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The Effectiveness Of The Flipped Classroom Strategy In Developing Secondary School Female Students' Mathematics Achievement And Habits Of Mind

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ABSTRACT

The present research aimed to identifying the effectiveness of flipped classroom strategy in developing achievement in mathematics and the habits of mind among secondary stage students. To achieve this aim, the researchers prepared: a guide for teaching Polynomials and its Functions Unit according to the flipped classroom strategy; a student activity booklet for the student; an achievement test on the unit content; and a scale of the habits of mind. The research tools and material were presented to a group of jurors for review. The research adopted the quasi-experimental design. The sample of the research consisted of (61) female students purposefully selected from the second-year secondary school female students, Khayber Al-Janoub Secondary School, during the first semester of the 1439-1440 academic year. They were divided into two groups: an experimental group (N=30) female student who studied via the flipped classroom strategy, and a control group (N=31) student who studied via the traditional method. The research results revealed that the experimental group students outperformed the control group students in developing mathematics achievement and habits of mind. There was a positive statistical relationship between developing mathematics achievement and habits of mind for the experimental group of students who were taught by using the flipped classroom strategy. In light of the research findings, the researchers recommended: the need to employ the flipped classroom strategy when teaching mathematics to secondary school female students; paying attention to the development of habits of mind when teaching mathematics; and conducting more studies and research on the flipped classroom strategy and habits of mind.

Keywords: Flipped Classroom Strategy, Mathematics Achievement, Habits of Mind.

Introduction

Vision 2030 for the Kingdom of Saudi Arabia is characterized by paying attention to the individual as the most important wealth owned by the nation.Offering education to all individuals, the state can become among the ranks of the developed countries. Therefore, Vision 2030 focused on a comprehensive and complete development of the educational system and all its components, to produce a generation characterized by initiative, perseverance, and leadership (Al-Abdul Latif, 2016). Given the 2030 vision - especially in the field of education - we note that it came in line with what has been characterized by the educational field in recent years of the emergence of modern educational trends, criticizing the teaching methods used in the various stages of education, for their great focus on the amount of what the student possesses of information, without regard to the development of mental habits.

Modern trends in education call for the development of habits of mind to be a main goal in all stages of education; for habits of mind to be an essential part of students' lives and learning. Given its importance and impact on learning, habits of the mind are among the important variables related to academic achievement.This has been confirmed by many studies (Riyani, 2012), recommending the need for teachers to integrate habits of mind, such as flexible thinking, thinking about thinking in mathematics curricula, and spreading the culture of mind habits in the school environment.

The results of several studies showed that it is possible to develop habits of mind duringmathematics teaching (Youssef, 2015),(Hilal, 2013), and (Jacobbe& Millman, 2009). These studies emphasized the use of teaching strategies based on mathematical discovery and mathematical problem solving such as a self-organized problem-centered learning strategy, teaching strategies based on the six thinking hats, mathematical discovery strategies, mathematical problem solving, and reflective teaching strategies.

Researchers interested in teaching mathematics emphasize that there is a need for new ways to be presented to learners, by taking advantage of modern developments in our world today. Given the importance of using technology in the field of education, especially mathematics education, one of the National Council of Teachers of Mathematics (NCTM) school mathematics principles is the principle of technology. This principle states that technology programs should be used to help students understand mathematics and benefit from it in their lives (Al-Ghamdi, 2015).

Not using technology has its downsides, as well as completely relying on technology has its downsides. Therefore, the concept of blended learning emerged, combining traditional education and e-learning; its effectiveness was confirmed by certain studies, such as Al-Hawas(2010) and Al-Maadi(2015). One of the most

prominent techniques of blended learning is flipped classrooms or flipped learning. It is defined that the student obtains the scientific material at home, so that he/she is well acquainted with it by sending the teacher files in the form of multimedia explaining the new concepts, using technology. The material is available to the student before the lesson all time. Therefore, there is room for discussions and solving exercises during the lesson (Bergmann &Sams, 2014).

Flipped classroom education has many benefits, most notably investing class time, building a strong relationship between the student and the teacher, supporting students' comprehension, improving their achievement, developing their thinking and abilities, encouraging better use of technology, and early preparation for the lesson before class time.It gives students the freedom to choose the time, place, and speed of learning.It limits the effects of students' absence from school (Al-Shanti, 2016).

