Simulation tools toward mastery of the most essential learning competencies in Mathematics 8

Dyan Armie B. de Guzman, Delon A. Ching, EdD

dyanarmie.deguzman@deped.gov.ph
Laguna State Polytechnic University, San Pablo City Campus, Laguna, Philippines, 4000

Abstract

The study aims to determine the effectiveness of integrating simulation tools towards the mastery of the Most Essential Learning Competencies in Mathematics of 30 Grade 8 Junior High School Students of Talangan Integrated National High School, Nagcarlan District 2022-2023. The simulation tools used in this study were, Construction tool-MathPad, Geogebra, CK12, and Video Simulation. The competencies include describing a mathematical system, Illustrating the need for an axiomatic structure, illustrating triangle congruence, solving corresponding parts of congruent triangles, and proving two triangles are congruent. The researcher employed the sequential mixed method of research; the first method was the experimental method, where the researcher used simulation tools to teach the competencies for six weeks, gathered quantitative data using pre-test and post-test design, then interviewed the students and gathered qualitative data. The results show a significant difference between the pre-test and post-test performance of student respondents exposed to simulation tools. The emerging factors that helped the student-respondents maximize the capacity of mastering the most essential learning competencies are manipulative representation, availability of the defined terms, examples included, teacher factor, and students' interests.

Keywords: Simulation tools; Most Essential Learning Competencies; sequential mix method; Mathematics 8

---

1. Introduction

Teachers now have access to new instructional technology that students may utilize better to understand the material in general and in particular. Additionally, these tools allow teachers and students to collaborate on projects, increasing the student's engagement in their education. The capabilities of technology tools inspire students to take on active roles and to be independent. They also give them a chance to see how scientific phenomena are investigated through various representations, which help them better grasp the subject being studied.

The use of computers as teaching aids for mathematics by instructors has been advocated in several research papers conducted in the information age. According to Barlis and Fajardo (2013), using a computer to educate is a valuable substitute for traditional methods of instruction. Aydin et al. (2015) urged mathematics professors to create computer-based lectures they could utilize in their different classrooms and advocated for using computers.

One of the computer-based lectures is using simulation tools in teaching Mathematics. According to Shodiev (2015), through real-life phenomena, one can create interactive visualization to reach the students' imagination. In exposing the students to real-life simulation, students can start thinking computationally and dynamically.

According to Garcia et al. (2015), the students exposed to computer simulations performed and participated actively during discussing selected physics topics rather than those exposed to conventional teaching. This is supported by Nguyen (2016), the process of numerical simulations is the application of mathematical knowledge to the study of real-world problems. The problem to be studied is transformed into a mathematical problem, and then mathematical tools and methods are used to initially solve real-life world problems in obtaining results.

Landriscina (2013) fully explores the relationship between mental models and simulation and provides examples of when simulation may be used. Facilitate a shift in thinking. Links embodied cognition, the expanded mind hypothesis, and simulation. It gives specific examples and instructions for creating simulations that are helpful for teaching.

Mathematics instruction usually expands on earlier learning. It will be challenging for a learner to handle the new talents if they do not possess the basic skills in mathematics. The underlying mathematics would be unstable. To create a strategy that will address the issue, teachers must decide between remediation and looking for fresh approaches to reinvent existing tactics. Thanks to technological innovation, teachers can now use technology in their classes. Since most children are already familiar with technology, technology-based teaching strategies are simple for the students to understand. The use of video integration as a recruitment tool is noteworthy. Video is beneficial for both teachers and students, as it improves course performance in several ways, including student motivation, confidence, and attitudes (Carmichael et al., 2019).

Strategic technology use can encourage mathematical practices, but these practices do not emerge naturally from the simple presence of technology; instead, they need to be encouraged. Helping students develop these habits should be a clear goal of our instruction as teachers. This can call for students to participate in strategic tasks and become the subject of teacher modeling, discussion, and intervention. Students can improve their mathematical practices when teachers provide opportunities for them to interact meaningfully with technology, and we may observe and impact those practices (Belnap and Parrott, 2020).

Generally, the studies were conducted outside the country in connection to studies conducted outside the country; the researcher conducted a study that focused on the Junior High School students in Nagcarlan District Talangan National High School. The mastery of most essential learning competencies was measured using pre-test and post-test and determined the factors in using simulation tools that helped the students maximize the capacity of mastery of most essential learning competencies through interview questions.

1.1. Background of the Study

The topic of instructional technology's use in the classroom has been hotly contested for a long time. The involvement of numerous parties with sometimes conflicting interests (including students, parents, teachers, school administration, policymakers, educational experts, and others) appears to be one of the contributing factors to this ongoing debate, particularly the issue of whether using educational technology has increased student understanding or sparked more disagreements. There are proponents and opponents of employing computers in the classroom, as in many arguments. The proponents claim that when technology is utilized effectively in the classroom, it supports the teacher's instruction of the course content and aids the students in understanding the topics that are being covered. They frequently refer to research showing a beneficial connection between the use of educational devices in teaching and learning and students' learning results, attitudes toward it, and experiences with education.

The opposition and critics are far less enthused and more dubious about the use of technology in the classroom. They refute this assertion that educational technology has a favorable effect on students' results and caution against viewing it as a solution to the issue of raising students' academic performance. They contend that, even if there is an influence, it will have little effect on learning effectiveness. This is why the TPACK for ICT integration framework, created by Mishra and Koehler in 2006, cited by Lye (2013), emphasized the importance of three elements: pedagogical knowledge (PK), content knowledge (CK), and technical knowledge (TK). Technical knowledge is the teacher's understanding of technology, while pedagogical knowledge refers to the teacher's capacity to instruct. Content knowledge specifies what is being taught. The combination of three domains offers a way to comprehend how instructions are developed before using them in teaching, which helps with comprehending how technology is used in the classroom.

As mentioned in D.O. 35, s. 2016. According to section 15.4 of the 2016 document "The Learning Action Cell as a K to 12 Basic Education Program School-Based Ongoing Professional Development Plan for the Enhancement of Teaching and Learning," this is the case. that instructors must enhance classes using straightforward integration techniques using developmentally appropriate information and communication technology (ICT). ICT may improve collaboration in the processes of instruction and evaluation, and instructors can use it with the resources and instruments already present in their classrooms.

Guidelines on the Implementation of the DepEd Computerization Program, a separate DepEd

IJRP.ORG
International Journal of Research Publications
ISSN: 2708-3578 (Online)

Order (D.O. 78, s. 2010), stated that the goal of the DCP is to equip public schools with the right technologies to improve the teaching-learning process, address the challenges of the 21st century, and integrate ICT into the educational system.

This research examined the impact of ICT integration, in particular the usage of simulation tools, on developing mathematical competencies against the stated backdrop. Students' performance won't increase simply by incorporating technology into the curriculum; rather, careful and suitable selection of when and how to integrate technology is crucial (Charp, 2000), cited by Yamin and Ishak (2017). In education, a skilled teacher is more significant than technology, so educators must be experts in their fields conceptually and practically. So, having topic knowledge and knowing how to organize and convey it are essential for teaching. Digital technology makes it possible to rethink duties significantly and to create new ones that weren't before possible.

The researcher noticed that in their school, DepEd tablets were randomly distributed to students who did not have gadgets. That is why the researcher decided to maximize the benefit of using those tablets inside the classroom by using simulation tools in teaching and learning.

1.2. Theoretical Framework

Three theories—the constructivist Theory of Bruners, the cognitivist Theory of Piaget, and the cognitive load theory of Sweller—serve as the study's foundation. According to Bruners' Constructivist Theory, learning is a dynamic procedure in which students build fresh concepts or ideas based on existing or prior information. The learner uses the cognitive framework to choose and modify knowledge, construct hypotheses, and come to judgments. Regarding instruction, the instructor should motivate students to find concepts on their own.

According to Bruner, instruction should focus on four key areas: a learner's disposition toward learning, how to organize a body of knowledge so that the learner readily comprehends it, how to present the material effectively in sequence, and the nature and pace of rewards and punishments. Good knowledge structure techniques should lead to information simplification, the creation of fresh ideas, and increased information manipulation.

The Theory is connected to the study since Constructivist Theory explicated that the teacher should encourage the students to discover principles by themselves; through simulation tools that can help students learn and stimulate them to formulate the principles. Since they can understand mathematics using simulation tools, students had more interest in discovering learning since most learners today belong to 21st-century learners. The Constructivist Theory is explained further with the help of the diagram below.

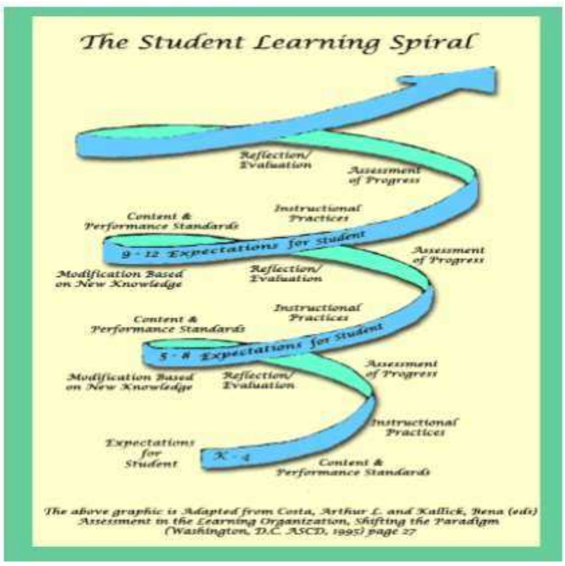

Figure 1. Bruners' Constructivist Theory of Learning

The research also makes connections between it and Piaget's cognitivist theory. Given that there are four phases of mental growth for children, according to cognitive theory. His idea revolves around comprehending the foundation of intelligence and how children gain information. According to the cognitivist view of learning, perception, insight, and meaning are necessary for learning. According to this view, learning is an internal cognitive process in which students evaluate the information they have learned through their senses.

According to the stages' four descriptions, during the sensorimotor stage (ages 0 to 2 years), toddlers acquire knowledge about the world through simple actions and understand that their actions affect the world around them. (2) Preoperational Stage, 2 to 7 years old, where children learn to simulate play but still have difficulty using reasoning and considering the perspectives of others. People frequently have trouble comprehending the concept of consistency. The third is Concrete Operational Stage: Children in this stage, which lasts from 7 to 11 years old, start to think about other people's feelings and thoughts as well as their own. Children realize that their ideas are original and that not everybody else necessarily shares their feelings, beliefs, or thoughts. Ages 12 and higher are considered at the fourth stage of Formal Operational, which entails improving logic, the capacity for deductive reasoning, and a grasp of abstract concepts.

This theory is related to the study in that the students' logical skills were enhanced at the stage of Formal Operational through a simulation tool. Since they are part of the 21st Century Learners, they enjoyed using simulation tools in learning mathematics. Piaget's Cognitivist Theory can be further explained by the diagram below.

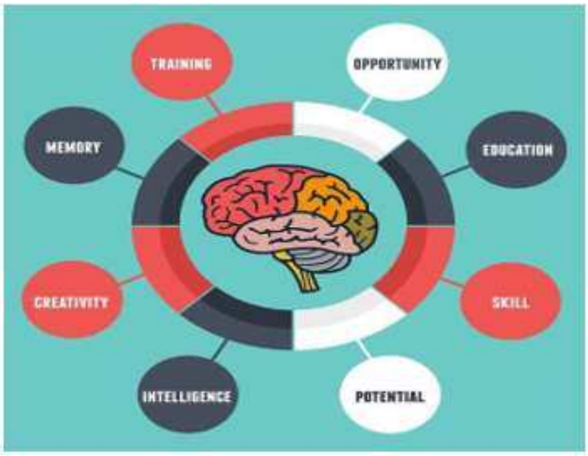

Figure 2. Piaget’s Cognitivist Theory of Learning

The last theory, Sweller's Cognitive Load Theory, contends that learning thrives in environments that are compatible with the structure of the human brain. Although the exact composition of cognitive processing architecture is unknown, it can be inferred from experimental study findings. Instead of a collection of memorized information, the things in long-term memory are "complex frameworks that empower us to observe, comprehend, and solve problems." We can handle several items as a single element because these structures are called schemas. Sweller's theories work best when used in making educational materials that are cognitively or technically difficult. As an illustration, consider the usage of simulation tools. The cognitive load theory has significant effects on the development of learning materials that must, to be successful, maintain learners' cognitive loads as low as possible while they are learning. The figure below can help you better understand Sweller's theories.

