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Online Teaching Competencies, Attitude Towards Mathematics and Academic Achievement of Grade 10 Learners in Geometry: a Path Analysis

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A B S T R A C T

This study aimed to determine the influence of online teaching competencies and attitude toward mathematics on the academic achievement of grade 10 learners in geometry. Also, it sought to find out the best fit model that would explain the academic achievement in geometry. Grade 10 learners from selected private schools that utilized online learning modality were chosen using complete enumeration. An adapted set of questionnaires were used in obtaining the data. A quantitative research design using the descriptive-correlational method was employed. The collected data were treated using the mean and standard deviation, Pearson product moment correlation, linear regression analysis, and path analysis. Findings revealed that the levels of online teaching competencies, mathematics attitude, and academic achievement in geometry were high, moderately high, and low, respectivelyFurthermore, a respecified model showing the indirect effect of the online teaching competencies on the academic achievement in geometry through the attitude towards mathematics as a mediator was found to be the best fit model for the academic achievement in geometry.

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INTRODUCTION

The global trend of low academic performance in mathematics, including geometry, is one of the most serious issues confronting modern educational institutions (Zoubi &Younes, 2015). It has been pointed out that secondary school learners often fail to develop an adequate understanding of geometrical concepts and to demonstrate good reasoning and problem-solving abilities (Ugulu, 2019). This problem on learners' weak mathematics skills, including geometry, is reflected in the result of the Program for International Student Assessment (PISA), which reported that 63 percent of the participating countries fall below the average mathematics score set by the Organization for Economic Cooperation and Development (OECD, PISA 2018).

In the study of Alghadari and Herman (2018), they pointed out that several concepts in geometry are thought to be difficult for students to grasp. Such concepts include learning transformation, which refers to the process of transforming a geometric shape in the coordinate plane. In this concept, learners struggled to comprehend the relationship between the concepts used to solve the problem and the fundamental geometry principles they had just learned. Additionally, learners struggle comprehending a given situation, identifying suitable problem-solving methods, developing mathematical models, and executing proper mathematical operations. (Haviger & Vojkuvkova, 2014).

In the same manner, students found it hard and difficult in dealing with quadrilaterals. Such problem stems from analyzing and distinguishing properties of various quadrilaterals (Mammarella et al. 2017). Given the pressing condition, students in the Philippines demonstrated lower performance in Mathematics which involves Geometry as compared to the other countries around the world. There are several proofs which point out support to such phenomenon, to mention a few: the 2018 PISA, reported that Philippines got a mean score of 353 in mathematics which is classified as below level 1 proficiency, and even ranked 78 out of 79 participating countries (OECD, PISA 2018). Another one is the United Nations Educational, Scientific and Cultural Organization (UNESCO) reported the low numeracy level of Filipino learners in mathematics particularly in embracing abstract concepts related to Geometry and Algebra, which reflects poor learners' mathematical skills among others (Zengin, 2017).

There have been several studies that strongly pointed out a number of factors affecting mathematics performance. One was from Buff et al. (2011) who singled out affective qualities such as the attitude of learners as significant indicator of cognitive activity and improved levels of achievement. Another study was conducted by Das et al. (2016) found out that learners' attitude towards mathematics and their performance in mathematics are significantly correlated. In fact, a teacher may change learners' negative attitudes into positive attitudes toward mathematics by providing feedback about areas of strengths and weaknesses in order to help learners regulate discomfort or anxiety (Peters, 2013).

Having the gap articulated, the researcher felt the urgency to conduct this study to fill it in, focusing on the combined influence of online teaching competencies, and attitudes towards mathematics on academic achievement in geometry. The findings of this study may help teachers recognize foreboding factors that affect the academic achievement in geometry and eventually develop some programs that may be used to inspire and enable the learners to be more comfortable in learning mathematics, particularly in learning Geometry concepts and skills. Hence, the researcher believes that conducting this study would benefit the teachers, schools and most of all the learners who are the center of the teaching- learning process. In particular, the educators may read them as part of their professional development, and other researchers may use the findings as part of their related literature and studies.

