

*Paper*—The Effect of Using Flipped Classroom Strategy on the Academic Achievement of Fourth Gra...

## The Effect of Using Flipped Classroom Strategy on the Academic Achievement of Fourth Grade Students in Jordan

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**Abstract**—This study aimed at investigating the effect of flipped classroom strategy on the academic achievement in the subject of science among fourth grade students in Jordan. The study population consists of all fourth grade students in the Directorate of Private Education in Amman area, totaling 2134 students during the second semester of the academic year 2015-2016. The study sample consists of 44 male and female students who were chosen purposely from the study population. The study sample was distributed into two groups: the experimental group that consisted of 22 students, who has studied according to flipped classroom strategy, and the control group that consisted of 22 students, who has studied in the ordinary method. To achieve the objectives of the study, an achievement test was prepared and its validity and reliability were checked. ANCOVA, Means, and Standard Deviations were used to analyze the collected research data. The study deduced the following results: 1) There are statistically significant differences in the Means on the educational achievement test attributed to the teaching strategy, in favor of the members of the experimental group, and 2) there are no statistically significant differences in the Means on the academic achievement test attributed to gender. In light of the findings, the study recommended encouraging science teachers to teach students using teaching strategies emanated from the use of modern technologies, particularly the flipped classroom strategy. In addition, the study suggested that colleges of education should train prospective teachers on the use of teaching strategies stemming from modern educational theories and strategies such as the flipped classroom strategy during the period of preparing them to teach. Furthermore, the study recommended re-applying this experience and identifying its effectiveness at other schools stages and other subjects in other content areas.

**Keywords**—Flipped Classroom Strategy, Academic Achievement, Science Subject, Jordan.

## **1 Introduction and Background**

In recent years, the international educational system has witnessed rapid and sequential changes. Effects of such changes are reflected on to what extent the developed and developing countries are interested in reforming and using new strategies in learning and teaching processes. Consequently, many countries attempted to make structural modifications on teaching methods in order to face the acceleration resulted from the huge changes in knowledge and informational fields. Such challenges require doing a comprehensive review of the educational system in most countries in the world. This leads to find out new approaches to develop and update teaching processes. These approaches focus on the role of learner and make him/her the center of learning process. They assert that each student can learn and reach the proficiency level, if teaching and learning environments and teaching methods are suitable to his/her abilities and needs. One of such modern methods and strategies is the flipped classroom model. Tully [21] pointed out that flipped classroom is one of the teaching and learning patterns and strategies that facilitates student-teacher interaction by using technology tools. Flipped classroom method has the potential to create fundamental changes in the educational context and institutions.

According to Bergmann and Sams [9] the concept of flipped classroom means what is done at home as a traditional learning is done during the classroom period, and what is done during the classroom period as a traditional learning, is done at home. Furthermore, the information of content is presented to the student outside the classroom period through technology tools such as video, which created by teacher to explain a certain lesson or information related to the lesson. Alzwekh [7] mentioned that flipped classroom is a form of modern teaching methods that uses the advanced techniques smartly and funnily in order to meet the needs of students at the present time. In addition, the idea of flipped classroom is based upon flipping learning assignments between classroom and home by increasing the role of effectiveness of modern technological tools in teaching and learning processes. DeLozier and Rhodes [11] defined the flipped classroom as the teaching practice of teachers occurs by assigning lectures outside of class and devoting class time to a variety of learning activities. In this practice, students are responsible for reviewing all prepared materials. In this model teachers prepare lessons through videos or any multimedia that the students can view at homes or in any other places by using their tablets or smart phones before attending the class, while the time of lecture is advocated for exercises, activities, practices and helping solve home assignments.

The previous definitions point out that the concept of flipped classroom means flipping the processes of teaching and learning in the classroom and home by activating the role of modern technological tools in preparing and presenting lessons. That is, the teacher prepares the material in which he/she explains the new information by using modern audio and visual multimedia, and reactive evaluation in order to be available for the student before starting the lesson. The role of teacher in this strategy is a mediator and a motivator of students to learn through the prepared materials before class time.