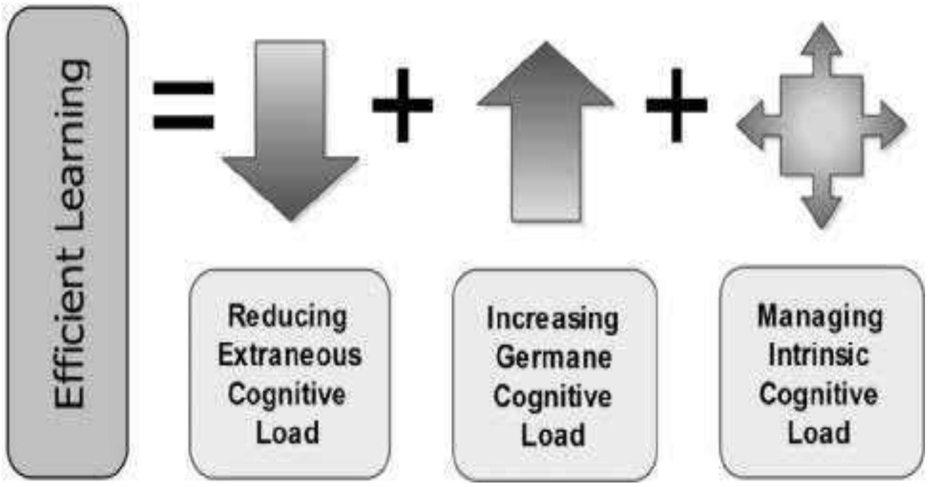

Figure 3. Sweller's Cognitive Load Theory

1.3. Conceptual Framework

According to Ravitch & Riggan (2016), using a conceptual framework may help you connect the numerous different features and impacts of your research with what you understand, care about, and value as the study's essential aspects.

The researcher constructed the following figure to represent the relationship among the variables used in the study.

In Figure 1, Research Paradigm below, the dependent variables are the Most Essential Learning Competencies while the independent variables are the Simulation tools integrated towards the mastery of the most essential learning competencies in Mathematics 8.

Independent Variable

Simulation Tools
- Construction tool-MathPad
- Geogebra
- CK12
- Video Simulation

Dependent Variable

Most Essential Learning Competencies
- Describe a mathematical system
- Illustrate the need of axiomatic structure
- Illustrates triangle congruence
- Solves corresponding parts of congruent triangles
- Proves two triangles are congruent

Figure 4. The Research Paradigm of the Study

1.4. Statement of the Problem

The study supposedly determined the effectiveness of integrating simulation tools towards the mastery of the most essential learning competencies in Mathematics of Grade 8 Junior High School learners of Talangan Integrated National High School, Nagcarlan District.

Specifically, this study answered the following questions:

1. What is the pretest and posttest performance of the student-respondents in the assessment provided based from the Most Essential Learning Competencies as to:
   1.1. describe a mathematical system;
   1.2. illustrate the need of axiomatic structure;
   1.3. illustrates triangle congruence;
   1.4. solves corresponding parts of congruent triangles; and
   1.5 proves two triangles are congruent?
2. Is there a significant difference between the pretest and posttest performance of the student-respondents in the assessment provided based on the Most Essential Learning Competencies?
3. What emerging factors from the use of simulation tools helped students to maximize the capacity of mastering the most essential learning competencies in Mathematics 8?

1.5. Research Hypothesis

In relation to the stated problems, the researcher formulated a hypothesis for the study. Below is the hypothesis formulated:

1. There is no significant difference between the pretest and posttest performance of the student-respondents in the assessment provided based on the Most Essential Learning Competencies

1.6. Significance of the Study

This section provided a brief description of the various significance of the study to the following:

School Heads. With this study, the school heads may know how to develop their instructional, supervisory plan for their teachers, especially in mathematics, where they use simulation tools.

Teachers. They may benefit from the study by developing their professional skills by using simulation tools and improving their teachings.

Students. Students will benefit from the study in that they will learn to appreciate Mathematics more and fulfill their needs to improve their performances. They have fun while learning Mathematics and end the fear of learning it.

Future Researchers. Future researchers may benefit from the study in a way that they can expand their ideas related to this study.

1.7. Scope and Limitation of the Study

The study focused on mastering the most essential learning competencies of thirty (30) Grade 8 Junior High School students of Talangan Integrated National High School. In Talangan Nagcarlan, Laguna, they were exposed to simulation tools for teaching mathematics for six weeks. The Mastery of the Essential Learning Competency was based on the pretest and post-test.

The study was limited to 30 student respondents who were exposed to different simulation tools in the academic year 2022-2023. They were used for the possible mastery of the most essential learning competencies. The researcher conducted the research in the school year 2022-2023.

1.8. Definition of Terms

For better clarification and understanding, the following terms are defined operationally.

CK12. It is a free online tool that simulates topics on the most essential learning competencies. It also includes digital interaction and the context of the lesson.

Construction tool- Math Pad. It is an online animated construction tool used to construct different geometric figures. It includes a manipulative protractor, ruler, segment maker, pencil, and eraser.

GeoGebra. This is an online and downloadable tool for constructing different mathematical systems. It plays a vital role in letting the student visualize abstract mathematics.

Simulation Tools. They are any tools that served as a geometric model, either animated or still figures, that were used to present a concrete idea for mastering the most essential learning competency.

Video Simulation. It is a premade video simulation tool from youtube. It shows simulations of the lesson and is supported by the teacher's follow-up questions leading to the visualization of how the concepts in mathematics were grasped.

Most Essential Learning Competencies. It is a set of learning competencies that the Department of Education introduces.

Describe a Mathematical System. It refers to the four classifications of mathematical systems defined terms, undefined terms, postulates, and theories in geometry.

Illustrate the Need for Axiomatic Structure. It is a continuation of a mathematical system that describes, gives meaning, and examples of the defined terms, undefined terms, postulates, and theories in geometry.

Illustrate Triangle Congruence. It refers to the definition, the rules that illustrate congruent triangles, including the Side-Angle-Side (SAS), Angle-Side-Angle (ASA), and Side-Side-Side (SSS) Congruence Postulates and identification of congruent triangles and the concept CPCTC (Corresponding Parts of Congruent Triangles are Congruent).

Solves Corresponding Parts of Congruent Triangles. The application of the three postulates SAS, ASA, and SSS proves that the other corresponding parts of the two congruent triangles are congruent.

Proves Two Triangles are Congruent. It refers to the lesson in proving triangle congruence. It also includes another definition, postulates, and theorems like vertical angle theorems, properties of triangle congruence, the median of an equilateral triangle, and the line segment bisector that can be used in proving two triangles are congruent.

2. Literature Review

This chapter contains relevant literature and writing from renowned specialists, both of which significantly impact the issue being researched.

ICT integration uses simulation tools to introduce, reaffirm, augment, and expand abilities. Integrating simulation tools into classroom practice involves a fundamental shift away from the traditional instruction model of knowledge transmission toward autonomous, active, and collaborative learning through students' participation in simulation tool-based learning environments and shared learning resources.

Adopting information and communication technology in the educational setting is discussed here. Researchers in professional growth groups and human-computer interface circles have shown a lot of interest in incorporating simulation tools. The use of mathematical simulations in the context of proof is highlighted in this article.

2.1. Simulation Tools

Summermann et al. (2020) highlight the use of mathematical simulations in the context of proof in this article. Since proving is a fundamental mathematical activity and this relationship has not yet been thoroughly investigated, it has significant implications for mathematics research and pedagogical practice. These repercussions necessitate, in part, that the simulation-based evidence offered to be accepted as such. This problem cannot be solved in this generic formulation and will instead depend on the same requirements that other proofs must meet, such as the precise form and implementation of the proof and the context in which it is used.

For Baker et al. (2019), using simulation-based proofs is not limited to mathematical education, proving in a mathematical simulation, and starting a conversation with learners about what proof is. It is possible to improve knowledge of the concept of proof by debating whether or to what extent the arguments presented in a simulation constitute proof or how visual arguments connect to proofs in general in the sense of the discussion above.

Research on mathematics education will also benefit from taking simulation proofs into account. Researchers looking at methods of teaching proofs or learning proofs may consider using simulations for either purpose if they approach the topic from the student's perspective. The effects of their use might then be evaluated for their impact on people's perceptions of the nature of proof.

The interactive simulation study aimed to ascertain how interactive simulations affected the teaching of linear equations. The researcher came to the following conclusions in light of the findings. Following the treatment, both groups' performance increased, with more students achieving better results in the PhET simulations. Significant changes between the pretests and post-tests were found for both groups. It was discovered that while the pretest scores of the groups using PhET Simulations and regular instruction did not significantly differ, the post-test results did differ significantly.

According to Garcia (2020), the researcher recommends that Teachers should incorporate simulations into their lessons more frequently. If there is no simulation in the discussion, teachers could deliver the material more technologically interactive when teaching math topics, including simulations in the discussions. In addition, the school administration must require all math teachers to use PhET simulations as part of their lesson plans.

According to Riikka & Lamsa's (2014) study, most treatments resulted in participating children's math abilities improving more than those of the children in control groups, with impact sizes ranging from modest to substantial. When teaching incorporated one or more of the following instructional features: explicit instruction, peer-assisted instruction, concrete-representational-abstract sequence, computer-assisted education, or games, progress in learning mathematics was visible.

According to Terano's (2015) research, instructional materials are a crucial tool for teaching-learning in a classroom setting. Textbooks, encyclopedias, the chalkboard and blackboard, computer-assisted presentations, and other items that are significant and helpful during discussions and teaching are some examples of this. It followed a standard format used in the earlier research we assessed for organization and format. The material is acceptable regarding compliance with the numerous CHED CMOs for engineering. Regarding its contents, organization, and format, the material has received great marks from several reviewers.

According to Ulandari et al. (2019) study, learning materials developed and evaluated in class VII of SMP Negeri 17 Medan have satisfied experts' valid requirements. The findings demonstrated that instructional resources based on realistic mathematics instruction approaches matched the successful requirements and may enhance students' self-efficacy and mathematical problem-solving skills. In light of the study's findings, it was advised that math teachers try to teach mathematics using learning materials based on actual mathematics education approaches.

Abtahi's (2016) research investigates how youngsters learn about adding two fractions by looking at the physical characteristics of mathematical equipment. The findings demonstrated that children's perceptions of the tools' mathematical affordances, attachments to their mathematical significance, creation of mathematical artifacts, and solutions to problems involving the addition of fractions were all influenced by the physical characteristics of the tools.

Geogebra. The study of Cayvaz et al. (2020) looked into how middle school students' scientific achievement, inquisitive abilities, and attitudes toward science were affected by simulation-based instruction. The achievement test results showed learners in middle school performed considerably better on the work and energy theme after receiving instruction via simulations. Because of the tool utilized in the three distinct classrooms with three different science teachers, this finding suggests that the simulation-based training used in the current study is repeatable.

As for Bellnap & Parrott (2020), studying ideal objects, abstract concepts, and their relationships is known as mathematics. The majority of mathematical ideas were not first developed as abstract concepts but rather through work on actual issues and representations. Expert problem solvers and professional mathematicians know that understanding and insights are frequently achieved the hard way by creating, arranging, and studying numerous instances. As a result, professionals frequently refrain from generalizing and speculating in favor of first attempting to comprehend by experience, investigation, and testing; they take several cases into account before making generalizations.

Task 1 allows students to investigate graphical transformations (such as shifts, compressions, and reflections) brought on by changes to a function's defining equation, which is relevant to many algebra courses. Students can rapidly and accurately create correct graphs using graphing technology, such as graphing calculators or software like Desmos or GeoGebra. This eliminates the lengthy graphing procedure that could otherwise be required. Because of this, they can think about various examples, which is crucial for the pattern recognition and generalization required for this task.

For Wassie & Sergaw (2019), the chance for GeoGebra to rapidly expand globally has arisen as students have recently mastered technology usage. Unlike other similar programs, GeoGebra is a downloadable, web-based, and open-source math software. Users of GeoGebra can simultaneously view the algebra window and the graphics window. A flexible environment is created through clever GeoGebra integration in a suitable classroom setting, engaging students and improving cooperative learning. Additional investigation of the difficulties in utilizing GeoGebra is required as it gains popularity across other nations and cultures. Large-scale investigations on the effects of GeoGebra on students' academic progress, regarding the pedagogical expertise required to integrate GeoGebra successfully, and about the difficulties posed by time limits and curricular flexibility should also be conducted. The community requires more studies into GeoGebra's potential to support mathematics education in articles, workshops, and conferences. Textbooks and course curricula, particularly those offered at institutions for teacher education, should be created in an integrated manner.