Research problem and questions

It is noted that there isunderachievement in students' learning mathematics.This underachievement may be prevalent in all educational stages. Perhaps the highest indicator of students' underachievement in mathematics, in Saudi Arabian students in 2015, is mathematics tests "Trend International of Mathematics and Science Studies" (TIMSS).With regard to the content axis and the axis ofthinking levels,intermediate second grade (8th grade) students scoredan overall average of 368 less than the international average (500) by 132 points in the thirty-ninth rank out of the thirty-nine participating countries (The Center of Research Excellence in the Development of Science and Mathematics Education, 2015).

There are several reasons for this underachievement, the most important of which is the teacher's use of teaching methods that reduce the role of the student. These methods focus on how much information the student memorizes, without focusing on developing mental habits, negatively affecting the student's achievement in mathematics, and making the studentunable to compete with peers in other countries (Al-Gharibi, 2009).

On the other hand, many studies confirmed the effectiveness of modern methods based on the use of e-learning in teachingmathematics, such as flipped classrooms, including El-Sayed (2014),Al-Maadi(2015) and Bhagat et al (2016); they confirmed the effectiveness of flipped classroom in developing many variables.

In light of the above discussion, the problem of the current research is determined by underachievement in mathematics and thinking skills of secondary school students. In light of the importance of developing students' habits of mind, using appropriate teaching strategies to teach mathematics, and making use of techniques modern, the current research is concerned with answering thismain question: what

is the effectiveness of the flipped classroom strategy in developing mathematics achievement and some habits of mind for second grade female students?

The following sub-questions are derived from the main question:

1. What is the effectiveness of the flipped classroom strategy in developing mathematics achievement for second-grade secondary school female students?
2. What is the effectiveness of the flipped classroom strategy in developing some habits of mind among female students of the second year of secondary school?
3. What is the nature of the correlation between habits of mind and achievement in mathematics among female students in the second year of secondary school?

Research hypotheses

To answer the research questions, the following hypotheses were tested:

1. There is no statistically significant difference, at the level ($\alpha \leq 0.05$) between the mean scores of the experimental group and the control group in the post application of the achievement test due to the difference in the teaching strategy used (the flipped class strategy - the usual method).
2. There is no statistically significant difference, at ($\alpha \leq 0.05$), between the mean scores of the experimental group and the control group in the post-application of Habits of Mind scale due to the difference in the teaching strategy used (the flipped classroom strategy - the usual method).
3. There are no statistically significant correlations, at($\alpha \leq 0.05$) level, between the development of the habits of mind and the development of academic achievement among the female students of the second year of secondary school due to the difference in the teaching strategy used (the flipped classroom strategy - the usual method).

Research objectives

The current research aims to:

1. Identifying the effectiveness of the flipped classroom strategy in developing mathematics achievement for second year secondary school students.
2. Studying the effectiveness of the flipped classroom strategy in developing some habits of mind among second year secondary school students.
3. Determining the relationship between the habits of mind and achievement in mathematics among second year secondary school students.

Research significance

This research gains it significance from the following:

1. Suggestion the flipped classroom strategy as one of the teaching strategies that help develop mathematics achievement and the habits of mind.
2. Preparing a teacher guide and a student notebook of activities in the third chapter lessons (polynomials and their functions unit) of the mathematics course for the second grade of secondary school using the flipped classroom strategy, as well as an achievement test on the classroom lessons, to be used in teaching mathematics.
3. Directingfemale teachers' attention to the necessity of taking into account the development of the habits of mind when teaching mathematics.
4. Preparing a scale for the habits of mind of second year secondary school students that female teachers and educational supervisor can benefit from.
5. Directing the attention of researchers in the field of mathematics education to the importance of studying the impact of using the flipped classroom strategy in mathematics teaching.

Research limitation

The current research is limited to the following:

Thematiclimitations: Chapter Three (Polynomials and their Functions Unit), second grade secondary school mathematics course, and some habits of the mind: perseverance, striving for accuracy, constant readiness for continuous learning, thinking flexibly, questioning, and posing problems, and mutual thinking.

Time limitations: The first semester of the 2019-2020 academic year for a period of five weeks.

Humanlimitations: The research sample consisted of (61) female students in the second year of secondary school at Khayber Al-Janoub Secondary School.

Spatiallimitations: Second year secondary school students in Bisha Governorate.

Research terms

Flipped classroom strategy: operationally known as a strategy that relies on reversing the roles between home and school. The teacher provides the students with educational content that contains educational concepts and generalizations at home in the form of (videos - audio clips - pictures and texts)via Padlet. On the next day in the classroom, there is interaction between the female students and the teacher, and among female students themselves. The time of the class is invested in employing new knowledge and benefiting from it in developing the students' achievement and mental habits.

