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The Impact Of Active Learning In The Classroom Environment On Eighth-Grade Students' Self-Efficacy In Learning Geometry In Jordan

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ABSTRACT

Recent international assessments, including TIMSS (2023) and PISA (2022), have revealed a significant decline in Jordanian students' performance in mathematics, underscoring the need for more effective and psychologically responsive teaching approaches. Among the psychological factors influencing academic outcomes, self-efficacy—defined as a learner's belief in their ability to succeed in academic tasks—has emerged as a critical predictor of student motivation, persistence, and overall performance. High levels of self-efficacy are particularly important in cognitively demanding areas such as geometry, where abstract reasoning and spatial thinking are essential.

This study investigates the effect of active learning strategies on the self-efficacy of eighth-grade female students in mathematics in Jordan, positioning self-efficacy as a key mechanism for improving academic outcomes. Employing a quasi-experimental design, the research involved 80 students divided equally into an experimental group that received instruction through active learning methods and a control group that followed traditional teaching practices. Pre- and post-tests using a validated self-efficacy scale were administered to both groups. Results revealed a statistically significant improvement in the self-efficacy scores of the experimental group.

These findings support the hypothesis that active learning positively influences self-efficacy, which in turn plays a pivotal role in enhancing student achievement in mathematics. The study recommends integrating active learning strategies into the mathematics curriculum and providing targeted professional development for educators. Further research is encouraged to explore the bidirectional relationship between self-efficacy and achievement across broader educational settings.

Background:

Traditional instructional methods that emphasize memorization and passive listening often fall short in helping students develop a strong sense of self-efficacy, particularly in geometry where conceptual understanding is essential. In contrast, active learning methods that involve student participation, group work, and real-world problem solving have been shown to improve learners' confidence in their abilities. Ching and Hew (2021) found that when students are given opportunities to engage meaningfully in learning, they develop higher self-efficacy through mastery experiences, observational learning, and social encouragement. This aligns with Bandura's theory, which identifies these factors as core elements in the development of self-efficacy. Likewise, MacFarland et al. (2016) observed that students in active learning environments expressed greater motivation and belief in their ability to succeed, which contributed to better academic engagement and perseverance. In the context of Jordanian education, adopting such practices could play a vital role in strengthening students' confidence while learning geometry and increasing their willingness to participate actively in the classroom.

Methods: *A quasi-experimental design was used to evaluate the effects of teaching methods on student outcomes. The study involved 80 eighth-grade female students from Al-Fudain Middle School, divided into an experimental group (n = 40) taught using active learning strategies and a control group (n = 40) taught using traditional*

methods. The intervention lasted seven weeks and focused on a geometry unit. Data collection included Mathematical Literacy Self-Efficacy Scale. Validity and reliability of the instruments were confirmed through expert reviews and pilot testing. Statistical analyses included ANCOVA to examine differences between groups.

Results: *The findings revealed a statistically significant improvement in self-efficacy scores among students in the experimental group compared to those in the control group. Specifically, the mean self-efficacy score for the experimental group was M = 3.88 (SD = 0.352), while the control group reported a mean of M = 3.21 (SD = 0.373). An ANCOVA analysis confirmed that this difference was significant, $F(1, 77) = 68.082$, $p < 0.001$, with a partial eta squared (η^2) = 0.469, indicating a large effect size. This suggests that nearly 47% of the variance in self-efficacy scores can be attributed to the instructional method supporting the effectiveness of active learning strategies in enhancing students' confidence and belief in their mathematical abilities.*

