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The Impact Of Using The Flipped Learning Strategy On Mathematics Achievement Among Sixth-Grade Primary Students

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Abstract
This study aimed to investigate the impact of using the flipped learning strategy on the mathematics achievement of sixth-grade female students. The researchers employed a quasi-experimental design, which was appropriate for the nature of the study. The sample consisted of 47 students from Al-Hussan Model Private Schools, who were selected purposefully. The students were divided into two groups: an experimental group and a control group, with both groups undergoing pre- and post-tests. The experimental group was taught using the flipped learning strategy, whereas the control group received instruction through traditional methods. The results indicated that the use of the flipped learning strategy did not have a significant effect on the mathematics achievement of sixth-grade female students.
Keywords: *Flipped Learning, Mathematics, Achievement, Primary Students.*

1. INTRODUCTION

Learning is an essential and continuous process that results in interaction and commitment to an external environment in a person's life. To achieve success with education and achieve desired outcomes, it is important to diversify teaching strategies and methods to address the diversity among students and cater to their different needs (Ahmad et al,. 2025).

Moreover, the rapid changes and tremendous technological advancements that the world is witnessing today require the educational system to evolve and adapt accordingly (Abdelbaki, 2021). Today, teachers are required to embrace their new role by using available technological tools and resources in their learner-centered teaching methods, shifting away from traditional approaches. This shift allows students to be engaged in the educational process for as long as possible and at the highest quality of learning, all with the aim of increasing students' motivation toward learning and, consequently, enhancing their academic achievement (Al-Saliti, 2015).

One of the relatively modern teaching strategies is the flipped learning strategy, also referred to as inverted learning or the flipped classroom. This approach places the learners in an active role by actively engaging with available resources (Abdelfattah, 2021). It also provides learners with the opportunity to solve short-term memory problems by allowing them to repeat and study the educational material before class time, which could be utilized optimally. Additionally, this strategy aims to integrate technology into education by relying on the internet to facilitate interaction between teachers and students, as well as among students themselves. (Menon et al., 2023). It also capitalizes on the widespread use of tablets and mobile devices, which have become integral to students' daily lives (Al-Ahoul, 2016).

The flipped learning strategy is characterized by its foundation in constructive theory, which gives the learner an active, positive role in the educational process and holds them responsible for their own learning. In this model, learners are independent knowledge seekers who actively participate in classroom activities, engage in exercises, and self-evaluate their performance and learning outcomes (Johnson & Renner, 2012).

Math is a vital subject in primary school, serving as a key indicator of students' ability to progress academically and achieve success. However, numerous female students encounter challenges in mastering it and attaining satisfactory outcomes. many female students face difficulties in learning it and achieving good results (Hussein & Ali, 2015).

The objective of this research is to assess the effect of using the flipped learning strategy on the achievement of sixth-grade female students in mathematics

2. Theoretical Framework and Previous Studies

Flipped Learning Strategy

Flipped learning is closely related to blended learning and consists of two main parts: individual learning th at happens outside of school using technology; the second is effective and active group learning that occurs i nside the classroom (Al-Nawaiseh, 2025). The primary goal of flipped learning is to assign the learners an a ctive and positive role, enabling them to independently address problems and develop their ability to analyz e and solve them by utilizing available educational resources, such as printed materials or educational packa ges, to help them understand the fundamental concepts and ideas in the lesson (Al-Nawaiseh et al; 2025). S ubsequently, in the classroom, students are involved in applying knowledge, engaging in discussions, and sol ving problems collaboratively.

The Advantages of Flipped Learning

Flipped learning has many advantages, as mentioned in the study by Aldalmi and Ali (2021), which include:

- Flexibility and curriculum updates by teacher.
- Application and problem-solving in the classroom help the teacher better understand the difficulties faced by the learners.
- The ability for learners to progress according to their individual abilities, taking into account differences among students.
- Promote more effective use of advanced technologies in education.
- Enhances self-directed learning.
- Mitigate issues related to the teacher shortages or their absence.
- Encourage positive interactions between the learners and the teacher, as well as among the learners themselves.