Habits of mind: operationally defined as a set of smart skills and behaviors that the student performs when facing mathematical problems or situations in order to reach the goal.It is determined by the degree that the student obtains throughHabits of Mind Scale according to the classification of Costa and Kallick, including six

mental habits in this study (perseverance, striving for accuracy, constant readiness for continuous learning, thinking flexibly, questioning and posing problems, and mutual thinking).

Literature Review

Flipped classroomstrategy

Definition of the flippedclassroom strategy

The flipped classroom is one of the approaches to blended learning. Students are in charge of a large part of the learning process and mastery of the teaching content. Based on this approach, the role of the teacher shifts from the main role who holds the control of matters in the classroom, and the primary and only source of information, to a guide and adviser for the students, facilitating their learning.The general form of the classroom environment has also changed, from teacher-based teaching to student-based learning, where the student has become the main focus within the classroom environment (Abaeian&Samidi, 2016).

Al-Kahili (2015, p. 35) defined the flipped classroom strategy as "a deliberate learning and teaching strategy that employs educational technology (video, etc.) in delivering the student's academic content before and outside class to employ class time to do homework and the actual practice of knowledge through various active activities. It is a type of blended learning.

Learning in aflipped classroom strategy environment

The flipped classroom strategy learning environment revolves around the teacher presenting the content to the students in aflipped manner. Students are given pre-made videos that deal with the basic and theoretical concepts of one of the subjects. They can watch them outside the classroom, with a basic idea about the topics. They can watch in their spare time to form an idea about the topics that will be presented in the classroom environment later. Learning in the flipped classroom environment consists of two basic types of activities: technology-assisted learning outside the classroom in an individual learning process carried out by the student, and the teaching activities, in various forms, which are based on the student's interaction and activity, making the student the focus of the educational process (Bishop & Verleger, 2013).

The flipped classroom strategy includes three basic components of the classroom environment: before entering the classroom environment, during the classroom environment, and after completing the activities within the classroom environment.Students deal, for the first time, with the contents of the course, before moving to the stage of being present in the classroom by relying on many methods, such as watching educational videos online, or reading books.The stage of working within the classroom environment depends largely on effective learning

strategiesbecause the students have been dealing with the content provided for the study. The provided content allows the application with ease and simplicity. The last component of learning, based on flipped learning,deals with post-teaching stage as assessment of student learning is made (Heinerichset al, 2016).

Flipped classroom strategy and mathematics education

In the flipped classrooms, the mathematics teacher finds the time to provide actual assistance to the students, enabling them to have a deep understanding of the mathematical concepts and the ability to assimilate them accurately. Students make sufficient effort to understand complex mathematical concepts. Flipped Mathematics classrooms are living laboratories of thinking processes by using computers, investigation, inquiry and research (Bergmann&Sams, 2014).

Some experiences indicate the positive impact of flipped classrooms on improving achievement and comprehension. The most prominent of these experiences include the experience of University of Michigan, where some students were facing challenges in solving problems practically outside the classroom in traditional lectures and there was no help from their peers or the teacher. When flipped classrooms were used, teachers were given time to solve exercises and correct misconceptions among students (El-Zein, 2015). They include also experience of Byron High School that designed the mathematics curriculum, presenting it in video format, and making it available to students around the clock, to watch these lessons at home as homework. Classroom time is allocated to discussion and practice. Fulton (2011) points to relying on the flipped classroom strategy in teaching mathematics enables students to do homework in the classroom, and to proceed with learning at their own pace, and teachers to deal better with students with learning difficulties and different patterns of study. It makes class time more effective and creative.

A series of studies were conducted to address the flipped classroom strategy in mathematics, including El-Sheikh (2018), which targeted identifying the effect of using the flipped classroom strategy in the teaching of mathematics on the academic achievement of third grade intermediate school students. It found that there are statistically significant differences between the mean scores of the control and experimental groups in the post-measurement of the achievement test, in favor of the experimental group.The effect size of the flipped classroom strategy on the development of mathematics was large. Lo & Hew(2017) aimed to develop an instructional design framework that can be used in planning the flipped classroom approach, providing a remedial approach in mathematics based on flipped classrooms with underachievers in mathematics. The approach was effective in improving underachievers' performance in mathematics. It was also effective in improving performance of students with high mental abilities. The results of the study indicated that the response of students on the scale of attitude towards learning using flipped classrooms indicates a positive attitude towards the use of