Conclusion: *This study confirms that active learning plays a pivotal role in enhancing self-efficacy among eighth-grade students in Jordan, particularly in the context of learning mathematics, particularly in geometry. The quasi-experimental findings revealed statistically significant gains in self-efficacy scores for the experimental group, highlighting the impact of student-centered instruction on learners' confidence and motivation. Beyond the quantitative data, students reported greater engagement, enjoyment, and appreciation for mathematics, particularly in geometry, when learning became interactive, relevant, and cognitively stimulating. These outcomes reveal the limitations of traditional teaching methods and emphasize the transformative potential of active learning. To improve the quality of mathematics education in Jordan, particularly in geometry, it is essential for policymakers to embed active learning principles within national curricula. This includes investing in professional development programs that equip teachers with the skills and tools necessary to create interactive and reflective classroom environments. Teachers are encouraged to adopt instructional strategies that promote inquiry, collaboration, and real-life application of knowledge. Students, in turn, should be supported in taking an active role in their learning journey, developing a growth mindset, and gaining confidence in solving complex mathematical problems, particularly those involving geometry. Future research is needed to explore the broader applicability of active learning across different academic disciplines and educational stages. Studies with larger and more diverse samples will help validate the current findings and provide deeper insight into the long-term impact of self-efficacy on student achievement in mathematics, particularly in geometry. Moving toward a more active and student-centered learning model holds great promise for improving academic outcomes and fostering resilient learners who are equipped for the challenges of the twenty-first century.*

Introduction

Self-efficacy has become increasingly recognized as a vital psychological factor influencing students' success in mathematics. It shapes their motivation, persistence, and willingness to engage with complex content. This is especially evident in geometry, which is considered one of the most cognitively demanding branches of mathematics due to its abstract concepts, spatial reasoning, and logical structures. Students with low self-efficacy in geometry often encounter heightened anxiety, tend to avoid challenging tasks, and show reduced academic resilience, regardless of their actual capabilities (Rabab'h & Veloo, 2024; Al-Shara, 2021).

In response to global educational shifts, learner-centered approaches such as active learning have gained increasing momentum. Rooted in constructivist and social cognitive theories, active learning encourages student engagement through inquiry, collaboration, and experiential tasks fostering both cognitive development and emotional empowerment (Freeman et al., 2014; Pereira &

Lopes, 2023). These strategies not only enhance understanding of mathematical concepts but also promote a stronger sense of confidence and ownership over the learning process.

Although numerous international studies have affirmed the positive influence of active learning on students' self-efficacy, there remains a significant research gap in the Jordanian educational context particularly in relation to geometry instruction. Traditional, teacher-centered methods still prevail in many classrooms, potentially limiting students' ability to develop both conceptual understanding and self-belief (Batoul, 2019).

Given this gap, the current study seeks to explore the impact of active learning strategies on the self-efficacy of eighth-grade students in Jordan as they learn geometry. By addressing both cognitive and psychological dimensions of mathematics education, the study aims to offer evidence-based insights that can inform instructional reform and enhance student outcomes in one of the most challenging yet essential areas of the curriculum.

Methods

Study design

Quasi-experimental approach was followed to demonstrate the impact of the teaching method (active learning, the regular method) as an independent variable, on self-efficacy in mathematics among second-year intermediate students in Jordan as dependent variables.

Study settings and population

The study population comprised eighth-grade female students at Al-Fudain Middle School during the second semester of the 2022/2023 academic year. In the Al-Qasba area of Al-Mafraq governorate, the total number of eighth-grade students, both male and female, was 4,178, distributed across 352 schools and 397 classes.

Two branches were randomly selected, and a sample of 80 students was divided equally into an experimental group (n = 40) and a control group (n = 40). The experimental group studied the engineering unit using active learning strategies, while the control group was taught using traditional methods. The selected school was one of 12 schools with at least two eighth-grade classes, ensuring sufficient student numbers and facilitating oversight of both groups. Al-Fudain Middle School, the largest school in the county with 126 eighth-grade students, was intentionally chosen to allow for variability among students.

Measurement tool:

Mathematical Literacy Self-Efficacy Scale

The **Mathematical Literacy Self-Efficacy Scale** used in this study is a 5-point Likert-type instrument consisting of 22 statements, with response options ranging from "Always," "Most of the time," "Sometimes," "Rarely," to "Never." The original scale was developed in English by Özgen and Bindak (2018) to assess students' beliefs in their ability to understand and apply mathematical concepts effectively in real-life contexts. It focuses on core components of mathematical literacy, including problem-solving skills, conceptual understanding, and confidence in using mathematics, and is grounded in Bandura's self-efficacy theory.

