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Professional Research Thesis

Titled

Active Learning Strategies in Mathematics and Their Role in Developing Problem -Solving Skills.

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Supervisor signature

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ACKNOWLEDGMENTS AND DEDICATION

To those whose prayers were the reason for my reaching this position.

To the souls of my mother and father, who departed this world but whose spirits never left my heart.

I dedicate this work to their pure souls, hoping that Allah will place it in the scale of their good deeds.

To my dear sisters, gifts from my mother and father, flowers of my life, and joy of my days.

My support and strength, I present to you the fruit of my efforts and a building block of my aspirations.

Thank you for the love, support, and embrace.

To my esteemed supervisor, Dr. Hagar Refaat, who was my pillar, supporter, and inspiration throughout my academic journey. I extend to you my deepest gratitude and appreciation.

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Introduction:

In the Name of Allah, the Most Gracious, the Most Merciful All praise is due to Allah, Lord of the worlds And peace and blessings be upon our Prophet Muhammad Our teacher and teacher of mankind, and upon his family and companions, the lamps of darkness

"My Lord, expand for me my breast and ease for me my task and untie the knot from my tongue that they may understand my speech" (Quran 20:25-28)

*Education in the **modern era** is considered a dynamic and renewable process that aims to build the learner's personality and develop their intellectual, emotional, and skill-based abilities, enabling them to interact with the variables of contemporary life. This has led to the emergence of new approaches that focus on the active role of the learner within the classroom, as a partner in knowledge construction and a central axis in the educational process, rather than merely a passive recipient. This is known as active learning, achieved through its numerous, diverse, purposeful, and enjoyable strategies that represent a set of teaching methods that actively engage students in the learning process through activities based on thinking, discussion, collaborative work, problem-solving, exploration, and projects.*

These strategies serve as an alternative to traditional methods that focus on rote learning and lecturing, aiming to develop thinking skills, enhance deep understanding, and stimulate intrinsic motivation for learning. Numerous educational studies have confirmed that active learning contributes to improving student achievement and developing critical

thinking skills, creative thinking, communication, and decision-making abilities. Despite emerging in the early twenty-first century, it has become essential to focus on these strategies across various academic subjects, particularly mathematics.

Mathematics is considered one of the core academic subjects that relies on understanding, analysis, and reasoning, preparing learners to face daily life problems in a systematic and organized manner. Among the most prominent skills that mathematics seeks to develop in learners is problem-solving, which is considered one of the highest levels of mathematical thinking. It is the student's ability to understand problems, analyze them, choose appropriate strategies for solving them, and evaluate solutions. Educators emphasize that an active classroom environment represents the appropriate place for training students in effective thinking and developing problem-solving skills.

The study Problem:

The problem is identified through my personal observations as a mathematics teacher, where I noticed a decline in students' performance in mathematics in general, and in solving numerical and verbal problems in particular. Students face difficulty in distinguishing between the four operations due to weaknesses in their prior knowledge. The problem also emerges from the reality of the educational field in general, where reliance on traditional teaching methods prevails, leading to students' aversion to mathematics and perceiving it as rigid, which has negatively reflected on their academic achievement levels. Hence, this research comes to address the use of active learning strategies in teaching mathematics and investigate their role in developing students' problem-solving skills, contributing to raising their academic levels.

Accordingly, the study problem is represented in the following question:

To what extent do active learning strategies in mathematics contribute to developing problem-solving skills?

The importance of studying:

First: Theoretical Significance:

This study derives its importance from addressing a vital topic in the field of education, specifically active learning strategies and their role in developing problem-solving skills, which are fundamental skills in mathematics learning. The study's significance is further highlighted by the following aspects:

1. *It contributes to enriching the educational literature related to the use of active learning strategies in mathematics teaching.*
2. *It provides a comprehensive descriptive analysis of previous studies (2015-2025), which helps researchers and education stakeholders gain an integrated overview of the effectiveness of these strategies.*
3. *It clarifies similarities and differences between the results of previous studies and identifies research gaps, thus opening avenues for more specialized future studies.*

Second: Practical Significance:

The importance of this study lies in providing analytical information and results that can benefit:

1. *Teachers and educational supervisors in gaining a better understanding of active strategies that have proven effective in developing problem-solving skills in mathematics.*
2. *Curriculum planners and educational developers in designing modern mathematical content based on active methods that rely on participation and critical thinking.*

3. *Educational institutions in utilizing the study's results to establish training programs for qualifying teachers to use active learning effectively.*

Objectives of the study:

- *Identifying the most prominent active learning strategies that have been employed in mathematics teaching, as reported in previous studies during the period (2015-2025).*
- *Determining the problem-solving skills that previous studies have focused on, and the extent of the impact of active strategies on their development.*
- *Revealing the points of agreement and disagreement between the results of related previous studies.*
- *Identifying research gaps and shortcomings that have not been adequately covered in previous studies during the specified period.*

Study hypotheses and questions:

Study Questions:

1. *What are the most prominent active learning strategies that have been employed in mathematics teaching during the period between (2015-2025)?*
2. *What is the role of active learning strategies in developing mathematical problem-solving skills as reported in previous studies?*
3. *What are the similarities and differences between the results of previous studies across different educational stages (elementary - middle school - secondary - university - teacher education)?*
4. *What are the research gaps that previous studies have not addressed and that the current research can address?*

Study Approach:

This study is based on the descriptive analytical comparative approach, by analyzing, interpreting and extracting results from previous studies and comparing them without experimental intervention from the researcher.

The limits of the study:

Spatial boundaries: The State of Libya.

Time limits: *This study is limited to analyzing previous studies during the time period (2015-2025).*

Study plan:

The study plan will be organized as follows across several chapters, sections, subsections, and a conclusion:

Introductory Chapter: *Theoretical Framework and Scientific Concepts*

Section One: *Active Learning and Its Strategies*

- *Subsection One: Definition of Active Learning and Its Types*
- *Subsection Two: The Importance of Active Learning in Mathematics Teaching*
- *Subsection Three: Most Prominent Strategies in Previous Studies*

Section Two: *Problem-Solving Skills*

- *Subsection One: Concept of Problem-Solving Skills and Their Types*
- *Subsection Two: Steps for Solving Mathematical Problems*
- *Subsection Three: The Relationship Between Active Learning and Developing Problem-Solving Skills*

Section Three: *Mathematics and Education*

- *Subsection One: Nature of Mathematics as a Subject and Its Importance*
- *Subsection Two: Characteristics of Mathematics Learning and Mathematical Thinking Development*
- *Subsection Three: Challenges Facing Mathematics Learning and Problem-Solving*

Chapter One: *Analysis of Previous Studies*

Section One: *Elementary Stage*

- *Subsection One: Electronic Educational Games*
- *Subsection Two: Project-Based Learning*
- *Subsection Three: Results of Both Studies and Analysis of Their Effectiveness*

Section Two: *Middle and Secondary Stages*

- *Subsection One: Learning Stations*
- *Subsection Two: Flipped Classroom*
- *Subsection Three: Results of Both Studies and Analysis of Their Effectiveness*

Chapter Two: *Analysis of Teachers' Active Learning Practices and Their Impact on Students*

Section One: *Effectiveness of Active Learning on University Students' Achievement and Learning Retention*

- *Subsection One: Description of Active Learning Strategy Used with University Students*
- *Subsection Two: Recommendations from the Study on Active Learning Impact and Current Research in Light of University Students' Results*
- *Subsection Three: Study Limitations and How to Address Them*

Section Two: *Teachers' Active Learning Practices*

- *Subsection One: Concept of Teacher Practices and Their Importance in Developing Problem-Solving Skills*

- *Subsection Two: Results of the Study Addressing Elementary Mathematics Teachers*
- *Subsection Three: Analysis of Teachers' Practice Extent and Its Connection to Other Study Results*

Section Three: *Comparison and General Analysis of Previous Studies*

- *Subsection One: Comparison Between Teacher Practices in Schools and Student Practices at University*
- *Subsection Two: Similarities and Differences Between Previous Studies*
- *Subsection Three: Comparing Current Research with Previous Studies and Extracting Research Gaps*

Conclusion:

This appears to be the conclusion of a comprehensive research study on active learning strategies in mathematics education and their role in developing problem-solving skills. The conclusion effectively summarizes the research journey and findings.

