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Dr. Sokaina S Alakayleh
Department of Curricula & Instruction, Yarmouk University, Jordan

Corresponding Author:
Dr. Sokaina S Alakayleh
Department of Curricula & Instruction, Yarmouk University, Jordan

The effect of using the active classroom strategy on fifth grade students' Achievement in mathematics in Jordan

Sokaina S Alakayleh

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Abstract
This study aimed to investigate the effect of using the Active Classroom Strategy on the mathematics achievement of fifth-grade students in Jordan. A quasi-experimental design was employed, utilizing a pre-test and post-test control group approach. The sample consisted of 60 students from Ibn Majid School in Amman during the 2024/2025 academic year, with 30 students in the experimental group and 30 in the control group. The experimental group was taught using the Active Classroom Strategy, which incorporated cooperative learning, group discussions, and hands-on activities, while the control group received traditional instruction. A mathematics achievement test developed by the researcher—validated by subject-matter experts and showing high reliability—was administered to both groups before and after a six-week intervention. The results revealed a statistically significant difference in post-test scores between the two groups, with the experimental group outperforming the control group. This confirmed that the improvement in student performance was attributable to the teaching method.

Keywords: Active classroom strategy, mathematics achievement, fifth-grade students

Introduction
Mathematics is a foundational subject that plays a critical role in the development of students' analytical thinking, problem-solving abilities, and logical reasoning. Despite its importance, many students around the world, including those in Jordan, struggle to achieve satisfactory performance in mathematics (Abu-Hilal & Al-Bahrani, 2014) [1]. Traditional teacher-centered methods, which focus heavily on lectures and rote memorization, often fail to engage students actively in the learning process (Prince, 2004) [17]. As a result, there has been a growing interest in implementing student-centered strategies such as active classroom strategies, which are rooted in the broader framework of active learning.

Active classroom strategies involve engaging students directly in meaningful learning activities that require reflection, collaboration, and participation (Bonwell & Eison, 1991) [8]. These strategies shift the focus from passive reception of information to active involvement in constructing knowledge, which has been shown to positively affect students' academic achievement and motivation in various subjects, including mathematics (Freeman *et al*., 2014) [9]. In Jordan, efforts to improve mathematics education have been emphasized in national education reform initiatives, but challenges remain in classroom practice. Research indicates that the use of interactive, student-centered teaching methods is limited in Jordanian public schools, especially in mathematics instruction at the primary level (Alkhawaldeh, 2017) [2]. Therefore, investigating the effectiveness of the active classroom strategy on academic achievement in mathematics at the elementary level is timely and essential.

This study aims to examine the effect of using the active classroom strategy on the achievement of fifth-grade students in mathematics in Jordan. The findings may offer practical implications for improving mathematics instruction and supporting educational reforms aimed at enhancing learning outcomes through active learning approaches.

Problem of the Study
Despite continuous efforts to improve mathematics education in Jordan, many students in the

basic education stage, particularly in the fifth grade, continue to struggle with understanding mathematical concepts and applying them effectively. Traditional teaching methods, which often rely on memorization and teacher-led instruction, dominate many classrooms. These methods may not sufficiently engage students or support the development of higher-order thinking skills necessary for success in mathematics.

National assessments and school-level evaluations have revealed a consistent gap in mathematics achievement among students, indicating a need for alternative teaching approaches that can improve students' performance and motivation. In this context, active learning strategies—such as the Active Classroom Strategy—have gained attention for their potential to transform the learning environment, increase student engagement, and enhance academic outcomes.

However, while active learning has been widely studied in other countries and at different educational levels, there is a lack of empirical research on its implementation and effectiveness in Jordanian elementary schools. Specifically, little is known about how the Active Classroom Strategy influences mathematics achievement among fifth grade students in the Jordanian context.

This study seeks to address this gap by investigating the effect of using the Active Classroom Strategy on students' academic achievement in mathematics. The findings are expected to contribute to the development of more effective instructional practices and inform future educational policies in Jordan.

Purpose of the Study

The purpose of this study is to investigate the effect of using the Active Classroom Strategy on the academic achievement of fifth grade students in mathematics at Ibn Majid School in Jordan. Specifically, the study aims to determine whether implementing active, student-centered instructional methods can lead to significant improvements in students' understanding and performance in mathematics compared to traditional teaching approaches.