For Arbain & Shukor (2015), Math education shouldn't just be theoretical; it should also include a variety of learning strategies and the use of teaching tools that have been shown to increase students' interest in math. The teacher's task to impart knowledge that will benefit the students has been made easier by the mathematical software readily available in the market or online. However, it is up to the teacher to use the available resources without spending extra time creating new teaching tools.

In summary, this study discovered that GeoGebra software increases students' proficiency in statistics. Students had favorable opinions of the GeoGebra program regarding their passion, self-assurance, and drive. Mathematics teachers should be made aware of this program so that students can more thoroughly explore the realm of mathematics and hone their critical and creative thinking abilities.

As for Tamam & Dasari (2021), the benefits of using GeoGebra in mathematics learning include: (1) GeoGebra is an excellent tool for improving the quality of learning, especially for exploring, visualizing, and constructing mathematical concepts; (2) it improves students' mathematical abilities such as mathematical proof abilities, mathematical reasoning abilities, and mathematical problem-solving abilities; and (3) GeoGebra is genuinely helpful for both students and teachers, and it is simple to use.

For Majerek (2014), we demonstrate the advantages of incorporating dynamic mathematics software into the teaching and learning process. We conclude that by using this application, all students can be encouraged to study mathematics regardless of their mathematical knowledge level. Current science education trends call for visualization techniques, and GeoGebra perfectly fits this trend.

As to Mendes et al. (2012), when solving mathematical problems, applying algebraic rules automatically and obtaining immediate results is beneficial. However, demonstrating the outcome of applying a rule in a classroom setting may not be enough. When seeing a rule in action for the first time, it may be necessary to examine it in greater detail to comprehend what it does. As a result, we offer the option of animating the rule application. Animations involve slowly moving the various elements that comprise the formulae until they reach their final position.

MathPad. The recognition system in MathPad can be considered an informal application of grammar-based parsing. The program explicitly codes the rules that govern how symbols are arranged into math expressions. Input is processed like an organization of grammar productions that could be parsed naively. The system includes sophisticated heuristics tailored to mathematical structures (fractions, integrals, etc.). While this method is highly adjustable, it is less adaptable than other, less explicitly specified methods. MacLean (2014).

According to Haq & Elhoweris (2013), Math Pad is an electronic processor with a toolbar and a calculator. A worksheet for problem-solving in Graphic computation presentation using charts, fraction bars, and decimals interconnects one of the program's additional features. Basic Coins practice identifying coin values by using a computerized vending machine. Students use a touch screen to purchase various products from the vending machine.

For Godoy (2021), the nature of education has changed due to the fast advancement of technology, especially when it is used in conjunction with effective pedagogical principles. This combination has produced fresh chances to raise the caliber of instruction and learning.

Video Simulation. Niess and Walker (2010), cited by Antigua (2017), also suggested using digital videos as learning tools for mathematics. Students must be able to visualize, reason, and communicate to understand any geometrical concept. These abilities can be enhanced by incorporating digital videos into the teaching methods. They claim that engaging students in various mathematical processes can help teachers encourage reasoning and critical thinking. Students are also allowed to assess their prior knowledge and understanding. The incorporation of this technology also assists students in understanding and creating multiple representations of mathematical ideas.

Abu & Abidin (2013) stated that this study demonstrated the effectiveness of VPG (Educational

Video or Video Pembelajaran Geometry) in improving Van Hiele's geometric reasoning skills in 9th-grade SMP students at Parepare. Data analysis showed that 60 of her 90 students in the L0 group sample improved. Apart from that, data analysis shows that many students still did not show improvement in their thinking level after using the VPG.

Gambari et al. (2016) critically examined mathematics and its problems, especially in secondary education, in a rapidly changing world. The literature on the effectiveness of collaborative, competitive, and individualized educational strategies was reviewed. Significant gaps remain in the use of technology, such as video-based instructional packages, to support educational strategies. Using video-based teaching packages in a supportive, competitive, and individualized environment is revolutionary. Usage of Video-based instruction in a collaborative setting seems to be the answer. COOVIP is more effective in teaching geometry mathematics concepts and is also gender friendly.

According to Markovic (2012), a regression analysis was done to determine how students' grades for the presentational design of multimedia learning materials predicted their grades for the quality of the materials. According to research findings, improvements in presentational design for multimedia learning materials result in improved grades, particularly for higher-quality multimedia learning materials.

An initial study by Plass et al. (2014) has demonstrated that a good learning experience may be facilitated by invoking pleasant emotions in learners through an appealing visual design (layout, colors, images, etc.).

CK12. The Ck12 applet, according to Hruby & Vesenka (2016), was created for the in-depth study of momentum conservation at the high school and college levels. It was previously used in an introductory physics course at an unknown private liberal arts institution in New England. In this setting, we supplemented the pen-and-paper approach to momentum conservation with an applet that allowed students to examine their responses. The goal is to offer a different graphing method from the conventional vector momentum charts. Students are helped to understand the notion of momentum via a spatial approach. Numerical solutions created in lectures or laboratories typically lack transparency in this regard. A clearer idea of momentum conservation in terms of terminal velocity and direction under various collision scenarios is provided by this applet. The applet is particularly helpful for analyzing results and looking into issues that could be too mathematically challenging for some audiences in the context of elastic collisions. The applet automatically generates solutions for various linear equation systems with unknown terminal velocities.

Perdana et al. (2019) used PBL and interactive CK12 simulations to study the link between analytical thinking abilities and scientific reasoning in physical learning. The study examined these two concepts' relationships. The interactive optics simulation CK 12 was used for this investigation. The survey sample consisted of 28 of her students from Yogyakarta, Indonesia, who were chosen at random. After studying in class, pre-and post-tests were used to gather data. Using t-tests, MANOVA-tests, and correlation analysis, descriptive statistical techniques were used to assess the data. Survey findings show pupils often possess weak analytical and scientific reasoning abilities. Using web-based simulations in problem-based learning can help students develop their analytical and scientific thinking abilities. The association between analytical thinking abilities and scientific reasoning is also examined through correlation analysis. The findings indicate that analytical thinking and scientific reasoning have a statistically significant association.

For Tsakeni (2021), the CK-12 app resembles a real lab in that the learners can freely manipulate variables. The app is interactive and does not assist learners in their experiments, but it allows learners to make mistakes, thus identifying external factors that could lead to inaccurate results. The process skills developed are (but are not limited to) observing, communicating, classifying, reasoning, and predicting.

According to Wright (2020), there are lots of open instructional resources (Goers) that may be accessed to train technological know-how labs online, which includes CK12.org interactive, Poet digital labs, PBS interactive, Howard Hughes Medical Institute, and Lab Exchange (see hyperlink in Resources to the Wavelet bookmarking device for those loose simulations and more). In addition to Goers, some loose online labs and simulations can be had via agencies and college websites. Try looking for digital simulations with key phrases, including online labs, digital simulations, and digital interactive (in case you region the word duo; among the two key phrases, it will deliver up seek consequences for each topic). When doing a web look for digital labs, keep away from Adobe Flash (URLs finishing in .WWF). The browser helps for it to become discontinued, and college students are likely to revel in trouble with this report type. I introduce lab simulations to college students at some point during a synchronous (stay) consultation by finishing a digital simulation to illustrate a way to use the simulation. This is an awesome time to version your expectations, ask better degree questions and test for understanding. It is likewise useful for college kids to view and pay attention to an instance of ways you anticipate simulation inquiries to be answered. The written lab guidelines, a teacher-designed screencast that opinions the guidelines, and the simulation as a task in our studying control system. Before posting the screencast, I add it to an internet site known as EdPuzzle (for instance, see Resources). You can set EdPuzzle to pause the guidelines video at unique factors and require college students to reply to teacher-created questions that test for understanding. I inform college students net the lab till they get hold of a 100% at the lab guidelines video (EdPuzzle reviews the scholar rankings in a web grade book). If a scholar is suffering with the lab, I name them and manually them via the lab simulation, however handiest when they have watched the video. Another helpful strategy is making a frequently asked questions (FAQs) section and posting it on your learning management system (LMS). This space is available for students to ask questions and provide any type of support. I check the context of this interaction for any misconceptions and clarify them over a subsequent consultation or via a screencast. After that, the screencast is posted within the FAQs dialogue box, and an email with the screencast attached is sent to the whole class. A few lab simulations include student questions that might be utilized as formative evaluation. For those who might find setting up simulation challenging. For instance, a CK12.org simulation uses the game of fishing to illustrate the concept of density. The researcher places varying densities of lures inside the water. The strength at which to entice will float depends on the density.

2.2. Most Essential Learning Competencies

For Capate & Lapinid (2015), as part of the government's efforts to address the perceived needs of the education sector, the Department of Education (DepEd) has pushed for a change in the basic education curriculum - the introduction of an enhanced K to 12 basic education programs. In the Filipino context, education remains a top priority. However, many factors must be considered when implementing changes in an academic curriculum, especially in mathematics. On the one hand, a carefully planned exchange program is required in the curriculum. We also need to consider practical teaching materials for the trajectory of the formative process and summative evaluation of curriculum programs and the practical process of introducing new curricula in schools.

According to Bautista & Valtoribio (2016), when categorized in accordance with the descriptors, the teaching guide for Grade 8 geometry contains a variety of thinking skills and concentration. The KPUP model was not used to classify activities either. The assessment emphasizes higher-order cognitive abilities. Some of the pre-and post-assessment items were categorized using the KPUP model and had explanations for the responses, while other items did not.

As a result, there appear to be discrepancies in the KPUP model's application to the learning objectives, activities, and evaluations. The guide's preference for higher-order thinking abilities is also a bonus.

According to Balagtas et al. (2019), this study examines the alignment between the TIMSS 2015 assessment framework and the 2016 Philippine K-to-12 Math and Science curriculum to measure readiness and inform decisions about their participation. By mapping the curriculum to competencies across the two documents, this study found that mathematics grades K through 12 scored higher than scores in mathematics 8, science 4, and science 8 in the TIMSS 2015 assessment frame. It shows that it matches the workpiece.

Brigham (2018) identified emergent and a priori codes defining good mathematics education. A thorough examination of the teacher editions of the textbook series shows that if the instructor's instructions are strictly followed, pupils are not given a chance to develop and share their solutions to problems meant to aid in their understanding of the equivalence of fractions. Additionally, they are not offered chances to link various tactics. The teacher introduces each relationship.

Describe a Mathematical System. Undefined term: To build logic-based mathematical systems, mathematicians express their ideas using words such as B. These words are not defined and are sometimes called "primitive terms." These words usually have some meaning from what we have experienced. It turns out that any attempt to define basic undefined terms such as points, quantities, numbers, elements, etc., quickly leads to so-called "circular reasoning." A point is a position where something exists. But what does the object's position mean: one point. Similarly, trying to define other terms not defined in mathematics leads to circular reasoning. In practice, the expression quickly becomes unimaginably long unless we introduce a definition.

The definition additionally analyzes common concepts to categorize quadrilaterals with opposing parallel sides. Since you can accomplish this, you can. "A quadrilateral with opposite sides that are parallel is a parallelogram." Using this definition, we have created a class of parallelograms, supposing that quadrilaterals, antipolars, and parallels have already been specified. Khan (2015).

As to Reif et al. (2019), the researcher presented a series of experiments that shed light on the internal representation of linguistic information in BERT. They also provided a mathematical justification for the square-spaced tree embeddings discovered by Hewitt and Manning. So far, they've shown that just as they have a particular syntactic subspace; they have proofs of subspaces that represent semantic information. The conjecture that the internal geometry of BERT can be divided into several linear subspaces, with separate spaces for different syntactic and semantic information.

Bowman et al. (2017) state low-level geometric elements like points, lines, and planes are used in conventional simultaneous localization and mapping (SLAM) techniques. They are unable to give the environment's landmarks meaningful labels. In unclear or repeated contexts, loopback identification based on low-level characteristics is frequently viewpoint-dependent and error-prone. On the other side, object identification techniques may extract landmark classes and scales, producing a condensed collection of instantly recognized landmarks that are perfect for clear eye-gaze independent loop closure. However, maps with many items of the same type have serious data association issues. Contrary to classical SLAM, which is a continuous optimization over metric information, data correlation, and discovery are discrete issues that are often tackled via discrete inference. In this study, we propose an optimization issue for sensor states and semantic landmark placements, integrating metrics, semantics, and data relationships and breakdown it into two interconnected problems. Calculating landmark class probabilities and discrete data associations while constantly optimizing over metric states.

