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MALMATH: A COMPUTER-ASSISTED MATHEMATICS PROBLEM SOLVING SOFTWARE FOR STUDENTS' COGNITIVE DEVELOPMENT

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ABSTRACT

Technology is changing the way that educators educate and how students learn in the ever-changing educational environment. This research explores the use of technology in mathematics education, emphasizing the ways in which devices such as laptops and mobile apps might improve instruction. Teachers are pushed to employ digital media, which is becoming more and more ingrained in students' lives, to improve the effectiveness and engagement of their lessons.

Numerous advantages come with using technology in mathematics education, such as creative ways to convey difficult ideas and chances for active learning. It helps with the comprehension and recall of mathematical concepts by acting as a motivating and educational tool. The study places a strong emphasis on using MALMATH, a smartphone app that improves students' problem-solving skills by providing them with detailed answers and graphical representations for arithmetic problems.

However, tests like PISA demonstrate that a large number of students still find mathematics difficult, with many having difficulty grasping fundamental concepts. In order to solve these issues, this study uses technology to produce interesting learning materials that are suited for digital natives. The project intends to improve mathematical success and cognitive development by combining native language preferences with mobile technologies.

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The results demonstrate how much MALMATH enhances students' performance in thinking, knowing, and solving problems. To help with the integration of MALMATH into mathematics education, an instructional guide was created. It offers suggestions for using MALMATH as an introduction tool, lesson extender, problem-solving incentive, and means of fostering stronger ties between the home and the school. The study suggests looking into the use of MALMATH in additional critical thinking-intensive topics. Future research should continue to explore its potential to enrich mathematics and related disciplines.

Keywords:

To aid in the study's comprehension, the following terms are operationally defined:

Cognitive is a mental action or process that involves using thought, experiences, and senses to acquire information and understanding. Fundamentally, it pertains to the capacity to perceive, respond, process, comprehend, retain, and effectively react to information.

Educational technology refers to technology that, typically, helps to facilitate cooperation in an atmosphere of active learning. Teachers can use educational technology to make digital, interactive textbooks, gamify lessons, collect attendance, give homework assignments, administer quizzes and examinations, and get immediate feedback on their lesson plans, delivery methods, and content.

Instructional guide refers to a creative work that incorporates textual and visual elements. It accompanies the Localized Game, Game Cards, or similar materials and is primarily intended to provide instructions or guidance to the player of the Localized Game, specifically regarding the gameplay contained within it.

Judging is the abilities and cognitive resources that empower students to make proficient decisions in critical situations or dilemmas encountered while solving mathematical problems.

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Knowing refers to a branch of mathematics that fosters logical reasoning and cognitive rigor, while also providing a valuable approach for cultivating mental discipline.

MALMATH is a math program that answers the problems you give it while providing you with a graph view and a step-by-step breakdown of how it did it. The application of mathematical methodologies, including integrals, trigonometry, limits, derivatives, logarithms, equations, and algebraic operations, facilitates the resolution of diverse problem sets.

Problem solving is the process of delineating a problem, ascertaining its root cause, discerning, ranking, and selecting prospective solutions, and subsequently implementing said solution.

Remembering refers to students' cognitive domain identifying the steps to solve, factor, evaluate, etc in mathematics problems.

Thinking refers to the term "students' cognitive domain" pertains to the mental processes and abilities that students employ when engaging in mathematical activities such as exploration, questioning, systematic problem-solving, visualization, making conjectures, providing explanations, formulating generalizations, justifying claims, and proving mathematical concepts.

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INTRODUCTION

In learning, technology is used almost daily. Because knowledge transfer has become a common practice in many countries, it benefits educators and students. Today's breakthroughs and revolutionized civilizations have changed how people think, work, and live as a result of technology integration. The coming of the computer revolution, according to Etcuban (2019). A computer is a technology that can be used in the mathematics classroom in a variety of ways. It may be a tool for improving the efficiency of idea, skill, and problem-solving learning in comparison to conventional practice. Technology can be transformative in the hands of excellent teachers. It cannot function on its own, but if a skilled and knowledgeable instructor uses it, learning would be meaningful. For students to learn effectively, the teacher must employ various technological manipulation or transformation tactics. Almost every aspect of modern life has been impacted by innovation, and education is no exception.

With the advent of technology, classroom teachers are doing its best to support learning through technology. Technology is an incredible motivator, exploratory tool, and instructional tool for students. Teachers, as the ultimate users of such technology, must also be considered, a must the foundation, which includes necessary assistance, training, and so forth.

The lives of contemporary students are predominantly influenced by digital media and technology. The subject matter encompasses various dimensions of connectivity. There is a common assertion that the individuals in question are often identified as millennials or digital natives, who possess diverse educational expectations. There is a notable observation that learners exhibit a keen interest in utilizing technology. The individual's curiosity serves as a driving force behind their exploration of this particular technology, potentially leading to its utilization.

Teachers now have more resources at their disposal to aid students in understanding mathematical ideas, and students of all academic levels can benefit from a

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balanced approach that combines classic and cutting-edge teaching techniques. Technology is important for both teaching and learning mathematics because it changes curriculum and enhances student learning. Mathematics is not only a subject; it also has a lot of practical uses. As a result of this study, students will get some fundamental knowledge, talents, and life skills that will enable them to make a meaningful contribution to society. In spite of the usefulness of Mathematics, the students find Mathematics a very difficult subject. According to the Programme for International Student Assessment (PISA), a significant number of students at the age of 15 in UNICEF-supported nations struggle to acquire fundamental numeracy abilities. More than half of children, or over 1.3 billion kids, in the majority of these nations do not perform at the required level in mathematics, (OECD, 2023).

Technology-related changes in mathematics have been called for for a while now. Teachers can connect classroom materials with useful and developmentally appropriate tasks that students can engage in by utilizing resources like computers, calculators, and other technology in addition to concrete materials. For example, using technology to learn mathematics can encourage students to engage in more active mathematical practices like thinking, knowing, remembering, judging and problem solving.

Based on learners' preferences, once it is suitable, the teacher employs technology presenting her lessons. The teacher makes advantage of cellphones by integrating them into the classroom. In some lessons, there are android apps. The selection of applications is contingent upon their ability to assist students in comprehending the material. As a consequence of this, students will acquire an enhanced comprehension of the educational significance of mobile phones. There exist a multitude of freely accessible offline applications that can be effectively employed in the facilitation of teaching and learning. One such application is MALMATH. The aforementioned program is particularly relevant during the initial quarter of Mathematics 8 lectures, as it focuses on the topic of simplifying algebraic expressions. It is anticipated that the adoption of mobile technologies will be as widespread as the diverse range of perspectives on their impact on education.

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Computer-assisted education is one of the greatest gifts of the digital age. Information retention and comprehension can be improved by computer-assisted education. With the aid of computers, education has become more engaging. In a public school like, Gen. Pio Del Pilar National High School that caters students who are primarily from marginalized families, who are victims of broken families, working students, or self-sufficient, It could be helpful to develop an instructional resource that individuals can access remotely, aiming to persuade them that the study of mathematics is not as tedious as they previously perceived.The advent of computer-assisted education has led to an increased level of autonomy among students, thereby reducing their dependence on teachers and traditional forms of instruction. MALMATH is a computational tool designed to assist users in solving mathematical problems. This program not only provides solutions to problems but also offers a detailed, sequential explanation of the steps involved. Additionally, MALMATH includes a graphical representation of the problem, enhancing the user's understanding and visualization of the mathematical concepts involved. The utilization of this mathematical tool enables the resolution of various mathematical problems, including but not limited to integrals, trigonometry, limits, derivatives, logarithms, equations, and algebraic equations. In this time of pandemic, students might rely on the computer assisted app to make sure that their answer is correct. This mathematical application could enhance the confidence of the pupils in responding mathematical problem solving and helps to strengthen their cognitive component.

According to multiple research studies, the deliberate utilization of technological tools can effectively facilitate the acquisition of mathematical procedures and skills, while also fostering the cultivation of advanced mathematical proficiencies, including problem-solving, reasoning, and justification. Watson et al. (2015) asserts that the integration of technology within secondary mathematics instruction has been shown to enhance student engagement and academic achievement. There exists a substantial body of evidence indicating an increasing prevalence of mobile technologies in the realm of education.

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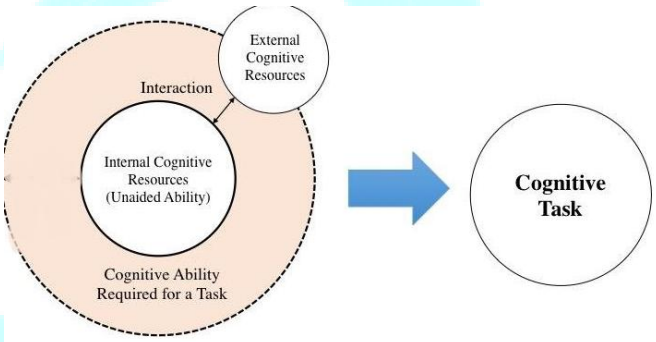
As a result, the goal of this study was to combine students' taste for using mobile phones and their desire to learn Mathematics in their native language into an educational material that would pique their interest. The purpose of this study was to see how successful MALMATH is as a computer-assisted Mathematics Problem Solving software for kids' cognitive development, retention, and math achievement.

Theoretical Framework

This study is anchored with Edward Hutchins' Distributed Cognition Theory (1995) as reflected in Figure 1. The distributed cognition approach is primarily concerned with the function of the cognitive system and aims to understand how learners configure the environment in order to accomplish a task in the system (Xu & Clarke, 2012).