Similarly, Al-Saadoun (2022) emphasizes that the flipped learning strategy affords various benefits for students, including enabling them to select the appropriate websites or sources to obtain the required content and allowing them to learn at their own pace. Additionally, it prepares students for exams, thereby positively impacting their academic achievement and performance. Additionally, flipped learning enhances students' problem-solving abilities and develops higher-order thinking skills, allowing them to gain a more profound understanding of learning content and focus on their learning styles.

Steps of Flipped Learning

Flipped learning has different steps than traditional learning, and these are the main ones mentioned in Al-Qahtani (2021) ,Tabieh & Hamzeh (2022) :

1. Planning and selecting appropriate content, defining objectives and targeted skills, choosing suitable tools and technological media, and determining tasks and activities both inside and outside the classroom.
2. Teachers prepare educational materials in electronic formats (texts, images, videos, etc.) and send them to the students through technological means. They also assign students the activities and tasks they must complete before class.
3. Students study the educational material, take notes and inquiries, and complete the required activities and tasks.
4. Students come to the class with a preliminary understanding and knowledge of the educational material, discussing their questions with the teacher and applying what they learned with their classmates.

In flipped learning, the roles of both the teacher and the learner are significantly shifted. The teacher acts as a designer, observer, and evaluator, building learner-centered methods and approaches, guiding the learner to be active, inquisitive, and reliant on self-directed inquiry-based learning. The teacher must also embody sufficient flexibility in dealing with learners, dividing them into groups, and creating an appropriate learning environment for them (Tabieh & Hamzeh, 2022). Additionally, the teacher needs to monitor the learners and encourage them to refer to educational resources, review content, and engage seriously in activities and tasks. On the other hand, the learner is a discussant who asks questions and connects their experience with what they have observed from references and sources (Al-Nawaiseh, 2025). They are also a collaborative learner who seeks to solve problems independently and reach solutions. Furthermore, they discover relationships between elements of the subject, research, and investigate, and employ their critical thinking

skills to hypothesize possible solutions. Additionally, they interact with their classmates and teacher, either directly or remotely (Al-Zahrani, 2020).

Flipped learning is a type of learning that relies on appropriate technology used to transform lessons and educational materials into content that can be recorded or available online, allowing students to access it outside of class time and utilize the time within the classroom with the teacher for practical activities, problem-solving (Abdelbaki, 2021).

Despite the numerous advantages and benefits, flipped learning faces some challenges and difficulties in its implementation, as mentioned by Al-Sharman (2015):

- The teacher need for a significant amount of time and effort to design an effective educational model and appropriate content.
- The necessity of adequately preparing students in advance and equipping them for flipped learning activities, and designing tasks that cater to their individual differences.
- The need to motivate students and encourage them to engage in activities based on electronic learning independently of the teacher.
- This strategy may not be appropriate for all types of courses or educational content.

Academic Achievement in Mathematics

A student's academic achievement serves as a critical indicator of their educational progression, significantly influencing subsequent academic pathways and ultimately shaping professional trajectories.(Al-Nawaiseh et al., 2024). Therefore, it is essential to study the factors influencing academic achievement and to understand the methods and strategies that contribute to and improve the students' performance. Many researchers focus on academic achievement in mathematics because it is a crucial indicator of the quality of the educational process. Additionally, mathematics is a scientific subject linked to many other subjects, such as physics, chemistry, and engineering, and directly impacts progress in these fields (Al-Ghamdi, 2018).

Mathematics is a subject that requires various teaching strategies to appropriate its abstract nature, and integrating media significantly contributes to embodying abstract mathematical concepts through drawings, simulation models, and animations (Ahmad et al., 2023) Therefore, employing flipped learning in mathematics can help mitigate the challenges of teaching this subject, enhance students' achievement in it, and add an element of enjoyment to learning it. Additionally, it is learner-centered learning, allowing students to learn at their own pace and according to their abilities (Al-Sayed & Hussein, 2023).