Illustrate the Need for Axiomatic Structures. There are many factors to consider when creating a P.S.I. Some are The subject, individual differences, and a combination of student and teacher interests. This study addresses the construction of teaching materials for university students. P.S.I. covered finite geometries. It contained elements of axioms and geometric constructions.

With the help of math and module writing professionals, descriptions, relationships, axioms, homogeneous coordinates, theorems, and proofs were planned, produced, amended, and assessed. Field experts have verified that: 1. Students can easily read the material. 2. Future readers will enjoy the design. 3. The terminology is acceptable and comprehensible.

Dickins (2009) cited by Dickins (2020), these axioms, consisting of six axioms and subsequent definitions, provide a formal account of the semiotic (including linguistic) theory of extended axiomatic functionalism. Systems ontology deals with abstract semiotic entities in senology (linguistics, phonology), logology (linguistics, lexicology), and delology (designated semantics). The Signum ontology provides a set theoretically well-grounded representation of the relationships between system ontology entities and semiotic appearances (utterances). Axiom B and the definitions below cover almost all aspects of system ontologies except paraontotactics.

According to Heis et al. (2020), Euclid's Elements' fifth postulate is the infamous parallel premise. If a straight line dropped on two straight lines and made them less than two right angles on the same side, the two straight lines would meet on the side where the internal angles were less than two right angles if they were created indefinitely.

By the late 19th century, Beltrami and Klein had shown the consistency of negating axioms, and of course, Einstein had disproved them about physical space as well. Unsurprisingly, some philosophers have claimed that the actual possibilities of non-Euclidean physical spaces undermine Kant's mathematical philosophy—indeed, his entire theoretical philosophy. Furthermore, some of Kant's detractors have considered Kant's silence on this subject fault worthy since they were astonished that Kant says nothing about the well-known issues with Euclid's axiom of parallels. Here is an example from William Ewald's well-known book From Kant to Hilbert: Kant had very little to say about Euclid's Axiom of Parallels or its significance to his theory of geometry in his philosophical writings.

He was undoubtedly aware that mathematicians had tried in vain to prove the axiom and that the lack of proof was considered a notoriously unresolved problem. Still, neither the axiom nor the possibility of other geometries is mentioned in the Critique of Pure Reason. And here is an even more damning judgment from a century ago: Kant has demonstrated throughout the Critique of Pure Reason that he only had a very poor understanding of the fundamentals of mathematics and had no idea what was going on in the field of first principles of geometry at the time. By considering the condition of the argument over Euclid's axiom in the late eighteenth century, these critiques of Kant become more apparent. Euclid's axiom of parallel lines was probably valid in late 18th-century Germany. Still, because it lacked the characteristics of real unprovability (such as certainty and simplicity), it was regarded as a true axiom.

Illustrate Triangle Congruence. Two significant subjects found in the local high school mathematics curriculum are the congruency and similarity of triangles. It is necessary to use deductive reasoning to support the congruence of two triangles. If two triangles are the same size and shape, they are said to be congruent. Students must learn to evaluate the preconditions and derive the conclusion by determining whether or not these circumstances are sufficient while learning the idea of congruent triangles. Actual object display is scarcely a helpful analogy for learning to support this claim with reasoning (Leung et al. 2014).

According to Seago et al. (2013) recognize that two-dimensional figures are congruent with one another if a series of rotations, reflections, and translations can be used to create the second from the first; given two congruent forms, explain a sequence that demonstrates their congruence.

For Shahbari & Daher (2020), the students' conversations during their study of Islamic decoration showed that they were successful in defining the terms "congruence" and "congruent triangles" through their use of imagination, connections, inference, and knowledge. They discovered and developed the necessary criteria for two triangles to be congruent as a result, i.e., Congruent triangles have three theorems: (S, A, S), (A, S, A), and (S, S, S). The students completed rationalization exercises that relied on the theorems as well. We describe the characteristics of each stage of the student's learning in the following section. We only describe the events in one of the two groups when separate processes occurred to prevent duplication.

According to Haj-Yahya (2022), students could distinguish between descriptions and theorems and did not necessarily accept the congruent and similar triangle theorems as official definitions of congruency and similarity. According to the participants' justifications for their choices and the results of the interviews, it seems that two problems kept some people from choosing or accepting these theorems as descriptions. The first was an argument for uniformity because each notion has a single, widely recognized definition. The second was an emphasis on the fundamental ideas behind the concepts: the fundamental ideas behind similarity and congruency are principally represented by a triangle's side lengths.

Solves Corresponding Parts of Congruent Triangles. For instance, according to the Common Core Georgia Performance Standards (CCGPS) (Georgia Department of Education, U.S.A., 2013), cited by Lin and Lin (2014), students should use triangle similarity criteria to solve problems, demonstrate relationships between geometric figures, and draw geometric inferences. Participants must use the basic principle of similar triangles, which stipulates that two triangles are similar if their respective angles are equal. To answer the puzzles, their corresponding sides have the same ratios (mathematically represented as ABCDEF). For instance, after reading one of the overlapping triangles, a mental operation is required to locate the comparable second triangle by shifting one of the triangles up (or down). The problem solvers would remember that analogous sides are in proportion after discovering the corresponding similar triangles and would then deduce the necessary equations.

For instance, given the similarity between A.B.C. and A.D.E., solvers must compare two triangles to locate the equivalent sides and mathematically deduce the formula. Aside from the fundamental quality of similar triangles, each situation is unique in that it calls for a particular set of cognitive processes to identify a similar-triangle pattern. When a person reads one of the triangles in issue one and then walks to the right (or left) to discover the identical second triangle for the corresponding angles, they must do a straightforward mapping operation. This is because the pairs of similar triangles' spatial relationships are in translation. To solve a problem, one must mentally separate two comparable triangles.

The study of Zita (2021) also described how the teacher responded to each of these wrong answers. In the first activity, they expected students to be able to distinguish between congruent and similar numbers. They also assumed that students would construct a definition of "similar triangles" and state their properties based on the given activity. One student completed the definition of a congruent triangle using the teacher's follow-up question.

"Triangles are similar if their corresponding angles are congruent and their corresponding parts are proportional. "The results showed that the teacher predicted the students' possible responses well. Second, predicting student difficulties involves predicting errors in completing activities, assignments, and misunderstandings related to similar triangular themes. The student also assumed that she could complete the activity within 10 minutes.

As to Galman (2019), when solving a geometry problem involving similar triangles, students drew two triangles correctly labeled with appropriate measurements instead of just doing the math. This made it easier to identify the missing values needed to determine the perimeter of one of the triangles.

Proves Two Triangles are Congruent, according to Cirillo & Herbst (2012). The importance of the student in proof significantly decreased during the 20th century. This narrowing happened simultaneously as the two-column proof writing format became standardized. The two-column style is a great scaffold to aid students in this work if the objective is for the student to just use the "givens" to condense the assertions and a rationale that demonstrates a conclusion. However, if we increase the amount of work that students must perform when proving, we might need to consider different types of issues and ways to display information to support and scaffold their work.

In a study by Verzosa et al. (2019), researchers examined the relationship between her use of the ProveIt app and students' ability to write two-column proofs. Non-Android technologies that facilitate two-column proofs require users to guess based on numbers and enter statements to back up their proofs. In contrast, ProveIt is Android-based and allows users to trace parts of their characters. In ProveIt's Triangle Congruence mode, the user determines, through logic, pairs of congruent parts in the geometry and traces the pairs. Blinking colors provide visual feedback. The part pair turns green for correct identification and red otherwise. The goal is to identify enough pairs of congruent parts to satisfy the stated congruence postulate of the triangles (such as Side-Angle-Side).

According to Leung (2014), the teacher of the 1999 TIMSS video intended to teach the concept of satisfaction through activities that allow students to explore the minimum conditions necessary to justify the congruence of triangles. The first goal seems to have been achieved. Identify three sufficient features (side and angle combinations). A second objective was to identify her four conditions: S.S.S., A.S.A., S.A.S., and R.H.S. TIMSS teachers did not clearly explain the reason for R.H.S. Nothing special, nor a future teacher. A competent teacher should understand why R.H.S. A.S.S. is special and why A.S.S. is an inadequate condition. In other words, a competent teacher uses a clear counterexample that "A.S.S. is a congruent condition" while at the same time, R.H.S. is a special case of A.S.S.

2.3. Synthesis

These studies are related to the current research of the researcher. The result of the study about Simulation tools greatly influences why there is a need to use different simulation tools. Different learning materials have already been developed, yet mastering learning competencies in mathematics are still difficult to achieve. These innovative simulation tools are undeniably found effective and beneficial to the learners. As shown in the different studies conducted by different researchers, learning material is an effective tool a teacher and students can use to provide a concrete understanding of the competencies.

3. Research Methodology

The approaches and study parts are covered in this chapter. It includes the population and sample, the research technique, the research instrument, and the statistical data analysis of the results.

3.1. Research Design

This study used the sequential mixed method design, an explanatory sequential design according to Creswell et al. (2011), which entails gathering quantitative data first, followed by qualitative data to support or supplement the quantitative findings. This strategy is justified because, while quantitative data and findings offer a basic image of the study topic, more analysis—specifically the acquisition of qualitative data—is required to enhance, expand, or clarify the overall picture.

The first method is the pre-experimental pretest-posttest design, where a single group of students was given a pretest and then exposed to simulation tools in teaching the lessons. By the end of the exposure, a posttest was given. The Pretest and Posttest determined the students' mastery level in the most essential learning competencies. Efendi et al. (2018) demonstrate that this design employs a pretest and posttest or pretest and final test; before receiving a better assessment, the researcher performs a pretest first, and the posttest is done after acquiring the material, with the hope of comparing before and after the material was delivered, followed by an interview with the students exposed to the simulation tools. The collected data in the quantitative and the qualitative were compared or related before the interpretation.

3.2. Respondents of the Study

The respondents for this research consisted of students from one heterogeneously grouped class from Grade 8 Escuro having 30 students in Talangan Integrated National High School. Barangay. Telangana, Nagcarlan, Laguna, during the school year 2022-2023. Since the researcher is teaching in grade 8. Grade 8 Mathematics students were used as respondents with the use of cluster sampling.

3.3. Sampling Technique

The respondents for this study were chosen by the researcher using a cluster sampling technique. The research's 30 respondents came from one section of mathematics students in Grade 8, whom the researcher selected since the researcher handles this section and they have the greatest number of tablet recipients. Cluster sampling is a probability sampling method where the subjects are picked according to the availability of their sections. The researcher's cluster was considered when collecting data and managing the researcher. Cluster sampling is the most popular kind of sampling technique, according to Theory and Practice in Language Studies (2012), because it creates low and high sets of groups that can be compared while keeping all other variables constant.

3.4. Research Instrument

To gather sufficient data for analysis, the researcher made the same test for the pre-test and post-test for the quantitative data analysis and an interview question for qualitative data analysis.

Construction. To determine the mastery level of the topics included in the MELC of Mathematics 8 for the third grading period. The researcher crafted the same test for the pre-test and post-test. The test is composed of 8 questions per week. The experimental research using simulation tools lasted six weeks, so the researcher made 48 questions for the pre-test and post-test. The test came from K to 12 curriculum modules, and the teacher made tests.

To determine the emerging factors from using simulation tools that helped students to maximize the capacity of mastering the MELC in Mathematics 8. The researcher considered the suggestion of the panel to limit the question to three direct-to-the-point questions. Following this direction, the researcher crafted the three interview questions for the students subjected to simulation tools.

Validity. To ensure the validity and reliability of the pre-test, post-test, and interview questions. Before consulting the external validator, the researcher presented the material to the thesis adviser for approval. The validator was one principal, two master teachers, one teacher III in mathematics, and an English teacher.

Furthermore, the researcher first conducted a pilot testing of pre-test and post-test on 30 grade 9 students of Talangan INHS. The result of the pilot testing was carefully analyzed and revised to ensure the validity and reliability of the material.