Figure 1

Theory of distributed cognition



According to Xu & Clarke (2012), the student possesses the ability to learn. (1) Internal Cognitive Resources - this term refers to an individual's acquired knowledge or skills. (2) External Cognitive Resources - artifacts of technology, such as devices, technology, and media (3) Interaction - learners interact within a well-structured learning environment. (4) Cognitive Ability Required for a task - cognitive application of the manipulatives necessary for learning. (5) Cognitive Task - This phase illustrates that cognition is a product of the learner's cognitive capabilities enhanced by the utilization of external technology. This

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educational theory advocates for the cultivation of skills essential for the contemporary era, encompassing critical thinking, knowledge acquisition, memory retention, evaluative discernment, and effective problem-solving. In a learning environment that is based on this theory, learners will apply their "knowledge and skills—by thinking critically, remembering concepts, judging and applying knowledge to new situations, analyzing information, comprehending new ideas, communicating, collaborating, solving problems, and making decisions.".

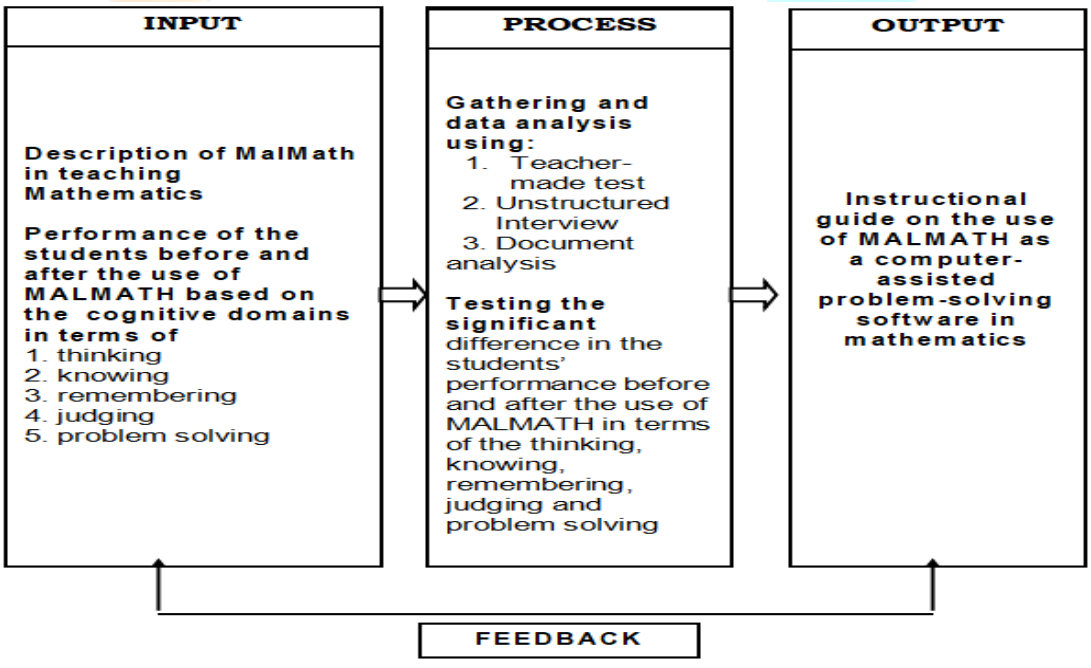
Outside of school, innovation has become an increasingly important part of students' lives, and it can also assist them in comprehending complex concepts or enabling peer collaboration within the classroom.

Conceptual Framework

Figure 2 presents the research paradigm showing the interrelationship among the variables used in this study.

Figure 1

Conceptual Framework



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It shows the interrelationship of the different variables used in the study wherein it consists of three stages, the INPUT, PROCESS and OUTPUT and at the end there is a feedback from the input going to have the output. On the Input, there is a a description of MALMATH in teaching Mathematics as well as the performance of the students before and after the use of MALMATH based on the cognitive domains in terms of thinking, knowing, remembering, judging and problem solving. On the Process, there is a gathering and data analysis using the first, teacher-made test, second the unstructured interview and last is the document analysis. Also, in this part there is a testing on the significant difference in the students' performance before and after the use of MALMATH in terms of thinking, knowing, remembering, judging and problem solving. On the last part which is the Output, there is a development of instructional guide on the use of MALMATH as a computer assisted problem solving software in mathematics.

The primary objective of the feedback loop is to discern and pinpoint areas within the MALMATH system that necessitate enhancement, thereby contributing to its overall advancement. The purpose of the assessment and learning process is to enhance a student's proficiency in utilizing the software. The provision of feedback is crucial in order to offer the researcher's perspective on areas that require improvement.

Statement of the Problem

The study aims to describe the use of MALMATH as a computer-assisted problem-solving software in mathematics among Grade 8 Junior high school students during the SY 2021-2022.

It specifically aims to provide answers to the following questions:

1. How can MALMATH be described in teaching Mathematics in terms of:

1.1 characteristics,

1.2 use or functions, and

1.3 applications?

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2. What is the performance of the students before and after the use of MALMATH based on the following cognitive domains:

2.1 thinking,

2.2 knowing,

2.3 remebering,

2.4 judging, and

2.5 problem solving?

3. What is the difference between the students' performance before and after the use of MALMATH in terms of the aforementioned variables?

4. What instructional guide can be developed on the use of MALMATH as a computer-assisted problem-solving software in mathematics?

Hypothesis

This study tested the hypothesis that there is no significant difference between students' performance before and after the use of MALMATH as mathematics computer-assisted problem solving software in terms of thinking, knowing, remembering, judging and problem solving.

Scope and Delimitations of the Study

The purpose of this study is to investigate the cognitive process development among Grade 8 students in Gen. Pio Del Pilar National High School, located in the division of Makati, during the school year 2021-2022 as they solve mathematical problems using the MALMATH application.

This study is limited only to forty (40) Grade 8 students and ten (experts) , students is under the supervision of the researcher.The study was conducted during the third quarter of Academic Year 2021-2022. The Researcher used multiple choice of test wherein the questions are solving with a multiple choice type of test.

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The focus of the study does not encompass all subject matter within the domain of Grade 8 Mathematics. The coverage of the First Quarter is narrowly focused on a specific topic.This tutorial demonstrates the process of converting the linear equation Ax + By = C into the slope-intercept form y = mx + b, and vice versa. It also provides guidance on solving problems that involve linear equations in two variables and linear inequalities. Furthermore, it serves as a visual representation of the rectangular coordinate system.

Significance of the Study

The study may provide benefits to the following groups:

Mathematics teachers may be provided with meaningful and reliable data on students' current state of mathematics problem-solving ability that can be used as basis in developing learning activities and creating an environment that may help junior high school students improve their academic performance.

Students may be provided information as to the necessary skills for mathematics problem solving.

School administrators may **i**ncrease their understanding on the application of educational technology and, consequently, their readiness to take on liability for offering these educational teaching tools to students and instructors.

Parents may be afforded data who are doing everything possible to assist their children in overcoming difficulties with math problems special in this time of Pandemic.

Curriculum writers may use the findings of this study as a guide for them to understand how to use educational technology, and some of the topics in mathematics will be aligned to it.

Future researchers may find the benefits and drawbacks of collaborating with schools can assist researchers in establishing effective school partnerships for the conduct of mathematics research.

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Future researchers should consider a variety of strategies for rescuing students from their current plight.

REVIEW OF THE RELATED LITERATURE

This chapter presents the conceptual literature and studies related to the computer-assisted mathematics problem solving software for students' cognitive.

Technology integration

In learning, technology is used almost daily. Because knowledge transfer has become a common practice in many countries, it benefits educators and students. Today's breakthroughs and revolutionized civilizations have changed how people think, work, and live as a result of technology integration. The coming of the computer revolution, according to Etcuban (2019). A computer is a technology that can be used in the mathematics classroom in a variety of ways. It might be a tool for improving the efficiency of idea, skill, and problem-solving learning in comparison to conventional practice. Technology can be transformative in the hands of excellent teacher. It cannot function on its own, but if a skilled and knowledgeable instructor uses it, learning would be meaningful. For students to learn effectively, the teacher must employ various technological manipulation or transformation tactics. Almost every aspect of modern life has been impacted by innovation, and education is no exception.

According to the National Council of Teachers of Mathematics, the integration of technology into mathematics education is imperative in the current era, necessitating that educational institutions guarantee universal student access to such tools. (NCTM, 2018). Technology can be used effectively by teachers to increase student engagement, understanding, and mathematical proficiency. All students can have access to mathematics with the right use of technology.

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According to the results of several studies (Gadanidis & Geiger; Pierce & Stacey, 2015), the deliberate utilization of technical resources has the potential to foster the acquisition of mathematical knowledge and abilities, it aids in the cultivation of advanced mathematical abilities, including logical reasoning, problem-solving, and the ability to provide justifications.. It has been shown that incorporating technology into secondary mathematics courses improves student engagement and performance, according to Watson et. al (2015). There is a lot of proof that mobile technology are becoming increasingly common in education. Mobile technologies are being used more frequently in the developed world in a variety of fields, such as how to use portable devices for fundamental language, skill, numeracy, health and safety training, as well as some aspects of teaching and learning, as well as context-related education in both developed and developing nations. By enabling many institutions to set up student and administrative support as well as learning opportunities in ways that complement current practices, handheld technologies offer a substantial opportunity to expand learning access.

Technology use in schools and at home has risen dramatically in the twenty-first century. Technology's current role has evolved from purely entertaining to being a crucial tool for classroom learning. Computers, smart boards, smart pens, and calculators represent various technological tools employed within educational settings. The aforementioned technological advancements are of significant importance within the field of education, specifically in the instruction of science, technology, engineering, and mathematics (STEM) disciplines. Their purpose is to enhance students' opportunities to engage with and learn mathematics and science. (CCSSM, 2015; NCTM, 2018). These tools, in particular, help pupils understand the underlying principles in mathematics and improve their reasoning abilities (NCTM, 2018).

