

## Cultivating Calculus Excellence: Smart Learning and Peer Tutoring for Math Empowerment in Female Science College Students

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### Abstract

*The aim of the current research is to investigate the impact of integrating the learning for mastery strategy supported by smart electronic applications and the peer tutoring strategy in teaching Calculus 1 on the development of academic achievement and self-efficacy in mathematics among female students in the College of Science, Saudi Arabia. To achieve the research objective, a quasi-experimental design was employed. The research instruments included an achievement test and a mathematics self-efficacy scale, which were distributed to 60 female students from the Biology Department at the College of Science. The research results revealed statistically significant differences between the average scores of the experimental group and the control group in the post application of the achievement test and the mathematics self-efficacy scale in favor of the students in the experimental group. The current research recommends the importance of utilizing the integration of various teaching strategies, such as learning for mastery and peer tutoring, in teaching Calculus 1 at the university level. It also suggests training faculty members to use these strategies to develop different aspects for their students, such as self-efficacy in mathematics.*

**Keywords:** *learning for mastery, smart electronic applications, female undergraduate students, peer tutoring, self-efficacy in mathematics.*

### Introduction

Mathematics is considered a key gateway to various scientific and applied fields, particularly in university studies. Most college students take one or more mathematics courses, which are essential requirements in their academic curriculum. One such course is Calculus 1, which is a fundamental prerequisite for various disciplines such as science, engineering, business, and more (Ferrer, 2016).

Several studies have found that students face difficulties when studying Calculus 1. Some struggle to apply their previous mathematical knowledge to solve familiar problems (Klymchuk et al., 2010). Others exhibit weaknesses in foundational mathematical concepts (Byerley et al., 2012), and some encounter challenges in finding derivatives and dealing with basic rules (Byerley et al., 2012; Kremžárová, 2011).

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Erens and Eichler (2012) attributes these difficulties to the routine teaching of Calculus, focus on preparing students for final exams, and the lack of technology integration in teaching. On the other hand, Hsieh et al. (2007) emphasize that university students not only need to possess the capabilities and skills necessary for successful academic tasks but also require the development of strong self-efficacy and a belief in their ability to successfully complete tasks. This was confirmed by the study of Al-Zoubi et al. (2019), indicating a decline in the level of understanding differentiation and integration concepts and a decrease in self-efficacy among first-year university students.

Encouraged by Braun et al. (2017), faculty members in universities and colleges are urged to explore effective teaching methods that inspire students to work hard, develop a love for learning, and embrace challenges in problem-solving. One effective teaching strategy in mathematics education is the learning for mastery (LM) strategy, aiming to provide all or most learners with successful learning experiences. It assumes that the majority of students can reach their maximum learning potential if the teaching style is organized, guidance and assistance are provided when students face various problems, and there is sufficient time available to master what they have learned (Kansarah & Attar, 2010).

Additionally, peer tutoring (PT) is a strategy that helps stimulate students' motivation for learning, develop thinking skills, and enhance collaborative work under the teacher's supervision. This strategy trains students to collaborate, incorporating the impact of high-knowledge peers. PT places responsibility on students, encouraging them to discuss, question, practice, and evaluate learning with direct peer feedback (Noori & Karoomi, 2011).

Moreover, numerous studies highlight the importance of employing technology in teaching strategies to make them more effective. The use of technology stimulates students, increases their participation, and develops their attitudes, leading to effective learning (Alqahtani & Mohammad, 2015; Cochrane, 2014; Reed, 2017; Stone, 2016). Studies by Bressoud et al. (2016), and Jaradat and Khasawneh (2019) demonstrate the effectiveness of using technology in teaching Calculus 1 to improve conceptual understanding by forming a mental image.

One such technological tool is smartphones, which have become widespread among students and play a significant role in the teaching and learning process. Therefore, it is essential for students to leverage their capabilities and applications in the learning process, keeping abreast of new and useful information to achieve a high level of mastery and enhance their self-efficacy in mathematics. Some studies (e.g., Alarmiti, 2015; Youssef, 2014) have demonstrated the effectiveness of learning using smartphones in student achievement and the development of concepts and study skills. Other studies (e.g., Alsubaiei & Alghamdi, 2014; Reeves et al., 2017) highlight the importance of utilizing smartphones in university curricula, which can improve and increase student engagement in the learning process.