Importantly, the researcher wishes to share the findings in Learning Activity Cell (LAC) sessions, and annual research forum organized by the DepEd. Also, the dissemination of the results of this study includes presentation in a national and international research forum. Moreover, the researcher plans to publish the findings of this study in an online and print platform so that many can fully access the study.

Objectives

This study aimed to determine the influence of online teaching competencies and attitude towards mathematics on the academic achievement of grade 10 learners in geometry.

LITERATURE REVIEW

This study is anchored on the following theories, namely: **Theory of Educational Productivity** by Walberg (1981), and **Affective-Cognitive Consistency Theory** by Rosenberg (1968). The Theory of Educational Productivity explains the relationship between learning variables and student's educational productivity or outcomes. Adding on, the Theory of Academic Achievement explains that individual students' psychological characteristics and immediate psychological environments influence educational outcomes such as cognitive, behavioral, and attitudinal. Further, the nine key variables that affect educational productivity: student ability/prior achievement, motivation, age/developmental level, the quantity of instruction, quality of instruction, classroom climate, home environment, peer group, and exposure to mass media outside of school (Walberg et al.,1986).

As the purpose of this study has been pointed out, specific utilization of variables identified by Walberg is of prime concern. Objectively, there are three immediate categories of variables affecting educational productivity: characteristics of the students such as ability, motivation, and age; instruction that includes quality and quantity; and environment which refers to classroom climate, home environment, peer group and media exposure. The said theory further elaborates the articulation of attitude reflective of the students' motivation to become productive. In the same vein, the Theory of Educational

Productivity is fit to anchor this study because every instruction coming from the teachers whether it is done face-to-face of via online or not may affect educational productivity among learners.

METHODOLOGY

This section presents the methodology of the study which includes the research design, research locale, research respondents, research instruments, data gathering procedure, statistical tools to be used, and ethical considerations.

Research Design

This quantitative study utilized a descriptive-correlational design. Quantitative methods emphasize objective measurements and the statistical, mathematical, or numerical analysis of data collected through polls, questionnaires, and surveys, or by manipulating pre-existing statistical data using computational techniques. Quantitative research is a research approach that focuses on quantifying the collection and analysis of data. It is formed from a deductive approach where the emphasis is placed on the testing of theory, shaped by empiricist and positivist philosophies (Bhandari, 2020).

In this study, the use of descriptive-correlational is appropriate since the researcher will be looking into the relationship between online teaching competencies and academic achievement in geometry and the relationship between students' attitudes towards mathematics and academic achievement in geometry.

Research Locale

The study was conducted in the four selected private schools in Davao City that have implemented online learning during the COVID-19 pandemic which are coded as School A, School B, School C, and School D.

Research Respondents

The respondents of this study were the Grade 10 learners currently enrolled in the four selected private schools for the school year 2021-2022. Complete enumeration was utilized in selecting the respondents since the population of the Grade 10 learners in the selected schools were limited. Complete enumeration is a method wherein data is collected from all the elements of the population (Creswell 2017). In addition, 200 is the minimum sample size recommended for SEM research (Kenny, 2015),

In this study, the selection of the respondents was based on the following criteria: bonafide grade 10 learners and who was enrolled in online class. Similarly, the1 earners in the other grade levels of the selected schools and those utilizing modular learning mode were excluded from the study.

Statistical Tools

The statistical tools will be used in treating the problems in this study at .05level of significance are the following:

Mean. In statistics, mean is a measure of central tendency that summarizes an entire dataset with a single number representing the data's center point or typical value. This was used to determine the status of online teaching competencies of mathematics teachers and the learners' levels of attitude towards mathematics, and the academic performance of grade 10 learners in geometry.

Standard Deviation. The standard deviation is a statistic that measures the dispersion of a dataset relative to its mean and is calculated as the square root of the variance. This was used to describe how measurements of a group are spread out with respect to the mean. The lower its value, the consistent respondents' rating are.