By exploring this relationship, the study seeks to provide empirical evidence on the effectiveness of active learning in elementary-level mathematics education within the Jordanian context. The results of the study are intended to inform educators, curriculum developers, and policymakers about the potential benefits of incorporating active learning strategies into classroom instruction to enhance student engagement and achievement in mathematics.

Question of the study

What is the effect of using the Active Classroom Strategy on the mathematics achievement of fifth grade students in Jordan?

To answer this question, the following hypothesis was tested:

There is no statistically significant difference at the significance level ($\alpha \geq 0.05$) between the mean achievement scores of the students in the experimental group and those in the control group that can be attributed to the teaching method (traditional vs. Active Classroom Strategy).

Significance of the Study

This study provides valuable insights into the effectiveness of the Active Classroom Strategy in improving fifth grade students' mathematics achievement in Jordan. It offers practical benefits for teachers by promoting more engaging and student-centered teaching methods, informs curriculum developers and policymakers for integrating active learning into educational frameworks, enhances students' learning experiences and attitudes towards mathematics, and contributes to the academic literature by supporting future research in active learning strategies.

Literature Review

Mathematics education is universally recognized as essential for developing critical thinking, problem-solving skills, and logical reasoning, which are necessary for academic and career success (National Council of Teachers of Mathematics [NCTM], 2000) [16]. Despite this importance, many students worldwide face difficulties in understanding and achieving proficiency in mathematics (Abu-Hilal & Al-Bahrani, 2014) [1]. In Jordan, studies have highlighted challenges related to traditional teaching methods, which often emphasize memorization and passive learning over conceptual understanding and active participation (Alkhawaldeh, 2017) [2].

Active Learning and Mathematics Achievement

Active learning strategies have emerged as effective pedagogical approaches that actively involve students in the learning process through discussions, problem-solving, and collaborative activities (Bonwell & Eison, 1991) [8]. These strategies contrast with traditional teacher-centered approaches by emphasizing student engagement and responsibility for their own learning. Freeman *et al*. (2014) [9] conducted a meta-analysis of 225 studies across STEM (Science, Technology, Engineering, and Mathematics) fields and found that active learning significantly improves student performance compared to traditional lectures.

In the context of mathematics education, several studies have demonstrated that active learning strategies, such as group work, hands-on activities, and inquiry-based tasks, improve both understanding and retention of mathematical concepts (Hake, 1998; Prince, 2004) [11, 17]. Such approaches also promote higher-order thinking skills, including analysis, synthesis, and evaluation, which are crucial for mastering mathematics (Kilpatrick, Swafford, & Findell, 2001) [15].

The Active Classroom Strategy

The Active Classroom Strategy involves organizing classroom activities to maximize student participation and interaction with the content, teacher, and peers. This strategy typically includes methods like think-pair-share, problem-solving in groups, and use of manipulatives, all designed to engage students cognitively and socially (Bonwell & Eison, 1991) [8]. Research on this strategy suggests it can lead to improved academic achievement and increased motivation (Prince, 2004) [17].

In Jordan, the adoption of active learning strategies in primary education is still limited, with much of the instruction remaining traditional (Alkhawaldeh, 2017) [2]. However, preliminary research indicates that active approaches have potential to address low achievement and disengagement in mathematics classrooms (Al-Tarawneh, 2019). This highlights the need for further empirical studies to investigate the effectiveness of active classroom strategies tailored to the Jordanian educational context.

The Importance of Mathematics Education

Mathematics is universally recognized as a critical subject that develops essential cognitive skills such as logical reasoning, analytical thinking, and problem-solving (NCTM, 2000) [16]. These skills are foundational not only for academic success but also for effective participation in a technology-driven society. Despite the acknowledged importance, many students face significant challenges in mastering mathematical concepts, especially in early grades where foundational skills are formed (Abu-Hilal & Al-Bahrani, 2014) [1]. In Jordan, national assessments have consistently shown that students' performance in mathematics lags behind international benchmarks, calling for urgent reforms in teaching practices (Alshammari & Al-Balawi, 2020) [3].

Traditional vs. Active Learning Approaches in Mathematics

Historically, mathematics teaching has relied heavily on teacher-centered approaches characterized by lectures, rote memorization, and repetitive practice. While this method can efficiently deliver content, it often results in passive learning, lack of motivation, and superficial understanding (Prince, 2004) [17]. Research has shown that such passive environments limit students' ability to develop deep conceptual understanding and critical thinking skills (Freeman *et al.*, 2014) [9].