#### Research problem:

The idea for the current research emerged from the identified problem, which is the academic underachievement of students in the Calculus 1 course at the university level and their low level of self-efficacy in mathematics. This problem has been highlighted in various educational studies (Alhejaly, 2011; Al-Sharif et al., 2019; Al-Slouli et al., 2019; Sayed, 2019; Sayed, 2021). These studies recommended the need to implement modern methods and strategies in higher education to address this issue and enhance students' effectiveness in the educational setting by utilizing modern technological tools. Therefore, the current research aims to investigate the impact of integrating the LM strategy supported by smart mathematical applications and the PT strategy in teaching the Calculus 1 course on the development of academic achievement and self-efficacy in mathematics among female students in the College of Science.

#### Research Questions:

The main research question is as follows:

What is the impact of integrating the LM strategy supported by smart mathematical applications and the PT strategy in teaching the Calculus1 course on the development of academic achievement and self-efficacy in mathematics among female students in the College of Science?

To answer the main research question, the following sub-questions were formulated:

1. What is the impact of integrating the LM strategy supported by smart electronic applications and the PT strategy in teaching the Calculus1 course on the development of academic achievement among female students in the College of Science?
2. What is the impact of integrating the LM strategy supported by smart electronic applications and the PT strategy in teaching the Calculus1 course on the development of self-efficacy in mathematics among female students in the College of Science?

#### Hypotheses:

In light of the above, the following hypotheses were formulated:

1. There is a statistically significant difference between the average scores of students in the experimental group and the control group in the post application of the achievement test in the Calculus1 course in favor of the experimental group due to the teaching strategy.
2. There is a statistically significant difference between the average scores of students in the experimental group and the control group in the post application of the self-efficacy scale in mathematics in favor of the experimental group due to the teaching strategy.

#### Research Delimitations:

**Objective:** The study focused on the Calculus1 course, one of the mandatory courses for female students majoring in Biology in the College of Science.

**Spatial:** The study was conducted at the College of Science, Imam Abdulrahman Bin Faisal University in Saudi Arabia.

**Temporal:** The research was implemented in the first semester of the academic year 2023/2024.

**Human:** The study involved a group of female students majoring in Biology in the College of Science.

#### Research terms:

**Learning for Mastery (LM):** Defined by Salem (2009) as an educational approach in which the scientific material is divided into small instructional units. Students are assigned to read the unit and prepare questions related to it for discussion during the session. A student does not move from one unit to another unless they pass the test at the end of each unit with a mastery grade (90%). If a student does not reach mastery, remedial activities are provided until they achieve mastery in an equivalent retest, then they proceed to the next unit. In this research, procedural LM is defined as an educational approach used to teach the Calculus1 course. The course is divided into sequentially presented lectures, each with its own objectives and appropriate teaching procedures. After each lecture, the student takes an achievement test, and if the student does not achieve mastery (80% or more), they are given additional time for guidance, support, and correction until reaching the desired mastery level. The previous mastery grade mentioned was 90%. Was this 80% intentional?

**Smart Electronic Applications:** Advanced programs designed to operate through smartphones, facilitating rapid access to knowledge by providing communication,

interaction, and learning methods anytime and anywhere (Annahar, 2016). Defined by Huang et al. (2011) as programs that operate on smartphones, leveraging the advantages of these devices to facilitate users' communication and quick access to information, often for free. Procedurally in this research, smart electronic applications are defined as digital applied mathematics programs for smartphones that can be downloaded from specialized stores, allowing students to interact with them to solve mathematical problems.

Peer Tutoring (PT): Defined by Hegazy (2022) as an educational strategy where low-achieving students are trained by another student with higher achievement or ability in the academic field. Procedurally in this research, it is defined as an educational strategy in which students teach each other. A student who has mastered the lesson, under the supervision and guidance of the teacher, teaches her peer who has deficiencies in the lesson. Therefore, the process requires full integration and positivity from both parties to induce learning.