2.1 Previous Studies

Amawi and Al-Assaf's research (2021) sought to identify the effectiveness of using the flipped learning strategy with the activation of the tablet pen device in the achievement and motivation towards learning mathematics among tenth-grade students in Wadi Al-Seer District. The research used the semi-experimental approach on a sample of 93 students, which was divided into an experimental group (48 students) and a control group (45 students). The experimental group studied the flipped learning strategy using the tablet pen, while the control group learned traditionally. The results showed superiority in favor of the experimental group in both achievement and motivation towards mathematics.

Al-Shammari& Al-Masaad (2019) aimed to measure the impact of the flipped classroom strategy on academic achievement and motivation towards learning informatics among eleventh-grade students in Kuwait. The sample included 62 students from a secondary school in the Ahmadi Educational Zone, distributed into two groups. The results showed the superiority of the group that learned according to the flipped grade in terms of achievement and motivation. The study recommends employing this strategy to support student learning.

Tabieh and Hamzeh (2022) conducted a study to compare the impact of flipped and blended learning methods with traditional education on the development of mathematical creative thinking skills (fluency, flexibility, originality) among tenth-grade students. The sample consisted of 540 students from private schools, distributed into a control group and two experimental groups. The results showed that the two experimental groups, especially the flipped learning group, excelled in the mathematical creative thinking test. The study recommends employing modern educational methods and virtual activities to develop students' creative skills in mathematics.

3. Research Problem

One of the researchers observed a decline in the achievement level of sixth-grade female students in mathematics compared to other subjects while serving as an academic supervisor at the primary stage at Dammam district. This decline was apparent from analyzing the students' exam results and monitoring their attendance in class.(Al-Nawaiseh, 2025). The reasons may be attributed to a lack of motivation to learn due to the complexity of mathematics and its abstract concepts, which may be challenging for students to visualize easily. Contemporary and efficient pedagogical approaches are essential for accurately conveying abstract concepts and thereby facilitating comprehension and learning (Tabieh & Hamzeh, 2022. Consequently, it was noted that the teachers possessed insufficient knowledge of effective pedagogical techniques; there arose a need to explore diverse teaching methods to simplify the material and decode its concepts, blending challenge and enjoyment into the educational process.(Al- Nawaiseh et al., 2024). This study will investigate the impact of using the flipped learning strategy on the achievement of sixth-grade female students in this context.

The problem is defined by answering the following central research question: What is the effect of using the flipped learning strategy on the achievement of sixth-grade female students in mathematics?

4. RESEARCH METHODOLOGY

The researchers implemented a quasi-experimental design with a sample consisting of 47 sixth-grade female students who were purposively selected and assigned to two groups: an experimental group (n = 23) and a control group (n = 24). Both groups participated in pre- and post-measurements to evaluate the intervention effects. The experimental group received instruction through the flipped learning approach, while the control group was taught using traditional instructional methods.

4.1 Participants

This study involved 47 female sixth-grade students from Al-Hussan Model Schools in the Dammam district, divided into a control group and an experimental group.

4.2 Statistical Analysis

Several statistical procedures were employed to evaluate the impact of using the flipped learning strategy on the achievement of sixth-grade primary students in mathematics. First, a pretest analysis using t-tests was conducted to establish baseline equivalence between the experimental and control groups. Descriptive statistics, including means and standard deviations, were calculated for the sixth-grade female students' mathematics achievement scores on both pretest and posttest measures. Finally, a one-way analysis of covariance (ANCOVA) was performed on the posttest data, with pretest scores serving as the covariate to control for initial differences between groups and to increase statistical power. All analyses were conducted using SPSS with a significance level set at $\alpha = .05$.