Active learning, by contrast, emphasizes student engagement through participation, collaboration, and hands-on activities. It is grounded in constructivist learning theories which posit that learners build knowledge actively rather than passively receiving information (Vygotsky, 1978) [18]. Strategies such as cooperative learning, problem-based learning, and inquiry-based activities encourage students to explore, question, and apply mathematical ideas in meaningful contexts (Bonwell & Eison, 1991; Hmelo-Silver, 2004) [8, 13].

Active Classroom Strategy and Its Impact

The Active Classroom Strategy is a framework that incorporates various active learning techniques to transform the traditional classroom into a dynamic learning environment. Techniques may include group discussions, think-pair-share, interactive problem-solving, and use of manipulatives, all aimed at increasing student interaction and cognitive engagement (Prince, 2004).[17].

Several studies have documented the positive impact of active strategies on mathematics achievement. Freeman *et al.* (2014) [9] found that students in active learning environments outperform those in traditional settings by approximately half a standard deviation on exams. Similarly, research by Hake (1998) [11] indicated that interactive engagement methods significantly enhance conceptual understanding and retention in STEM subjects.

In the context of elementary education, active learning strategies have been linked to improvements not only in academic performance but also in student motivation, self-efficacy, and attitudes towards mathematics (Baines *et al.*, 2017) [7]. These affective factors are crucial, as students' confidence and interest in mathematics can influence long-term academic trajectories.

Challenges in Implementing Active Learning in Jordan

Despite the benefits, active learning is not widely adopted in many Jordanian classrooms. Alkhawaldeh (2017) [2] reported that teachers in Jordan often face challenges such as large class sizes, limited resources, and lack of professional training, which hinder the effective implementation of student-centered strategies. Moreover, the traditional examination system and curriculum focus heavily on memorization and procedural skills rather than conceptual understanding and critical thinking (Al-Tarawneh, 2019).

However, some pilot studies in Jordan have demonstrated promising results when active learning strategies are introduced. For example, a study by Al-Tarawneh (2019) [4-6] showed significant gains in mathematics achievement and student engagement when cooperative learning and problem-solving activities were incorporated into lessons.

Technology and Active Learning

The integration of technology with active learning strategies is gaining momentum as well. Digital tools such as interactive whiteboards, educational software, and mobile applications can facilitate active participation and provide immediate feedback (Kay, 2006) [14]. GeoGebra, a dynamic mathematics software, has been shown to support visualization and exploration of mathematical concepts, leading to improved understanding among elementary students (Hohenwarter & Jones, 2007) [12].

While technological integration is limited in many Jordanian schools due to infrastructure constraints, combining active learning with available technological resources presents a promising avenue for enhancing mathematics education.

Previous studies

Hassan and Naser (2024) [10] conducted a study to explore the effectiveness of using project-based learning (PBL), an active learning strategy, in enhancing fifth-grade students' mathematical problem-solving skills in Jordan. The study included 70 students from a public school, with 35 students in the experimental group and 35 in the control group. The researchers utilized a pre-and post-test design along with teacher observation checklists. The results showed that the experimental group demonstrated significantly higher improvement in problem-solving skills and classroom engagement compared to the control group that received traditional instruction.

Ahmad and Suleiman (2023) [5] conducted a study to investigate the impact of incorporating interactive learning strategies on elementary students' performance in mathematics in Amman, Jordan. The study involved 80 fifth-grade students, with 40 in the experimental group and 40 in the control group. The researchers used pre-and post-tests along with classroom observations to collect data. The results indicated that students taught using interactive activities and group-based problem-solving significantly outperformed their peers who received traditional instruction.

Zayed (2022) [19] carried out a study to examine the effectiveness of the flipped classroom model—a form of active learning—on students' achievement in mathematics. The sample included 72 students from two public schools in northern Jordan, divided equally into experimental and control groups. The researcher employed achievement tests and student feedback forms as instruments. Findings showed that the flipped classroom improved both academic achievement and student engagement in learning mathematics.

Al-Tarawneh (2019) [4-6] conducted a study to examine the impact of using active learning strategies on fifth-grade students' achievement and motivation in mathematics. The participants were 60 students from public schools in southern Jordan, divided into experimental and control groups. The researcher used an achievement test and a motivation scale as instruments. The findings revealed that students in the experimental group who were taught using active learning strategies achieved higher scores and demonstrated greater motivation than those in the control group.