Innovation has had a big impact on education. It has greatly increased access to education. Innovation has also increased the number of avenues for communication and collaboration. Additionally, it has begun to alter how students and teachers carry out their duties. For instance, in a typical study hall, the teacher serves as the main source of

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information, and the students latently absorb it. The teacher steps in since the sage on stage has been receiving training for a while and is still mostly receiving proof at this time. However, given the access to information and educational opportunities that innovation has enabled in many classrooms, we see the educator's role shifting to the tutor as an afterthought. Students who use technology to collect pertinent information bear increased responsibility for their study. (Munter,et al)

Teachers are currently given more resources at their disposal to aid students in understanding mathematical ideas, and students of all academic levels can benefit from a balanced approach that combines classic and cutting-edge teaching techniques. Technology is important for both teaching and learning mathematics because it changes curriculum and enhances student learning. Mathematics is not only a subject; it also has a lot of practical uses. As a result of this study, students will get some fundamental knowledge, talents, and life skills that will enable them to make a meaningful contribution to society. The effective and coordinated use of innovation has an impact on all aspect of mathematics education, including what is taught, how pupils learn it, and how it is assessed (Jimenez, & Staples, 2015)

The most important thing is to pique the interest of today's students. Being a teacher is a difficult task, especially in many people consider mathematics to be the most thought-provoking course. Teachers, on the other hand, are more likely to create engaging teaching materials that capture students' attention. Choosing the right instructional material is critical when planning a lesson because it is so significant in the teaching-learning process. It is undeniable that the twenty-first century is the era of technology in terms of bridging learners. The fact that virtually everyone uses technology in their daily lives as if it were an integral part of their system is another indication that it must be integrated into education (Turan, & Goktas, 2016)

An abundance of data exists in contemporary society that effectively conveys fundamental mathematical concepts through diverse forms of representation. The progress in technology has facilitated the development of unconventional, multi-

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dimensional graphical depictions that are not optimally presented on a two-dimensional medium such as paper, according to Angott (2017),

Mobile learning through smartphone applications has shown to be effective in a number of settings, including science education. Previous research has demonstrated that the utilization of mobile phones, Personal Digital Assistants (PDAs), tablets, and other electronic devices can effectively accomplish a range of educational objectives in both formal and informal learning settings. This enables users to capitalize on the adaptability and personalized learning opportunities afforded by technology..The utilization of mobile applications in the field of education, specifically in science education, has demonstrated several noteworthy findings. Firstly, it has proven to be efficacious in augmenting students' learning experiences. Secondly, it is deemed pertinent and consequential as a burgeoning approach to learning, considering the current challenges faced by higher education. Lastly, students have exhibited favorable attitudes and perceptions towards the adoption and utilization of such technology for educational purposes. The knowledge base around the use of mobile applications to assist science learning must be continually expanded, nevertheless, in order to advance science education and enhance student learning in a contemporary setting. Problem solving and critical thinking skills are necessary for the complex society of the twenty-first century (Dias, L. 2017).

Graduates who want to tackle the unique challenges provided by changing cultures as they embrace new relationships in the community and workplace must possess deeper capacities than simply applying skills obtained through memorization. In order to effectively impart these skills, educators must modify their instructional approaches.

Mathematics is a discipline that necessitates the application of problem-solving techniques, critical thinking skills, logical reasoning, and the integration of technology in order to achieve success. The utilization of technology to facilitate education and foster the development of higher order skills represents a notable progression in the field of education (Saavedra & Opfer, 2012). Through the utilization of technology, students have the ability to apply their skills in various contexts, engage in introspection regarding their

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own and their educators' instructional approaches, and participate in cooperative learning with their peers. To cooperate with peers, understand their thinking, and practice clearing up misconceptions, Saavedra & Opfer .However, depending on the situation, different technologies are emphasized and integrated in the teaching and development of high-order arithmetic skills .

The primary aim of Lanchita's (2019) study was to establish a correlation between the utilization of Math Apps by senior high school students at Spring Integrated School (SIS) and their academic achievements. The primary instrument employed by the researchers for data collection was a custom-designed questionnaire.The subject matter was divided into two distinct sections. In the first section of the study, participants were asked to provide their perspectives regarding the utilization of mathematics applications. The second section of the study involved the administration of a questionnaire to senior high school students, aiming to assess the frequency of their engagement with mathematics applications.

To elucidate the perceptions of senior high school students regarding the utilization of math applications for the purpose of learning mathematics, this study aims to examine the aspects of routine learning, independent learning, collaborative learning, and outdoor mathematics., as well as the extent to which they use these apps and their math academic achievement, the researcher employed a descriptive-correlative methodology.

The obtained p-value of 0.0498 suggests that there is a statistically significant difference between the utilization of math applications and the level of academic achievement as perceived by senior high school students at Spring Integrated School. The findings align with the research conducted by Zhang (2015), which demonstrated that students exhibited significant improvement in their performance on assessment 3 after engaging with the lengthy multiplication app for a duration of one hour ($t(16) = 2.889$, $p < .05$). The mean score exhibited a 15% increase, rising from 7.7 out of 15 on the pre-test to 9.9 on the post-test. The findings indicate that there is a positive perception among senior high school students regarding the use of math apps for learning mathematics, as

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evidenced by the overall weighted mean score of 3.87. The Integer Free application exhibited the lowest mean usage volume of 4.10, while the Math Calculator application displayed the highest mean usage volume of 4.79. These findings indicate consistent and frequent usage pattern, respectively, in math apps. Its weighted average as a whole was 4.19, which was reflected frequently. Academic achievement is quite excellent for students. There were 34.92 percent unfinished, 47.62 percent very satisfactory, 12.70 percent satisfied, 4.766 percent fair, and 0 percent failed, respectively.

Usage of Computers

At home. The utilization of computers by students in their home environment has been found to have a diverse range of impacts on their performance in arithmetic. For instance, a study conducted in Germany found no significant association between the utilization of home computers by 15-year-old students and their level of proficiency in arithmetic. "The knowledgeable users, the sensible users, the recreational users, and the indifferent users," the writers recognized four different user profiles. The smart users were comfortable and enthusiastic about using computers, and they spent most of their time word processing, looking for homework help, playing games, performing research, and talking with others. The sensible and recreational users, on the other hand, had less overall interest in using computers at home, although they were still entertaining to some extent. The leisure users enjoyed viewing movies, playing video games, and listening to music (Dias, L. 2017)

In school. The volume and type of computer use by kids in school varies, as do the links between computer use and math achievement. Based on the findings of the 2011 National Assessment of Educational Progress (NAEP), it was observed that a majority of eighth-grade students, specifically 76%, in the United States never or seldom used a computer for math instruction at school. Students may use computers at school for the following purposes: first, the production software, such as Inan et. al (2012) identified four categories of software: The software applications encompass various functions, such as word processing, spreadsheet analysis, graphic design, presentation creation, content

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creation, concept mapping, and planning. Additionally, the user can utilize internet browsing software, CD-based reference materials, and communication tools for research purposes. Lastly, educational software, including drill-practice-tutorial, problem solving, and process software. Computer use in the classroom can help kids succeed in math, but it can also make classroom management difficult for teachers. Eyyam and Yaratan discovered that using technology in the classroom improved secondary school students' math achievement and attitudes. In their meta-analysis of 46 studies, Li and Ma (2011) demonstrated significant positive effects of computer technology on students' mathematics achievement in K-12 classrooms in the United States. The influence of students' computer usage on mathematics performance was found to be more pronounced in elementary school students compared to their secondary school counterparts. In contrast, a negative correlation was found between the utilization of technology and the academic performance in mathematics among middle school students. In summary, the utilization of computers for mathematics education in schools has the potential to yield positive outcomes for students. However, it is important to note that the specific activities selected may also have adverse effects on student behavior. According to McKnight and colleagues, the researchers focus on students' computer use and the linkages to their learning in these investigations. However, these results do not explain the cognitive abilities that computer use at school provides.

MALMATH

MALMATH is a computational tool designed to solve mathematical problems, offering users a graph view and providing detailed step-by-step explanations. The work is not compensated. Students who encounter challenges with their assignments, as well as those who observe their peers facing similar difficulties, can derive advantages from gaining a comprehensive understanding of the problem-solving process. Individuals in secondary education and tertiary institutions, educators, and guardians can all benefit from it.

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MALMATH is an Android app that can provide graphic analysis and step-by-step answers to math issues. Simply enter a math problem and click the "solve" or "click" button to utilize the software. According to PISA (Program for International Student Assessment), many 15-year-old students in UNICEF-supported nations struggle to acquire fundamental numeracy abilities. More than half of the students, or around 1.3 billion students, fail to achieve the required level of proficiency in mathematics in the majority of these nations (OECD, 2023).

Math is taught at every level of our educational system, from primary schools to universities, due to its unavoidable practical applications. Everyone needs help occasionally with math issues, whether they are math professionals or novices. So, in the absence of a teacher or friend who could be a beneficial source of support, we can ask the pervasive Internet for advice or use the manuals available in book stores. The brand-new math-solving program was known as MALMATH.

MALMATH'S key feature is that it shows the user the steps needed to solve each problem after it has been resolved. MALMATH offers additional sub-steps because he is aware that certain people don't comprehend concepts as quickly as others. Up until the most thorough explanation a user may require, even the sub-steps may contain further stages.

Students can plot functions in MALMATH depending on the problem, it will either draw the function or fill the region. Additionally, because several functions are enabled, students can simultaneously plot two different functions and contrast the resulting graphs. MALMATH will also analyze the graphs in addition to that. This indicates that it will display to students a table of intervals from the domain to the inflection points.