4.3 Research Tools

A criterion-referenced achievement test was designed to evaluate the learning outcomes related to the unit (regular fractions and decimal fractions), aiming to measure the students' understanding of the concepts and skills associated with the specified unit. This test, which consists of 20 items, was reviewed by several mathematics teachers, confirming its validity as a measure of the required skills. Furthermore, the Cronbach's alpha coefficient for the test was calculated to ensure its reliability, with an overall reliability rate of 0.84, which is acceptable for scientific research purposes.

To calculate the coefficients of difficulty and discrimination for the test items, responses from 21 students outside the study sample were collected and analyzed using the SPSS program, as shown in Table 1.

Table 1: Demographic Discrimination and Difficulty indices of the Math Concept Test

Discrimination Index	Difficulty Index	Item number	Discrimination Index	Difficulty Index	Item number
0.53	0.30	**1**	0.65	0.37	**11**
0.66	0.33	**2**	0.58	0.29	**12**
0.56	0.45	**3**	0.46	0.29	**13**
0.57	0.44	**4**	0.78	0.44	**14**
0.72	0.46	**5**	0.40	0.51	**15**

0.33	0.31	**6**	0.31	0.34	**16**
0.69	0.33	**7**	0.65	0.34	**17**
0.46	0.45	**8**	0.56	0.56	**18**
0.49	0.44	**9**	0.45	0.51	**19**
0.48	0.46	**10**	0.84	0.45	**20**

As indicated in Table 1, the difficulty coefficients of the questions ranged between 0.30 and 0.56, and the discrimination coefficients ranged between 0.31 and 0.84. These values are considered acceptable for scientific research purposes

4.5 Research Procedures After the study problem emerged, both the independent and dependent variables were identified. The independent variable is the teaching method, with two levels: the flipped learning strategy and the traditional strategy. The dependent variable is student achievement in the mathematics unit about ordinary and decimal fractions.

1. We designed a measurement tool, an achievement test with 20 items, and applied it as a pretest for both groups.
2. The unit (ordinary fractions and decimal fractions) was taught to the control group students using the tradithional method, while the experimental group was taught using the flipped learning strategy through the students' tablets. The teaching process lasted for three weeks, as outlined in the time allocation for the mathematics subject in the second semester of the 2023-2024 academic year. We provided the students in the experimental group with video clips, presentations, and worksheets that explained the skills related to ordinary and decimal fractions. They reviewed the lesson content before class, solved the attached questions for assessment, and formulated questions based on the content for classroom discussion. On the other hand, the control group was taught using the traditional method during class sessions, and the students were assigned homework to be submitted in the next class shown in figure 1.
3. We administered the achievement test as a posttest for both groups once we had completed teaching the assigned unit.
4. The students' results were analyzed, compared, and used to draw conclusions and formulate appropriate recommendations.

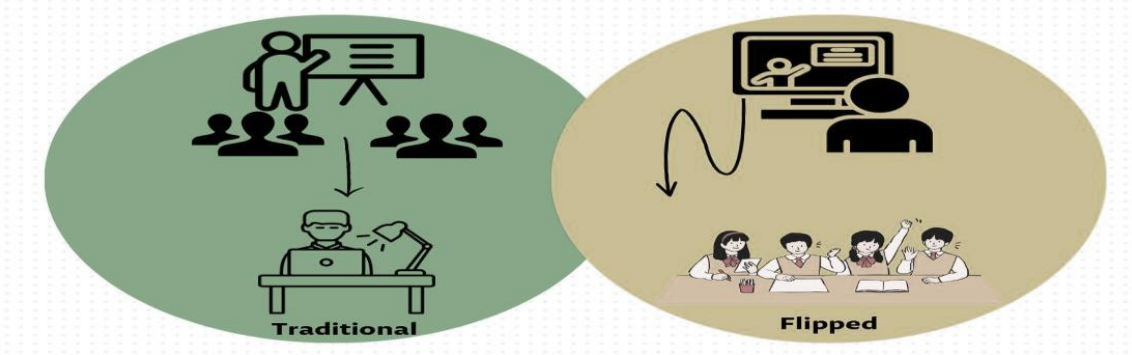

Figure 1: Traditional Method vs. Flipped Learning Method

5. RESULTS

5.1 Equivalence of Groups

To verify the equivalence of the groups, the means and standard deviations of the study sample's pretest scores in mathematics were calculated according to the group variable (experimental and control). To determine whether there were statistically significant differences between the means, an independent samples t-test was conducted. Table 2 presents the results.

