. The delivery of the lessons starts in October 2023.

Results and Discussions

Table 2 shows statistical analysis of t test related to the first hypotheses.

Table 2. Independent Samples t Test

					Levene's Test					
	group	**N**	**Mean**	**SD**	**F**	**Sig.**	**t**	**df**	**Sig.**	**Partial Eta Squared**
Pretest	Exp	118	8.71	2.71	0.711	0.400	0.011	236	0.991	0.48
	Control	120	8.71	2.31						
Posttest	Exp	118	13.74	2.33						
	Control	120	10.99	1.82	6.374	0.012	10.138	236	0.000	

Data Description

The data presents the results of an Independent Samples t Test, comparing the means of two groups (Experimental and Control) across two conditions (pretest and posttest).

Variables and groups

Groups: Experimental and Control.

Pre-test Analysis:

— The variances between the Experimental and Control groups are not significantly different.

— There is no significant difference in the pretest scores between the Experimental and Control groups.

Post-test Analysis:

— The variances between the Experimental and Control groups are significantly different in fever of experimental group.

— There is significant difference in the post test scores between the Experimental and Control groups in fever of experimental group.

Effect Size: The effect size is large, indicating a significant impact of the group differences.

This analysis provides a detailed view of the comparison between the Experimental and Control groups, highlighting the significant difference in the post test scores in fever of the experimental group.

Table 3 shows statistical analysis of t-test related to the second hypotheses.

Table 3. One Way ANOVA test between the two subgroups (previous achievement level) of experimental group participants

Geometric thinking skill	Previous achievement level	N	Mean	SD	Source of variance	Sum of Squares	df	Mean Square	F	Sig.
Visual	Average and Below	79	4.16	0.59	Between Groups	8.754	1	8.754	27.98	0.00
	Above Average	39	4.74	0.50	Within Groups	36.297	116	0.313		
	Total	118	4.36	0.62	Total	45.051	117			
Analytic	Average and Below	79	3.86	0.80	Between Groups	5.831	1	5.831	11.64	0.00
	Above Average	39	4.33	0.48	Within Groups	58.135	116	0.501		
	Total	118	4.02	0.74	Total	63.966	117			
Informal deduction	Average and Below	79	2.90	0.61	Between Groups	18.637	1	18.637	34.52	0.00
	Above Average	39	3.74	0.94	Within Groups	62.626	116	0.540		
	Total	118	3.18	0.83	Total	81.263	117			
Formal deduction	Average and Below	79	1.65	1.03	Between Groups	69.925	1	69.925	71.17	0.00
	Above Average	39	3.28	0.92	Within Groups	113.973	116	0.983		
	Total	118	2.19	1.25	Total	183.898	117			

Groups: previous achievement level (Average and Below; Above Average)

Post-test Analysis

There is significant difference in the post test scores between the two groups of previous achievement level (Average and Below; Above Average). The results show significant difference in all geometric thinking skills for above average students.

The current study set out to test the hypothesis that tenth graders who take part in an Islamic patterns-based program and those who get more conventional geometry lessons do not differ significantly in their ability to think geometrically. A quantitative study was carried out to test this idea by comparing the geometrical reasoning abilities of two sets of tenth graders. According to the study's findings, students who were taught geometrical thinking skills through an Islamic patterns-based program outperformed their counterparts who were taught standard geometry. This discovery provides more evidence that teaching geometry with Islamic patterns can help students better grasp and apply the language of geometry. It is possible that the distinctive aspects of the Islamic patterns-based curriculum explain the disparity in geometrical reasoning abilities between the two sets of students. It seems that by relating the material to students' cultural and religious backgrounds, this method of teaching promotes a more profound awareness and comprehension of the fundamental mathematical concepts. In addition, the study agrees with other studies that have shown how effective it is to teach mathematics with real-world, practical applications in order to boost students' analytical and problem-solving skills. In general, the study's results have significant bearing on geometry teaching since they support the idea that incorporating Islamic patterns is a good way to enhance the geometrical reasoning abilities of tenth graders. The precise processes by which teaching geometric concepts using Islamic patterns improves students' learning should be the focus of future studies, as should the approach's long-term effects.

Furthermore, the findings demonstrated a noteworthy disparity in all aspects of geometric reasoning abilities among students who performed above average. Above-average students benefit from participating in Islamic patterns' activities. Furthermore, they have a significant capacity for self-directed learning, autonomy, and exceptional levels of achievement. This method has the potential to foster success among these students.

Conclusion

The results of this study have important implications for mathematics educators and curriculum developers. By incorporating Islamic patterns into geometry instruction, teachers can create a more inclusive and engaging learning environment that resonates with the cultural backgrounds of their students. Moreover, the findings suggest that a well-designed, culturally-responsive instructional program can effectively support the development of geometric thinking skills, even for students who may initially struggle with the subject matter.