The key objective of MALMATH is to give students thorough solutions to math problems in a way that helps them comprehend the process of solving the problems. Its main goal is to teach pupils how to solve math problems rather than to solve every single problem. The following are the skills that were enhanced integrating technology such as MALMATH in mathematics:

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Remembering. Like other taxonomies, Bloom's Taxonomy uses a hierarchical learning strategy. It is justified by the notion that learning at higher levels requires having acquired the required skills and information at lower ones. A pyramid-shaped diagram of Bloom's Taxonomy is frequently used to represent this structure. If you picture it as a cake, it emphasizes how each level is constructed on the foundation that was established by the levels before it. This pyramid has evolved throughout time as well. The Revised Bloom's Taxonomy emphasizes students' learning outcomes by employing complex language. The updated taxonomy is a revision of BLOOM'S TAXONOMY, published in 1956 and focusing on cognitive capacities and learning behavior. In place of nouns like "evaluation" or "synthesis," verbs like "create" or "evaluate" are now commonly utilized. Six levels are highlighted: recall, comprehension, application, analysis, evaluation, and creation. Calculation-related examples of cognitive levels include memorizing how to solve, factor, evaluate, etc.

Thinking. Investigating, speculating, methodically working, visualizing, speculating, explaining, generalizing, justifying, and proving... are all fundamental to mathematical thought. These groups of exercises are made to improve your ability to function as a mathematician. What are the constituent elements of mathematical thinking? The five key areas upon which they were founded include: representation, reasoning and proof, communication, problem solving, and connections. The reason for the recognition of these standards may stem from their alignment with the five process standards established by the National Council of Teachers of Mathematics. (NCTM, 2011). Understanding and managing the scope and limitations of a given concept are part of the mathematical thinking competency, as are asking questions that are characteristic of mathematics and being aware of the types of solutions that mathematics may provide. Extending the scope of a concept by abstracting and generalizing results is another.

Problem solving. The significance of problem-solving in mathematics education arises from the concept that mathematics primarily revolves around logical reasoning rather than rote memorization. Students have the capacity to acquire problem-solving

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abilities, which surpass the mere act of memorizing and adhering to a predetermined set of instructions. By engaging in problem-solving activities, students have the opportunity to enhance their comprehension of mathematical concepts, foster greater involvement in the subject matter, and recognize the significance and practicality of mathematics. The utilization of mathematical problem-solving techniques can facilitate the enhancement of students' capacity to effectively structure and arrange knowledge, scrutinize information, and engage in critical, creative, and rational thinking (Tambunan, 2019).

Judging. When solving mathematical problems, students often face difficult decisions that require sound judgment. Judging skills are the faculties and mental tools that help them do this. These capabilities can be utilized to formulate subjective assessments, meticulously assess options, evaluate and prioritize factors, and reach conclusions. Students who possess the ability to exercise sound judgment frequently encounter less difficulty in resolving challenges (Amalric, & Dehaene, 2019).

Knowing. Due to its capacity to foster logical reasoning and cognitive rigor, mathematics serves as a valuable instrument for cultivating mental discipline. A comprehensive comprehension of mathematics is imperative for acquiring knowledge in various academic domains, including physics, social studies, as well as music and art.

Computer-assisted education is one of the greatest gifts of the digital age. Information retention and comprehension can be improved by computer-assisted education. With the aid of computers, education has become more engaging. In a public school like, Gen. Pio Del Pilar National High School that caters students who are primarily from marginalized families, who are victims of broken families, working students, or self-sufficient, developing an instructional resource that individuals can utilize for self-study may yield advantageous outcomes, as it has the potential to persuade them that the process of acquiring mathematical knowledge is not as tedious as they had previously perceived. The advent of computer-assisted education has led to an increased level of student autonomy, thereby reducing their dependence on traditional teaching methods and in-person instruction. MALMATH is a mathematical software application that offers problem-solving

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capabilities along with comprehensive step-by-step explanations and a graphical representation of the solution. The utilization of this mathematical tool enables the resolution of various mathematical problems, including but not limited to integrals, trigonometry, limits, derivatives, logarithms, equations, and algebraic equations. In this time of pandemic, students might rely on the computer assisted app to make sure that their answer is correct. This mathematical application could enhance the confidence of the pupils in responding Mathematical problem solving and helps to strengthen their cognitive component

As a result, the goal of this study was to combine students' taste for using mobile phones and their desire to learn Mathematics in their native language into an educational material that would pique their interest. The purpose of this study was to see how successful MALMATH is as a computer-assisted Mathematics Problem Solving software for kids' cognitive development, retention, and math achievement (Utami, et al. 2020)

Mathematics Problem Solving

Reasoning in mathematics in mathematics, reasoning is defined as "the ability to abstract a given situation and represent it symbolically...considering the units involved; paying attention to the meaning of quantities" (CCSSM, 2011). Students should be able to "create and analyze mathematical conjectures, generate and evaluate mathematical arguments, and select and employ diverse types of reasoning," according to the NCTM reasoning and proof standard (NCTM, 2011). The development of reasoning skills is a significant and beneficial outcome of mathematics education due to its inherent linkages to students' capacity for logical and systematic thinking (Mullis et al., 2015). According to Mullis et al. (2012), reasoning can be defined as the cognitive aspect of mathematical learning outcomes. This encompasses various abilities such as generalization, integration, justification of conclusions, and the ability to solve non-routine problems. Indeed, in mathematics, logical justificationIncreasing student understanding of certain mathematics while also allowing them to apply content-specific knowledge in a variety of ways.

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Computer technologies play a crucial role in various curriculum strands of mathematics by facilitating students' engagement in decision-making, reflection, reasoning, and problem-solving activities (NCTM, 2014). Furthermore, incorporating technology into the classroom enables for greater access to information, instructor help, and engagement with peers and virtual communities. Sethi, & Jalandharachari, (2012) discovered that using computer technology to teach kids in Turkey encouraged them to think rationally and solve problems. The findings of these studies back up the idea that using computers to learn arithmetic is linked to mathematical reasoning. However, in the contemporary technological era, it is necessary to investigate whether these = correlations hold across different cultural contexts.

Cognitive Resources

Self-regulated learning (SRL) is a multifaceted construct that involves the interplay of various control systems, including cognition, attention, metacognition, emotions, motivation, and volition. Various cognitive and affective processes that all include integrating information processing and control are said to make up self-regulation, according to the research. Despite the fact that there has been a lot of study on how motivation and affective factors affect arithmetic performance as well as the effects of working memory and attentional systems, Educational psychology research often overlooks the significance of individual variations in working memory capacity (WMC) and attentional resources as micro-processes of self-regulated learning (SRL) (Boekaerts, 2017). The existing body of cognitive literature indicates that working memory capacity (WMC) may provide an explanation for the availability of different resources within a specific learning environment, contingent upon the goals of the student(s). In contrast, executive attention (EA) may contribute to the maintenance of focus. The primary focus of this study pertains to the associations between cognitive processes and elements of self-regulated learning. It aims to examine their impact on arithmetic performance in a

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broad sense, as well as the processing and outcomes associated with different types of objects, taking into account their complexity and difficulty characteristics.

Cognitive Task

Extensive scholarly inquiry has been conducted to examine the influence of working memory, attention, motivation, and learning strategies on mathematical achievement and overall self-regulation. The full extent of the influence of these factors on performance, the ways in which they are interconnected, and the specific contributions they make to the prediction of mathematical performance are not yet fully understood. Currently, advancements in procedures and technology have facilitated the ability to analyze the aforementioned impacts. This includes the utilization of predictive systems for modeling purposes. Consequently, methodologies that incorporate diverse datasets, encompassing student characteristics, have emerged as a means to forecast future performance. Notably, these methodologies eliminate the need for traditional testing. The academic performance of students has been found to be associated with their future development outcomes, including higher educational attainment, improved employment prospects, and enhanced socioeconomic status. In conjunction with various other academic proficiencies, mathematics has been acknowledged as a pivotal aptitude in the realm of global leadership, as well as for individuals seeking careers in the fields of science, technology, and engineering. There has been a deliberate endeavor to develop executive function (EF) training programs with the aim of enhancing students' EF skills and academic performance. Moreover, there exists a correlation between executive functions (EF), which refer to the ability to regulate and oversee one's actions and thoughts, and the attainment of academic achievements. Consequently, instructional programs have been devised with the aim of enhancing children's mathematical proficiency owing to the favorable consequences observed. The present investigation investigated the effectiveness of a computerized training program designed for students, which encompassed exercises targeting working memory as well as math games. There are two notable benefits

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associated with the utilization of computer-based training programs in educational environments. Firstly, the implementation of such programs is characterized by a high degree of simplicity. Secondly, these programs offer the advantage of easily adjusting the complexity of tasks to align with the individual child's level of ability. The examination of children's cognitive abilities, specifically executive functions (EF) and intelligence quotient (IQ), along with their academic performance in terms of grades and proficiency in subjects such as mathematics and language, has led to a focused endeavor in developing EF training programs. These programs aim to improve students' executive functions and subsequently enhance their academic achievements. The findings indicated that the participation of children in the program resulted in enhancements in their cognitive abilities, including nonverbal IQ and inhibition, as well as their academic performance in mathematics and reading, in comparison to children who did not partake in the program. The principal determinant responsible for the noted enhancements can be ascribed to the practice of working memory exercises. The results of this study have validated the effectiveness of incorporating computer-based training that encompasses working memory (WM) and mathematics tasks into the standard school curriculum. This integration has been shown to have a positive impact on children's academic competencies and cognitive abilities (Menon, & D'Esposito, 2022).