Pearson Product Moment Correlation. The Pearson product moment correlation is one of the measures of correlation which quantifies the strength and direction of such relationship. This was utilized to measure the significant relationship of online teaching competencies, attitude toward mathematics, and academic performance.

Regression Analysis. Multiple regression is a statistical technique that can be used to analyze the relationship between a single dependent variable and several independent variables. This was used to determine the significance of the influence of the online teaching competencies, and attitude towards mathematics in academic performance of grade 10 learners in geometry.

Path Analysis. Path analysis is a statistical technique that allows users to investigate patterns of effect within a system of variables. It is one of the several types of the general linear model that examine the impact of predictor variables on multiple dependent variables. This was employed to assess the interrelationships of the variables. The following indices were computed in evaluating the goodness of fit of the models: CMIN/DF, Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA) and P of close Fit (PCLOSE).

RESULTS AND DISCUSSION

Status of the Online Teaching Competencies of the Mathematics Teachers

Presented in Table 1 is the status of the online teaching competencies of the mathematics teachers. It has an overall mean of 4.07, described as high, which means that the mathematics teachers' online teaching competencies are oftentimes manifested. This indicates that math teachers demonstrate capability in carrying out online classroom instructions which include but are not limited to providing teaching-learning activities that facilitate active learning in an online platform. The overall standard deviation is 0.56, implying consistency in the responses.

The finding of this study supports the proposition of Tracy et al. (2011) that the essential and common competencies identified by a successful online

instructor are being acquainted with the basic ideas and structures of effective online teaching, being capable of creating learning experiences, and being able to use a range of current and new technologies that successfully promote learning and achievement of learners. Additionally, successful online educators can design, create and execute strategies that foster active learning, application, engagement, participation, and collaboration within an online environment. Furthermore, Palloff and Pratt (2011) said that successful online instructors promote and facilitate students' active communication, interaction, collaboration, and engagement.

Active Learning. This indicator reflects a category mean of 4.08, which is regarded high, indicates that online teaching competencies of mathematics teachers are oftentimes manifested. This indicator's mean values range from 3.97 to 4.36. The statement *providing additional resources that encourage students to go deeper into the course content* has a mean of 3.97, described as high, while the item, *being able to show respect to students in their communications* reflects a mean of 4.36 described as very high which means that this particular teaching competency is always manifested. This shows that active learning as one of the indicators of online teaching competencies is oftentimes manifested, which indicates that teachers often provide learners activities that encourage them to participate and take an active role in their own learning, thus contributing to a deeper understanding of the content of the subject.

This finding conforms to the idea of Halim and Shukor (2013) that in active learning, the student assumes responsibility for their own learning while also being allowed to make decisions about various aspects of the learning process. In this way, the abilities of problem-solving, critical thinking, and learning to learn can be fostered and developed. Further, they noted that students complete the majority of the tasks through active learning, using their wits to generate ideas and attempt to solve the problems that have been set before them, and students are ultimately able to apply what they have learned. In addition, active learning strategies encourage students to work not only in the classroom but also to apply their knowledge outside of the classroom (Haak, 2011).

Active Teaching. This indicator reveals a category mean of 4.03 described as high which means that active teaching is oftentimes manifested by the mathematics teachers. The means for this indicator range from 3.94 and 4.15. The item, *being able to provide clear, detailed feedback on assignments and exams that enhances the learning experience* shows a mean score of 3.94 described as high which means that this aspect is oftentimes manifested. Meanwhile, the item on *being able to show caring and concern that students are learning the course content* has a mean of 4.15, described as high which means that this particular item is oftentimes manifested by the mathematics teachers. This implies that the mathematics teachers have emphasized creating exercises with clear educational objectives, outlining clear procedures, and implementing assessment protocols that include giving feedback and clarification, among others.