### **1.1 Implementing flipped classroom strategy**

Shorman [17] indicated that the flipped classroom method focused on flipping or inverting the teaching and learning processes. That is, in a traditional teaching environment learning of new knowledge occurs in classroom. Then, the student returns to his or her home and completes home assignments. However, implementing flipped classroom method enables students to learn new information ahead of time at home through several technology tools and educational websites prepared and shared by teachers. For example, teachers prepare and share a video ranging from 5- 10 minutes. In addition, he or she can use other technological tools to promote flipped classroom such as multimedia, social media websites, educational games, YouTube for Educational purposes, TED Talk, Khan Academy, iTunes University or other educational websites.

Asiksoy and Ozdamli [8] demonstrated that flipped classroom approach is a type of student-centered approach. That is, students could actively learn information of new lessons at any time at home by using smart phones or computer devices such as iPads. Those technology tools enable students to play back educational videos several times in order to understand the new information. In addition, it is possible to accelerate the educational videos to skip the parts that they are mastered in. In addition, it is possible to take notes. By implementing flipped classroom strategy, the individual differences of students can be considered, performance can be improved, boredom will disappear, and excitement and learning enjoyment will increase.

After reviewing learning materials, students attend the physical environment of classroom readily to apply what they have learned before at home. The teacher starts with evaluating levels of students' understanding and revising what has been learned at home; then he/she presents the activities, and group problem-based projects to be performed in the classroom instead of prioritizing classroom time in passive listening to the teacher's explanation. Home assignments do not exist in the flipped classroom as students administer activities that are home assignments in the classroom.

Alzain [5] showed that blending such technologies in its nature does not achieve strategy of flipped classroom. Therefore, it is necessary to know the fundamentals or criteria on which the effective flipped classroom is built. Such criteria include: 1) Culture of learning is centered on the student who becomes the center of teaching and learning processes. 2) The teacher identifies the content that students will learn outside of the classroom in order to invest the time in classroom in applying what is prepared by students. 3) The role of teacher in the flipped classroom is greater than his/her role in the traditional learning. In classroom, the teacher provides immediate feedback for students, facilitates further activities and evaluates their works.

### **1.2 Positives of flipped classroom**

According to Strohmeyer [18] applying flipped classroom strategy achieves many benefits. These benefits include that flipped classroom: 1) guarantees for teacher making good use of classroom period; so, he/she makes use of time in guiding and helping, 2) enhances the critical thinking, self- learning, building experiences, communi-

cation skills, and cooperation among students, 3) provides a technique to evaluate the students' understanding because tests and short tasks that students perform are indicators of weaknesses and strengths in their understanding of content. Alshahry [4] added some other positives of flipped classroom that include: 1) developing the role of teacher as a lecturer to become a guide and supervisor, and developing the role of student to become a researcher participating in the teaching and learning processes, 2) helping students' self-learning according to their abilities and individual differences, 3) providing students with excited educational environment, and enhancing high thinking skills such as critical thinking skills.

Alzain [5] asserted that the flipped classroom is a modern technological solution for treating academic weaknesses of students and developing levels of their skills of thinking. Al-Zain added that the flipped classroom strategy provides teacher with enough time to converse and discuss with students in classroom instead of memorization. Furthermore, through applying the model of flipped classroom the intellectual abilities of learners can grow up. By utilizing this method learners can develop their knowledge in scientific, practical and behavioral sides. Dickenson [12] addressed that the flipped classroom is considered as one of the active practices that enable the learner to link between what is learned and his/her personal life and experiences. In such process, learner will be able to link what he/she learns with his/her intellectual behaviors, until it becomes a part of his/her personality.

### **1.3 Obstacles of flipped learning: installment**

Although flipped classroom model has many advantages, Tully [21] mentioned some issues related to applying flipped classroom strategy. These issues include that this teaching strategy depends on using internet and technological devices at students' homes. Therefore, it is difficult for students who have not such devices to benefit from this strategy. Further, it requires a motivated teacher who has the will to follow-up students' progress. This requires providing additional working hours and effort from teachers. Furthermore, teachers should be professional in integrating modern technological in education. Therefore, implementing this strategy could be difficult for educators who are not qualified in using technology or communication skills.

Some obstacles may face the educational and learning process while applying technology tools in the classroom. These obstacles include: 1) the lack of devices and software used in recording and preparing lessons, 2) the lack of teachers' skills in using the technology tools skillfully to develop teaching methods, motivation and communicating with students, 3) the insistence of teachers to follow the traditional method in their teaching process. However, those teachers can be convinced through presenting successful practices of applying technology in the classroom comparing with the traditional method [16].