The study demonstrates a systematic approach using comparative descriptive analytical methodology to examine active learning strategies employed in mathematics teaching from 2015-2025. The research structure follows a logical progression from identifying common strategies to analyzing teacher practices, providing a holistic view of the field.

Key findings indicate that active learning strategies like cooperative learning, learning stations, project-based learning, and flipped classroom showed varying degrees of effectiveness in enhancing classroom interaction, developing critical and creative thinking skills, and improving problem-solving abilities. The research also identified implementation challenges including insufficient teacher training, limited resources, and misalignment of some strategies with different educational stages.

The study's methodology allowed verification of some research questions while revealing gaps in others, often related to sample characteristics or methodological limitations in previous studies. This honest assessment of limitations strengthens the research's credibility.

The recommendations are practical and address identified gaps: teacher training on active learning strategies, systematic integration into mathematics curricula, provision of supportive educational environments,

and encouragement of further applied research in diverse educational contexts.

The conclusion acknowledges the study's modest scope while positioning it as a contribution to educational literature that may guide researchers, teachers, and educational decision-makers toward more effective teaching practices. This balanced perspective - recognizing both achievements and limitations - reflects sound academic practice.

The research appears to fulfill its stated objectives of identifying prominent active learning strategies, analyzing related previous studies, and demonstrating their role in developing problem-solving skills among learners.

Results:

These findings present a comprehensive overview of how active learning strategies impact problem-solving skills development across different educational levels. The results show several important patterns:

***Cross-Stage Effectiveness**: The consistency of positive outcomes across elementary through university levels suggests that active learning strategies have broad applicability in mathematics education, though the specific mechanisms may vary by developmental stage.*

***Implementation Gap**: The contrast between demonstrated effectiveness in controlled studies and the moderate level of actual teacher implementation reveals a significant challenge. This gap suggests that while the strategies work when properly applied, translating research into classroom practice requires substantial support systems.*

***Developmental Considerations**: The findings indicate that different strategies may be more suitable for different age groups - elementary students benefiting from games and projects that make abstract concepts concrete, while older students respond well to strategies that promote independence and critical analysis.*

***Sustainability Factors**: The university-level finding about learning retention is particularly noteworthy, as it suggests that active learning not only improves immediate performance but creates more durable knowledge structures that support long-term problem-solving capability.*

***Environmental Dependencies**: The emphasis on teacher and environmental factors highlights that these strategies are not self-*

implementing solutions but require systematic changes in how mathematics education is structured and supported.

However, several questions remain about the generalizability of these findings: Most studies appear to have relatively small sample sizes, and the moderate implementation levels among practicing teachers suggest there may be practical barriers not fully captured in the research settings. The long-term effects beyond immediate post-intervention measurements would benefit from more extensive longitudinal studies.

The research points toward the need for comprehensive teacher development programs and institutional support systems rather than simply introducing new pedagogical techniques.

Recommendations:

- *Training mathematics teachers at various educational stages to effectively use active learning strategies in classrooms, with focus on developing students' problem-solving skills and creative thinking.*
- *Encouraging university faculty to adopt active learning strategies in teaching mathematics courses due to their positive impact on student achievement and enhancing learning retention.*
- *Integrating diverse active learning strategies such as electronic educational games, project-based learning, flipped classroom, and learning stations within curricula, while considering students' abilities and interests.*
- *Linking teachers' practice of active learning strategies to professional incentives such as promotions or bonuses to ensure sustainable implementation and improve education quality.*
- *Monitoring actual implementation of strategies within schools and universities and periodically evaluating their impact on achievement and developing problem-solving skills.*
- *Encouraging universities and colleges of education to include practical courses for training students to employ active learning strategies in mathematics teaching and developing problem-solving skills.*

- *Exploring and using modern educational tools and technologies such as augmented reality and educational simulation to support active learning and improve students' problem-solving results.*
- *Conducting future studies to evaluate the impact of different active learning strategies on developing students' problem-solving skills across different educational stages, with focus on each strategy's effectiveness in diverse educational contexts.*

The reviewer:

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