The finding backs up the findings of Andres (2019) that frequent practice activities and tests/quizzes have been shown to encourage students to stay on task, provide opportunities for reinforcement and clarification, and promote long-term retention. In practice, repeated instructor guidance through worked examples provided concrete experience and active manipulation for comprehension, application, and retention. Also, it confirms the finding of Freeman et al. (2014) that instead of simply listening to the instructor, active teaching involves learners in the learning process via classroom activities and/or discussions, placing a premium on higher-order thinking and often needing collaboration.

Classroom Decorum. This indicator shows a category mean is 3.96, which is considered high and indicates that teachers oftentimes manifested classroom decorum. The range of mean values for this indicator is 3.89 to 4.04. The item, *being able to identify areas of potential conflict within the course*, received a mean of 3.89 described as high which means it is oftentimes manifested, while the item, *effectively managed the course communications by providing a good model of expected behavior for all course communication* reflects a mean of 4.04 described as high which means that it is oftentimes manifested. The result indicates that mathematics teachers have managed to resolve conflicts that arise during the teaching-learning process.

This result concurs with the idea of Claessens et al. (2017) that teachers are constantly involved in negotiation processes, and their responses to potential conflicts with students are influenced by the unique characteristics of teachers' roles as accountable for classroom management and the various dimensions of concern for self and concern for others in teacher-student interactions. Additionally, it supports the research findings that teachers continually adjust their practices and manage complexity in the classroom, which is a major obligation not only in terms of planning, teaching new programs, and organizing the learning environment but also in terms of managing the relational aspects of educational responsibilities (Garca-Moya et al., 2015; and Hagenauer et al., 2015).

Administration/Leadership. The category mean of this indicator is 4.09, described as high which means that teachers oftentimes manifest administration/Leadership. The means of the items of this indicator, administration/leadership, range from 4.01 to 4.25. The Item *making grading visible for student tracking purposes*, shows a mean of 4.01, described as high, which means it is oftentimes manifested. Meanwhile, the item, *adhering to the school's policies, especially the Data Privacy Act of 2012 or RA 10173*, has a mean of 4.25, described as very high which means it is always manifested. This suggests that mathematics teachers have demonstrated leadership in facilitating learning in an online classroom.

The descriptive result of this category is parallel to the study of Warren (2021), that the teacher is one of the essential factors in determining how well students perform in the classroom and that the leadership abilities of teachers are critical because they are fundamental in improving the instructional quality

both inside and outside the classroom. Additionally, finding affirms the study of Whitehead and Greenier (2019) that teacher leadership roles include excellent classroom educators, change catalysts, mentors, resource providers, learning facilitators, curriculum specialists, researchers, and educational policymakers. As such, teachers are given opportunities to exercise leadership that requires the appropriate leadership qualities and attributes to make decisions (Jacques et al., 2016) so that they can have a significant impact on students, colleagues, and the community.

Technological Competence. The category mean of this indicator is 4.10 described as high which means that technological competence of mathematics teachers is oftentimes manifested. The means of the items of this indicator range from 4.09 to 4.10. The item *being confident with the technology used in the course*, got a mean of 4.09, described as high which means that it oftentimes manifested. Meanwhile, the item on *being proficient with the technologies used in the online classroom* has a mean of 4.10, described as high which means it is oftentimes manifested. This means that teachers often shown adeptness in using technologies necessary for online classes.

This result support the study of Cooperman (2018) that teachers involved in virtual teaching are expected to be technologically literate. Additionally, finding also affirms the study of Vongkulluksn et al. (2018) about the benefits of technology use among teachers which revealed that teachers who are adept at utilizing technology prefer to spend more time teaching in classrooms. Moreover, the technological competencies of teachers enable them to easily adapt to new teaching strategies and approaches because they know how to search for interactive online teaching strategies that will improve the learning engagement of learners in mathematics.