Self-Efficacy in Mathematics: Defined as individuals' judgments of their abilities to organize and accomplish tasks that require clear types of performances (Bandura, 2001). It is the individual's inherent confidence in their abilities during new or demanding situations (Brown, 2020). Mathematical self-efficacy is defined as an individual's confidence in their ability to perform a specific mathematical task or solve a mathematical problem (Hackett & Betz, 1989). In this research, procedural self-efficacy in mathematics is defined as the student's thoughts and beliefs about their ability to learn mathematics and their possession of capabilities and potentials to accomplish mathematical tasks, measured by the score obtained on the self-efficacy scale in mathematics prepared by the researchers.

## Theoretical Framework & Literature Review:

### Learning for Mastery:

The Learning for Mastery (LM) strategy is distinguished by boosting the student's self-confidence without a sense of failure. The non-mastery student is provided with sufficient time and assistance to achieve the desired goals without blame or notification of failure. LM also contributes to fostering positive attitudes and active engagement through formative assessments, developing positive student attitudes toward the learned material, and addressing learning difficulties promptly before they accumulate. The strategy enriches the learning experience for some students through enrichment activities, enhancing students' motivation to pursue the subject more broadly and deeply. Ultimately, LM prioritizes the individual needs and capacities of students, fostering a positive attitude towards learning and achieving the required educational goals (Abu-Zaineh, 2017; Al-Nawarej et al., 2019). Ziadeh et al. (2013) emphasize that LM allows students to learn according to their personal abilities and performance levels. All students can learn when provided with various forms of education that suit their abilities, needs, and readiness. LM raises students' academic achievement levels and helps them retain what they have learned.

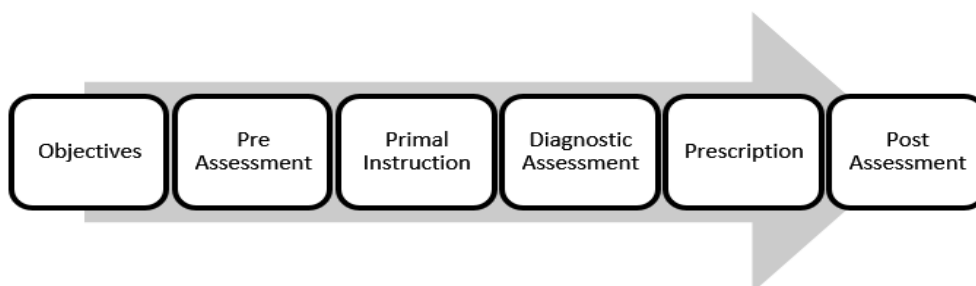


Figure 1: Learning for Mastery Model

Zabid (2017) identified six essential elements of the LM model:

1. Objectives: Identifying the goals expected of students after studying the course.
2. Pre-Assessment: Determining the point from which students begin their learning, presented at the beginning of the educational material.
3. Primal Instruction: Teaching students collectively in a manner similar to conventional teaching, with no specific method to reach mastery. It is up to the teacher to choose the method that aligns with students' preferences and the goals to be achieved.
4. Diagnostic Assessment: Diagnosing strengths and weaknesses and identifying students who have reached mastery and those who have not.
5. Prescription: Determining suitable materials and educational activities for students who have and have not reached mastery, offering corrective teaching to those who have not.
6. Post-Assessment: Revealing students' mastery level of the program's educational objectives at the end of the educational process.

According to Abu-Zaineh (2017), this strategy is based on ten basic steps: (1) segmenting the content into small instructional units, (2) defining behavioral objectives for those units, (3) specifying mastery criteria for learning objectives in each instructional unit, (4) preparing diagnostic test models used to measure what students have learned from the unit and what they have not, (5) preparing a variety of instructional materials and methods to help students who do not reach mastery, (6) teaching the first small instructional unit, (7) applying a diagnostic test at the end of teaching the first instructional unit to identify non-mastery students and reveal their weaknesses, (8) applying corrective procedures to bring non-mastery students to the level of mastery, (9) reapplying an equivalent form of the diagnostic test to non-mastery students after addressing their weaknesses, (10) and applying a final test to measure students' achievement after completing teaching.

Many studies have shown the effectiveness of LM in developing academic achievement (Alsaray, 2015; Folger, 2005; Ifamuyiwa & Rosanwo, 2016; Ironsmith & Eppler, 2007), acquiring mathematical concepts, improving creative thinking skills (Zabid, 2017), retaining learning for a longer period compared to traditional methods (Toheed et al., 2017), and addressing difficulties in performing arithmetic operations (Mohammed & Al-Saadi, 2019).