this style of teaching. Buch & Warren(2017) aimed to identify the flipped classroom methodology, determine students' perceptions about flipped classes, and determine the performance of students within these classes. They concluded that there is outperformance in in the group of students who studied using the flipped classrooms compared with the control group.In addition, they had a strong belief that flipped classes help in building mathematical understanding.Under flipped learning, they were given maximum effort in learning mathematics, as well as giving them the opportunity to reflect on their efforts and practice in mathematics. Foldnes (2017) aimed to examine the relationship between student attendance in the classroom and academic achievement in mathematics in flipped classrooms; as well as its relationship to the performance of mathematical skills and the attitude towards mathematics. A statistically significant and positive correlation was found between attendance and performance in mathematics. In other words, the higher the percentage of students' attendance in the flipped classrooms, the higher the rate of performance in mathematics. It was also concluded that participation in flipped classrooms enhances positive attitudes towards mathematics and enjoying it.This indicates a mutual and dynamic relationship between behavior (attendance) and attitudes (enjoying mathematics), and also with mathematical skills. In addition, Akharashida (2017) sought to identify the impact of the use of the flipped classroom strategy in developing mathematical thinking and motivation towards learning mathematics among first year secondary students (science section). The strategy was effective in developing mathematical thinking and motivation towards learning mathematics. Additionally, Lai & Hwang (2016) attempted to determine the effect of a teaching approach based on the flipped classroom through self-organized learning in developing the performance of students in a mathematics course. The results showed that the students of the experimental group have achieved a remarkable outperformance over the students of the control group.Al-Zayoud (2016) aimed to specify the effect of using the flipped classroom on the achievement of first year secondary female students (science section) in mathematics and the attitudes towards it. The results showed that there was a statistically significant difference attributed to the teaching method in favor of the experimental group. They also showed the presence of positive attitudes among the students towards the flipped classroom.

Habits of mind

Definition of habits of mind

There are many definitions of habits of mind according to the various viewpoints and trends that tackled it. Nofal (2008, p. 68) sees habits of mind as "a set of skills, attitudes, and values that enable an individual to build preferences from smart performances or behaviors, based on the stimuli around, leading him/her in the end to choose a mental process, performance, or behavior from a set of options available to him/her to confront a problem or an issue, or to effectively implement

and maintain this approach."Al-Duqail (2014, p. 14) adds that mind habits are "the set of behaviors, intellectual skills and mental attitudes that the student chooses and prefers based on his/her information stored in memory and previous experiences over other patterns when facing a problem, and the ability to choose which patterns should be used to take advantage of themto achieve the desired goal to solve the problem or the perplexing educational situation."

Habits of Mind classification

According to Costa and Kallick, habits of mind is a combination of intelligent behaviors, cognitive processes, and thinking skills. They divided habits of mind into sixteen mental habits: perseverance, controlling recklessness, listening with understanding and empathy, thinking flexibly, metacognition, striving for accuracy, questioning and posing problems, applying previous knowledge in new situations, taking responsible risks, thinking and communicating accurately and clearly, collecting data using all of the senses, creating, visualizing and inventing, responding with surprise and awe, finding humor, mutual thinking, and constant readiness for continuous learning. The current research seeks to develop six mental habits of the Costa and Kallickclassification: perseverance, thinking flexibly, questioning, posing problems, striving for accuracy, mutual thinking, and constant readiness for continuous learning (Costa &Kallick, 2003a):

1. Perseverance: It means the learner's ability to embark on the task entrusted to him/her and continue to work and not give in easily to the difficulties he/she faces during work.

2. Thinking flexibly: It means the ability of the learner to think of new alternatives, options, solutions, and different points of view when facing a situation or solving a specific problem.

3. Constant readiness for continuous learning: It means the learner's ability to learn continuously and with confidence, along with a curiosity for knowledge and research, improving development, learning, adaptation, and self-improvement.

4. Striving for accuracy: It means the ability of the learner to continuously work with perfection, examine information to ensure its accuracy, and review and evaluate what has been accomplished; to ensure that a specific level of established standards and criteria is reached.

5. Questioning and posing problems: It means the ability of the learner to ask and generate questions; to solve problems when they occur or when they are presented by obtaining information from multiple sources.

6. Mutual Thinking: It means the ability of the learner to justify ideas, test the validity of solutions strategies, accept feedback, interact, cooperate, and work with a group.

The Importance of habits of mind in an educational situation

Younis & Allam(2016) see that habits of mind help to manage situations and meet challenges that help people respond to situations appropriately to solve problems, support sudden action wisely in various situations; employing them makes the individual depend on specific patterns of mental behavior.

Al-Rabighi (2015) believes that developing habits of mind has an effective educational importance that lies in the following points: directing the learning process, organizing it and assuming its responsibility; using thinking skills to manage thinking, develop it in a timely manner; choosing the appropriate procedures; developing achievement; paying attention to details;and smart dealing with life situations.