Policy Enforcement. The category mean of this indicator is 4.09, which is considered high and indicates that policy enforcement of mathematics teachers oftentimes manifested. The indicator's mean values range from 4.08 to 4.09. The item *being able to monitor students' adherence to policies on plagiarism* got a mean of 4.08, described as high which means it is oftentimes manifested. Meanwhile, the item on *being able to monitor students' adherence to academic integrity policies and procedures* has a mean of 4.09, described as high which means it is oftentimes manifested. This means that teachers have implemented a set of policies necessary for educational practices.

This finding supports the result of the study of Clagon (2020) that school policies and procedures establish expectations, ensure the safety of learners, and ensure they receive a high-quality education. Schools need to have clear policies and procedures that guide day-to-day operations. These policies may cover various topics, including attendance, learner discipline, and emergency procedures. Consequently, the finding is similar to that of Ehaine (2014) which aimed to determine the relationship between the enforcement of a school's discipline policy and students' academic performance and revealed clearly that enforcement of school discipline is encouraged to control students' behavior

because it was found to have an effect to the overall academic performance of learners.

Multimedia Technology. The category mean is 4.13, which is considered high and indicates that multimedia technology is oftentimes manifested by the mathematics teachers. The range of this indicator multimedia technology's items' values is 4.11 to 4.16. The item *using a variety of multimedia technologies to achieve course objectives* got a mean of 4.11, described as high which means it is oftentimes manifested, while the item *using multimedia technologies that are appropriate for the learning activities* has a mean of 4.16, described as high. This means that teachers were able to utilized media technologies in the teaching-learning process.

The result of this study is parallel to the idea of Malik and Agarwal (2012) that multimedia technology has the potential to improve teaching and learning outcomes in education. Multimedia technology aids in problem-solving through experiential learning, aids in comprehending abstract concepts, facilitates individualized and cooperative learning, aids in managing and administering classroom activities and learning content, and simulates real-world problem-solving environments. Additionally, Silaban and Tanjung (2015) identified the benefits and advantages of utilizing interactive multimedia in the classroom. These include the following: a more comprehensive learning system; an innovative and interactive system; the teacher will always be required to be innovative in the pursuit of a breakthrough in creative learning; the ability to integrate text, images, audio, music, animated images, or video into a cohesive whole that supports learning objectives; and the ability to increase learners' motivation during the learning process to achieve the desired learning objectives.

Table 1. Status of the Online Teaching Competencies of the Mathematics Teachers

	Mean	SD	Description
Active Learning			
1. being able to show respect to students in their communications with them.	4.36	0.75	Very High
2. encouraging students to participate in the discussion, if necessary	4.27	0.79	Very High
3. facilitating learning activities that help students construct explanations/solutions.	4.10	0.75	High
4. providing opportunities for hands-on practice so that students can apply learned knowledge to the real-world.	4.01	0.82	High
5. providing additional resources that encourage students to go deeper into the content of the course.	3.97	0.89	High

6. encouraging students to share their knowledge and expertise with the learning community.	4.00	0.83	High
7. encouraging student-generated content as appropriate.	4.11	0.79	High
8. encouraging students to interact with each other by assigning team tasks and projects, where appropriate.	4.03	0.89	High
9. including group/team assignments where appropriate	4.03	0.88	High
10. using peer assessment in their assessment of student work, where appropriate.	3.98	0.80	High
Category Mean	**4.08**	**0.64**	**High**
Active Teaching			
1. being able to provide clear, detailed feedback on assignments and exams that enhances the learning experience.	3.94	0.88	High
2. being able to provide prompt, helpful feedback on assignments and exams that enhances learning.	3.97	0.89	High
4. being able to show caring and concern that students are learning the course content.	4.15	0.82	High
4. using appropriate strategies to manage the online workload.	4.01	0.86	High
5. helping keep the course participants on task.	4.07	0.78	High
Category Mean	**4.03**	**0.69**	**High**
Classroom Decorum	**Mean**	**SD**	**Description**
1. effectively managing the course communications by providing a good model of expected behavior for all course communication.	4.04	0.75	High
2. helping students resolve conflicts that arise in collaborative teamwork.	3.97	0.82	High
3. being able to identify areas of potential conflict within the course.	3.89	0.82	High
4. resolving conflicts when they arise in teamwork/group assignments.	3.94	0.82	High
Category Mean	**3.96**	**0.69**	**High**
Administration/Leadership			
1. clearly communicating expected student behaviors.	4.02	0.82	High
2. adhering to the school's policies	4.25	0.73	