#### Smart Electronic Applications:

The education sector in the twenty-first century has witnessed a qualitative leap in the use of modern technology. Smartphones have become prevalent among a large number of students, and their use in the teaching and learning process has become important and necessary. Ali et al. (2021) identifies several factors contributing to the use of smart educational applications, including the growing use of smartphones, the variety of services they offer in education, the prevalence of distance learning, the search for new learning systems that achieve higher quality than traditional practices, and keeping pace with the rapid developments in communication and information technology.

One of the most significant advantages of smartphone applications is their free and rapid dissemination. Smartphones are used in the educational process without temporal or spatial constraints (Buyya et al., 2009). The use of smartphone applications in educational activities inside and outside the classroom stimulates motivation, interaction, and collaboration among students (Moussa & Mostafa, 2014). These applications also assist teachers in delivering information to students (Bisong & Rahman, 2011), enable a greater number of students to participate in the educational process through the smart devices they use regularly in their daily lives (Ali et al., 2021), and help students master educational content (Ayyad, 2014).

Several studies (e.g., Ali et al., 2021; Aljarrah, 2020; Johnson et al., 2016; Obina et al., 2022; Zhang, 2015) have indicated the effectiveness of using smartphone applications in the teaching and learning process. The students' interaction with these applications has provided them with opportunities to improve training and self-analysis at their own pace, enhance mathematical problem-solving skills and critical thinking, and improve their academic performance.

#### Peer Tutoring Strategy:

Research indicates that, when comparing various student interaction patterns, the cooperative approach enhances achievement, motivation to learn, self-esteem, and positive relationships among students (Ahmed, 2016). Peer Tutoring (PT) is considered one of the cooperative learning strategies aimed at acquiring knowledge and experiences through student consultation and learning from each other (Alfiky, 2003). Mohamed (2016) mentions several advantages of PT, including its relative ease of implementation for teachers, instilling confidence in students, breaking the fear barrier, helping students progress in learning at their own pace, and providing continuous opportunities for practice, training, and feedback for error correction.

Additionally, Zeitoun (2009) points out that PT involves several conditions, including the teacher specifying the lesson and outlining the plans that students will follow in implementation, students being aware of the goals of this method, the peer teacher mastering the foundations of the material to be taught to their peer learner, the teacher providing materials and resources to assist the peer teacher in fulfilling their duties, and the teacher preparing evaluation tools to measure the occurring changes in both the peer teacher and the peer learner.

Numerous studies have demonstrated the effectiveness of PT in various aspects, including its effectiveness in teaching calculation skills at home (Mayfield & Vollmer, 2007), enhancing academic achievement in mathematics (Parkinson, 2009), developing the ability to understand the concept of infinity in secondary school students (Akram, 2015), fostering critical thinking skills in mathematics (Abu Shaaban, 2010), improving mathematical skills for students with learning difficulties (Hegazy, 2022), and enhancing basic skills for female students experiencing difficulties in learning mathematics (Al-Shahrani & Al-Zoubi, 2019).

## Methodology

The current study utilized a quasi-experimental design to assess the impact of the independent variable (integration of LM strategy supported by smart electronic applications and PT strategy) on the dependent variables (academic achievement and self-efficacy in mathematics) among a sample of female biology students. Figure 2 illustrates the research design. Participants were randomly assigned to two equivalent groups, one experimental and the other control. The experimental group was taught using the integration of the LM strategy supported by smart electronic applications and PT strategy, while the control group received the same course in the conventional manner. Measurement tools were applied to both groups before and after the intervention.