Student Performance in Problem Solving

The findings of extensive research on the influence of computer utilization on academic achievement among students are inconclusive. In a study conducted by Spiezia (2011), it was found that there is a statistically significant positive relationship between students' utilization of computers and their academic performance in the field of science. This conclusion was drawn based on an analysis of data obtained from the Program for International Assessment in Education (PISA-2006). Likewise, it was discovered that the extent to which children are exposed to information and communication technology (ICT)

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both in their home environment and within the educational setting significantly influenced their performance in ninth-grade mathematics.

According to Petko, et al. (2016), research conducted in Chinese Taipei, Singapore, and Finland revealed that the utilization of technology in educational settings and for recreational purposes had a detrimental impact on students' mathematical performance. The PISA data is widely utilized in a significant number of recent extensive research endeavors. The importance of conducting extensive studies that specifically examine the influence of computer usage on mathematics performance was emphasized, with the suggestion of utilizing the TIMSS dataset as a suitable source of data.

The current study evidence indicates that scholars have conducted evaluations on the influence of technology integration on overall mathematics achievement. The existing body of literature concerning the relationship between computer usage and its associations with specific cognitive domains, particularly those related to higher order thinking, is currently constrained in scope. In light of the growing significance of problem-solving and reasoning skills in the 21st century competencies, it is crucial to recognize the interconnectedness between teachers' utilization of computers and their students' engagement with computer technology. Furthermore, it is imperative to incorporate an examination of students' mathematical cognition within this discourse. The existing literature identifies three key themes that influence faculty members to enhance their research productivity: the significance of acquiring mathematical knowledge, the utilization of technology for resolving mathematical problems, and the potential impact of computers on students' ability to solve specific mathematical problems (Saavedra & Opfer 2012).

The research gaps that exist in the related literature include that students' perceptions of math topics acquired through traditional teaching and learning methods – to address this gap, this study will demonstrate students' perceptions of mathematical problems solved via computer. This new normal acclimates students to a new standard of learning enabled by a digital platform. The literature review neglected to emphasize how well-

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prepared students are for the digitized platform. This study will demonstrate the mathematical utility of the computer. The ability of various software packages to be dynamic and interactive enhances the somewhat static environment that existed in traditional paper-and- pencil classrooms. The study will address this research gap by determining the effectiveness of computer use in terms of student achievement through an analysis of the students' pretest and posttest scores.

The benefits of the aforementioned mobile math learning applications include their interactivity, diversity, efficacy in enhancing arithmetic skills, convenience for counting and displaying graphs, sketching geometric objects, solving algebra, and issues with mathematical programming. Similar to research, online and by making math classes more engaging, mobile learning applications encourage students compared to traditional teaching approaches, they are more entertaining and interactive. The hope is raised for the development of new learning tools in the near future thanks to the developers' work. that develop a fresh approach to schooling.

RESEARCH METHODOLOGY

This chapter provides an overview of the research methodology employed in the study. It encompasses the selection of appropriate research methods and designs, the establishment of the population frame and sampling scheme, the characterization of participants, the identification of study instruments, the implementation of data gathering procedures, and the application of statistical treatment to the collected data.

Research Method Used

The Quasi- Experimental Research will be used to find the effectiveness of the use of computers to solve Mathematics problems and how it affects to the cognitive development process of the learners.

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With the Quasi- Experimental Research, the Pretest- Posttest one shot design will also be using wherein the dependent variable is measured once before the treatment is implemented and once after it is implemented.

Additionally, because of the aforementioned definitions, this method is deliberate in the process of gathering, analyzing, classifying, and tabulating data to provide useful and accurate interpretation of data using the use of statistical methods. In particular, the researcher used test, interviews, focal groups, the implementation and evaluation to build the cognitive process in Mathematics via computers.

Population and Sampling Scheme

The participants of this study were the Grade 8 Junior High School students of General Pio Del Pilar National High School, Division of Makati. The forty (40) students from grade 8 levels were selected as participants using the purposive sampling technique. The students were chosen based on the selection criteria that they have basic computer expertise that can be applied in Mathematics. been trained The forty students who took part are those who are capable of using computer applications in mathematics. Additionally, ten (10) mathematics experts, including head teachers, coordinators, and mathematics teachers, also were also interviewed regarding the use of MALMATH.

Description of the Respondents

The respondents are the 40 students from the Grade 8 of General Pio Del Pilar National High School under the researcher's supervision. The respondents are those who are capable in using computer applications in mathematics. Additionally, there are 10 experts (Mathematics teachers) who are capable also in using Mathematics application and willing to use the different features of MALMATH in their respective classes.

Research Instruments Used

The following are the instruments to be used in the study:

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Grade 8 High School Mathematics pre and post test. The test is based on the First Quarterly Examination; it is built using the table of specifications and 60 % easy, 30 % average, and 10% difficult questions, according to a Department of Education memorandum. It was validated by experts that evaluated the content of Mathematics 8, First Quarter. The test was divided into five sections to assess the students' cognitive processes: thinking, knowing, remembering, judging, and problem solving. The test was utilized and was administered to students during the limited face to face.

The validation process involves the assessment of a 25-item teacher-created test that encompasses various topics in Mathematics. These topics include the rectangular coordinate system, linear equations in two variables, slope of a line, converting linear equations from the form Ax + By = C to y = mx + b and vice versa, as well as problem-solving involving linear equations in two variables and linear inequalities. The test was checked by her research adviser; after which it undergo content validation. The content validators include five mathematics teachers and one (1) department head. Their comments and suggestions were considered to further improve and refine the questionnaire. The reliability was also computed using Cronbach's Alpha and validity and reliability of the items were determined, which was 0.82 and consider as highly reliable items.

Unstructured Interview.

The unstructured interview was also conducted to support the answers which were not expounded in the study. The interview was conducted to elicit answers and clarifications to the respondents on items which are not covered in the questionnaire. The interview focused on the teachers and students evaluation on the use of MALMATH. The interview was done during the respondents' free time via Google meet. The link was sent to the respondents.

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Data Gathering Procedure

The Researcher prepared all the materials needed. The researcher made a letter of request that addressed to the Superintend of the Division of City School of Makati and to the Principal of General Pio Del Pilar National High School for the permit to conduct the study at the General Pio Del Pilar National High School.

The participants were gathered on Google Meet with the consent of the parent by sending letter about the study of the researcher for a briefing and explanation of the MALMATH application's background. Both respondents and experts were fully informed what MALMATH is and how to utilize the application offline by the researcher. Experts must demonstrate the application to their students so that they can observe and experience the MALMATH'S different features.

The forty participants complete the pre-test without using MALMATH. Individual questionnaires will be given, with responses written on a separate sheet of paper. In addition, the experts evaluating the applications will teach their class using MALMATH in some of their math problems.

The students reconvened for the administration of the Post-test. They utilized the MALMATH program to answer the same set of questions. Students are already familiar with the MALMATH and its various features. In addition, students and experts will evaluate the MALMATH as a software program.

Data were gathered for the purpose of evaluating digital instructional materials based on student and teacher evaluation in terms of content, objectives, and usability. On the other hand, the results of students' performance on pre- and post-assessment exams. Following the evaluation, experts can use the MALMATH software with their own instructional guides. The work of the experts can be combined by the researcher to create a single instructional guide for using MALMATH as a computer assisted problem solving software in mathematics.

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Statistical Treatment of Data

The following statistical tools were used in this study:

Percentage was used to answer Problem 2 pertaining to the description of the performance of the students before and after the use of MALMATH based on the cognitive domains as to thinking, knowing, remembering, judging and problem solving. Ymas (2010) defined the formula,

$$\% = \frac{f}{n} x \ 100$$

where: % - percentage

f - frequency

n - number of respondents

t - test for correlated samples was used to answer problem 3 referring to the testing of the significant difference in the students' performance before and after the use of MALMATH in terms of thinking, knowing, remembering, judging and problem solving.

The formula is defined by,

$$t = \frac{\bar{D}}{\sqrt{\frac{\sum D^2 - \frac{(\sum D)^2}{n}}{n(n-1)}}}$$

where:

$\bar{D}$ - the mean difference before and after the use of MathMal

$\sum D^2$ - the sum of the squares of the difference before and after the use of MALMATH

$\sum D$ - the summation of the difference before and after the use of MALMATH

n - the sample size

All statistical computations were guided with the use of the Statistical Software package SPSS version 22.

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Weighted mean was used to answer problem 3 referring to the testing of the significant difference in the students' performance before and after the use of MALMATH in terms of thinking, knowing, remembering, judging and problem solving by observing the level of student's mast ery.

$$W = \frac{\sum_{i=1}^{n} w_i X_i}{\sum_{i=1}^{n} w_i}$$

W = weighted mean
n = number of items to be average
Wi = weights applied to x values
Xi = data values to be average

PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA

This chapter covers the presentation, analysis and interpretation of the data in the light of the research questions formulated in the study.

1. Description on the Use of MALMATH

1.1 Characteristics of MALMATH

MALMATH is a math problem solver with a graph view and step-by-step explanations. It's unpaid. Students who struggle with their assignments and others' difficulties benefit from understanding the process of solutions. Students in high school and college, teachers, and parents can all benefit from it.

MALMATH is an Android app that can provide graphic analysis and step-by-step answers to math issues. Simply enter a math problem and click the "solve" or "click" button to utilize the software.

Numerous advantages associated with utilizing mobile devices, such as their interactivity, portability, ease, and other features like internet searching, can be used to

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explain the beneficial impact of using the MALMATH program on students. (Drigas & Pappas, 2015). Students could use matching and overlapping geometric transformations to perform geometric transformations, control the graphic drawing panel's settings, alter the backdrop color, and adjust the line thickness of the drawing as desired. As a result, this program made learning easier.