A number of studies were conducted to addresshabits of mind in mathematics.Al-Kubaisi& Al-Ameli (2016) sought to identify the effectiveness ofgeogebra program in achievement and habits of mind for second grade intermediate school students in mathematics. The results showed the outperformance of the experimental group over the control group in the achievementposttest and habits of mind posttest. Dwirahayu et al (2017) studied the extent to which a mathematics teacher perceives the habits of mind and the ability to generalize for eighth-grade students in an Islamic school in Jakarta, Indonesia. The results concluded that each person has the ability to generalize for oneself, whether it is in the form of the learning process. Eroğlu&Tanışlı (2017)integrated the components of mental habits in algebra in terms of the practice of teaching performance in the classrooms. The results focused on the practice of the algebraic habits of mind in the classrooms. The students demonstrated different methods of algebraic reasoning and used multiple presentations. They generalized solutions and made abstractions, and were able to transform their relational and generalized ideas, initially expressed orally, into symbolic arguments and mathematical data, allowing for the systematic development of algebra. It also revealed that different algebraic thinking methods appeared among the students as a result of the inquiry and various guiding questions. These ways of thinking may become habits of mind in a longer process.Al-Saadi (2016) explored the effect of the Daniel model on the achievement of mathematics and habits of mind among fourth grade secondary school students (science section).The results revealed the effectiveness of Daniel model in the achievement of mathematics and the habits of mind among fourth grade secondary school students (science section).

Research Methodology

The two researchers used the experimental approach with its quasi-experimental design to identify the effectiveness of the independent variable (the

flipped classroom strategy) in the dependent variables (mathematics and habits of mind).

Research population and sample

The research population consists of all female students in the second year of secondary school, (science section), in government schools in the Bisha governorate. The research sample consisted of (61) in second grade secondary schoolfemale students, Khayber Al-Janoub Secondary School, during the first semester of the 2018-2019 academic year. They were randomly selected and divided into two groups: experimental (31) female students who studied using the flipped classroom strategy, and the control female students (30) who studied using the usual method.

Research experiment material

A) A teacher's guide to teaching according to the flipped classroom strategy: The guide was prepared with the aim of helping teachers to teach a "Polynomial and its Functions Unit" in the mathematics course for the second grade of secondary school, (sciencesection), in the first semester according to the flipped classroom strategy. The guide was presented in its initial form after preparing it to a group of jurors specialized in curriculum andinstruction of teaching mathematics. Modifications were made to the guide in light of the jurors' opinions and suggestions.

b) Student activity notebook: The activity notebook was prepared for the student to help the student take advantage of the flipped classroom strategy, while studying a (Polynomial and its Functions Unit.)Modifications were made to the notebook.

Research instruments

A) Mathematics achievement test: The achievement test was prepared on the content of the (Polynomial and its functions Unit) at the cognitive levels (remembering - understanding - application - analysis - synthesis). The questions were prepared in the form of multiple choice. The test was presented to a group of jurors to ensure its validity. It was also tested in a pilot study on a sample of (70) female students of the second year of secondary school (science section) to validate it. The reliability coefficient was calculated using the half-split;it was (0.82). The discrimination coefficients were calculated, which ranged between (0.25 - 0.74). The internal consistency validity was also calculated, and the value of the consistency coefficients at the levels of remembrance, understanding, application, analysis and synthesis were respectively (0.40), (0.77), (0.75), (0.50), (0.64). The time for performance on the test was calculated, and it was (45) minutes. The number of the test itemsin its final form was (24), and the final score was (24).

B) Habits of Mind Scale: The scale is designed to measure the six habits of mind within the limitation of the research (perseverance, thinking flexibly, striving for accuracy, questioning and posing problems, constant readiness for continuous learning, and mutual thinking) for second grade secondary school female students. The scale included (38) statements on a 3-Likert scale (always, sometimes, rarely). The scores are (3, 2, 1) if the statements are positive, and (1, 2, 3) if the statements are negative. Therefore, the highest score for the scale is 114, and the lowest score is 38. The scale was presented in its initial form to a group of jurors to ensure the validity of the content and to determine the extent to which the items are related to each dimension of the scale. In light of their opinions, the necessary modifications were made to the scale. The reliability of the scale was verified using the Alpha-Cronbach method on a sample of (40) second grade secondary school female students (science section); it was (0.72). The scale was validated by the internal consistency method, by calculating the correlation coefficient between the scale dimensions and the scale as a whole.