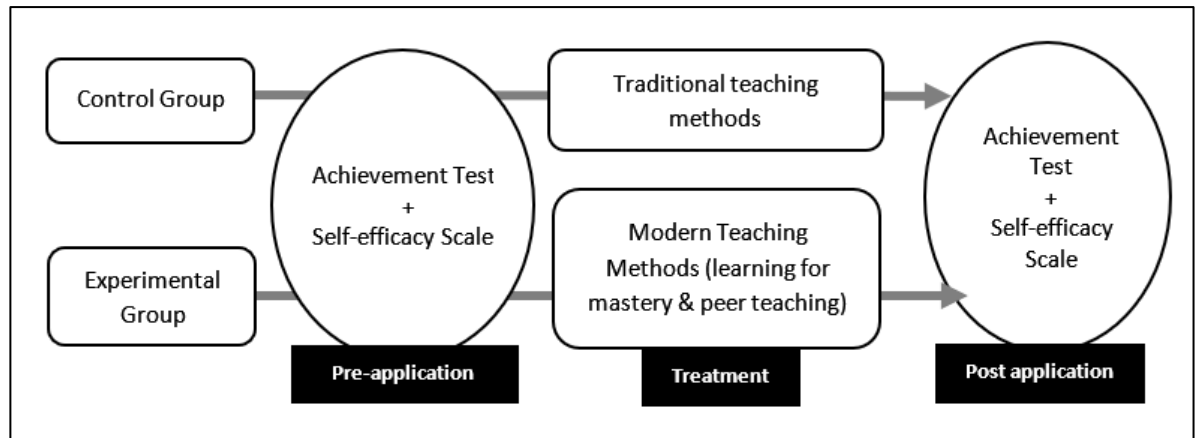


Figure 2: Experimental Research Design and Procedures

#### Population & Sample:

The research population consists of all female biology department students at Imam Abdulrahman Bin Faisal University enrolled in the Calculus 1 course. Sixty students voluntarily agreed to participate in the current research, and they were randomly assigned to two groups (30 = experimental group, 30 = control group).

#### Research Procedures:

To implement teaching using LM supported by smart electronic applications and PT, researchers adopted the idea that most female students have the ability to master all or most of the cognitive content presented to them. The following steps were then taken:

##### A. Planning Phase:

During this phase, researchers:

- Identified the scientific content to be taught to the students and divided it into smaller units.
- Defined the educational objectives and skills that students should achieve with a mastery level of 80% or more for each lecture.
- Specified the activities and tasks that students would perform.
- Determined how to incorporate the Photo Math application in each lecture.
- Developed tests to measure the students' mastery of the scientific content and performance of skills during and at the end of the lesson.
- Formed peer teaching groups, with each group consisting of two students: a teacher-peer and a learner-peer.
- Specified prerequisites for learning (such as prior experiences, lesson introductions, and reading the textbook) and arranged the classroom environment to present lesson content.

##### B. Implementation Phase:

In this phase:

1. Prepared students for LM supported by smart electronic applications and PT (presented only in the first lecture), providing a simplified explanation, emphasizing its importance and benefits, giving instructions and necessary conditions, and confirming that each student can master learning Calculus 1.

2. Clarified the tasks and educational objectives that needed to be mastered.
3. Distributed activity notebooks to each student.
4. Explained the lecture thoroughly, answering students' questions.
5. One of the researchers played the role of guide and mentor during the solution of activities and exercises using the Photo Math application, intervening when necessary, and at the same time, identifying students who grasped the lecture and those who did not.
6. Utilized the PT strategy (teacher-peer and learner-peer), where students who understood the lecture explained it to their peers who did not grasp it during their presentation. The teacher's role was to guide and direct, intervening when obstacles or problems arose.
7. After completing PT, the teacher applied a diagnostic test to ensure students' mastery of the scientific content and educational activities (80% or more), diagnose their errors, and identify unmastered objectives. In this step, the teacher:
  - Distributed the diagnostic test.
  - Each student corrected her own test or corrected the answers of another student by presenting the answer to each paragraph and recording the grades.
  - Identified students who met the mastery criterion and those who did not, appreciating and thanking all students.
8. Reapplied the PT strategy, dividing students into small groups, with proficient students teaching non-proficient ones (teacher-peer and learner-peer). The teacher's role remained that of a guide and mentor, intervening when obstacles or problems arose. For the remaining proficient students, they were directed to solve additional exercises using the Photo Math program (enrichment activity).
9. Reapplied the diagnostic test to non-proficient students to confirm their mastery level.
10. Repeated the above steps for each lecture in the Calculus 1 course.
11. Assigned homework to students, guiding them to solve it once using the Photo Math program and once without it, and then comparing the two solutions.