specially the Data Privacy Act of 2012 or RA 10173.			Very High
3. being proficient in the chosen learning management system (LMS).	4.07	0.77	High
4. making grading visible for student tracking purposes.	4.01	0.90	High
5. integrating the use of technology that is meaningful and relevant to students.	4.12	0.76	High
Category Mean	**4.09**	**0.65**	**High**
Technological Competence			
1. being proficient with the technologies used in the online classroom.	4.10	0.75	High
2. being confident with the technology used in the course.	4.09	0.75	High
Category Mean	**4.10**	**0.69**	**High**
Policy Enforcement			
1. monitoring students' adherence to policies on plagiarism.	4.08	0.77	High
2. monitoring students' adherence to Academic Integrity policies and procedures.	4.09	0.72	High
Category Mean	**4.09**	**0.69**	**High**
Multimedia Technology			
1. using multimedia technologies that are appropriate for the learning activities.	4.16	0.74	High
2. using a variety of multimedia technologies to achieve course objectives.	4.11	0.76	High
Category Mean	**4.13**	**0.69**	**High**
Over-all Mean	**4.07**	**0.56**	**High**

Level of Attitude towards Mathematics of the Grade 10 Learners

Table 2 shows the level of students' attitude in mathematics. The indicators used for this variable are confidence in mathematics, the importance of mathematics, and engagement in mathematics. The overall mean of the level of students' attitude in mathematics was 3.31 with a description of moderately high, which implies that students' positive attitude towards mathematics is sometimes positive. This indicates that the learners involved in this study sometimes exhibited positive attitude towards mathematics. They sometimes believe in their capability to perform well in mathematics. The learners sometimes demonstrated being comfortable, calm, cheerful, and relaxed in doing task. The overall standard deviation of 0.74 established from the responses of the participants in the survey indicates a small range of dispersion, which describes homogeneity in their perceptions.

Confidence in Mathematics. This indicator reflects a category mean of 3.16, described as moderately high and means that the learners' confidence in mathematics is sometimes positive. The means of the items of this indicator range from 2.69 to 4.48. The item *feeling relaxed even when thinking about having to do a mathematics problem* got a mean of 2.69, described as moderately high which means that the learners' confidence in this aspect is sometimes positive. Meanwhile, the item *wanting to develop their mathematical skills* has a mean of 4.48, described as very high and means that the learners' confidence in this aspect is always positive. This finding suggests that learners experience situations that find them not so confident in the course of the teaching and learning process.

This finding is parallel to the result of Van der Bergh (2013), who revealed that students who have high self-confidence are more likely to believe in their abilities and be successful in mathematics learning, thereby overcoming the fear of failing in mathematics. Likewise, students with high self-confidence are willing to take on mathematical challenges, which in turn helps them to achieve higher levels of academic success; students with low self-confidence, conversely, do not believe in themselves, and as a result, they tend to avoid taking on mathematical challenges (Adelson & McCoach, 2011).

Importance of Mathematics. The category mean of this indicator is 3.71, described as high, which means that the learners' attitude on importance of mathematics is oftentimes positive. The means of the items in this indicator range from 3.24 to 3.98. Adding on, Item 6, *planning to take as much mathematics as they can during my education*, reflects a mean of 3.24, described as moderately high which means that the learners' attitude in this aspect is sometimes positive. Meanwhile, item 3, being *one of the most important subjects for people to study*, has a mean of 3.98, described as high which means that the learners' attitude in this aspect is oftentimes positive. This finding implies that learners have recognized the importance of mathematics in their daily activities and its contribution across the different disciplines.