Pre-application of research instruments

The research instruments were pre-applied to the experimental and control groups. Table (1) shows the results of the pre-application of the research instruments.

Table (1): The results of the pre-application of the study instruments on the experimental and control groups

	Group	N	Mean	St. Deviation	df	T-value	Significantlevel
Mathematics achievement test	experimental	30	6.03	1.88	59	0.06	Non-significant
	control	31	6.06	2.19			
Habits of Mind Scale	experimental	30	84.73	9.31	59	0.95	Non-significant
	control	31	82.32	10.43			

Table (1) shows that the differences between the mean scores of the students of the experimental and control groups on the research instruments are not statistically significant, indicating that the two research groups were equivalent in the achievement pre-test andhabits of mind pre-scale.

Teaching the two research groups

The experimental treatment of the flipped classroom strategy was applied to experimental group. The researcher taught Chapter Three lessons (Polynomial and its Functions Unit), Mathematics Textbook to second grade secondary school students(experimental group) according to the flipped classroom strategy. The same lessons were taught to the control group in the usual method by a

mathematics teacher at the school.Teaching theunit included (24) lessons for each group, 6 lessons per week.

Post-application ofresearch instruments

After the completion of the teaching the experimental and control groups, the research instruments were post-applied. The results were obtained.

Research results and interpretation

In light of the research problem and hypotheses, the results of the research are shown as follows:

First: The results related to answering to the first question:

An achievement test was applied to both groups, experimental and control, after finishing the experiment to answer the first research question: " What is the effectiveness of the flipped classroom strategy in developing mathematics achievement for second-grade secondary school female students?" The scores of the students were extracted, and the t-test was applied to independent samples through the SPSS statistical software package to identify the differences between the experimental and control groups in the (Polynomials and their Functions Unit) test as a whole and its sub-levels (remembering, understanding, application, analysis, and synthesis). Table (2) explains this.

Table (2): The significance of the differences between the mean scores of the experimental group and the mean scores of the control group on the achievement post-test

Cognitive level	Group	N	Mean	St. Deviation	df	T-value	Significant level	η^2	d-value	Effect size
Remembering	experimental	30	1.93	0.25	59	7.24	0.05	0.47	1.88	Large
	control	31	0.871	0.76						
Understanding	experimental	30	4.87	1.33	59	10	0.05	0.63	2.61	Large
	control	31	1.81	1.05						
Application	experimental	30	8.37	2.14	59	8.65	0.05	0.56	2.27	Large
	control	31	4.03	1.76						
Analysis	experimental	30	1.6	0.5	59	7.93	0.05	0.52	2.09	Large

	control	31	0.45	0.62						
Synthesis	experimental	30	2.77	0.43	59	2.62	0.05	0.1	0.78	Medium
	control	31	2.45	0.51						
Total	experimental	30	19.53	3.75	59	12.26	0.05	0.72	3.21	Large
	control	31	9.61	2.46						

The results in Table (2) indicate that the values of "t" are statistically significant, at (0.05) level. This indicates that there are statistically significant differences between the mean scores of the students of the two experimental and control groups in the achievement test and its functions as a whole, andsub-levels of (remembering, understanding, application, analysis, and synthesis in favor of the experimental group students.This refers to the rejection of the first research hypothesis: there is no difference is statistically significant, at the level of ($\alpha \leq 0.05$), between the mean scores of students in the experimental group and control group in the achievementpost-test, attributable to the different teaching strategy used (flipped classroom strategy - the usual method). Table (2) shows that the size of the effect of the use of flipped classroom strategy in the development of the achievement of the content of the polynomial and its functions as a whole and its cognitive levels is great, except for the synthesis level as the size effect was moderate. In general, the previous results indicate the significant impact of the flipped classroom strategy in developing mathematics achievement. This result is attributed to the following: the classroom environment in the flipped classroom makes the student feel comfortable and confident in asking questions in the classroom, contributing to solving the problems that hinder understanding the subject matter. The student learns at the appropriate time, in the right way and at the right place. He/She is able to retrieve what he/she has missed. He/She is informed about his/her colleagues' contributions and benefit from them.

The previous finding shows the effectiveness of the flipped classroom strategy in the development of achievement. It is consistent with El-Zein (2015) statement that learners who have studied using flipped classrooms receive twice the grades of their peers who have studied in the usual method. Bergmann &Sams (2014) argued that flipped classrooms enable learners to deeply understand mathematical concepts and be able to understand them accurately, confront them and make sufficient effort to understand complex mathematical concepts. The current research finding is also consistent with studies that have examined the impact of flipped classrooms and their effectiveness in the development of

achievement in mathematics such as the study (El-Sheikh, 2018; Lo & Hew, 2017; Foldnes, 2017; Buch& Warren, 2017; Al-Zayoud, 2016).