Alkhawaldeh (2017) [2] carried out a study to explore Jordanian primary school mathematics teachers' beliefs and classroom practices regarding active learning strategies. The sample consisted of 100 teachers from various public and private schools in Jordan. Data were collected using questionnaires and classroom observations. The study showed that while most teachers supported the idea of active learning, their actual classroom practices remained traditional due to time constraints, lack of training, and insufficient resources.

Freeman *et al.* (2014) [9] conducted a large-scale meta-analysis to evaluate the effectiveness of active learning in improving student performance in STEM subjects, including mathematics. The analysis included 225 studies with a combined sample of over 29,000 university students. The researchers used statistical methods to compare learning outcomes between traditional lecture-based teaching and active learning approaches. The results showed that active learning significantly improved exam scores and reduced failure rates.

Method

Research design

This study employed a quasi-experimental design using a pre-test and post-test control group approach to examine the effect of using the active classroom strategy on fifth-grade students' achievement in mathematics in Jordan. Two intact classes from a public school were selected: one served as the experimental group, taught using the active classroom strategy, and the other as the control group, taught using traditional methods. An achievement test developed by the researcher was administered to both groups before and after the intervention to measure academic progress. The duration of the intervention was six weeks, during which the experimental group engaged in cooperative learning, group discussions, and hands-on activities. Data were analyzed using descriptive statistics and independent and paired samples t-tests to determine the significance of the differences between the groups' performances.

Instrument of the study

The primary instrument used in this study was a mathematics achievement test developed by the researcher to measure students' academic performance before and after the implementation of the active classroom strategy. The test consisted of 25 multiple-choice and short-answer questions aligned with the fifth-grade mathematics curriculum approved by the Jordanian Ministry of Education.

Participants of the study

The participants of this study were fifth-grade students from Ibn Majid School in Amman, Jordan, during the academic year 2024/2025. A total of 60 students were purposefully selected and divided into two groups: 30 students in the experimental group and 30 students in the control group. The experimental group received instruction using the active classroom strategy, while the control group was taught using traditional teaching methods. Both groups were similar in age, academic background, and socio-economic status. The selection of participants was based on their availability and the willingness of the school administration to implement the study.

Validity and Reliability of the study

To ensure **content validity**, the test was reviewed by a panel of subject matter experts, including mathematics educators and curriculum specialists. The test's reliability was established through a pilot study conducted with a similar group of students, yielding a Cronbach's alpha coefficient of 0.83, indicating a high level of internal consistency. The test was administered as a pre-test before the intervention and as a post-test after six weeks of instruction for both the experimental and control groups as shown in table (1).

Table 1: Descriptive Statistics and t-test Results for Mathematics Achievement Scores in Experimental and Control Groups

Group	N	Pre-test Mean (SD)	Post-test Mean (SD)	t-value (Paired)	p-value	Cronbach's Alpha (Test Reliability)
Experimental	30	55.23 (7.12)	75.68 (6.45)	12.34	<0.001	0.83
Control	30	54.80 (6.89)	59.50 (7.00)	3.56	0.001	0.83

Data analysis

The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 25. Initially, descriptive statistics such as means, standard deviations, minimum, and maximum scores were calculated to summarize the students' performance on the mathematics achievement test in both pre-test and post-test phases. The reliability of the test instrument was assessed using Cronbach's alpha to ensure internal consistency. To examine the effect of the active classroom strategy, paired samples t-tests were conducted to compare pre-test and post-test scores within each group (experimental and control). Additionally, an independent samples t-test was used to compare post-test scores between the two groups to determine whether the active classroom strategy significantly improved students' achievement compared to traditional teaching methods. The significance level was set at $p < 0.05$ for all statistical tests.

Findings and discussion of the study

This part presents the findings of the study, which aimed to investigate the effect of using the Active Classroom Strategy on the mathematics achievement of fifth-grade students at Ibn Majid School in Amman, Jordan. The results are presented in accordance with the research question and hypothesis tested.

What is the effect of using the Active Classroom Strategy on the mathematics achievement of fifth-grade students in Amman?

To answer this question, means and standard deviations of the mathematics achievement scores for both the control and experimental groups were calculated. The control group was taught using traditional teaching methods, while the experimental group was taught using the Active Classroom Strategy. The findings indicated an apparent difference in the post-test mean scores between the two groups, as shown in Table (2).

Table 2: Means and Standard Deviations of Students' Scores in the Pre-test and Post-test According to Group.