Table 1. Reliability of the Pre-test and Post-test

Item Placement	P_U Tally	f_U	P_U	P_L Tally	f_L	P_L	D_x=P_U-P_L	D_x *Evaluation*	$D_f = \frac{P_u + P_l}{2}$	D_f *Evaluation*
1	III	3	0.38		0	0.00	0.38	Reasonably Good	0.19	Difficult
2	IIII	4	0.50	卌	5	0.63	-0.13	Poor Item	0.56	Average
3	卌 I	6	0.75	IIII	4	0.50	0.25	Marginal Item	0.63	Average
4	卌 II	7	0.88	卌	5	0.63	0.25	Marginal Item	0.75	Average
5	III	3	0.38		0	0.00	0.38	Reasonably Good	0.19	Difficult
6	II	2	0.25	I	1	0.13	0.13	Poor Item	0.19	Difficult
7	卌	5	0.63	I	1	0.13	0.50	Very Good Item	0.38	Average
8	III	3	0.38	I	1	0.13	0.25	Marginal Item	0.25	Average
9	III	3	0.38		0	0.00	0.38	Reasonably Good	0.19	Difficult
10	卌	5	0.63	I	1	0.13	0.50	Very Good Item	0.38	Average
11	II	2	0.25		0	0.00	0.25	Marginal Item	0.13	Difficult
12	II	2	0.25	II	2	0.25	0.00	Poor Item	0.25	Average
13	II	2	0.25	I	1	0.13	0.13	Poor Item	0.19	Difficult
14	卌	5	0.63	I	1	0.13	0.50	Very Good Item	0.38	Average
15	IIII	4	0.50		0	0.00	0.50	Very Good Item	0.25	Average
16	III	3	0.38	I	1	0.13	0.25	Marginal Item	0.25	Average
17	IIII	4	0.50	I	1	0.13	0.38	Reasonably Good	0.31	Average
18	II	2	0.25	I	1	0.13	0.13	Poor Item	0.19	Difficult
19	卌 II	7	0.88	卌	5	0.63	0.25	Marginal Item	0.75	Average
20	卌 II	7	0.88		0	0.00	0.88	Very Good Item	0.44	Average
21	卌 I	6	0.75	III	3	0.38	0.38	Reasonably Good	0.56	Average
22	I	1	0.13	I	1	0.13	0.00	Poor Item	0.13	Difficult
23	IIII	4	0.50	I	1	0.13	0.38	Reasonably Good	0.31	Average
24	卌 I	6	0.75	II	2	0.25	0.50	Very Good Item	0.50	Average
25	IIII	4	0.50		0	0.00	0.50	Very Good Item	0.25	Average
26	IIII	4	0.50	II	2	0.25	0.25	Marginal Item	0.38	Average
27	卌 II	7	0.88	卌 II	7	0.88	0.00	Poor Item	0.88	Easy
28	卌 I	6	0.75	IIII	4	0.50	0.25	Marginal Item	0.63	Average
29	卌	5	0.63	IIII	4	0.50	0.13	Poor Item	0.56	Average
30	IIII	4	0.50	卌	5	0.63	-0.13	Poor Item	0.56	Average
31	IIII	4	0.50	III	3	0.38	0.13	Poor Item	0.44	Average
32	卌	5	0.63		0	0.00	0.63	Very Good Item	0.31	Average
33	III	3	0.38	I	1	0.13	0.25	Marginal Item	0.25	Average
34	II	2	0.25	II	2	0.25	0.00	Poor Item	0.25	Average
35	II	2	0.25		0	0.00	0.25	Marginal Item	0.13	Difficult
36	I	1	0.13	II	2	0.25	-0.13	Poor Item	0.19	Difficult
37	III	3	0.38	II	2	0.25	0.13	Poor Item	0.31	Average
38	卌 II	7	0.88	IIII	4	0.50	0.38	Reasonably Good	0.69	Average
39	卌	5	0.63	III	3	0.38	0.25	Marginal Item	0.50	Average
40	III	3	0.38		0	0.00	0.38	Reasonably Good	0.19	Difficult
41	II	2	0.25	I	1	0.13	0.13	Poor Item	0.19	Difficult
42	卌	5	0.63	I	1	0.13	0.50	Very Good Item	0.38	Average
43	III	3	0.38		0	0.00	0.38	Reasonably Good	0.19	Difficult
44		0	0.00		0	0.00	0.00	Poor Item	0.00	Very Difficult
45		0	0.00		0	0.00	0.00	Poor Item	0.00	Very Difficult
46		0	0.00		0	0.00	0.00	Poor Item	0.00	Very Difficult
47	卌 II	7	0.88	III	3	0.38	0.50	Very Good Item	0.63	Average
48		0	0.00		0	0.00	0.00	Poor Item	0.00	Very Difficult
49		0	0.00		0	0.00	0.00	Poor Item	0.00	Very Difficult
50		0	0.00		0	0.00	0.00	Poor Item	0.00	Very Difficult

Table 1 shows the result of pre -test and post- test. The poor item was revised in order to strengthen the validity and reliability of the test questionnaire.

3.5. Research Procedure

Implementation. The researcher first submitted the permit to conduct research to the division superintendent and sought the approval of the principal to start the study with 30 grade 8 students.

Before using simulation tools in Mathematics, a pre-test was given to the students to determine their prior knowledge of the topic.

After assessing the students using a pre-test questionnaire with 48 items, the researcher prepared the lesson using simulation tools. Every lesson was designed specifically for the students and used flexible grouping. For six weeks, the group was exposed to simulation tools. After that, a post-test, the same as the previous test, was given to the students to assess whether there were differences. After the post-test, the researcher interviewed the students using guide questions. The guide questions were used to extract the factors of the simulation tools, to maximize student's mastery of the selected most essential learning competencies in Mathematics 8 during the third quarter.

3.6. Data Analysis

The data gathered were subjected to statistical treatment to test the hypothesis and for analysis and interpretation using the tools below:

1. **Frequency** – This was used to compute the number of pupils in the group.
2. **Mean** – This was used to determine the average distribution of scores based on the students' pre-test and post-test.
3. **Percentage** – This is used for the pre-test and post-test scores of the students.
4. **Standard Deviation** – This measures the variability of the pupils' answers.
5. **T-Test** – This was used to compare the means of the groups (pre-test and post-test).
6. **Thematic Analysis –** This was used to emphasize, identify, analyze, and interpret qualitative data patterns based on the result of the interview of the participants.

Ethical Consideration. The researcher protected the privacy of the participants. The researcher did not include the name of the participants in the data gathered. The names of the participants in the interview were changed. The collected data of the researcher in this study is valid.

4. Presentation, Analysis and Interpretation of Data

This chapter includes the tabulated data, the study's findings, the accompanying analysis, and the interpretation of the data as the result of the data analysis.

Part I. **Effectiveness of Integrating Simulation Tools Toward Mastery of Most Essential Learning Competencies (MELC) in Mathematics**.

This part shows the effect of simulation tools in mastering the most essential learning competencies in mathematics. The mastery level was measured using pre-test and post-test instrument.

Table 2. Mastery Level on MELC in Terms of Describing a Mathematical System

Scores	Pretest		Posttest		Interpretation
	f	%	f	%	
7-8	-	-	7	23.3	Fully Mastered
5-6	6	20.0	13	43.3	Mastered
3-4	15	50.0	9	30.0	Moving to Mastery
0-2	9	30.0	1	3.3	Needs Improvement
Total	30	100.0	30	100.0	

Legend: 7-8 Fully Mastered; 5-6 Mastered; 3-4 Moving to Mastery; 0-2 Needs Improvement

Table 2 shows the Mastery level of Grade 8 students on the MELC in terms of Describing a Mathematical System in the pre-test and post-test. The result shows an increase in performance from the pre-test to the post-test. The pre-test result of 30.0% of the class needing improvement on the pre-test means that those students who were in the needs improvement level do not recognize what a mathematical system is and do not have any idea about describing a mathematical system. In the pre-test, 50.0% of the students are at the "Moving to Mastery Level." This result shows that these students know about points, lines, and planes since they studied linear equations during the second grading period. Lastly, the post-test result showed that 43.3% of the students achieved mastery, and 23.3% achieved full mastery. At the Mastered level, the student can identify defined and undefined terms and define theorems and postulates with some confusion. Still, at the Fully Mastered level, the student can easily determine a defined and undefined term and define theorems and postulates.

Based on the pre-test and post-test results on describing mathematical systems, most students improved their mastery level in describing mathematical systems. In mathematics, describing and identifying the meaning of terms is easy, especially in geometry. Still, suppose the student does not fully grasp these concepts. In that case, the lesson describing a mathematical system will be confusing and frustrating since they need to establish the connection between describing it and the following geometry lesson.

Describing mathematical systems is the most essential part of studying geometry. According to Keuroghlian (2013), misconceptions about learning geometry could be due to terminologies and language used. Most of the students must reach mastery in describing mathematical systems to fully associate the concept of terms used in geometry with the lesson that follows it. That is why there is a good result shown in Table 2 that most of the students reach the mastered and fully mastered level.

Table 3. Mastery Level on MELC in Terms of Illustrating the Need of Axiomatic Structure

Scores	Pretest		Posttest		Interpretation
	f	%	f	%	
7-8	-	-	5	16.7	Fully Mastered
5-6	-	-	6	20.0	Mastered
3-4	17	56.7	14	46.7	Moving to Mastery
0-2	13	43.3	5	16.7	Needs Improvement
Total	30	100.0	30	100.0	

Legend: 7-8 Fully Mastered; 5-6 Mastered; 3-4 Moving to Mastery; 0-2 Needs Improvement

Table 3 shows the result of the pre-test and post-test performance of the students in the Essential Learning Competencies in Terms of illustrating the need for axiomatic structure. During the pre-test, 43.3% of the students fall under the needs improvement level. Students in the needs improvement level do not know the lesson. 56.7% of the students are in Moving to Mastery. Students moving to mastery level can define terms under defined and undefined terms on geometry and recognize examples of defined and undefined terms. The result of the post-test shows that the student's performance improves. The number of students who need improvement has reduced to 16.7%, and 46.7% are on moving to mastery. 20.0% of the students achieved Mastered. These students can easily describe, gives meaning, and recognize examples of defined and undefined terms in geometry but cannot easily determine whether the statement is a theorem or a postulate. Lastly, 16.7% of the students reached the Fully Mastered level. Students in Fully Mastered can easily describe, gives meaning, recognize examples of defined and undefined terms in geometry and determine whether the statement is a theorem or a postulate.

Despite reducing the percentage of students under the Needs Improvement during the pre-test, which has 43.3% to 16.7% on the post-test, it only shows that most students did not meet the expectation to have mastered to illustrate the need for axiomatic structure.

Studying geometry is a crucial part of learning mathematics, according to Ozerem (2012), since it gives students the skills they need to apply to other areas of mathematics and the ability to analyze and comprehend the world around them. Students must therefore acquire appropriate concepts in geometry and a solid comprehension of geometric ideas.

Table 4. Mastery Level on MELC in Terms of Illustrating Triangle Congruence

Scores	Pretest		Posttest		Interpretation
	f	%	f	%	
13-16	-	-	15	50.0	Fully Mastered
9-12	9	30.0	14	46.7	Mastered
5-8	18	60.0	1	3.3	Moving to Mastery
0-4	3	10.0	-	-	Needs Improvement
Total	30	100.0	30	100.0	

Legend: 13-16 Fully Mastered;9-12 Mastered; 5-8 Moving to Mastery; 0-4 Needs Improvement

The result of the pre-test and post-test in Table 4, mastery level on Most Essential Learning Competencies in terms of Illustrating triangle congruence, no student reached the Fully mastered level in the pre-test, while in the Post-Test 50.0% of the students Fully Mastered illustrating triangle congruence. From the pre-test result, 60.0% of the students are moving to mastery level, while on the post-test, it was reduced to 3.3%.

According to the data above, most students fully mastered illustrating triangle congruence. In this topic it tackles about Side- Angle-Side (ASA), Side-Angle -Side (SAS), Angle-Angle-Side (AAS) and Side-Side-Side

(SSS) congruence postulate, identification of congruent triangles, and the concept of CPCTC. Students in the needs improvement group do not know anything about the topic. The students moving to mastery already know the concept of unity and its corresponding parts. The students at the mastered level know how to determine the corresponding parts of a congruent triangle. The students of the fully mastered group can easily determine the corresponding parts of congruent triangles; moreover, they can construct mathematical statements showing congruent triangles.

The simulation tools the CK12 used in the topic mentioned earlier show that it greatly impacts reaching the fully mastered level. The CK12 helps the learner understand the topic because it includes examples, can be manipulated, and the correction in the challenges is readily available.

Chiriac and Balmus (2020) state that we specifically stress the value of digital textbooks in the classroom through their interactive capabilities, a crucial aspect of digital textbooks. Learning becomes understandable because of the interactive material, which keeps pupils interested and motivated. It is possible that the students fully mastered the lesson because the simulation tool boosted their interest.