Table (2): The means, standards deviations, and T-test according to the group variable on the total score of the study sample's pretest in the mathematics achievement test

Group	Number	Arithmetic Mean	Standard Deviation	(T) Value	Degrees of Freedom	Statistical Significance

The achievement test of mathematics	Experimental	23	11.19	3.38	1.37	45	0.363
	Control	24	12.50	2.66			

It is evident from Table 2 that there were no statistically significant differences ($\alpha \leq 0.05$) attributed to the group in the pretest for the subject of mathematics, based on the t-value of 1.37 and a statistical significance of 0.363. This result indicates that the groups were equivalent before the intervention.

5.2 Research Question

The main research question of this study is:

What is the effect of using the flipped learning strategy on the achievement of sixth-grade female students in mathematics?

This question is addressed through the following null hypothesis:

There is no statistically significant difference at the 0.05 level of significance between the mean scores of sixth-grade female students on the mathematics achievement test that can be attributed to the teaching method (control vs. experimental).

To test this hypothesis, the means and standard deviations of students' scores on the mathematics achievement test were calculated for both the pretest and posttest, based on the teaching method used (flipped learning strategy versus the traditional method). The differences between the two groups were analyzed, as illustrated in Table 3.

Table (3): The means and standard deviations of the sixth-grade female students' scores on the mathematics achievement test for the pretest and the posttest

Teaching Method	Number	Pretest		Posttest	
		Arithmetic Mean	Standard Deviation	Arithmetic Mean	Standard Deviation
Flipped Learning Strategy	23	11.19	3.38	15.61	1.96
Traditional	24	12.50	2.66	16.47	1.99

It is evident from Table 3 that there are apparent differences between the arithmetic means of the students' scores on the mathematics concepts test in the pretest and posttest according to the teaching strategy (flipped learning strategy), compared to the traditional method.

To determine whether these apparent differences are statistically significant, a one-way ANCOVA was used for the posttest of the overall mathematics achievement test according to the flipped learning strategy, compared to the traditional method, after controlling for the effect of their pretest scores. Table (4) illustrates this.

Table (4): One-Way ANCOVA Results for Posttest Scores on the Mathematics Achievement Test by Teaching Strategy (Controlling for Pretest Scores)

Source of Variance	Sum of Squares	Degree of freedom	Mean Sum of Squares	(F) Value	Level of Significance	Eta Square η^2
Pre-test	107.65	1	107.65	88.64	0.00	
Teaching Method	0.469	1	0.469	0.385	*0.00	0.010
Error	46.24	45	1.217			
Total	162.78	47				

*Statistically significant at the level ($\alpha \leq 0.05$)

It is evident from Table 4 that there are statistically significant differences at the significance level ($\alpha \leq 0.05$) in the sixth-grade scores on the mathematics achievement test according to the teaching strategy (flipped learning versus the traditional method). The value of (F) was (0.385) with a statistical significance of (0.00), which is statistically significant, indicating an effect of the teaching method used. To determine to whom the differences are attributed, the adjusted means and their standard errors were calculated according to the group, as shown in Table 5.

Table (5): Adjusted Means and Standard Errors for Total Mathematics Achievement Scores of Sixth-Grade Female Students by Group (Experimental vs. Control)

Teaching Method	Adjusted Posttest Mean	Standard Error
Flipped Learning Strategy	15.96	0.24
Traditional	16.18	0.25

The results in Table 5) indicate that the differences favored the control group, who were exposed to the traditional teaching method, compared to the members of the experimental group (flipped learning strategy). As shown in Table 4), the teaching method's effect size was small; the value of Eta squared ($\eta 2$) accounted for 1%) of the explained variance (predicted) in the dependent variable, the mathematics achievement test.
Therefore, we reject the null hypothesis of the study, which stated that "there is no statistically significant difference at the significance level ($\alpha = 0.05$) between the mean scores of sixth-grade female students on the mathematics achievement test, attributed to the teaching method (control, experimental)," and we accept the alternative hypothesis of the study, which states that "there is a statistically significant difference at the significance level ($\alpha = 0.05$) between the mean scores of sixth-grade female students on the mathematics achievement test, attributed to the teaching method (control, experimental)."