To ensure cultural relevance and linguistic clarity, the original English version of the scale was professionally translated into Arabic. The Arabic version was then reviewed by a panel of educational experts and language specialists to evaluate its content validity and appropriateness for Jordanian eighth-grade students. Minor linguistic and contextual adaptations were made based on the reviewers' feedback to enhance the tool's alignment with the students' cultural and educational context, ensuring its suitability for use in Jordanian schools.

Data collection and recruitment procedure

Experiment Implementation: The experiment began in the second week of the second semester of 2022/2023 academic year, where the experimental group was taught using active learning strategies. Meanwhile, the control group was taught using traditional methods with (5) lessons per week, according to a schedule adopted throughout the experiment, which lasted for seven weeks.

Administration of the Self-Efficacy Scale : During the seventh week of the experiment, both the experimental and control groups consisting of eighth grade female students,, took the Post-scale underwent the administration of the self-efficacy scale and interviews. Students' answers were corrected, and their scores were calculated for the scale.

Students received a 45 minutes lesson (based on the school schedule and contents of the 8th grade mathematics curriculum). The experimental group received an active learning method based on special treatment, while the control group was taught traditionally without it. Both groups were administered tests. The intervention program was implemented in 7 weeks. The first week was for preparation and pre-testing. In the second week, the students received training until the seventh week, when the posttests were administered (immediate and deferred posttests). Furthermore, the course was based on Vygotsky's (1978) instructions for scaffolding. This includes the role of teachers and others in supporting learners' development and providing support structures to reach that next stage or level (Yuill & Carr, 2018).

Data analysis

Data were analysed using IBM SPSS Statistics for Windows version 30.0 (IBM Corp., Armonk, NY).The Mann-Whitney U test and the Wilcoxon Signed-Rank test were employed to assess the significance of the difference between the average scores of female students in the experimental and control groups on the post-mathematics academic achievement test. To statistically control for any pre-test score differences between the two groups, a one-way analysis of covariance (ANCOVA) was performed at the significance level ($\alpha = 0.05$). Similarly, to determine the significance of the difference between the average scores of female students in the experimental and control groups on the self-efficacy scale after the mathematics intervention, while accounting for pre-test score differences, an analysis of covariance (ANCOVA) was also used at the significance level ($\alpha = 0.05$).

Results

The analysis revealed a significant positive effect of active learning strategies on students' self-efficacy in mathematics. Prior to the intervention, both the experimental and control groups demonstrated comparable levels of self-efficacy, with mean pre-test scores of 2.95 (SD = 0.392) and 2.90 (SD = 0.356), respectively. However, following the implementation of the active learning program, the

experimental group showed a notable improvement, achieving a mean post-test score of 3.88 (SD = 0.352), compared to 3.21 (SD = 0.373) for the control group.

A one-way analysis of covariance (ANCOVA) was conducted to control for potential differences in pre-test scores. The results confirmed a statistically significant effect of the instructional method on post-test self-efficacy scores, $F(1, 77) = 68.082$, $p < 0.001$, with a large effect size (partial $\eta 2 = 0.469$). This indicates that nearly 47% of the variance in self-efficacy scores can be attributed to the use of active learning strategies.

These findings suggest that incorporating active learning methods in mathematics instruction can meaningfully enhance students' beliefs in their own abilities, especially in cognitively demanding subjects like geometry. The experimental group's substantial gains in self-efficacy reflect the empowering nature of interactive, student-centered teaching approaches that foster greater confidence, autonomy, and engagement in the learning process.

Table 1 Descriptive statistics for the scores of female students in the experimental and control groups in the two applications (pre-test).

the group	Descriptive statistics	Pretest	Post test
Experimental group	Mean	2.95	3.88
	standard deviation	0.392	0.352
Control group	Mean	2.90	3.21
	standard deviation	0.356	0.373

ANCOVA analysis of self-efficacy scores yielded an F-value of 68.082 ($p < 0.01$) and an Eta squared value of 0.469, indicating that 46.9% of the variance was due to the teaching method.