Table 5. Mastery Level on MELC in Terms of Solving Corresponding Parts of Congruent Triangles

Scores	Pretest		Posttest		Interpretation
	f	%	f	%	
7-8	-	-	7	23.3	Fully Mastered
5-6	3	10.0	14	46.7	Mastered
3-4	11	36.7	6	20.0	Moving to Mastery
0-2	16	53.3	3	10.0	Needs Improvement
Total	30	100.0	30	100.0	

Legend: 7-8 Fully Mastered; 5-6 Mastered; 3-4 Moving to Mastery; 0-2 Needs Improvement

Table 5 shows the result of the pre-test and post-test Mastery Level on the MELC in terms of Solving Corresponding Parts of Congruent triangles. 46.7% of the students reached the mastered level in the post-test, from 10.0% in the pre-test. From the pre-test of 53.3%, the number of percentages of students who need improvement was reduced to 10.0% in the post-test result. 23.3% of the learners reach the Fully Mastered level.

As shown in the result, most students are in the upper level of mastery, which shows a good result of attaining Mastered and Fully Mastered. Mastering the concept of illustrating triangle congruence may be the main cause of knowing how to solve the corresponding parts of a congruent triangle since illustrating triangle congruence is the prerequisite to solving the congruent part.

According to Bruner (1961), cited by Simamora & Saragih (2019), discovery learning is a learning model that uses inquiry-based constructivist learning theory in problem-solving situations where learners learn through existing knowledge and previous experience to find facts and relationships with new material being studied. Students may have enough knowledge of the concept of congruent parts of congruent triangles are congruent, that they easily associate and use the knowledge learned in solving corresponding parts of the congruent triangle.

Table 6. Mastery Level on MELC in Terms of Proving Two Triangles are Congruent

Scores	Pretest		Posttest		Interpretation
	f	%	f	%	
7-8	-	-	12	40.0	Fully Mastered
5-6	-	-	15	50.0	Mastered
3-4	-	-	3	10.0	Moving to Mastery
0-2	30	100.0	-	-	Needs Improvement
Total	30	100.0	30	100.0	

Legend: 7-8 Fully Mastered; 5-6 Mastered; 3-4 Moving to Mastery; 0-2 Needs Improvement

As reflected in Table 6. Mastery level on MELC in terms of proving two triangles are congruent, the pre-test result shows that 100.00% of the learners fall under the needs improvement level. The post-test result shows that 50.0% of the student mastered the topic, and 40.0% of the student Fully Mastered it, proving two triangles are congruent.

The result of the post-test, as compared to the result of the pre-test, shows a recognizable improvement from needs improvement to almost all the students gained mastered to fully mastered on proving two triangles are congruent. Students cannot easily hit the correct answer in the pre-test since the question is not a multiple-choice test. The pre-test shows that students do not have any knowledge of proof. The post-test shows that the learners mastered proving two triangles are congruent, maybe because the students easily learned the concept of proving using simulation tools.

Hillmayr et al. (2020) Highlighted Technology-supported learning can improve student learning in science and mathematics. Providing teacher training moderates the overall effect. • Intelligent teaching systems and simulations show significant effects on student learning. • Drill and practice, or hypermedia systems, have a small impact on student learning. • Technology-supported learning positively impacts student attitudes.

Part II. Significant Difference Between Students' Pre-test and Post-test Performance.

This part shows the result of test of significance difference between pre-test and post-test using Paired t-test.

Table 7. Test of Significant Difference Between the Pre-test and Post-test Performance of the Student-Respondents

Competencies	Test	Mean	SD	t	df	Sig.
Describe a Mathematical System	Pretest	3.30	1.56	4.975	29	0.000
	Posttest	5.13	1.48			
Illustrate the Need of Axiomatic Structure	Pretest	2.63	1.10	4.650	29	0.000
	Posttest	4.33	1.94			
Illustrate Triangle Congruence	Pretest	7.47	2.19	9.918	29	0.000
	Posttest	12.33	2.12			
Solves Corresponding Parts of Congruent Triangles	Pretest	2.50	1.48	6.977	29	0.000
	Posttest	5.20	1.85			
Proves Two Triangles are Congruent	Pretest	0.07	0.25	33.585	29	0.000
	Posttest	6.17	1.05			

Legend: $p<0.05$-Significant, $p>0.05$ Not Significant

Table 7 shows the test of significant difference between the pre-test and post-test scores and the performance of the students exposed to simulation tools such as Construction tools- MathPad, Geogebra, CK 12, and video simulation on Most Essential Learning Competencies to describe a mathematical system, illustrating the need for axiomatic structure, illustrate triangle congruence, solves corresponding parts of congruent triangles, and prove two triangles are congruent.

It shows that there is a significant difference between the pre-test and post-test scores of students exposed to simulation tools in terms of describing a mathematical system (p-value=0.000), illustrating the need for axiomatic structure (p-value=0.000), illustrating triangle congruence (p-value=0.000), solve corresponding parts of congruent triangles (p-value=0.000) and prove two triangles are congruent (p-value=0.000).

The result implies a significant difference between the pre-test and post-test scores performance of the student-respondents in the assessment provided based on the Essential Learning Competencies. The result would tell that learning happens when the result of the post-test is higher than the result of the pre-test. Some factors influence the students' mastery result- respondents in this study use simulation tools in geometry mathematics eight (8) that enable some of them to reach the fully mastered level. The simulation tools used in this research are Ck12, Construction tool Math-pad, Geogebra, and Video Simulation. The Ck12, Construction Mat-Pad, and GeoGebra are all digital manipulative tools, but the Ck12 is not just a manipulative digital tool but also a digital book. Since using these simulation tools is new to them and the students are in the digital era, they best suit their interest in studying. The video simulation tools also boosted the students' learning capacity, especially the video that simulated body gestures of angles and sides, accompanied by catchy background music, which helped the students memorize all the triangle congruence postulates.

In the following tables 8.1 to 8.5, these factors arise, manipulative representations, teacher factor, students' interest, availability of defined terms, and included examples, contributed to the student’s gaining mastery of the essential learning competency in mathematics 8.

Overall, using digital tools greatly impacted students' learning results and attitudes toward the subject being taught. This demonstrates the possibility of learning with digital tools, especially given how difficult it can be for students to comprehend mathematical or scientific concepts in the classroom Hillmayr (2020). The simulation tools used in this study, like the mathPad, Geogebra, and Ck 12, are also considered digital tools. With this, it is proven that the use of simulation tools is effective in mastering the most essential learning competency in mathematics eight (8) geometry.

Part III. Emerging Factors from the Use of Simulation Tools

Tables 8.1 to 8.5 are the thematic analysis of the emerging factors using simulation tools that helped students maximize their capacity to master the most essential learning competencies. These are the emerging factors as the result of interviewing the students-respondent in using simulation tools.

Table 8.1. Emerging Factors from the Use of Simulation Tools

Statements	Codes	Themes
Hera: Dahil po nagagalaw po yung mga angles, like po yung triangles kapag po gusto mo syang ipagcongruent nagagalaw sya tapos yung mga dots naiilipat mo tapos may mga sukat din po na makikita.	Moving Dots	
Kitty: naigagalaw yung mga angles, mabilis naming naiintindihan.	Moving Angles	
Pres: Mam yun pong mga pageedit edit nung mga angles ganun po (researcher: pag galaw galaw) opo pag galaw galaw po nung mga angles	Move to Edit	Manipulative Representation
Ace: Mam nandyan na po yung mga kagamitan tapos po igagalaw na lang po namin.	Available to be Moved	
Jorn: Dun po sa gadgets nandun na yung mga tools na gagamitin, mas mabilis pong igalawgalaw kung saan saan, yung para pong sure ka na magmeasure.	Easy to Move	

From the statement gathered in Table 8.1, the theme of Manipulative Representation came up. Some students in their group used the tablet the school issued, while others used their gadgets and Android phones to access the simulation tools digitally. Using their touch screen gadgets, the students manipulate figures simulated digitally. In the simulation tools, there are challenges that the students must finish before they can answer questions included in the simulation tools. Those challenges include the manipulative digital simulation tool that helps the students connect the definition of terms to the concrete idea that leads to the mastery of the most essential learning competency.

Figure 4: Shows a topic in congruence that students need to manipulate digitally.

In identifying and building with stages, manipulatives from virtual media may contribute to creating a mathematical situation. For instance, using DGS (Dynamic Geometric Software) in learning geometry can help students discover the various properties of the building through the empirical abstraction procedure and the recognizing phase. DGS is a collection of flat visual representations that students can present on a computer screen and manipulate. The learner may then understand the connection between the manipulation carried out and the answer acquired to have the ability to raise the supposition by executing manipulations that result in a quick response from the computer's work Hakim et al. (2019).

Table 8.2. Emerging Factors from the Use of Simulation Tools

Statements	Codes	Themes
Pres: yung mga meaning po yung mga vertex po ganun ano po nandun po yung meaning sa link nandun na po mismo lahat. opo hindi na po kami mahihirapan maghanap ng mga meaning na gustong idefine.	Meaning of the terms available	
Kitty: Mam Kasi nandun na po yung mga examples ng mga sasagutan po. Kagaya po nung mga reflexive, mga congruent yung SAS mga SSS nan dun nadin po yung mga definition nila. Dun ko po nabasa yung definition nila mas lalo ko pong naintindihan.	Definition is available	Availability of defined terms
Thea: mam yun po, yung mga example po halimbawa po yung mga triangle tapos may mga given yung mga example po. Yung mga solution po na meron na don para po magets saka po yung mga dagdag na information na mga meaning dun sa baba po nung mga examples.	Additional Information and meaning	

The result is shown in Table 8.2. One of the emerging factors from using simulation tools that helped students maximize the capacity to master the most essential learning competencies is the Availability of defined terms. When the definition of terms is readily available, the students can easily grasp the concept they need to discover. At the start of the lesson, every technical term that is needed in the lesson should be defined first. If the terms to be used are not clear to students, students will not have a concrete understanding of the topic. In the simulation tool the students used, the terms needing definitions are highlighted when the word is tapped; the definition will appear. These simulation tools can easily define terms; the students need not browse other websites or open a book or other references just to find the meaning of the word students need to define.

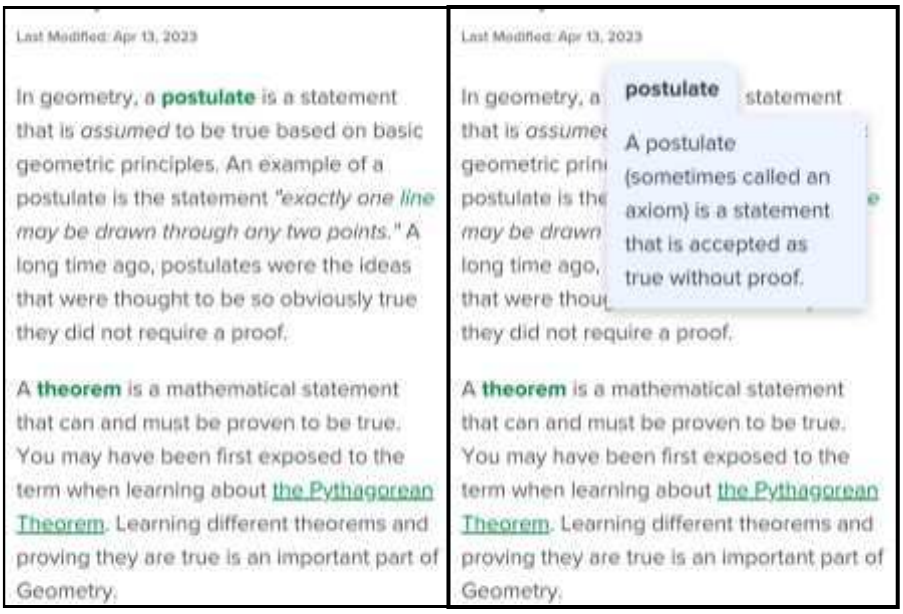

Figure 4: the part of simulation tool that shows the availability of defined terms.

According to Liu et al. (2014), it is anticipated that looking up words in a click-on dictionary, where the learner can simply click on the unfamiliar words with the mouse, will require less mental and cognitive capacities (i.e., gaze time investment) than searching up words in a key-in dictionary, where the unfamiliar words must be typed on the keyboard. But it's thought that making a greater effort to actively type the letters in the key-in dictionary helps students learn how to spell words since it directs their attention more intently and actively to the word's spelling. Using a click-on dictionary helps the student in geometry to conveniently define words and saves time so that they can focus their attention on what must be learned in geometry.