#### Instrumentation:

The researchers prepared a concise teacher's guide (to be presented by one of the researchers) illustrating the teaching of the course using the LM strategy supported by smart electronic applications and the PT strategy. The guide outlined the proposed procedural steps by the researchers, providing an overview of the LM strategy, the PT strategy, their importance, advantages, and the suggested procedural steps for integrating them in teaching Calculus 1. PowerPoint presentations for the course content were developed and organized according to the implementation procedures of the LM strategy supported by smart electronic applications and the PT strategy. An activity booklet for students, including worksheets on course topics and tasks aligned with the proposed strategies, was prepared. The activity sheets included instructions clarifying the different roles for students and outlining their required performances. The teacher's guide, PowerPoint presentations, and the activity booklet were presented to a group of curriculum and teaching methods experts, as well as educational technology specialists, for reviewing the scientific content, activities, and ensuring their scientific, linguistic, and technical accuracy. Some modifications were made to the teacher's guide, PowerPoint presentations, and the activity booklet based on the reviewers' recommendations.

#### A. Achievement Test:

The aim of the achievement test was to measure the academic achievement level of biology department students in the content of the Calculus 1 course. Achievement levels



to be measured were identified as recall, understanding, and application. The initial test structure included multiple-choice questions and essay questions based on the content analysis of the course.

Table 1: Correlation table between cognitive levels and the total score of the achievement test

Cognitive level	Correlation coefficient
Remember	0.84**
Understand	0.81**
Apply	0.80**

Note. \*\* significant at the 0.01 level

To ensure the validity of the test, it was initially presented to a group of experts who provided feedback and suggestions for modifications. The researchers made necessary adjustments based on the reviewers' opinions. Additionally, a pilot test was conducted on a sample of 35 mathematics department students at the end of the second semester of the academic year 2022/2023. Correlation coefficients between the cognitive levels and the total score for the achievement test were calculated using SPSS. The correlation matrix (see Table 1) showed statistically significant correlation coefficients for all three cognitive levels (remember, understand, and apply) at the 0.01 level, indicating the test's ability to distinguish between these levels. The test's reliability coefficient (K-R21) was calculated, resulting in a value of 80.0. The test duration was 120 minutes, including 5 minutes for test instructions. Difficulty coefficients for test items ranged from 22.0 to 75.0, and discrimination coefficients were calculated based on item difficulty, ranging from 20.0 to 24.0. The final test comprised 8 multiple-choice questions, 9 fill-in-the-blank questions, and two essay questions, each consisting of 6 items.

#### B. Self-Efficacy Scale in Mathematics:

After reviewing previous studies on the topic of self-efficacy, a self-efficacy scale was developed to assess the level of mathematics self-efficacy among biology department students in the College of Science. The scale covered three domains: mathematical language and its use, mathematical ideas in mathematical tasks, and solving mathematical tasks. The scale, initially presented to a group of curriculum and teaching methods experts, underwent revisions based on their feedback. The final scale included 21 items, with 6 items in the first domain, 6 in the second, and 9 in the third. The total score for the scale was composed of 63 points. The scale's ability to discriminate was verified through its application to a pilot sample of 35 students outside the study sample. The correlation matrix (see Table 2) showed statistically significant correlation coefficients for all three sub-domains and the total score at the 0.01 level, indicating the scale's ability to be considered as a whole with the possibility of using the total score.

Table 2: Correlation table sub-domain scores and the total score for the self-efficacy scale in mathematics

Sub-domain	Total score
Mathematical language and its use	0.85**
Mathematical ideas in mathematical tasks	0.83**
Solving mathematical tasks	0.78**

Note. \*\* significant at the 0.01 level

The reliability coefficient for the scale was calculated using Cronbach's alpha, resulting in a value of 88.0. The scale's duration was 35 minutes, including 5 minutes for scale instructions. The final scale consisted of 21 items.

## Results & Discussion:

### Results of the Achievement Test

To answer the first research question, which is "What is the impact of integrating the LM strategy supported by smart electronic applications and the PT strategy in teaching the Calculus1 course on the development of academic achievement among female students in the College of Science?" the first hypothesis was tested, which states "There is a statistically significant difference between the average scores of students in the experimental group and the control group in the post application of the achievement test in the Calculus1 course in favor of the experimental group due to the teaching strategy." Table 3 illustrates the results of the post application of the achievement test.