Due to the importance of this educational and learning strategy, the Ministry of Education in Jordan takes into account keeping up with educational developments in various fields. It provides adequate training for teachers to use new and modern teaching methods. The training aims at helping and participating in raising the level of information delivery to students and developing their motivation to convey this in-

formation easily. Through the Education Reform for Knowledge Economy Program Project (ERFKE) that the Ministry of Education in Jordan adopts [20], there is a focus on the necessity of using communication and information technology into teaching and learning processes. This focus can enable students to build required skills such as scientific thinking and critical thinking skills that allow them to be long life learners by using various teaching methods such as flipped classroom [20]. Therefore, this research study attempts to shed the light on the effect of using the flipped classroom model on the academic achievement among fourth grade students in science subject in private schools in Jordan.

## **2 Previous Studies**

Reviewing previous literature shows that flipped classroom strategy was studied in different contexts. For example, Alzwekh [7] study aimed at studying the effect of flipped classroom concept in teaching the computer curriculum on self-learning skill in a school in the eastern area in Saudi Arabia. He used the experimental scientific method through conducting an experiment on a sample of 26 female students. They learned through applying flipped classroom to learn skills of new computer courses at home. The results showed growing and increasing skills of self-learning among female students in the experimental group. In addition, they showed that flipped classroom strategy contributed to take into account individual differences, learning according to their abilities, and encouraging bearing responsibility. The study recommended applying flipped classroom strategy in teaching some courses, and training teachers to implement flipped classroom into the teaching and learning processes.

Both Almuaiter and Alqahtani [2] conducted a study that aimed to identify the effectiveness of the flipped classroom strategy in developing information security concepts among the female students of the College of Education at Princess Nora Abdul Rahman University in Saudi Arabia. The sample consisted of (100) female students who study special education. To achieve the goal of the study, the researchers developed a test to determine the level of students in the experimental group before and after applying the flipped classroom strategy. The results showed the effectiveness of the flipped classroom strategy in developing information security concepts among the female students of the College of Education at Princess Nora Abdul Rahman University. The study pointed out many of the recommendations, including: the need to encourage university instructors to use the flipped classroom strategy and holding seminars, courses, and training workshops on applying the flipped classroom strategy.

Almusawi [3] conducted a study aimed to investigate the effect of the flipped classroom strategy in the acquisition of geographical concepts and the development of creative thinking among the fourth-grade students. The researcher followed the experimental scientific method. He chose the sample of this study from schools of Rusafa Directorate in Baghdad. The results indicated that students who learned by the flipped classroom strategy were able to acquire geographical concepts and develop creative thinking skills more than the students learned by the traditional method.

Chipp's [10] study aimed at investigating the impact of using Flipped Classroom in teaching mathematics. The study was conducted at the New Jersey University in the United States on mathematics students, as the study sample consisted of 80 students. Empirical research was used, where a group of students has been taught mathematics course through using flipped classroom strategy, as the students received information at home through videos on the internet, and they were working in small groups at classroom to solve problems. Teaching of second group has used traditional teaching strategy. Although both classrooms have studied the same basic concepts of mathematics at the beginning, but the classroom that used flipped classroom strategy has achieved higher results in tests than the other classroom where students have been taught by using traditional teaching strategy. The study has recommended encouraging instructors to use modern technologies in teaching mathematics subject, given its positive effect on developing mental skills of the students during studying this subject.

Herreid and Schiller [13] have conducted another study in USA, where they used a poll opinion of the members of the national center for studying cases at teaching science to verify the use of flipped learning within teaching by teachers who supervise them. 200 teachers emphasized that they used flipped learning strategy. They mentioned reasons for using flipped learning that include: 1) providing sufficient time for students to work on the devices and equipment available at the classroom, 2) participating in activities and watching the lectures they have missed, 3) flipped learning provides reinforcement to the students' thinking inside and outside classroom time and it also increases their interaction within the educational process.

After reviewing the previous studies, the researchers did not find any national study that investigates the effect of flipped classroom strategy on the scientific achievement in the subject of science among fourth grade students, which necessitated conducting this research study. In addition, the focus of previous studies on the importance of applying flipped classroom strategy on the students' learning empowered the researchers to conduct a study to investigate the importance and the effect of employing new technologies and teaching and learning strategies on students' learning process, and their academic achievement. Therefore, this study attempts to identify the impact of using flipped classroom strategy on scientific achievement among fourth grade students in science subject.