1.2 Use or function of MALMATH

MALMATH'S key feature is that it shows the user the steps needed to solve each problem after it has been resolved. MALMATH offers additional sub-steps because he is aware that certain people don't comprehend concepts as quickly as others. Up until the most thorough explanation a user may require, even the sub-steps may contain further stages.

Students can plot functions in MALMATH depending on the problem, it will either draw the function or fill the region. Additionally, because several functions are enabled, students can simultaneously plot two different functions and contrast the resulting graphs. MALMATH will also analyze the graphs in addition to that. This indicates that it will display to students a table of intervals from the domain to the inflection points.

The key objective of MALMATH is to give students thorough solutions to math problems in a way that helps them comprehend the process of solving the problems. Its main goal is to teach pupils how to solve math problems rather than to solve every single problem. The following are the skills that were enhanced integrating technology such as MALMATH in mathematics:

The effect of MALMATH on first-year students' geometric performance It was decided to reflect. The results of a paired sample t-test showed that the there was a significant difference between the pre-test and post-test according to the results (t=6.801). The usage MALMATH application raises students' proficiency in geometry coursework. According to Beatson et al. (2020), using the inductive thinking technique supported by

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MALMATH application while studying has a positive impact on students' motivation to learn mathematics.

1.3 Application of MALMATH

Prior to the use of the MALMATH the students are required to download the apps in their own cellular phones. The students were oriented on the use and applications of MALMATH in specific topics in mathematics through Google link as shown in Figure 3. The orientation was conducted last May 30, 2022, wherein the researcher introduced the MALMATH to selected grade 8 students who have the knowledge on the use of some Math application

Figure 3.

Orientation of MALMATH With The Students

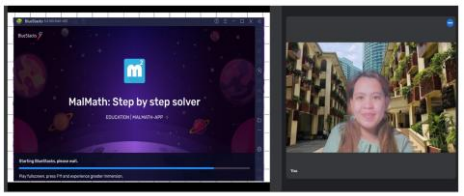
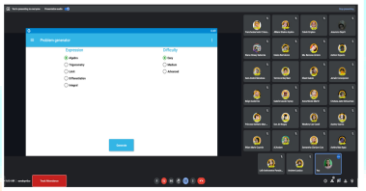


Figure 4.

Google meeting with the students



Math is taught at every level of our educational system, from primary schools to universities, due to its unavoidable practical applications. Everyone needs help occasionally with math issues, whether they are math professionals or novices. So, in the absence of a teacher or friend who could be a beneficial source of support, we can ask the pervasive Internet for advice or use the manuals available in book stores. The brand-new math-solving program was known as MALMATH. MALMATH can make the analysis of

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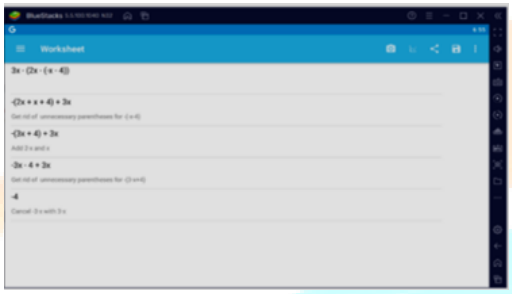
the graphs. This means that it will show students a table with points from domain to inflection intervals. MALMATH Application have its own problem generator related to specific subject area, students can try to solve problem in different difficulty like easy medium and advanced.

Figure 5.

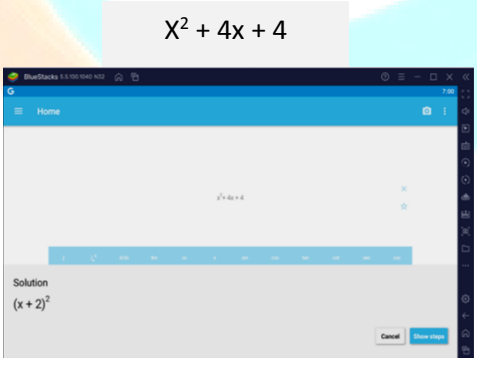
MALMATH in Simplifying Polynomials



For example the lecture is on simplifying polynomials, MALMATH can also provide a step by step solution to guide the students on how to solve a certain problem and let them learn by themselves. Figure 3 shows the step by step procedure in simplifying the polynomial 3x-(2x-(-x-4)).

Figure 6.

MALMATH in Factoring



In factoring for example, the students can also type their own math problem and let the MALMATH to answer it. In Figure 4, the student asked the MALMATH to factor X^2 +

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4x + 4 and the MALMATH gave immediately the answer (x+2)(x+2). The students can also check the step-by-step solution in order to see if their solution is correct or not.

Data reveal that after the use of MALMATH, the students' performance was increased in thinking. MALMATH is a highly influential instrument in the field of mathematics due to its capacity to facilitate visualization and manipulation of mathematical concepts. Additionally, it is noteworthy that MALMATH is an open source application, thereby rendering it accessible to all learners regardless of their computer specifications.

In unstructured interview, A teacher said that :*"MALMATH is a tool that helps us teachers support teaching mathematics subject such as topics in algebra."*

On the other hand, a student said,

The various features provided by MALMATH software was of great media to help us learners visualize abstract geometric objects
quickly, accurately, and efficiently."

Understanding and managing a concept's limits and constraints, asking questions with a mathematical slant, and being aware of the kinds of solutions that mathematics can provide are all examples of mathematical thinking proficiency. The major goal of MALMATH is to give students thorough solutions to math problems in a way that helps them comprehend the process of solving the problems. Its main goal is to teach students how to solve math problems rather than to solve every single problem. MALMATH is software designed in teaching Math.The basic idea of the software was to create dynamic software that harmonizes geometry, algebra, and calculus.

Results of the interview a teacher said,

"The utilization of this MALMATH promotes active participation among students during class lecture which is due to the students' involvement in the process and its appealing feature."

And Another teacher remarked,

"With the use of MALMATH, the students showed interest and

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positive attitude when introducing the software in class."

According to the findings of Shadaan and Leong (2013), software facilitates collaborative engagement between teachers and students, enabling

them to collectively navigate and reinforce conceptual understanding. Similarly, MALMATH proves to be a valuable resource for facilitating constructivist learning among educators and learners alike. The significance of problem-solving in the context of mathematics education stems from the underlying notion that the discipline of mathematics is fundamentally centered around the process of reasoning, rather than mere rote memorization.

A teacher also said in an interview,

"Problem-solving allows students to develop understanding and explain the processes used to arrive at solutions, rather than remembering and applying a set of procedures."

2. Performance of the Students Before and After the Use of MALMATH

The following tables illustrate the performance of the students before and after the use of MALMATH in terms of thinking, knowing, remembering, judging, and problem solving.

2.1. Thinking. Table 1 describes the performance of the students before and after the use of MALMATH in terms of thinking.

Table 1

Students' Performance Before and After the Use of MALMATH in terms of Thinking

Range	Category	Before MALMATH		After MALMATH	
		f	%	f	%
75 - 100 %	Mastered	11	26	22	55
50 - 74 %	Nearing Mastery	20	50	14	35
1 - 49 %	Least Mastered	9	24	4	10
Total		**40**	**100**	**40**	**100**

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It was found out that in before the use of MALMATH, there were 20 or 50 percent of the students were categorized as nearing mastery in thinking who scored 50 - 74 %, followed by that 11 or 26 percent of the students who scored 75 - 100 % who were categorized as mastered, and that 9 or 24 percent of the students scored 1 - 49 % and were categorized as least mastered. On the other hand, after the use of MALMATH it was found out that there were 22 or 55 percent of the students who were categorized mastered whose score ranges from 75 - 100 %, followed by 14 or 35 percent who were categorized as nearing mastery with scores ranging from 50 - 74 %, and that 4 or 10 percent were categorized least mastered whose scores ranged from 1 -49 %.

The strategic use of technology tools, such as Malmath, can, in the opinion of Hung and Zhang (2012), foster both the acquisition of mathematical procedures and skills as well as the development of higher mathematical proficiencies, such as problem-solving, reasoning, and justifying. The use of technology in secondary mathematics lessons has been found to increase student interest and performance, according to Watson's et als. (2015) findings.

2.2. Knowing. Table 2 indicates the performance of the students before and after the use of MALMATH in terms of knowing.

Table 2

Students' Performance Before and After the Use of MALMATH in terms of Knowing

Range	Category	Before MALMATH		After MALMATH	
		f	%	f	%
75 - 100 %	Mastered	6	15	13	32
50 - 74 %	Nearing Mastery	20	50	16	41
1 - 49 %	Least Mastered	14	35	11	27
Total		**40**	**100**	**40**	**100**

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It was found out that before the use of MALMATH, there were 20 or 50 percent of the students who were categorized least nearing mastery whose scores ranged from 1 - 49 %, followed by 14 or 35 percent of the students who scored 50 - 74 % and were categorized as least mastered, and that 6 or 15 percent of the students scored 75 - 100 % and were categorized as mastered. On the other hand, 16 or 41 percent of the students were categorized as nearing mastery with score ranging from 50-74 % after the use of MALMATH, followed by 13 or 32 percent who were categorized as mastered whose scores ranged from 75 - 100 %, and that 11 or 27 percent were categorized as least mastered whose score ranged from 1 - 49 %.

According to Beatson et al. (2020), there is a lot of evidence that mobile technologies such as the MALMATH are becoming more prevalent in education. The MALMATH has a mobile technology is becoming more widely used in the developed world in a variety of areas, including context-related education and how handheld devices can be used for basic language, skills, numeracy, and health and safety training, as well as some aspects of teaching and learning.

2.3. Remembering. Table 3 shows the performance of the students before and after the use of MALMATH in terms of remembering.