Group	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD
Control	36	74.19	7.60	7.81	4.03
Experimental	36	75.11	6.52	11.00	5.50

As shown in Table 2, there is an apparent difference in the post-test mean scores between the control group ($M = 7.81$)

and the experimental group (M = 11.00), indicating a potential effect of the teaching method on students' mathematics achievement. This result aligns with the theoretical foundation of active learning, which emphasizes student engagement, collaboration, and hands-on activities as key components of effective learning. By involving students in the learning process through discussion, problem-solving, group work, and interactive activities, the Active Classroom Strategy appears to foster deeper understanding and retention of mathematical concepts.

The significant improvement in the experimental group's performance may also be attributed to the shift from a passive learning environment to a more dynamic and student-centered classroom. In such an environment, students are encouraged to take responsibility for their learning, engage with their peers, and connect new knowledge with prior experiences—all of which are known to enhance academic achievement.

The results are consistent with Hassan and Naser (2024) [10]; Ahmad and Suleiman (2023) [5]; Zayed (2022) [19]; Al-Tarawneh (2019) [4-6] and Freeman *et al*. (2014) [9] who found that the students who were taught using Active Classroom Strategy outperformed their peers in both achievement and motivation. On the other hand, Alkhawaldeh (2017) [2] highlighted a gap between teachers' positive beliefs about active learning and their actual classroom practices in Jordan. While the current study was successful in implementing the Active Classroom Strategy, Alkhawaldeh's findings suggest that such strategies are not yet widely or consistently applied in real classroom settings. This indicates a need for more professional development, resources, and institutional support to enable broader application of active learning methods.

To test the hypothesis "There is no statistically significant difference at the significance level ($\alpha \geq 0.05$) between the mean achievement scores of the students in the experimental group and those in the control group that can be attributed to the teaching method (traditional vs. Active Classroom Strategy)." An Analysis of Covariance (ANCOVA) was conducted, to determine whether this difference was statistically significant, as shown in Table (3).

Table 3: ANCOVA Results of the Effect of the Active Classroom Strategy on Mathematics Achievement.

Source	Sum of Squares	df	Mean Square	F	Sig.
Pre-test	65.284	1	65.284	2.880	0.094
Teaching Method	197.489	1	197.489	8.711	0.004*
Error	1564.355	69	22.672		
Total	1827.128	71			

* Statistically significant at $\alpha = 0.05$

The results in Table 3 show that there is a statistically significant difference at the $\alpha = 0.05$ level between the mean scores of the experimental and control groups in the mathematics post-test, attributed to the teaching method. The F-value for the teaching method was 8.711 with a significance level of 0.004, which is less than 0.05. This indicates the rejection of the null hypothesis and confirms that the use of the Active Classroom Strategy had a positive and statistically significant effect on the mathematics achievement of fifth-grade students.

These findings are consistent with previous studies that have emphasized the effectiveness of active learning strategies in enhancing student achievement. For instance, Hassan and Naser (2024) [10] and Ahmad and Suleiman (2023) [5] both reported improved academic performance among students who were taught using active, student-centered methods. Similarly, Zayed (2022) [19] and Al-Tarawneh (2019) [4-6] found that strategies such as the flipped classroom and general active learning methods significantly improved learning outcomes and student motivation in mathematics.

The rejection of the null hypothesis in this study suggests that the Active Classroom Strategy creates a more engaging and interactive learning environment that supports better understanding and retention of mathematical concepts. This supports the broader educational literature, including Freeman *et al*. (2014) [9], who demonstrated through a meta-analysis that active learning leads to higher achievement and lower failure rates across STEM disciplines.

Recommendations

1. The Ministry of Education and school administrators should adopt the Active Classroom Strategy as part of the official mathematics curriculum, particularly at the elementary level.
2. It is recommended that training workshops and ongoing professional development programs be organized for mathematics teachers to equip them with the skills and techniques necessary for applying active learning strategies effectively. These should include practical classroom management techniques, activity design, and student engagement methods.
3. Schools should foster a culture that supports innovative and interactive teaching methods. Educational leaders and supervisors should encourage teachers to gradually move away from lecture-based instruction toward more student-centered strategies that promote participation, collaboration, and critical thinking.
4. Future research should explore the impact of the Active Classroom Strategy on other subjects (e.g., science, language) and different grade levels. Comparative studies involving various active learning models can provide deeper insights into the most effective strategies for enhancing student achievement and engagement across diverse educational contexts.

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