### **3 The study problem and questions**

As researchers, who are interested in the educational field, we have noticed that many new technology tools surround students and teachers. For example, the social networks applications are used regularly as one of the most important communication ways among the daily life of students and teachers. However, the teaching and learning processes are still depend exclusively on traditional methods. According to Murad [15] and Aldohoon [1] teachers use different applications and software for the personal purposes, but using these technologies for educational purposes was very low.

Given previous experience indicated that there is a big gap between modern teaching methods that followed by teachers, and learning methods that their students need based on their abilities and interests. According to Alzedanin [6] the advanced technology leads to create new challenges in face of the school administration to make use of advantages of the new technology in learning settings. She added that by emerging educational technologies, the teaching and learning processes are no longer limited only to transform knowledge from the teacher to the learner, but the teacher needs to search for modern teaching methods and strategies to keep up with the accelerated changes that arise in the educational system, as the student becomes its centre. Al-Zedanin pointed out that new strategies and methods should be based on cooperation, direct and positive interaction between learner and educational technologies through the teacher's guidance and supervision.

In view of what the academic curricula witness of rapid developments during the recent years, the curricula of primary school in Jordan have gained plenty of reform developments. This situation encouraged the researchers to conduct this study to investigate the effect of using the flipped classroom on the academic achievement among fourth grade students studying the science subject in Amman. The reviewers of the educational system in Jordan realize the need of developing teaching process and strategies. The reform in this field will meet students' needs and individual differences. The use of technology tools can play a vital role in the educational reform. Some of these tools become available to the students and teachers. In addition, there is a rarity of Arabic studies, – according to the researchers' best knowledge - that addressed the effect of using strategy of flipped classroom in the teaching process. As a result, this study is conducted as an attempt to detect the effect of using the strategy of flipped classroom on the academic achievement among fourth grade students in science subject in private schools in Amman, Jordan.

The study problem can be identified through answering the following main question: “What is the effect of using the strategy of flipped classroom on academic achievement among fourth grade students in science subject in private schools in Amman”? The following sub-questions are branched from this main question: The first question is: Are there statistically significant differences at the significance level of ( $\alpha = 0.05$ ) between means of achievement scores among fourth-grade students in science subject attributed to teaching method variable? The second question is: Are there statistically significant differences at the significance level of ( $\alpha = 0.05$ ) at academic achievement level between male and female students attributed to gender variable?

#### **4 The study objectives and importance**

This study aimed at identifying the effect of using the flipped classroom strategy on academic achievement among fourth-grade students in the science subject in private schools in Amman, Jordan. Specifically, it identifies the impact of the teaching strategies (traditional and flipped classroom) on the academic achievement among fourth-grade students in science subject in private schools in Amman, Jordan. Fur-

thermore, the study points out the impact of students' gender (male and female) on the academic achievement among fourth-grade students in science subject.

The importance of this study stems from many important points. First, the possibility to benefit from results and recommendations in developing and applying the flipped classroom strategy in the classroom environment at Jordanian public and private schools. Second, this study contributes to guide teachers and educational decision-makers to develop curricula that meet modern directions in field of information and communication technology, and in field of education to employ modern teaching methods such as flipped classroom. In addition, this study will contribute to the Arabic educational literature related to flipped classroom topics, as the reviewed previous literature suffered from the shortage of researches in this field.

## **5 The study terms and procedural definitions**

**Flipped classroom:** According to DeLozier and Rhodes [11] flipped classroom is a modern strategy in which the teacher provides the content of subject for students in several forms such as recorded lectures, videos, and electronic readings, so that students can review such materials and understand information before attending the classroom. In classroom, the teacher starts providing opportunities to discuss, review, and analyze such information. Then, students start working in groups or individually to complete several activities or projects inside the classroom. These procedures lead to acquiring knowledge and move from the memorization and understanding stages to the analyzing, applying, and producing stages by supervision and guidance of teacher.

The researchers defined it procedurally as designing an interactive teaching method that depends on integrating technology tools in the selected academic subject. This teaching method was implemented in the delivery of a selected unit in science subject for fourth grade students. The researchers chose a specific unit entitled seed plants unit from science subject textbook from the fourth grade. They developed the educational content resources related to the selected unit in advance by using various technology tools, applications, and techniques such as: preparing videos, brochures, handouts and educational learning materials before the time of implementing the unit. The teacher who taught the selected class was trained how to deliver the designed materials. Then, the teacher engaged in providing an interactive, collaborative, and active environment to build on what the learners have been guided to in advance and applied what have been learned inside the classroom.