Table 3

Students' Performance Before and After the Use of MALMATH in terms of Remembering

Range	Category	Before MALMATH		After MALMATH	
		f	%	f	%
75 - 100 %	Mastered	10	25	22	55
50 - 74 %	Nearing Mastery	12	29	14	35
1 - 49 %	Least Mastered	18	46	4	10
Total		**40**	**100**	**40**	**100**

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Data show that before the use of MALMATH, there were 18 or 46 percent of the students who were categorized least mastered whose scores ranged from 1 - 49%, followed by 12 or 29 percent of the students scored 50 - 74 % and were categorized as nearing mastery, and 10 or 25 percent of the students scored 75 - 100 % and were categorized as mastered. On the other hand, 22 or 55 percent of the students were categorized as mastered with scores ranging from 75 – 100 % after the use of MALMATH, followed by 14 or 35 percent who were categorized as mastered whose scores ranges from 50 - 74 %, and that 4 or 10 percent were categorized as least mastered whose scores ranged from 1 - 49 %.

Based from the findings of the National Council of Teachers of Mathematics (NCTM, 2011), technology is a vital tool for learning mathematics in the twenty-first century. The teachers need to harness the power of technology to deepen students' remembering skills, understanding, pique their enthusiasm, and improve their mathematical skills. Technology can provide access to mathematics for all pupils when used effectively.

2.4. Judging. Table 4 projects the performance of the students before and after the use of MALMATH in terms of judging.

Table 4

Students' Performance Before and After the Use of MALMATH in terms of Judging

Range	Category	Before MALMATH		After MALMATH	
		f	%	f	%
75 - 100 %	Mastered	4	10	20	49
50 - 74 %	Nearing Mastery	14	36	16	41
1 - 49 %	Least Mastered	22	54	4	10
Total		**40**	**100**	**40**	**100**

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Findings reveal that before the use of MALMATH, there were 22 or 54 percent of the students who scored 1 - 49 %, interpreted as least mastered, followed by 14 or 36 percent who scored 50 - 74 % categorized by nearing mastery, and 4 or 10 percent were categorized as mastered whose scores ranged from 75 - 100 %. On the other hand, after the use of MALMATH, it was found out that there were 20 or 49 percent of the students were categorized as mastered based on the scores ranging from 75 - 100 % after the use of MALMATH, followed by 16 or 41 percent of the students who were categorized as nearing mastery whose scores ranged from 50 - 74 %, and that 4 or 10 percent of the students were categorized as least mastered having scored 1 - 49 %.

Through the use of MALMATH the students can combine dynamic visualization of mathematical problems and provide appropriate judging. Judging skills are the abilities and mental tools that enable students to make effective decisions in critical situations or dilemmas encountered in solving problems in mathematics.

The MALMATH program aids a learner in creating new knowledge and connect it to prior understanding, which is associated with a positive method of instruction (Penchenkina, 2017). Additionally, it can improve kids' capacity for the ability to grasp mathematical concepts and so enhance learning.

2.5. Problem solving. Table 5 indicates the performance of the students before and after the use of MALMATH in terms of problem solving.

Table 5

Students' Performance Before and After the Use of MALMATH in terms of Problem Solving

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Range	Category	Before MALMATH		After MALMATH	
		f	%	f	%
75 - 100 %	Mastered	8	20	17	43
50 - 74 %	Nearing Mastery	19	48	18	44
1 - 49 %	Least Mastered	13	32	5	13
Total		**40**	**100**	**40**	**100**

Findings reveal that before the use of MALMATH, there were 19 or 48 percent of the students who were categorized nearing mastery whose scores ranged from 50 - 74 %, followed by 13 or 32 percent of the students who scored 1 - 49 % and were categorized as least mastered, and 8 or 20 percent of the students scored 75 - 100 % and were categorized as mastered. On the other hand, 18 or 44 percent of the students were categorized as nearing mastery with scores ranging from 50 - 74 % after the use of MALMATH, followed by 17 or 43 percent who were categorized as mastered whose scores ranged from 75 - 100 %, and 5 or 13 percent were categorized as least mastered whose score ranged from 1 - 49 %.

Numerous benefits of using mobile devices, including interactivity, ease, portability, and the MALMATH app's beneficial impact, can be used to illustrate internet search capability (Drigas & Pappas, 2015). MALMATH applications that effectively use graphs and visual aids to illustrate mathematical concepts and procedures can help students master and comprehend those concepts and methods. (Kovács et al., 2018) relates to functions and limit functions. Teachers may find it simpler to explain concepts with this software's user-friendly interface.

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3. Difference Between Students' Performance Before and After Using MALMATH.

Table 6 indicates the significant difference in the students' performance before and after using MALMATH.

Table 6

Significant Difference Between the Students' Performance Before and After Using the MALMATH

MALMATH areas	Weighted Mean		t-value		Decision	Remarks
	Pre-test	Post-test	Comp	Tab		
Thinking	62.34 (Nearing Mastery)	70.12 (Nearing Mastery)	3.27	1.645	Reject	Significant
Knowing	57.63 (Nearing Mastery)	75.38 (Nearing Mastery)	2.18	1.645	Reject	Significant
Remembering	60.21 (Nearing Mastery)	74.85 (Nearing Mastery)	2.43	1.645	Reject	Significant
Judging	59.35 (Nearing Mastery)	75.02 (Mastered)	3.10	1.645	Reject	Significant
Problem solving	65.45 (Nearing Mastery)	74.03 (Nearing Mastery)	2.76	1.645	Reject	Significant

The hypothesis was rejected and therefore there is a significant difference between the students' performance before and after the use of the MALMATH in thinking since the computed t-value of 3.27 is greater the tabular t-value of 1.645 using 0.05 level of significance. Data imply that the use of MALMATH enhances the students' performance in thinking.

Knowing. There is a significant difference between the students' performance before and after the use of the MALMATH in knowing since the computed t-value of 2.18 is greater the tabular t-value of 1.645 using 0.05 level of significance. Findings indicate that the use of MALMATH enhances the students' performance in knowing. The technological advancements like the MALMATH is significant for teaching science, technology,

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engineering, and mathematics (STEM) related courses and are designed to expand students' access to mathematics and science (NCTM, 2014). These tools, in particular, help pupils understand the underlying principles in mathematics and improve their knowing skills (NCTM, 2014).

Remembering. Since the computed t-value of 2.43 is greater the tabular t-value of 1.645 using 0.05 level of significance, the hypothesis was rejected and therefore there is a significant difference in the students' performance before and after the use of the MALMATH in remembering. Data implies that the use of MALMATH enhances the students' performance in remembering. According to Saavedra and Opfer (2012), one of the most recent breakthroughs in education is the use of technology such as MALMATH in teaching and mastering these higher order skills. Using such technology, students can improve their remembering skills in mathematics.

Judging. The hypothesis was rejected and therefore there is a significant difference in the students' performance before and after the use of the MALMATH in judging since the computed t-value of 3.10 is greater the tabular t-value of 1.645 using 0.05 level of significance. Findings indicate that the use of MALMATH enhances the students' performance in judging.

The results of large-scale studies on the impact of computer use on students' judging skills. Spiezia (2011) discovered a positive significant influence on the association between students' computer use and their achievement using data from the Program for International Assessment in Education (PISA-2006).

Problem solving. There is a significant difference in the students' performance before and after the use of the MALMATH in problem solving since the computed t-value of 2.76 is greater than the tabular t-value of 1.645 using 0.05 level of significance. Findings indicate that the use of MALMATH enhances the students' performance in problem solving.

Another study evaluated how a problem-based learning approach could boost students' motivation. MALMATH application adopting a Problem-Based Learning (PBL) methodology (Bond et al., 2018).

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The information t-test analysis was performed. The findings demonstrated that pupils were instructed utilizing the PBL methodology with the motivation for the MALMATH application was higher.

It exceeded those who received instruction. utilizing the PBL concept without a computer program. Using the MALMATH program to support learning tool for developing mathematical concepts and contributing to improvements thinking creatively in mathematics.

As a summary of result shown in table 6 in the difference of student's performance before and after using the MALMATH, though there is a significant difference but the verbal interpretation of the data tells that the level of mastery of the students is consistent in getting the nearing mastery between the range of 50% - 74 %.

4. An Instructional Guide Developed on the Use of MALMATH as a Computer-Assisted Problem-Solving Software in Mathematics

Below is the instructional guide developed on the use of MALMATH as computer-assisted problem-solving software in mathematics.

Overview of MALMATH

Using the MALMATH, which is founded on the scientific principles of Mathematics, students can gain a thorough comprehension of mathematical theories and facts in action and independently discover these theories and truths. The software has a variety of tools that students can use to develop their mathematical abilities, including all the aspects that make learning enjoyable and simple. A constructive approach to learning is highly compatible with using the MALMATH program to assist students create new information and apply it to existing knowledge (Viegas, 2017).

Additionally, it can improve students' learning by helping them better grasp mathematical concepts.

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Introduction

This instructional guide provides suggestions for using the MALMATH in the classroom, as well as resources to teach and reinforce the concepts of MALMATH. This guide includes the following sections, first is the accessing the MALMATH, second is the Math concepts in MALMATH, third is the used of MALMATH in classroom and lastly is the Special features of MALMATH.

Accessing the MALMATH Application

The MALMATH application can be downloaded from: https://play.google.com/store/apps/details?id=com.malmath.apps.mm&hl=en&gl=US After you downloaded the app, you can start type in a math problem, press the "solve" or "click" button.