Engagement in Mathematics. The category mean of this indicator is 3.07, described as moderately high and means that the learners' attitude concerning engagement in mathematics is sometimes positive. The means of the items of this indicator range from 2.69 to 3.70. The item *being happier in a math class than in any other class* has a mean of 2.69, described as moderately high which means that the learners' attitude is sometimes positive in this aspect. Adding on, the item *having mathematics as interesting* has a mean of 3.70, described as high and means that the learners' attitude is oftentimes positive.

This finding suggests that the learners exhibit a favorable attitude towards mathematics not all the time. Also, this finding confirms the argument of Attard (2012) that when students see the value of mathematics in everyday life, they become more engaged, confident, and connected to their studies. Similarly, finding supports that engagement in mathematics can also be seen in how much they enjoy themselves while doing tasks related to their math subject (Moenikia & Zahed-Babelan, 2010).

Table 2. Level of the Attitude towards Mathematics of the Grade 10 Learners

	Mean	SD	Description
Confidence in Mathematics			
1. wanting to develop their mathematical skills.	4.48	0.75	Very High
2. getting great deal of satisfaction out of solving a mathematics problem.	3.90	0.99	High
3. having Mathematics helps develop the mind and teaches a person to think.	4.08	0.82	High
4. not dreading Mathematics as a subject.	2.78	1.19	Moderately High
5. being able to think clearly when working with mathematics.	3.10	1.15	Moderately High
6. studying mathematics makes me feel confident.	3.31	1.15	Moderately High
7. making them comfortable in Mathematics.	2.96	1.11	Moderately High
8. being calm and cheerful in a math class.	3.04	1.07	Moderately High
9. feeling relaxed even when thinking about having to do a mathematics problem.	2.69	1.12	Moderately High
10. being reassured with Mathematics as a subject.	3.06	1.04	Moderately High
11. having a lot of self – confidence when it comes to mathematics.	2.76	1.13	Moderately High
12. solving mathematics problems without too much difficulty	2.87	1.11	Moderately High
13. expecting to do fairly well in any math class they take.	3.29	1.01	Moderately High
14. feeling secured when attempting mathematics.	3.01	1.08	Moderately High
15. learning mathematics easily.	2.94	1.09	Moderately High
16. being confident that they could learn advanced mathematics.	2.94	1.17	Moderately High
17. loving to use mathematics in college.	3.15	1.15	Moderately High
18. being comfortable expressing their own ideas on how to look for solutions to a difficult problem in math.	3.05	1.09	Moderately High
19. being comfortable answering questions in math class.	2.93	1.10	Moderately High
20. believing they are good at solving math problems.	2.85	1.09	Moderately High
21. being good at using formulas in solving mathematics problem.	3.14	1.08	Moderately High
Category Mean	**3.16**	**0.84**	**Moderately High**

	Mean	SD	Description
Importance of Mathematics			
1. being a very worthwhile and necessary subject.	3.93	0.92	High
2. being important in everyday life.	3.97	0.89	High
3. being one of the most important subjects for people to study.	3.98	0.87	High
4. having high school math courses as very helpful no matter what they decide to study.	3.89	0.90	High
5. thinking of many ways of using math outside of school.	3.56	0.95	High
6. planning to take as much mathematics as they can during my education.	3.24	1.02	Moderately High
7. thinking studying advanced mathematics is useful.	3.76	0.97	High
8. believing studying math helps them with problem solving in other areas.	3.70	0.85	High
9. having a strong math background could help them in my professional life.	3.84	0.92	High
10. knowing the application of circumference of a circle in real life.	3.26	0.99	Moderately High
Category Mean	**3.71**	**0.71**	**High**
Engagement in Mathematics			
1. being able to like the word mathematics.	3.23	1.05	Moderately High
2. being always sure in my mathematics class.	2.89	0.99	Moderately High
3. enjoying studying mathematics in school.	3.15	1.10	Moderately High
4. mathematics is interesting.	3.70	1.05	High
5. liking to solve new problems in mathematics.	3.13	1.05	Moderately High
6. preferring to do an assignment in math than to write an essay.	2.96	1.32	Moderately High
7. being able to like mathematics.	2.93	1.13	Moderately High
8. being happier in a math class than in any other class.	2.69	1.12	Moderately High
9. mathematics is fun.	3.24	1.03	Moderately High
10. willing to take more than the required amount of mathematics.	2.81	1.06	Moderately High
11. the challenge of math appeals to them.	3.17	1.06	Moderately High
12. liking the topic of Measurement.	3.06	1.01	Moderately