**Academic achievement:** According to Khatib and Tarawneh [14], it is mastering a set of skills and knowledge that can be owned by the student after presenting educational experiences in a specific subject or a group of subjects. Khatib and Tarawneh added that the academic achievement represents measuring the ability of student to understand the subject matters and his/her ability to apply them through measurement methods used by school such as oral and written exams conducted in different times in addition to the daily and seasonal exams.

The researchers defined it procedurally as being a total of achievement scores of student that were gained after using a group of teaching methods (flipped classroom



method and traditional methods), it is measured by scores that the student gets in the achievement test which was prepared by researchers.

## **6 Study Limitations**

This study is limited to fourth-grade students, who studied a unit that is entitled seed plants from fourth grade science textbook, part II issued in 2015 from the publications of the Ministry of Education in Jordan. The study was conducted in one of private schools in Shafa Badran area in Amman, Jordan. In addition, this study conducted in the second term/ academic year of 2015-2016. Moreover, the study results determined based on the responses of the study participants to study instrument and the scores of investigated validity and reliability of this instrument.

## **7 Study Methodology**

To answer the research question, a pretest/posttest Quasi-Experimental Design were used in order to analyze data and interpret results that the study revealed.

### **7.1 Study Population and Sample**

The study population consisted of all students (2134) in fourth-grade in the private schools in Amman, Jordan, in the second term of the academic year of 2015-2016. The researchers chose a purposive sample consisting of 44 female and male students of the fourth-grade (22 experimental, 22 control). To achieve the principle of equalization in the two groups, the study participants were randomly assigned into two groups based on their academic achievement in the academic year of 2014-2015. The experimental group, that was taught according to flipped classroom strategy, included 22 students (11 male, 11 female), and the control group included 22 students (12 male, 10 female) who was taught according to traditional teaching method.

### **7.2 Study Instruments and Implementation Procedures**

To respond to the study questions and main aims, the researchers selected the unit entitled seed plants, in the science book part II for fourth-grade. Then, the unit was analyzed and various learning objectives were identified. After that, the researchers developed the content of the unit by designing flipped classroom model that consisted of a variety of activities, handouts, brochures, PowerPoint presentations, and selected educational videos. The developed content of the unit was reviewed by science subject supervisors from the Ministry of Education in Jordan and senior science teachers. The content was checked to make sure that the designed flipped classroom strategy is developmentally appropriate to the fourth grade students. The adequate amendments were made based on the experts' feedback. The researchers trained the teacher who will present this strategy for the experimental group before the beginning of the se-

mester. The developed unit was implemented during the second semester of the academic year 2015-2016. In addition to the developed unit, the researchers developed an achievement test to measure the academic achievement level among fourth-grade students according to the identified learning objectives. The test included 20 questions consisted of multiple choices and open-ended questions. The pre-test was implemented at the beginning of the second semester of the academic year of 2015-2016 to both the experimental group and the control group. After that, the developed unit based on flipped classroom strategy was presented by the trained teacher to the experimental group. The teacher presented each lesson of the unit based on the training that she took before the beginning of the semester. The teacher met with the students 3 times a week. Each lesson lasted for 45 minutes. Some designed materials were distributed to the students ahead of time based on the coming lesson. The students were informed to review the materials and activities at home. When they meet with the teacher, the lesson began with the reflection from the students of the materials observed. Then, the teacher presented related activities to deepen the students' knowledge of the topic. The control group was taught by the traditional teaching method. Teaching through the traditional method focused on presenting the lessons of the unit by utilizing the textbook as the main and only resource. The teacher presented each lesson in the classroom and asked the students to complete the assignments of the lesson at home. After three weeks of the implementation of the unit, both of the groups responded to the post-test.

### **7.3 Achievement test validity**

To check the validity of the research instrument, the researchers presented the achievement test to a panel of 13 experts experiencing and specializing in measurement and evaluation, science curricula and teaching methods, supervisors of science subject, and some teachers who teach science subject for fourth-grade students in schools in Amman. The notes and comments of the experts were considered and the test was modified based on them. Thus, the achievement test consisted of 20 items.