Table 8.3. Emerging Factors from the Use of Simulation Tools

Statements	Codes	Themes
Junior: Mam kasi may mga example nga kung papaano gagawin. Kaya madali lang namin nasasagutan.	Example on how to do	Examples are Included
Kitty: Para sakin po mabiis ko pong naintindihan kasi nandun na po yung mga examples kung paano sya gawin pero at the same time po kailangan pa rin po namin ng teacher na magtuturo sa amin para po mas lalo pa naming maintindihan yung lesson po.	Examples on how to do	
Ace: Mam may mga example din po tapos yung mga nakasulat na tungkol dun sa lesson.	Examples are available	
Thea: mam yun po, yung mga example po halimbawa po yung mga triangle tapos may mga given yung mga example po. Yung mga solution po na meron na don para po magets saka po yung mga dagdag na information na mga meaning dun sa baba po nung mga examples .	Examples are given	

Table 8.3 shows that the examples included are one of the emerging factors that helped students maximize their capacity to master the MELC.

Giving examples are essential in teaching and learning. Most students do not easily understand a concept if it is only presented with definitions and explanations; students need to see examples and relate them to the concept before they can understand the lesson. Most of the simulation tools used in the lesson include examples and directions on how they can complete the challenge. An example helps the student clarify complex concepts. It is an ideal way to help students understand what the teacher or the topic wants them to understand.

According to the principles of instruction by Rosenshine (2012), the more effective teachers used the extra time to provide additional explanations, give many examples, check for student understanding, and provide sufficient instruction so that the students could learn to work independently without difficulty.

Table 8.4. Emerging Factors from the Use of Simulation Tools

Statements	Codes	Themes
Hera: Hindi pa rin naman po mabilis maintindihan kasi po need pa rin po ng explanation ng teacher and parang naggiging example na lang po sya don para mabilis maintindihan nung mga bata.	Explanation of teacher	Teacher Factor
Kitty: Para sakin po mabiis ko pong naintindihan kasi nandun na po yung mga examples kung paano sya gawin pero at the same time po kailangan pa rin po namin ng teacher na magtuturo sa amin para po mas lalo pa naming maintindihan yung lesson po.	Needs teacher to teach	
Thea: kapag ako lang po yung magisa na titingin dun sa mga simulation tools parang mahihirapan po kasi akong magisa pero ang mas natututo ako ay yung sa turo ng teacher kasi mas maiintindihan ko.	Teaching of a teacher	
Pres: ngayun lang po naming naencounter yung teacher na ganyan po yung ginagawa para maintindihan po naming yung mga lessons.	New teaching method	

The teacher Factor is one of the emerging factors from using simulation tools that helped students maximize the capacity to master the MELC, as shown in Table 8.4. According to the statement of the students, they emphasized that the students need the teacher to teach them.

Even some of the simulation tools used by the students in studying geometry have the features of having manipulatives, examples, interactive tools, and challenges the students must answer; the presence of the teacher is very much needed. When doing their activity, some learners do not easily understand the objective they must attain during the group work. The teacher should be there to act as a facilitator of learning. The teacher should clarify what should be discovered within the lesson. The teacher's presence makes the student feel that they are on the right track regarding what they are doing. During the exposure, students always ask the teacher what to do since their learning activity is new to them.

At first, the students are awkwardly manipulating things on their own. It is time for the teacher to intervene, telling them that if they made a mistake, they could always repeat to reload the activity since the link they are working on has unlimited access if they have an internet connection. Another role of the teacher is to facilitate the analysis and abstraction wherein if the teacher finds out that the students' concept does not correspond to what must be learned, it is time for the teacher to put the student back on track by explaining or raising a question to the student of what they are learning.

There are lots of studies about teacher factor that affects the student's performance. The study of Factors that explain the use of ICT in secondary-education classrooms: The role of teacher characteristics and school infrastructure has confirmed that the characteristics of teachers are more important than information and communication technologies infrastructure availability in explaining how ICT was used in Spain's Secondary Education Centers. Spanish schools have a high degree of information and communication technology infrastructure. It is one of the highest in Europe. But it will not be enough simply to build infrastructure. The teacher's characteristics, due to the high ICT training needs of teachers and low level of collaboration between teachers, make it difficult to use ICT in the classroom. To encourage the use of ICT in Spain's schools, these data should be used for intervention (Gil-Flores et al., 2016).

Table 8.5. Emerging Factors From the Students' Use of Simulation Tools

Statements	Codes	Themes
Pres: kapag interesado yung mga estudyante dun sa pinapagawa ng teacher mas gusto nya po maintidihan. Mas maiintindihan nya po yung lesson na itinuturo ng teacher.	Interest of the student in the task	
Thyjin: Mam mas mabilis ko talagang naintidihan kasi interesado talaga ako na mag aral gamit yung simulation tools.	Interested in the lesson	
Mari: hirap akong makaintindi kapag sa black board lang. Pero kapag minsan nababalikan ko yun. Parang pagtinuro nyo sa akin hindi agad tumatatak sa isip ko. Parang pag dun po sa sinend nyo nababalikan ko sya, parang tumatatak sya sa utak ko.	Review of the lesson using the tool.	Students' Interest
Vhie: kapag unang try nyo, parang hindi nyo alam yung gagawin. Pero kapag nakuha yung interes na para matutunan yung geometry pra po malaman kung ano yung tunay na function at kung ano po yung totoong ginagawa don.	Captured Interest	

Table 8.5 shows that students' interest is one factor that helped them maximize their capacity to master the MELC in Mathematics 8 Geometry.

The simulation tools seemed to capture the student's interest in learning the essential Geometry and Mathematics 8 competencies. The students enjoyed using the simulation tools because using tablets or gadgets in studying is new to them. Having control over manipulating digital manipulatives in their lesson boosted their curiosity and desire to explore more. They enjoyed answering the challenges because they could know immediately if they answered them correctly or not. Some students are really engaged in learning even without using simulation tools, as they have the discipline to learn. These simulation tools added to their interest because they seemed to enjoy using the gadgets as simulation tools in learning the MELC. According to Ajai and Imoko (2015), who endorse this idea, suitable incentives should be given to instructors in rural schools to motivate them to do their best work and employ teaching strategies to increase student's interest in learning mathematics. Additionally, Mathematics teachers should try to introduce students to a variety of games and simulation situations that are connected to the mathematical topics covered in class.

5. Summary of Findings, Conclusion and Recommendations

This chapter summarizes the research's conclusions after it has been presented, examined, and interpreted. The conclusions are derived from the data and developed recommendations for further study.

5.1. Summary of Findings

The significant findings of this research are as follows:

1. The mastery level in the MELC of the student-respondents during the pre-test assessment in terms of describing the mathematical systems, illustrating the need for axiomatic structure, and illustrating triangle inequality is moving to mastery while solving corresponding parts of congruent triangles and proving two triangles are congruent is needs improvement. Moreover, during the post-test assessment, illustrating the need for axiomatic structure is moving to mastery, describing the mathematical system, solving corresponding parts of congruent triangles, and proving two triangles are congruent is mastered. Lastly, in terms of illustrating triangle congruence resulted in fully mastered.
2. The results show that there is a significant difference between the pre-test and post-test scores performance of student-respondents exposed to simulation tools in terms of the competencies; describe a mathematical system, illustrate the need for axiomatic structure, illustrate triangle congruence, solve corresponding parts of congruent triangles, and proves two triangles are congruent with a p-value of 0.000 in all variables are less than 0.05.
3. The emerging factors from the use of simulation tools helped students to maximize the capacity of mastering the most essential learning competencies in Mathematics 8 are manipulative representation, availability of defined terms, examples included, teacher factor, and students' interest.

5.2. Conclusion

1. There is a significant difference between the pre-test, and post-test scores in the performance of the student-respondents in the assessment provided based on the Essential Learning Competencies in terms of describing a mathematical system, illustrating the need for axiomatic structure, illustrating triangle congruence, solving corresponding parts of congruent triangles, and proves two triangles are congruent. Therefore, there is enough statistical evidence to support the claim.
2. The emerging factors that helped the student-respondents maximize the capacity to master the essential learning competencies are manipulative representation and availability of the defined terms and examples included; these factors are features within the simulation tools used. There is also an emerging external factor in using simulation tools: the teacher factor and the student's interest. Both the teacher factor and students' interest have a vital role in the teaching and learning process, the teacher's knowledge of the subject and skills in teaching are the key factors for any strategy in teaching to be successful and the best motivation for students to learn is their interest to acquire knowledge. These emerging factors influence the result of the hypothesis to have a significant difference between the result of the pre-test and post-test.

5.3. Recommendations

Based on the results and conclusions of the study, the following recommendations are hereby suggested:

1. The school heads and administrators may give support in using simulation tools by providing teachers with electronic gadgets and strengthening internet signals in every classroom.

2. Since the study revealed that using simulation tools is effective in mastering the essential learning competencies in Mathematics 8, teachers may integrate simulation tools in teaching not just in Mathematics 8 but also in other areas in the field of education whenever these simulation tools are available.
3. Since the study uses only one group of students-respondents, the researcher suggests exploring the extent of the efficiency of using simulation tools by doing experimental research using two groups; one group will be using simulation tools while the other will be using a different approach.

Acknowledgements

The researcher extends her sincerest gratitude and appreciation for all the support and contributions to the success of this study.

The ALMIGHTY GOD, for his unmeasurable shower of blessing as a source of all knowledge, strength, and wisdom;

Mario R. Briones, President of Laguna State Polytechnic University, for his admirable leadership, exemplary service, and unwavering commitment to ensuring the institution's overall quality of education;

Edilberto Z. Andal, Associate Dean of the College of Teacher Education and Graduate Studies and Applied Research, for sharing his knowledge, dedication, and support in fostering high standards in research;

Delon A. Ching, her research adviser, for his contagious research knowledge that influences the researcher to make it to where she is. His service was beyond what was expected. The term 'kaibigan' will never be forgotten;

Anna Liza P. Del Rosario, her statistician, for her distinct expertise in guiding her to furnishing the data for statistical treatment and all the suggestions during the title defense;

Teresa M. Yambao, the researcher's technical editor, for polishing the terminology and grammar of this paper in accordance with the norms of writing research;

Asst. Prof. Angela L. Reginaldo, the researcher subject specialist, for critiquing and suggestions for the accomplishment of this research;

The External Validators, **Dr. Mercy S. Capistrano**- asst. Principal II, The Mathematics Teachers**, Dr. Elymar A. Pascual** - Master Teacher II, **Ma'am Yhezyl J. Condino**-Master Teacher II, **Ma'am Justina D. Coronado** -Teacher III and The English Teacher, **Mr. Feric C. Robis** – Master Teacher II, for spending your precious time and effort to critic and put suggestions for the revision of the research instrument;

The **Grade 8-Escuro 2022-2023,** for active participation and enthusiasm in studying, and to the selected students who volunteered for the interview. This research will not be completed without you;

Her **friends and fellow teachers** who supported and prayed for the completion of this paper;

Her husband, **Christian V. de Guzman**, and son **Armian King B. de Guzman,** for the love, inspiration, and support; and

To all the persons, who contributed not mentioned here, the researcher will forever be grateful to all of you.

References

Abtahi, Y. (2016). Things kids think with: The role of the physical properties of mathematical tools in children's learning in the context of addition of fractions (Doctoral dissertation, Université d'Ottawa/University of Ottawa).

Abu, M. S., & Abidin, Z. Z. (2013). Improving the levels of geometric thinking of secondary school students using geometry learning video based on Van Hiele theory. International Journal of Evaluation and Research in Education (IJERE), 2(1), 16-22.

Achenbach, T. M. (2017). Multi-informant and multicultural advances in evidence-based assessment of students' behavioral/emotional/social difficulties. European Journal of Psychological Assessment.

Ajai, J. T., & Imoko, B. I. (2013). Urban and rural students' academic achievement and interest in geometry: A Case-study with games and simulations method. Taraba State University Journal of Education Research and Production, 1(2), 56-63.

ANTIGUA, R. A. (2017). MATHEMATICS DIVISION (Doctoral dissertation, University of the Philippines Los Baños).

Arbain, N., & Shukor, N. A. (2015). The effects of GeoGebra on students achievement. Procedia-Social and Behavioral Sciences, 172, 208-214.

Aydin, A., Bang, L., & Bultan, T. (2015, July). Automata-based model counting for string constraints. In International Conference on Computer Aided Verification (pp. 255-272). Springer, Cham.

Balagtas, M. U., Garcia, D. C. B., & Ngo, D. C. (2019). Looking through Philippine's K to 12 Curriculum in Mathematics and Science vis-a-vis TIMSS 2015 Assessment Framework. EURASIA Journal of Mathematics, Science and Technology Education, 15(12), em1788.