Math Concepts in MALMATH

The MALMATH application is a dynamic math program created for use in elementary, secondary, and tertiary education. It integrates algebra, geometry, and calculus and enables students to effectively create points, vectors, lines, conjunctions, and conics. This enables direct entry of equations and coordinates. Because of this, the MALMATH application is able to work with additional variables, points, and vectors, compute derivatives and integrals, and offer alternative orders like roots and exponents (Llenada Santos, 2022)

Using MALMATH in the Classroom

As an Introduction to a concept

Why not consider enabling students to utilize MALMATH, a problem generator, as a means to independently explore and comprehend mathematical rules, instead of investing significant time in explicating numerous numerical rules and subsequently assigning a multitude of related exercises? A class discussion may be employed as a pedagogical tool to emphasize the acquired knowledge, reinforce the underlying principles, and address any potential misconceptions subsequent to the completion of a set of problems. In this method, students take charge of their own education, and the teacher's job becomes one

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of ensuring that pupils learn from a self-guided activity rather than one of being the repository of all knowledge

.**As an extension to a Lesson**

Following the completion of an instructional module, it is advisable to allocate students with a designated subject matter to consolidate their comprehension of the material covered in the classroom setting. As an illustration, following the instruction of a linear equation module, students can be tasked with solving specific problems related to the subject matter and subsequently presenting their solutions to the class, elucidating their comprehension of the solutions provided by the MALMATH software.

The review presented here is of high quality and effectively demonstrates the practical application of the skills acquired throughout the unit.

To Encourage Conversations About Problem-Solving Techniques

The three mathematical practices outlined in the Common Core State Standards for Mathematics can be developed by pupils with the aid of the MALMATH. Students are specifically required to make sense of amounts and their connections when faced with challenges. Not merely the computation of operations, but also their meaning, must be understood by students. Students utilizing MALMATH must understand how a number and an operation will impact the outcome. When attempting to solve a mathematical problem, take into account a variety of instruments, such as pencil and paper, a calculator, or a spreadsheet. The program directly calculates intermediate values, which is comparable to using a calculator. Alternately, students might use other resources to explore results in greater detail, including creating a spreadsheet with numerous instances. These kinds of research can be spurred on by MALMATH. Pay attentive attention to find a structure or pattern. Students may discover while working on a fractions-related problem that multiplying by 5/2 and dividing by 2/5 provide the same answer. Students could see more generally that multiplying by a fraction or decimal results in an increase in the overall value.The three mathematical practices align with the process standards originally established by the National Council of Teachers of Mathematics (NCTM) in their

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publication, Principles and Standards for School Mathematics, in 2000. One of the processes encompassed in this context is communication, whereby students effectively articulate their mathematical reasoning to peers, educators, and other individuals.

To strengthen the School - Home Connection

Encourage students to download MALMATH and try to solve specific issues to extend their classroom learning to the home environment. To let parents know about the application, you can also send a note to their homes. The program can be utilized, even casually, to reinforce knowledge and abilities picked up in class.

Encourage students to teach an adult at home how to use the MALMATH for a more formal use. Asking questions about their arithmetic learning after utilizing it will help pupils. How was math taught in school when you were there? is one example of a possible query. What kind of attitude did you have toward math as a student? Since you graduated, has that remained the same or changed? If today's technology had been around while you were in school, do you think your perspective on arithmetic would have changed? Since you were my age, how have you observed changes in technology? What technological tools do you utilize in both your personal and professional life? What practical applications of mental math do you have? Which aspects of the application did you enjoy?

Special Features of MALMATH

Step by step description

This is MALMATH'S key characteristic. The user is given the stages of the solution for each problem that is solved. MALMATH offers additional sub-steps because he is aware that certain people don't comprehend concepts as quickly as others. Up until the most thorough explanation a user may require, even the sub-steps may contain further stages.

Highlights

Highlighting the portion of the expression that was modified from the previous stage is one of MalMath's distinctive features. This provides a direct approach to understanding

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stages without the need to read the description or take into account the entirety of the term.

The option to activate animations allows users to resolve the problem incrementally, with the aid of visual cues that emphasize each step, thereby facilitating comprehension and tracking of the problem-solving procedure. In order to highlight a portion of the solution, users simply click the part of the solution they want to understand on how it changed from one solution to another.

Problem generator

Some students who have mastered the fundamentals of math seek form additional activities to test their comprehension. One of the most beneficial elements for those kids is the "problem generator". Numerous disciplinesuch as algebra, trigonometry, limits, differentiators, and integrals, produce problems. In addition, three levels of difficulty are available: Easy, Medium, and Advanced. The user will open the MALMATH application, on the upper left side (three lines) click the problem generator. The students can choose the level of difficulty and the area of the Mathematics that they wanted to generate. After generating the problem, the apps will show three buttons; next, solve and graph. The next button is for the user to change the problem that is being generated, the solve problem is to start solving the problem and the graph is to plot the generated problem.

Graph analysis

Student may plot functions in MALMATH, and depending on the issue, it will either draw the function or fill the region. Additionally, since numerous functions are supported, you can plot different functions simultaneously and contrast their graphs. MALMATH will also analyze the graphs in addition to that. This indicates that it will display a table with intervals from the domain to the inflexion. The user can use this feature by clicking the picture of the graph at the upper right corner. The user can zoom in and zoom out the graph of the function that generated. The MALMATH application will analyze the graph, it

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will show the different points like the domain, zeros, symmetry, asymptotes and other points from the menu.

The key objective of MALMATH is to give students thorough solutions to math problems in a way that helps them comprehend the process of solving the problems. Its main goal is to teach pupils how to solve math problems rather than to solve every single problem.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary of findings from the gathered data and analyzed data, the conclusions drawn from the findings and recommendations offered by the researcher in the light of the findings and conclusions.

Summary of Findings

From the data yielded from the instruments, the researcher summarized the following findings.

1.Description on the use of MALMATH

MALMATH is an educational tool designed to assist students and individuals who encounter difficulties in solving mathematical problems. It offers a comprehensive solution by providing step-by-step explanations and visual representations, such as graphs, to enhance understanding of the problem-solving process.

2. Performance of the Students Before and After the Use of MALMATH

Data below summarize the performance of the students before and after the use of MALMATH.

2.1 Thinking. The students were rated nearing mastery before and after the use of MALMATH as seen from the over-all mean score of 62.34 and 70.12, respectively.

2.2 Knowing. The performance of the students before and after the use of MALMATH was nearing mastery as described from the mean score of 57.63 and 75.38, respectively.

2.3 Remembering. The students performed both nearing mastery before and after the use of MALMATH as indicated from the mean score of 57.63 and 75.38, respectively.

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2.4 Judging. The performance of the students before the use of MALMATH was nearing mastery based from the mean score of 59.35, and was rated mastered after the use of MALMATH based from the mean score of 75.02.

2.5 Problem solving. The students performed both nearing mastery before and after the use of MALMATH as seen from the mean score of 65.45 and 74.03, respectively.

3. Difference Between Students' Performance Before and After Using MALMATH

Data below summarize the significant difference in the students' performance before and after using MALMATH.

Thinking. The hypothesis was rejected and therefore there is a significant difference in the students' performance before and after the use of the MALMATH in thinking since the computed t-value of 3.27 is greater the tabular t-value of 1.645.

Knowing. There is a significant difference between the students' performance before and after the use of the MALMATH in knowing since the computed t-value of 2.18 is greater the tabular t-value of 1.645.

Remembering. Since the computed t-value of 2.43 is greater the tabular t-value of 1.645, the hypothesis was rejected and therefore there is a significant difference in the students' performance before and after the use of the MALMATH in remembering.

Judging. The hypothesis was rejected and therefore there is a significant difference in the students' performance before and after the use of the MALMATH in judging since the computed t-value of 3.10 is greater the tabular t-value of 1.645.

Problem solving. There is a significant difference in the students' performance before and after the use of the MALMATH in problem solving since the computed t-value of 2.76 is greater the tabular t-value of 1.645.

4. Instructional Guide Developed for the Use of MALMATH

Based from the results of the study, an instructional guide was developed on the use of MALMATH as computer-assisted problem solving software in mathematics.

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Conclusions

Based from the findings of the study, the following conclusions were drawn:

1. MALMATH is a computer-based tool that enhances students' performance in mathematics.

2. The use of MALMATH improved the performance of the students in terms of thinking, knowing, remembering, judging and problem solving.

3. Significant difference exists between the students' performance before and after using MALMATH in areas of thinking, knowing, remembering, judging and problem solving.

4. An instructional guide was developed which may be utilized by mathematics teachers in the use of MALMATH as computer-assisted problem-solving software.

Recommendations

Based from the findings and conclusions of the study, the following recommendations are offered:

1. Mathematics teachers may integrate the use of MALMATH in their instruction by means of the following strategies

1.1 As an introduction to a lesson, where the teacher can use MALMATH as inspiration before talking about the topic at hand.

1.2 As an extension to a lesson. The teacher can ask students to participate in a follow-up activity where they may explore the various aspects of MALMATH.

1.3 As a motivation for discussing problem-solving techniques. The student has the opportunity to critically evaluate the unique approaches they may utilize to a given Math problem by comparing their own solution to the one suggested by MALMATH.

1.4 To strengthen the connection between the home and the school. Students can collaborate with their family members and share their understanding of how to solve mathematical concepts that MALMATH has provided a solution for.

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2. Consider exploring the MALMATH in teaching other subjects requiring critical thinking and problem solving like Science, Economics, Calculus and others.

3. School administrators may consider adopting the developed Instructional Guide for teachers in using the MALMATH to effectively implement in Mathematics discussion.

4. Future researchers may conduct future study exploring other features of MALMATH to further improve the the instructional delivery of Mathematics classes.

5. The best feature of MALMATH is with a reliable internet connection, one can solve math problems anywhere because it is available on all platforms. The fact that this program may be used effectively offline on smartphones is its strongest feature. MALMATH is 100% cost-free and useful for tackling challenging math problems.

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