In conclusion, the present study provides empirical evidence for the effectiveness of an Islamic pattern-based geometry program in improving the geometric thinking skills of students across various achievement levels. These findings contribute to the growing body of research on the integration of cultural elements in mathematics education and underscore the importance of tailoring instructional approaches to the diverse needs of learners.

References

An, Y. (2021). A History of Instructional Media, Instructional Design, and Theories, *International Journal of Technology in Education, 4* (1), 1–21.

Andini, S., Fitriana, L., Budiyono, B. (2017). Elementary School Students Visual Spatial Comprehension Based on van Hiele Theory: The Case in Madiun, East Java, Indonesia, in *International Conference on Mathematics, Science and Education 2017 (ICMSE2017)*, Semarang, Indonesia. DOI: 10.1088/1742-6596/983/1/012097.

Çavuş, H., Deniz, S. (2022). The Effect of Technology Assisted Teaching on Success in Mathematics and Geometry: A Meta-Analysis Study, *Participatory Educational Research, 9* (2), 358–397. DOI: 10.17275/per.22.45.9.2.

Cleary, T., Callan, G., Pawlo, E. (2020). *Self-Regulated Learning in School Contexts*, Cambridge University Press.

Desai, S., Bush, S.B., Farshid, S. (2021). Mathematical Representations in the Teaching and Learning of Geometry: A Review of the Literature from the United States, *Electronic Journal for Research, 25* (4), 6–22.

Gladys, S. (2023). Technology Integration in Geometry Teaching and Learning: A Systematic Review (2010–2022), *International Journal on Math, Science and Technology Education, 11* (3), 1–18. DOI: 10.31129/LUMAT.11.3.1938.

Haj-Yahya, A. (2022). Using Theoretical and Empirical Background Information to Affect Noticing of Geometrical Thinking, *Educational Studies in Mathematics, 111* (1), 493–513.

I.S.C. Boston College (2023). *TIMSS 2019 International Results in Mathematics and Science*. Boston College. Available at: https://timss2019.org/reports/ (date accessed: 10.11.2025).

Jablonski, S., Ludwig, M. (2023). Teaching and Learning of Geometry — A Literature Review on Current Developments in Theory and Practice, *Education Sciences, 13* (7), 682. DOI: 10.3390/educsci13070682.

Kuzle, A. (2023). Geometry Teaching in Transition: An Investigation on the Importance of School Geometry in Primary Education, *The Center for Educational Policy Studies Journal, 13* (2). DOI: 10.26529/cepsj.1267.

Murtiyasa, B., Rejeki, S., Setyaningsih, R.R. (2019). Students Thinking in Solving Geometric Problems Based on PISA Levels, *Journal of Physics Conference Series, 1320* (1), 012068. DOI: 10.1088/1742-6596/1320/1/012068.

Trimurtini, Waluya, S., Sukestiyarno, Y., Kharisudin, I. (2023). Effect of Two-Dimensional Geometry Learning on Geometric Thinking of Undergraduate Students During the COVID-19 Pandemic, *Journal of Higher Education Theory and Practice, 23* (3). DOI: 10.33423/jhetp.v23i3.5848.

Развитие навыков геометрического мышления у десятиклассников с помощью программы, основанной на исламских паттернах: активное обучение и динамическое применение

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Исламские математики разработали несколько геометрических форм, объединяющих математику и искусство. Арабские преподаватели математики и студенты забывают эту славную историю. Сейчас создается увлекательная образовательная программа, призванная восполнить пробелы в геометрическом мышлении учащихся. Данное исследование изучает способности десятиклассников к геометрическому мышлению, методы активного обучения и исламские мотивы. Целью исследования является создание интерактивной образовательной среды за пределами класса путем использования *Geogebra* и *MOODLE* в качестве системы управления обучением. Проведен квазиэкспериментальный проект с двумя группами: экспериментальной (118 чел.) и контрольной (120 чел.). Проведены предварительные и итоговые тесты. Разработан тест из 20 пунктов. Оценивались валидность и надежность (альфа Кронбаха — 0,81). Система управления обучением (СУО) школы была предоставлена учащимся для поиска учебных материалов, заданий, тренингов и оценок вне аудиторных занятий. Результаты показывают, что при оценке геометрического мышления уровни в экспериментальной группе значительно отличаются от показателей в контрольной группе при $\alpha = 0,05$. Статистически значимая разница в средних значениях теста на геометрическое мышление ($\alpha = 0,05$) наблюдается между четырьмя подгруппами экспериментальной группы: «плохо», «средне», «выше среднего» и «отлично» по уровням визуального, аналитического, неформального и формального вывода. Результаты исследования свидетельствуют о необходимости внедрения этой учебной программы преподавателями математики и разработки на ее основе инновационных методик обучения. Подобные исследования встречаются редко, поскольку они интегрируют активное обучение с исламской культурой, современными технологиями, геометрическим мышлением и многими другими образовательными идеями. Данное исследование способствует интеграции преподавателей математики.

Ключевые слова: геометрическое мышление, исламские паттерны, динамическое применение, *GeoGebra*; *MOODLE*, активное обучение.