Table 2 Results of the one-way analysis of variance (ANCOVA) for the scores of individuals in the experimental and control groups on the post-test self-efficacy scale

Source of variance	Sum of squares	Df	Mean squares	Computerized f value	sig	impact size
Pre-test (accompanying)	0.053	1	0.053	0.398	0.01	
Group (teaching method)	9.029	1	9.029	68.082	0.00	0.469
The error	10.211	77	0.133			
Total	19.242	79				

Real-World Problems and Self-Efficacy

Students noted that engaging with real-world scenarios boosted their confidence in applying mathematical concepts, enhancing self-efficacy and engagement.

Activating Prior Knowledge

Revisiting foundational concepts before advanced topics improved preparedness and confidence, strengthening students' perceived competence.

Observing Techniques

Visual aids and logical explanations deepened understanding and boosted confidence in tackling complex problems.

Application-Based Learning
Applying mathematics to real-life contexts fostered a sense of accomplishment and enhanced self-efficacy.

Concept Integration
Recognizing connections between mathematical ideas improved comprehension and confidence in solving intricate problems.

Discussion
This study demonstrated that active learning strategies significantly enhanced students' self-efficacy in mathematics, particularly in geometry—a cognitively demanding domain that often challenges students' confidence. Unlike traditional instructional methods, which rely heavily on rote memorization and passive reception of information, active learning fosters deeper understanding, meaningful engagement, and a sense of personal competence. Students in the experimental group, who were exposed to student-centered approaches such as collaborative problem-solving, visual aids, and real-world applications, reported higher levels of confidence in their mathematical abilities than their counterparts in the control group.

Quantitative data revealed statistically significant differences between the two groups, with the experimental group achieving higher post-test self-efficacy scores ($M = 3.88$, $SE = 0.058$) compared to the control group ($M = 3.21$, $SE = 0.058$), $F(1, 77) = 68.082$, $p < 0.001$, partial $\eta 2 = 0.469$. This large effect size indicates that nearly 47% of the variance in self-efficacy can be attributed to the use of active learning strategies. These results align with Bandura's (1997) social cognitive theory, which identifies mastery experiences, social modeling, and verbal persuasion as key mechanisms in the development of self-efficacy. Active learning provides precisely these conditions—students observe success, experience it firsthand, and receive feedback within a supportive and interactive environment.

Moreover, qualitative interviews enriched the findings by offering insights into students' lived experiences. Many described the active learning environment as dynamic and enjoyable, emphasizing how participation in hands-on activities, guided exploration, and concept integration helped them overcome anxiety and develop a stronger belief in their abilities. They noted that active learning made mathematical content feel more relevant and achievable, fostering a growth mindset and a willingness to persist through challenges.

In the context of Jordanian education where traditional methods still dominate these findings highlight the urgent need for instructional reform. Integrating active learning into the mathematics curriculum not only enhances academic achievement but also cultivates essential psychological traits such as self-confidence, independence, and resilience. As self-efficacy has been shown to be a key predictor of long-term academic success, the incorporation of active learning practices holds promise for both immediate learning gains and sustained educational development.

Comparison of Findings to Previous Research

The findings of this study strongly align with prior research highlighting the critical role of active learning in enhancing students' self-efficacy. Bandura's (1997) social cognitive theory identifies mastery experiences, vicarious learning, and social persuasion as essential mechanisms for developing self-efficacy, and these elements are deeply embedded in well-structured active learning environments. Prince (2004) and Freeman et al. (2014) demonstrated that active learning not only improves academic performance but also fosters a greater sense of control and perceived competence, which are foundational to students' confidence and persistence.

Freire (1970) and Kolb (1984) emphasized student-centered learning models that promote agency, autonomy, and emotional engagement. All of these factors contribute significantly to the formation of self-efficacy. In line with these theoretical perspectives, the current study showed that students who engaged in collaborative problem-solving and contextual mathematical tasks developed significantly higher confidence in their ability to understand and apply complex concepts.