Baker, M. J., Andriessen, J., & Schwarz, B. B. (2019). Collaborative argumentation-based learning. In The Routledge international handbook of research on dialogic education (pp. 76-88). Routledge.
Barlis Jr, J. M., & Fajardo III, J. D. (2013). p effectiveness of simulation and Computer Assisted Instruction (CAI) on the performance of students under regimental training on selected topics in physics II. International Journal of Applied Physics and Mathematics, 3(1), 82-86.
Bautista, G. H., & Valtoribio, D. C. (2016). An Assessment of Grade 8 Geometry Teaching Guide of the K to 12 Basic Education Program Based on Van Hiele Model of Geometric Thinking and Department of Education's Standards. American Journal of Educational Research, 4(18), 1281-1284.
Belnap, J. K., & Parrott, A. (2020). Putting technology in its place. Mathematics Teacher: Learning and Teaching PK-12, 113(2), 140-146.
Brigham, E. F., & Daves, P. R. (2018). Intermediate financial management. Cengage Learning.
Bowman, S. L., Atanasov, N., Daniilidis, K., & Pappas, G. J. (2017, May). Probabilistic data association for semantic slam. In 2017 IEEE international conference on robotics and automation (ICRA) (pp. 1722-1729). IEEE.
Capate, R. N. A., & Lapinid, M. R. C. (2015, March). Assessing the mathematics performance of grade 8 students as basis for enhancing instruction and aligning with K to 12 curriculum. In Proceedings of the De La Salle University (DLSU) Research Congress (Vol. 3).
Carmichael, M., Reid, A., & Karpicke, J. D. (2018). Assessing the impact of educational video on student engagement, critical thinking and learning. A SAGE white paper.
Cayvaz, A., Akcay, H., & Kapici, H. O. (2020). Comparison of simulation-based and textbook-based instructions on middle school students' achievement, inquiry skills and attitudes. International Journal of Education in Mathematics, Science and Technology, 8(1), 34-43.
CHIRIAC, T., & BALMUS, N. Collaborative Digital Textbooks: Theoretical Framework and Development Tools.
Cirillo, M., & Herbst, P. G. (2012). Moving toward More Authentic Proof Practices in Geometry. Mathematics Educator, 21(2), 11-33.
Creswell, J. W., Klassen, A. C., Plano Clark, V. L., & Smith, K. C. (2011). Best practices for mixed methods research in the health sciences. Bethesda (Maryland): National Institutes of Health, 2013, 541-545.
Dickins, J. (2020). Symbolisation for extended axiomatic functionalism. Linguistica Online, 23, 73-94.
D.O. 35, s. 2016. Retrieve from https://www.deped.gov.ph/2016/06/07/do-35-s-2016-the-learning-action-cell-as-a-k-to-12-basic-education-program-school-based-continuing-professional-development-strategy-for-the-improvement-of-teaching-and-learning/
D.O. 78, s. 2010. Retrieve from https://www.teacherph.com/deped-computerization-program-dcp-orientation-handbook/
Efendi, A., MUNFADLILA, A. W., & Zainudin, M. (2018). Improving of Nursing Student Learning Achievements in Islamic Religion Subject Using Cooperative Methods Team Assisted Individualy (Tai) Model at School of Health Bina Sehat PPNI Mojokerto. International Journal Of Nursing And Midwifery Science (Ijnms), 2(03), 222-227.
Galman, S. M. A. (2019). On Solving Mathematical Problems the Spatial-Visual Ways. Journal of Applied Mathematics and Physics, 7(03), 559.
Gambari, A. I., Shittu, A. T., Daramola, F. O., & James, M. (2016). Effects of Video-Based Cooperative, Competitive and Individualized Instructional Strategies on the Performance of Senior Secondary Schools Students in Geometry.
Garcia, A. V. (2020). Interactive Simulations in Teaching Linear Equations.
Garcia de Diego, L., Cuervo, M., & Martínez, J. A. (2015). Development of a learning-oriented computer assisted instruction designed to improve skills in the clinical assessment of the nutritional status: a pilot evaluation. PloS one, 10(5), e0126345.
Gil-Flores, J., Rodríguez-Santero, J., & Torres-Gordillo, J. J. (2017). Factors that explain the use of ICT in secondary-education classrooms: The role of teacher characteristics and school infrastructure. Computers in Human Behavior, 68, 441-449.
Godoy Jr, C. H. (2021). Augmented Reality for Education: A Review. arXiv preprint arXiv:2109.02386.
Haj-Yahya, A. (2022). Students' conceptions of the definitions of congruent and similar triangles. International Journal of Mathematical Education in Science and Technology, 53(10), 2703-2727.
Hakim, L. L., Alghadari, F., & Widodo, S. A. (2019, October). Virtual manipulatives media in mathematical abstraction. In Journal of Physics: Conference Series (Vol. 1315, No. 1, p. 012017). IOP Publishing.
Haq, F. S., & Elhoweris, H. (2013). Using assistive technology to enhance the learning of basic literacy skills for students with learning disabilities. International Journal of Social Sciences & Education, 3(4), 880-885.
Heis, J., Rechter, O., & Posy, C. (2020). Kant on Parallel Lines: Definitions, Postulates, and Axioms. Kant's Philosophy of Mathematics, 1, 157-80.
Hillmayr, D., Ziernwald, L., Reinhold, F., Hofer, S. I., & Reiss, K. M. (2020). The potential of digital tools to enhance mathematics and science learning in secondary schools: A context-specific meta-analysis. Computers & Education, 153, 103897.
Hruby, K., & Vesenka, J. (2016). Exploring Conservation of Momentum in Inelastic and Elastic Collisions and Explosions. North American GeoGebra Journal, 5(1).
Keuroghlian, A. M. (2013). Investigating difficulties faced by grade 1 to 6 students while learning geometry based on the Lebanese curriculum's objectives and content.(c2013) (Doctoral dissertation, Lebanese American University).
Khan, L. A. (2015). What is mathematics-an overview. International Journal of Mathematics and Computational Science, 1(3), 98-101.
Landriscina, F., & Landriscina, F. (2013). Simulation-based learning. Simulation and Learning: A Model-Centered Approach, 99-146.
Leung, K. C., Ding, L., Leung, A. Y. L., & Wong, N. Y. (2014). Prospective teachers' competency in teaching how to compare geometric figures: the concept of congruent triangles as an example. Research in Mathematical Education, 18(3), 171-185.
Lin, J. J., & Lin, S. S. (2014). Tracking eye movements when solving geometry problems with handwriting devices. Journal of Eye Movement Research, 7(1).
Liu, T. C., Fan, M. H. M., & Paas, F. (2014). Effects of digital dictionary format on incidental acquisition of spelling knowledge and cognitive load during second language learning: Click-on vs. key-in dictionaries. Computers & Education, 70, 9-20.
Lye, L. T. (2013). Opportunities and challenges faced by private higher education institution using the TPACK model in Malaysia. Procedia-Social and Behavioral Sciences, 91, 294-305.
MacLean, S. (2014). Automated recognition of handwritten mathematics.

Majerek, D. (2014). Application of Geogebra for teaching mathematics. Advances in science and technology research journal, 8(24), 51-54.

Markovic, M. (2012). Role and importance of presentation design in learning and in quality of multimedia learning material, M.Sc., Business department Polytechnic of Rijeka Trpimirova, Business department Polytechnic of Rijeka Trpimirova 2/V, Rijeka CROATIA

Mendes, A., Backhouse, R., & Ferreira, J. F. (2012). Structured editing of handwritten mathematics (Doctoral dissertation, University of Nottingham).

Mestre, L. S. (2012). Student preference for tutorial design: A usability study. Reference Services Review.

Niess, M. L., & Walker, J. M. (2010). Guest editorial: Digital videos as tools for learning mathematics. Contemporary Issues in Technology and Teacher Education, 10(1), 100-105.

Nguyen, T. H. T., Chen, J. C., Chiang, P. Y., Hu, C., Chen, C. H., & Liu, C. C. (2016). Numerical simulation of the oxygen concentration distribution in silicon melt for different crystal lengths during Czochralski growth with a transverse magnetic field. Journal of Crystal Growth, 452, 6-11.

Özerem, A. (2012). Misconceptions in geometry and suggested solutions for seventh grade students. Procedia-Social and Behavioral Sciences, 55, 720-729.

Perdana, R., Jumadi, J., & Rosana, D. (2019). Relationship between Analytical Thinking Skill and Scientific Argumentation Using PBL with Interactive CK 12 Simulation. International Journal on Social and Education Sciences, 1(1), 16-23.

Plass, J., Heidig, S. Gorlitz, H., Hayward, H. and Homer, B. (2014). Emotional design in multimedia learning: Effects of shape and color on affect and learning Learning and Instruction 29:128–140 · February 2014 with 2,164.

Ravitch, S. M., & Riggan, M. (2016). Reason & rigor: How conceptual frameworks guide research. Sage Publications.

Reif, E., Yuan, A., Wattenberg, M., Viegas, F. B., Coenen, A., Pearce, A., & Kim, B. (2019). Visualizing and measuring the geometry of BERT. Advances in Neural Information Processing Systems, 32.

Riikka, F., & Lämsä, T. (2014). How to Promote Knowledge Sharing in Organizations Using the Psychological Contract as a Management Tool. Management.

Rosenshine, B. (2012). Principles of instruction: Research-based strategies that all teachers should know. American educator, 36(1), 12.

Seago, N., Jacobs, J., Driscoll, M., Matassa, M., & Callahan, M. (2013). Developing teachers' knowledge of a transformations-based approach to geometric similarity. Mathematics Teacher Educator, 2(1), 74-85.

Simamora, R. E., & Saragih, S. (2019). Improving Students' Mathematical Problem Solving Ability and Self-Efficacy through Guided Discovery Learning in Local Culture Context. International Electronic Journal of Mathematics Education, 14(1), 61-72.

Siniguian, M. T. (2019). Fin Geom: A Personalized System of Instruction on Finite Geometry.

Shahbari, J. A., & Daher, W. (2020). Learning congruent triangles through ethnomathematics: The case of students with difficulties in mathematics. Applied Sciences, 10(14), 4950.

Shodiev, H. (2015). Computational thinking and simulation in teaching science and mathematics. In Interdisciplinary Topics in Applied Mathematics, Modeling and Computational Science (pp. 405-410). Springer, Cham.

Sümmermann, M. L., Sommerhoff, D., & Rott, B. (2021). Mathematics in the digital age: The case of simulation-based proofs. International Journal of Research in Undergraduate Mathematics Education, 7(3), 438-465.

Tamam, B., & Dasari, D. (2021, May). The use of Geogebra software in teaching mathematics. In Journal of Physics: Conference Series (Vol. 1882, No. 1, p. 012042). IOP Publishing.

Terano, H. J. (2015). Development and Acceptability of the Simplified Text with Workbook in Differential Equations as an Instructional Material for Engineering (ECE, MET) Camarines Sur Polytechnic Colleges, Nabua, Camarines Sur, Philippines Asia Pacific Journal of Multidisciplinary

Torrefranca (2017). Development and validation of Instructional Modules on Rational Expressions and Variations, the Normal Lights, Vol. 11, No. 1.

Tsakeni, M. (2021). Preservice teachers' use of computational thinking to facilitate inquiry-based practical work in multiple-deprived classrooms. EURASIA Journal of Mathematics, Science and Technology Education, 17(1), em1933.

Ulandari, L., Amry, Z., & Saragih, S. (2019). Development of Learning Materials Based on Realistic Mathematics Education Approach to Improve Students' Mathematical Problem Solving Ability and Self-Efficacy. International Electronic Journal of Mathematics Education, 14(2), 375-383.

Verzosa, D., De las Pena, M., Averino, M., Garces L. (2019). App-based scaffolds for writing two column proofs. International Journal of Mathematical Education in Science and Technology 50(5): 766–778

Wassie, Y. A., & Zergaw, G. A. (2019). Some of the potential affordances, challenges and limitations of using GeoGebra in mathematics education. Eurasia Journal of Mathematics, Science and Technology Education, 15(8), em1734.

Wright, D. (2020). Conducting science labs in a virtual world. Science Scope, 44(2), 10-15.

Xu, L. (2012). The Role of Teachers' Beliefs in the Language Teaching-learning Process. Theory & Practice in Language Studies, 2(7).

Yamin, F. M., & Ishak, W. H. W. (2017). Does the Blended Learning and Student Centered Learning Method Increase Student's Performance. In Proceedings of the 1st Inspirational Scholar Symposium (No. 2016, pp. 8-17).

Zita, J. (2021). Encompassing Learner-Centered Activities through Lesson Study Towards a Constructivist Classroom. Turkish Journal of Computer and Mathematics Education (TURCOMAT), 12(10), 4247-4254.