The previous result can be explained in the light that the student practices remembering, understanding, and applying outside the classroom, by watching videos, texts and pictures, listening to audio clips, or reading the lesson from the textbook as a minimum. In the classroom, the teacher helps the students with synthesis, analysis, and evaluation, givingthe students sufficient time to perform activities and solve exercises. This necessitates the use of high levels of Bloom's Classification of cognitive objectives that contribute to the process of meaningful learning (deep learning) (Bergmann &Sams, 2015; El-Sherman, 2015). Likewise, the previous result can be explained in the light of the fact that teaching using the flipped classroom strategy provides a great opportunity to apply the constructivist theory, leading to understanding and building knowledge socially; this enhances achievement.

Similarly, the previous result can be explained in the light of what Bergman &Sams (2015) indicated that the flipped classroom leads to deeper learning.Traditional classrooms usually cover minimum skills (remembering and understanding and rarely application) most of the time in the class; there is less time left for higher skills (analysis, evaluation and synthesis). As for the flipped classroom strategy, the focus is on the lower levels of the Bloom pyramid outside the classroom, using technology in delivering educational content to students. In class, the focus is on the higher levels of the Bloom pyramid. Therefore, we get deeper learning, which has the greatest impact on achievement.

Second: The results related to answering to the second question:

The habits of mind scale was applied to the experimental and control groups after implementing the experiment in order to answer the second research question: What is the effectiveness of the flipped classroom strategy in developing some habits of mind among female students of the second year of secondary school?

The scores of the students were extracted, and the t-test was applied to independent samples through the SPSS statistical software package to identify the differences between the experimental and control groups in the Habits of Mind Scale as a whole and its dimensions (perseverance, thinking flexibly, striving for accuracy, questioning and problem solving, constant readiness for continuous learning, and mutual thinking), as shown in Table (3).

Table (3): The significance of the differences between the mean scores of the experimental group and the mean scores of the control group on the Habits of Mind Scale in the post-application

Habits of Mind	Group	N	Mean	St. Deviati	df	T-val	Significant	η^2	d-val	Effect size

				on		ue	level		ue	
perseverance	experimental	30	17.13	1.57	59	2.22	0.05	0.12	0.91	Large
	control	31	15.97	2.41						
thinking flexibly	experimental	30	15.3	0.92	59	2.14	0.05	0.07	0.55	Medium
	control	31	14.47	1.93						
striving for accuracy	experimental	30	17.33	1.3	59	2.01	0.05	0.06	0.53	Medium
	control	31	16.5	1.87						
questioning, posing problems	experimental	30	15.37	1	59	2.95	0.05	0.13	0.77	Medium
	control	31	13.8	2.73						
constant readiness for continuous learning	experimental	30	18.9	1.67	59	2.58	0.05	0.11	0.68	Medium
	control	31	17.57	2.28						
mutual thinking	experimental	30	14.1	0.84	59	3.62	0.05	0.18	0.93	Large
	control	31	12.93	1.55						
Total	experimental	30	98.1	4.46	59	3.42	0.05	0.17	0.89	Large
	control	31	91.23	10.07						

The results in Table (3) indicate that the values of "t" are statistically significant at the level (0.05). This indicates that there are statistically significant differences between the mean scores of the female students of the two experimental and control groups in the Habits of Mind Scale as a whole and its dimensions in favour of the experimental group students. This refers to the rejection of the second hypotheses: there is no statistically significant difference, at the level of ($\alpha \leq 0.05$), between the mean scores of students of the experimental group and the control group inthe Habits of Mind Post-Scale due to the different teaching strategy used (flipped classroomstrategy - the usual method). Table 3 shows the size effect of using the flipped classroom strategy on developing the habits of the mind as a whole and developing habits: perseverance, mutualthinking is large, and medium in

developing habits: thinking flexibly, striving for accuracy, questioning, posing problems, and constant readiness for continuous learning. In general, the previous results indicate the significant impact of the flipped classroom strategy on developing the habits of mind among second-grade secondary school female students. These results areattributed to the following:

1. Giving enough time for classroom activities. Classroom applications motivate the student to think flexibly and in multiple directions. The exchange ideas with peers develops their ability to think mutually.
2. One of the most important objectives of learning in flipped classrooms is for the student to be active, effective, persistent, seeking to solve problems, and benefiting from his/her previous experiences in solving the current problems one faces.
3. The size of the effect of the independent variable was medium in developing habits: thinking flexibly, striving for accuracy, questioning and posing problems, and constant readiness for continuous learning. It may be due to the fact that the month period is not enough to develop six mental habits at once.