Table 3: Results of the post-application of the academic achievement test

Level of achievement	Group	N	Mean	SD	df	t	$\eta^2$																																
Remember	Experimental	30	7.2	1.85	58	3.861**	0.204																																
	Control	30	5.03	3.28				Understand	Experimental	30	9.25	1.90	58	3.468**	0.172	Control	30	7.15	2.65	Apply	Experimental	30	18.68	2.30	58	5.552**	0.347	Control	30	14.75	3.04	Whole Test	Experimental	30	35.20	3.44	58	7.019**	0.459
Understand	Experimental	30	9.25	1.90	58	3.468**	0.172																																
	Control	30	7.15	2.65				Apply	Experimental	30	18.68	2.30	58	5.552**	0.347	Control	30	14.75	3.04	Whole Test	Experimental	30	35.20	3.44	58	7.019**	0.459	Control	30	27.04	5.23								
Apply	Experimental	30	18.68	2.30	58	5.552**	0.347																																
	Control	30	14.75	3.04				Whole Test	Experimental	30	35.20	3.44	58	7.019**	0.459	Control	30	27.04	5.23																				
Whole Test	Experimental	30	35.20	3.44	58	7.019**	0.459																																
	Control	30	27.04	5.23																																			

Note. \*\* significant at the 0.01 level

The results of Table 3 indicate a statistically significant difference at a significance level of (0.01) between the mean scores of students in the experimental group and the control group in the post application of the achievement test in favor of students in the experimental group. This result validates the first hypothesis.

Table 3 shows that the effect size of integrating the LM strategy supported by smart electronic applications and the PT strategy in teaching the Calculus1 course on the academic achievement of female students in the College of Science was large ( $\eta^2 > 0.8$ ). This result is because the value of eta-squared ( $\eta^2$ ) is equal to (0.459) of the total variance of the dependent variable (academic achievement) attributed to the independent variable (integration of the LM strategy supported by smart electronic applications and the PT strategy in teaching the Calculus1 course). Thus, the first research question has been answered.

The previous result can be explained in light of what Al-Qawafina (2010) mentioned, stating that presenting instructional material in a systematic and sequential manner according to the LM approach helps students build concepts and generalizations in an accumulative manner. This includes diagnosing the learning difficulties faced by non-mastery students and providing appropriate remedial activities for them. Moreover, providing enrichment activities for mastery students has a positive effect on understanding and mastering the topics, thereby increasing achievement. In addition, using the technology-supported learning approach makes the learner active, engaged, and involved in the teaching and learning process.

This result can also be explained according to Almansouri (2013), Al-Shahrani and Al-Zoubi (2019), who indicated that PT contributes to improving mathematical skills, especially for those with learning difficulties. It also helps in positive interaction among students, forming constructive and purposeful social relationships in a safe environment. All of the above positively reflects on the level of academic achievement of female students.

The result of the current study can be attributed to what Abu Shaala (2022), Aljarrah (2020), and Shanana and Abu Loum (2021) mentioned, namely that the use of smart electronic applications takes into account individual differences among students, allowing each student to learn at their own pace and in the suitable place for them. Additionally, these applications have gained acceptance and appreciation from students because they learn in a new way compared to the traditional method, arousing their enthusiasm and increasing their learning. The current study's finding is consistent with what Jarrah and Al-Natour (2021) stated, that using smart applications as interactive and exciting tools leads to deep understanding of mathematical concepts and enhances them in students' memory. It increases their enthusiasm and participation in classrooms and helps in increasing knowledge of the studied concepts. Furthermore, this can be explained by what Tetzlaff (2017) stated, that students taught using smart applications are more interactive than students in traditional learning. Smart applications are more attractive, easy to use, and work on increasing the acquisition of mathematical concepts by stimulating the brain through linking it with moving images. This enhances brain capabilities and students' ability to think, infer, and concentrate, ultimately increasing academic achievement for female students.

#### Results of Self-Efficacy in Mathematics

To address the second research question, which is "What is the impact of integrating the mastery learning strategy supported by smart electronic applications and the peer teaching strategy in teaching the Calculus1 course on the development of mathematical self-efficacy among female students in the College of Science?" the second hypothesis was confirmed, which states "There is a statistically significant difference between the mean scores of students in the experimental group and the control group in the dimensional application of the self-efficacy scale in favor of students in the experimental group due to the teaching strategy." Table 4 indicates the results of the post application of the self-efficacy scale in mathematics.