### **7.4 Applying the achievement test to exploratory sample**

After completing preparation of the achievement test in its final form, the test was applied to an exploratory sample consisting of 20 fourth-grade students outside the study sample. The coefficients of discrimination (DisCo) and coefficients of difficulty (DifCo) for all items of the achievement test were calculated. Table (1) shows this.

It is shown from the above table that coefficients of difficulty for achievement test items range between (0.31-0.90), while coefficients of discrimination for achievement test items range between (0.20-0.80).

**Table 1.** Coefficients of difficulty and coefficients of discrimination of achievement test questions (exploratory sample)

Item no.	DifCo	DisCo	Item no.	DifCo	DisCo
1	0.31	0.42	11	0.90	0.40
2	0.64	0.30	12	0.53	0.20
3	0.63	0.45	13	0.65	0.30
4	0.74	0.59	14	0.34	0.70
5	0.38	0.60	15	0.63	0.40
6	0.44	0.50	16	0.44	0.50
7	0.81	0.45	17	0.70	0.60
8	0.68	0.25	18	0.54	0.40
9	0.71	0.80	19	0.70	0.60
10	0.60	0.20	20	0.69	0.40

### 7.5 Instrument Reliability

After applying the achievement test to the exploratory sample consisting of 20 students, the Internal Consistency Reliability was calculated by Cronbach's Alpha Coefficient which was (0.79), and this value is accepted for the purposes of this study.

### 7.6 Equalization of study groups

To check the equalization of the study groups (control, experimental), a t-test was applied to students' scores in the two groups in the achievement pretest. The result is shown in Table (2).

**Table 2.** Results of t-test on scores of achievement pretest of experimental and control groups

Instrument	Group	Num.	Mean	S.D.	df	F	Sig.
Achievement test	Experimental	22	4.63	2.12	42	0.140	0.890
	Control	22	4.72	2.18			

\*\* Statistically significant at the level of significance ( $\alpha=0.05$ )

Table (2) indicates that the value of F was (.14), which is not statistically significant at the level of significance ( $\alpha = 0.05$ ). The result reveals that there is no statistically significance between average scores of students of experimental and control groups in the achievement pretest. That is, the experimental and control groups are equivalent.

### 7.7 Study variables

The independent variables in this study are: 1) teaching strategies (flipped classroom, traditional), and 2) gender (female, male). The dependent variable of the study is the academic achievement (means of study sample scores on items of academic achievement test).

### 7.8 Statistical Treatments

The researchers used the following statistical analyses: 1) Means and standard deviations to calculate academic achievement according to the group variable and gender variable, 2) ANCOVA to check the effect of group on academic achievement, 3) T- test to check the equalization of the study groups, and to calculate the significance of difference in academic achievement according to gender variable.

## 8 Study Results and discussion

**The first question is:** Are there statistically significant differences at the significance level of ( $\alpha = 0.05$ ) between means of academic achievement scores among fourth-grade students in science subject attributed to teaching method variable? To answer this question, means, standard deviations, and modified means of academic achievement scores are calculated according to the group variable (experimental, control) as shown in table (3).

**Table 3.** Means, standard deviations, and modified means of academic achievement scores according to the group variable

Group	Pretest		Posttest		Modified mean	No.
	Mean	S.D.	Mean	S.D.		
Control	4.72	2.18	16.27	2.47	15.88	22
Experimental	4.63	2.12	19.09	1.01	19.03	22
Total	4.68	2.13	17.68	2.35	17.31	44

Table (3) demonstrates that the mean of pretest for the control group students is (4.72) and standard deviation is (2.18). In addition, the mean of pretest for the experimental group students is (4.63), and standard deviation is (2.12). Further, the mean of posttest in the control group students is (16.27) and standard deviation is (2.47). Furthermore, the mean of posttest for the experimental group students is (19.09), and standard deviation is (1.01).

Table (3) also reveals that there are clear differences in means and modified means of academic achievement scores attributed to the group variable (experimental, control). The modified mean for the control group is (15.88), while the modified mean for the experimental group is (19.03). To show the statistically significant difference between means, ANOVA test was used as shown in table (4).