This result is consistent with what was mentioned by Costa &Kallick(2003b) that there are many strategies and methods that can be used in the classroom and combined with the cognitive content of the study materials, which have proven effective in developing the habits of mind.The current research is also consistent with the studies that proved the effectiveness of different strategies in developing the habits of mind in mathematics, including Al-Kubaisi and Al-Ameli (2016) and Al-Saadi (2016).

The previous result can be explained in the light of the fact that the student in the flipped classroom turns into a researcher who uses technology effectively outside the classroom, enhancing self-learning skills, independence of others in learning and developing his/her own experience, and seeking to develop communication with others. This, of course, may develop the mental habits of the student: thinking flexibly, questioning and problem solving, constant willingness to learn, and mutual thinking. The previous result can also be explained in the light that the flipped classroom strategy works to change the learner's perceptions of the learning process, increases his/her motivation, and makes him/her more comfortable in posing questions and increasing the chances of interaction with the teacher. Additionally, the use of online communication tools, outside the classroom, enables students to share their work, and get feedback from their peers and teachers (Alharbi&Alshumaimeri, 2016), which enhances the learner's questioning, problem solving, mutual thinking, and perseverance.

Moreover, the previous result can be explained in the light that the flipped classroom strategy helps the student to feel self-efficacy when exchanging

knowledge with his peers, and in developing confidence in his/her personal abilities to perform the required tasks and transforming him/her from a negative learner into a positive one. It contributes to the development of students' problem-solving and communication skills, improving self-efficacy, feeling able to participate in a learning situation, and performing the tasks given to him/her effectively. Therefore, the flipped classroom strategy supports the development of the habits of mind in question.

Third: The results related to answering to the third question:

To answer the third question of the research: " What is the nature of the correlation between habits of mind and achievement in mathematics among female students in the second year of secondary school?" Thethird hypothesis was tested: there are no statistically significant correlations, at the level of ($\alpha \leq 0.05$),between the habits of mind and and the development of academic achievement for the second-grade secondary schoolstudents due to the different teaching strategy used (flipped classroom strategy - the usual method.)"Correlation coefficients were calculated between the scores of the female students of the experimental and control groups in the Habits of Mind Post-Scale and the Mathematical Achievement Test, as shown in Table (4).

Table (4): Correlation coefficients between the scores of the female students of the two experimental and control groups in the Habits of Mind scale and the achievement test in mathematics

Group	N	Correlationcoefficients	Significant level
experimental	30	0.41	0.05
control	31	0.29	Non-significant

Table (4) shows that there is a statistically significant and positive relationship between the development of habits of mind and mathematics achievement among the experimental students group who studied using flipped classroom strategy.There is a positive relationship between these two variables for the control group students who studied using the usual method, but it is not statistically significant. This may be attributed to encouraging the students of the experimental group to use the habits of mind while dealing with the activities, situations and mathematical problems. This led to an increase in the achievement of the experimental group compared to the control group. There is a positive relationship between achievement and habits of mind. This result is consistent with what Costa &Kallick (2003a)said that the habits of mind should be included in the mathematics curricula with all its elements because they achieve greater effectiveness for learners in practicing their daily activities. It is also consistent with

many studies that found a positive relationship between using habits of mind and mathematics achievement test scores.

The previous result can be explained in the light that the habits of mind help to manage situations and meet challenges that help people respond to situations appropriately to solve problems, support sudden action wisely in various situations.Employing them makes the individual depend on specific patterns of mental behavior (Younis & Allam, 2016). Therefore, the development of habits of mind increases achievement.

The previous result can also be explained in the light that the development of habits of mind works on the integrative view of knowledge that links all study subjects. It also links them with real life. The development of habits of mind takes into account individual differences and special tendencies, as mental habits do not limit learners' behavior and their differentiation, but rather work to improve and develop them. This has a positive impact on learning.

Recommendations

In light of the results of the research, certain recommendations are set out as follows:

1. Relying on the flipped classroom strategy when teaching mathematics to secondary school students because of its significant impact on the development of achievement in mathematics.
2. Working on developing the habits of mind when teaching mathematics through multiple strategies, as it is directly related to raising achievement in mathematics.
3. Providing the necessary capabilities and creating the appropriate environment for the application of the flipped classroom strategy in teaching.
4. Urging researchers and those interested in curriculum and instruction to try many modern strategies in teaching mathematics because of their positive impact on the development of academic achievement.

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