6. DISCUSSION

What is the effect of using the flipped learning strategy on the achievement of sixth-grade female students in mathematics? From this, the null hypothesis emerged, which states that "there is no statistically significant difference at the significance level ($\alpha = 0.05$) between the mean scores of sixth-grade female students on the mathematics achievement test, attributed to the teaching method (control, experimental)."
The results indicated that the use of the flipped learning strategy had no significant effect on the test scores for mathematics achievement among sixth-grade female students. This finding may be attributed to challenges faced by teachers in effectively implementing the strategy. Successful application of flipped learning requires thorough preparation, prior planning, and proficient use of technology in the classroom. A lack of training or access to necessary tools and resources may have hindered its effectiveness, thereby negatively affecting student performance. This conclusion is supported by the study of Al- Al-Nawaiseh et al. (2024) , which highlighted deficiencies in teacher experience, availability of resources, and access to required devices.
Transitioning from traditional teaching methods to modern approaches, such as the flipped learning strategy, may require support and self-management skills to effectively organize lesson time. Some students may lack these skills, causing them to feel frustrated and fail, which in turn reduces their academic achievement. A study (Feng & Yao, 2023) has proven that the absence of self-management and organizational skills among students may lead to poor academic performance due to their inability to manage their time properly.

Moreover, the nature of the subject matter—mathematics—may also influence the results. Al- Nawaiseh et al. (2024) emphasized that mathematics, particularly in the primary stages, requires direct guidance from the teacher to ensure understanding of the rules and concepts and correct application of problems, as it is difficult for students to rely on self-learning within the framework of flipped learning, as mathematics requires direct explanation and clarification of concepts to ensure that students grasp and understand it correctly.
Furthermore, the development of technological methods and the emergence of e-learning in all its forms, particularly after the COVID-19 pandemic, have paved the way for all students to acquire digital skills. Whether they have experienced the flipped learning strategy, they can deal with new digital data and possess the necessary skills to complete their assignments and lessons. (Abdullah & Alshaye, 2024) Therefore, there

may not be a clear impact of the flipped learning strategy on the experimental group, as the students in the control group also have digital skills to handle their various subjects, including mathematics.

Therefore, the current results indicate the importance of re-evaluating the conditions for implementing the flipped learning strategy and exploring more effective methods to activate it. It may be beneficial to integrate the flipped learning strategy with other strategies or to reduce students' reliance on self-learning at home and enhance it with more interactive activities within the classroom.

7. Recommendations

Invite mathematics teachers to benefit from the current research results in reconsidering and developing their teaching of mathematics using new methods to appropriately implement the flipped learning strategy. Conduct training courses for teachers on the optimal application of the flipped learning strategy effectively in the educational process, and provide the necessary materials, devices, and software in schools to optimally implement the flipped learning strategy. Additionally, new studies can be conducted with different designs and measurement tools to investigate the impact of using and employing modern electronic strategies in various subjects and at different stages.

Ethical Approval

This study was conducted in accordance with ethical guidelines, and approval was obtained from the relevant institutional review board prior to data collection.

Consent to Participate

Informed consent was obtained from all participants, ensuring their voluntary involvement in the study and their understanding of the purpose, procedures, and confidentiality measures.

Consent for Publication

All participants consented to the publication of anonymized data and findings derived from this study for academic and research purposes.

Declaration of Conflicting Interests

The authors declare no potential conflicts of interest with respect to the research, authorship, and publication of this study.

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