Table 4: Results of the post-application of the self-efficacy scale in mathematics

Sub-domain	Group	N	Mean	SD	df	t	$\eta^2$
Mathematical language and its use	Experimental	30	15.98	1.17	58	9.1**	0.588
	Control	30	12.20	1.921			
Mathematical ideas in	Experimental	30	16.01	1.325	58	8.18**	0.535

mathematical tasks	Control	30	12.58	1.827			
Solving mathematical tasks	Experimental	30	22	2.24	58	6.83**	0.445
	Control	30	14.54	2.706			
Whole Test	Experimental	30	56.80	3.02	58	8.397**	0.549
	Control	30	49.01	3.98			

Note. \*\* significant at the 0.01 level

Table 4 demonstrates a statistically significant difference at a significance level of (0.01) between the mean scores of students in the experimental group and the control group in the post application of the self-efficacy scale in mathematics in favor of students in the experimental group. This result validates the second research hypothesis.

Table 4 shows that the effect size of integrating the LM strategy supported by smart electronic applications and the PT strategy in teaching the Calculus1 course on the development of mathematical self-efficacy among female students in the College of Science was large ( $\eta^2 > 0.8$ ). This result is because the value of eta-squared ( $\eta^2$ ) is equal to (0.549) of the total variance of the dependent variable (self-efficacy in mathematics) attributed to the independent variable (integration of the LM strategy supported by smart electronic applications and the PT strategy in teaching the Calculus1 course). Thus, the second research question has been answered.

This result can be explained in light of what Damen (2022) and Mulungye et al. (2022) mentioned, that using the LM strategy in teaching positively affects achievement and participation, and the learners' self-efficacy grows due to increased confidence that they can learn and achieve mastery. Additionally, using feedback and positive responses from teachers to students enhances the opportunity to develop their self-efficacy in mathematics.

Furthermore, this result can be interpreted in light of what Al-Siraira (2007), Abdelkarim (2008), and Yıldız and Gunduz (2020) stated, that implementing the PT strategy provides positive opportunities for interaction between each student and their peer, where each student is responsible for the success or failure of their peer by achieving the assigned task. Each peer assists their colleague with a lower level of understanding, clarifying anything that is unclear or misunderstood, thereby helping to raise the self-efficacy of the peer with a weaker level. Adopting the PT strategy also helps in increasing harmony among classmates, thereby enhancing the student's confidence by benefiting from their peer, leading to the development of self-efficacy.

The current research result can also be explained in line with what Al-Balwi (2019) indicated, that using smart electronic applications helps in developing self-confidence and motivation, which, in turn, assists in raising self-efficacy among female students in mathematics.

## Conclusion:

The current research aimed to uncover the impact of integrating the learning for mastery strategy supported by smart electronic applications and the peer tutoring strategy in teaching the Calculus1 course on the development of academic achievement and self-efficacy in mathematics among female university students. The results indicated a significant and positive effect of the proposed strategies on enhancing academic achievement and increasing the level of self-efficacy in mathematics among participants.

The current research recommends the importance of utilizing the integration of different teaching strategies, especially learning for mastery and peer tutoring, in teaching university-level mathematics courses, as they have a significant impact on the teaching and learning processes. Furthermore, the research underscores the importance of leveraging and employing electronic applications for smartphones in mathematics education due to their influence on stimulating students' motivation to learn. In this regard, organizing training courses and workshops for university professors to train them in using the learning for mastery strategy supported by smart electronic applications in teaching university-level mathematics courses is essential. Moreover, mathematics courses should include teaching and learning activities centered around the use of smart electronic applications to enhance the teaching and learning processes, along with providing modern technological tools and programs in universities. The current research suggests conducting further future studies to explore the impact of integrating the learning for mastery strategy supported by smart electronic applications and the peer tutoring strategy on other aspects of mathematics education, such as creative thinking, critical thinking, visual thinking, and numerical sense among learners.

#### Ethics Approval and Consent to Participate:

The research was approved by the Ethics Committee of the Imam Abdulrahman Bin Faisal University (IRB Number: IRB-2023-15-556). The research was conducted in accordance with the Declaration of Helsinki.

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