**Table 4.** Results of ANCOVA test for the effect of group variable on academic achievement

Source	Sum of squares	df	Mean squares	F	Sig
Pretest (accompanied)	62.126	1	8.875	4.344	0.00
Group	33.800	1	33.800	16.545	0.00**
Error	57.200	51	2.043		
Total		53			

\*\* Statistically significant at the level of significance ( $\alpha=0.05$ )

Table (4) shows that the value of F is (16.545), which means that there are statistically significant differences at the significance level of ( $\alpha=0.05$ ) between means of academic achievement scores among fourth-grade students in science subject attributed to teaching method variable. Table (4) demonstrates that statistically significant differences attribute toward experimental group. This result indicates that teaching by using flipped classroom strategy increases the motivation to learn as being internal source of excitement, on contrary to the traditional method in which excitement is depending on teacher's notes, comments, questions, answers and forms of enhancement that student receives, thus the source of excitement is external. By using flipped classroom strategy, enhancement is raised from the practical activity itself, from the excitement that the learner feels during presenting information and the practical application he does. Such activities present the content attractively leading to develop the scientific thinking in students through observation, understanding, classifying, analyzing and assessment. The activities are close to the level of students and take into account the individual differences. Thus, such differences appeared for the experimental group on academic achievement test.

This study result agreed with Strohmyer [18] insights that students who experienced flipped classroom method pointed out positive perceptions of increased engagement and interactions, as well as more in-depth learning in flipped environments. This method supports how students learn, provides more opportunities to interact with their peers and the teacher in a productive and active learning by utilizing critical thinking skills. The study of Chipp [10] indicated that the classroom in which strategy of flipped learning are used, achieve higher results in tests than the classroom in which strategy of traditional method is used.

**The second research question is:** Are there statistically significant differences at the significance level of ( $\alpha=0.05$ ) at academic achievement level between male and female students attributed to gender variable? To answer this question, means and standard deviations of the academic achievement test scores were calculated according to gender variable. Table 5 shows the results.

**Table 5.** Means and standard deviations of academic achievement test scores according to gender variable

Gender	No.	Academic achievement test scores	
		Mean	S.D.
Males	23	17.56	2.44
Females	21	17.80	2.29

Table (5) shows mean of males' scores in academic achievement is (17.56), and standard deviation is (2.44). In addition, mean of females' scores in academic achievement is (17.80), and standard deviation is (2.29). That is, there is a clear difference in means of academic achievement scores between males and females. However, to check is there a statistically significant difference at the significance level of ( $\alpha = 0.05$ ) at academic achievement level between male and female students attributed to gender variable, t-test was used to identify the significant difference between the means. Table 6 shows this.

**Table 6.** Results of t-test at academic achievement level between male and female students attributed to gender variable

Group	No.	Mean	df	F	Sig.
Males	23	17.56	42	- 0.341	0.73
Females	21	17.80			

\*\* Statistically significant at the level of significance ( $\alpha=0.05$ )

Table (6) shows that the value of F is (-0.341), which means that there are not statistically significant differences at the significance level of ( $\alpha=0.05$ ) at academic achievement level between male and female students attributed to gender variable. This result can be interpreted that students whether males or females are similar in using modern technological methods because of the availability of modern technological devices as a result of the huge scientific and technological development and the easiness to access such modern technologies. Such technologies become at the hand of such students as they are at the primary stages. Such stages are considered the stages of learning, researching and exploring. Female and male students have positive attitudes towards this strategy which help them to learn by involving learners in the process of learning in an effective way that respects their individual abilities.

## 9 Conclusion and further recommendations

This study aimed at investigating the effect of flipped classroom strategy on the academic achievement in the subject of science among fourth grade students. The results showed that students who were taught by using the strategy of flipped classroom as a teaching strategy got higher scores in the academic achievement test than students who were taught by using the traditional strategy as a teaching strategy. In addition, there were no statistically significant differences between male and female students in the academic achievement test. The study findings encourage teachers of science to teach students by using modern teaching strategies, in particular, flipped classroom strategy as it improved the academic achievement of students. In addition, the findings urge preparing pre-service teachers at faculties of education to have adequate training to use new teaching strategies raised from the modern educational theories such as flipped classroom strategy. Further, the findings recommended providing schools with adequate technology tools, modern laboratory devices, and high speed internet to help teacher to prepare the needed materials according to the flipped classroom strategy. Furthermore, the study suggested re-applying this research study by investigating the effect of flipped classroom strategy on other variables such as other content subjects or areas and other grades from different academic stages.

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