Student reflections further reinforced these quantitative results. Participants described the learning experience as more empowering, enjoyable, and meaningful when active learning methods were applied. Their feedback aligns with Michael's (2006) observations, which associate active learning environments with greater emotional involvement and a stronger belief in personal competence. Additionally, Trilling and Fadel (2009) emphasized that 21st-century skills such as adaptability, problem-solving, and self-directed learning are best cultivated through educational practices that empower learners both psychologically and cognitively.

Together, these findings underscore that self-efficacy is not simply a byproduct of academic success. Rather, it is a central component of meaningful and transformative learning. The close alignment between international literature and the current study's results suggests that the psychological benefits of active learning, especially in strengthening students' belief in their capabilities, are both universal in principle and adaptable within the Jordanian educational context. This provides a compelling foundation for educational reform through learner empowerment.

Theoretical and Practical Implications

Self-efficacy theory, rooted in Bandura's (1997) social cognitive framework, defines self-efficacy as individuals' belief in their capability to execute actions required to manage prospective situations. It is shaped through four core sources: mastery experiences, vicarious experiences, verbal persuasion, and physiological states (Usher & Pajares, 2008). These mechanisms are activated through dynamic and participatory educational strategies—central to active learning environments.

Active learning also resonates with Merrill's First Principles of Instruction (2002), which emphasize problem-centered learning, activation of prior knowledge, demonstration, application, and integration. Each of these principles contributes to reinforcing learners' confidence, autonomy, and persistence—hallmarks of high self-efficacy. When students solve authentic problems, apply knowledge in interactive contexts, and reflect on their progress, they are more likely to internalize success and build resilient learning identities.

Complementing these modern theories, Ibn Khaldun's educational philosophy offers a timeless perspective. He criticized rote memorization and emphasized the importance of applied, experiential learning. According to Ibn Khaldun, knowledge must be "practiced and reflected upon

to be truly internalized," a view that parallels Bandura's notion that self-efficacy is developed through lived, meaningful experiences. His integration of ethical, social, and intellectual development aligns with current efforts to educate the whole learner.

Recent research supports the interplay between active learning and enhanced self-efficacy. For instance, Putwain et al. (2020) and Kim & Park (2021) confirmed that interactive learning experiences improve students' academic confidence and motivation. These findings underline the necessity of replacing passive instructional methods with more engaging, student-centered approaches to nurture both academic performance and self-belief—especially in subjects like mathematics and geometry, where students often struggle with abstraction and self-doubt.

Limitations and Directions for Future Research'

Despite its contributions, the study has limitations:

1. It focused solely on grade 8 students in Jordan, limiting generalizability. Future research should examine active learning's impact on diverse age groups and educational contexts.

2. The sample size was relatively small. Larger studies are needed to validate and expand upon these findings.

Conclusion and Recommendations

This study confirms that active learning plays a pivotal role in enhancing self-efficacy among eighth-grade students in Jordan, particularly in the context of learning mathematics, particularly in geometry. The quasi-experimental findings revealed statistically significant gains in self-efficacy scores for the experimental group, highlighting the impact of student-centered instruction on learners' confidence and motivation. Beyond the quantitative data, students reported greater engagement, enjoyment, and appreciation for mathematics, particularly in geometry, when learning became interactive, relevant, and cognitively stimulating. These outcomes reveal the limitations of traditional teaching methods and emphasize the transformative potential of active learning.

To improve the quality of mathematics education in Jordan, particularly in geometry, it is essential for policymakers to embed active learning principles within national curricula. This includes investing in professional development programs that equip teachers with the skills and tools necessary to create interactive and reflective classroom environments. Teachers are encouraged to adopt instructional strategies that promote inquiry, collaboration, and real-life application of knowledge. Students, in turn, should be supported in taking an active role in their learning journey, developing a growth mindset, and gaining confidence in solving complex mathematical problems, particularly those involving geometry.

Future research is needed to explore the broader applicability of active learning across different academic disciplines and educational stages. Studies with larger and more diverse samples will help validate the current findings and provide deeper insight into the long-term impact of self-efficacy on student achievement in mathematics, particularly in geometry. Moving toward a more active and student-centered learning model holds great promise for improving academic outcomes and fostering resilient learners who are equipped for the challenges of the twenty-first century.

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