			High
13. being able to like working on the topic of Circles.	2.88	1.01	Moderately High
Category Mean	**3.07**	**0.88**	**Moderately High**
Over-all Mean	**3.31**	**0.74**	**Moderately High**

Level Academic Achievement in Geometry

Reflected in table 3 is the level of the academic achievement in Geometry of the grade 10 learners which was measured based on the percent of correct answers. The table on the achievement of the learners discloses an overall mean of correct answer of 39.31, which denotes a low descriptive level which means that the academic achievement in geometry of the grade 10 learners is fairly satisfactory. The finding implies that learners at this level possess the minimum knowledge and skills, and core understanding but need help throughout the performance of the authentic task. Moreover, the standard deviation of 12.46 implies that the scores vary.

Further, the learners' low achievement in geometry in this study is parallel to what has been constantly reported as low achievement test scores among Filipino learners in mathematics, which includes geometry, both in the National and International Achievement. Example is the poor performance in the 2016-2017 National Achievement Test (NAT) in mathematics (DepEd Regional memorandum, 2018) and the second from the bottom rank of the Philippines on the 2018 Programme for International Student Assessment result (OECD, PISA 2018). Furthermore, the data provide support to the argument put up by Mammarella et al. (2017), which asserts that students had a challenging time working with quadrilaterals. Such problem arises while trying to analyze and differentiate the properties of various quadrilaterals.

Table 3.Level of Academic Achievement in Geometry

	Mean	**SD**	**Description**	**Significance**
Academic Achievement in Geometry	39.31	12.46	Low	

of the Relationships of Online Teaching Competencies, Attitude towards Mathematics, and Academic Achievement in Geometry

The data in table 4 shows the relationships of online teaching competencies, attitude towards mathematics, and academic achievement in geometry. It can be seen from the result that Online Teaching Competencies are not significantly related to academic achievement, as reflected in the p-value of 0.94, which is greater than the 0.05 level of significance. The correlation coefficient r-value of 0.01 denotes a negligible positive correlation. The finding

confirms the conclusion of Alexander (2016) in his study that revealed no evidence of a significant relationship between the teaching

Table 4.Significance of the Relationships of Online Teaching Competencies, Attitude towards Mathematics, and Academic Achievement in Geometry

	Academic Achievement in Geometry		
	r	p-value	Remarks
Online Teaching Competencies	.01	.94	Not Significant
Attitude towards Mathematics	.20**	.00	Significant

**Correlation is significant at the 0.01 level (2-tailed).

competency evaluation rating and students' achievement in math and reading. On the contrary, the result of this refutes those of Andres (2017), who revealed that teaching competency is a positive predictor of the course grade and motivation to learn, and Yusof et al. (2020), who found that teacher leadership competency was significantly associated with students' academic achievement.

In addition, it can be gleaned from the table that there is a significant relationship between attitude towards mathematics and academic achievement in geometry, as evident in the p-value of less than 0.05. The r-value of 0.20 shows a weak positive correlation, indicating that although both attitudes towards
mathematics and academic achievement tend to go up in response to one another, the relationship is not very strong.

This result is anchored on Rosenberg's (1968) Affective- Cognitive Consistency Theory, which states that changes in an individual's affective component would result in changes in the individual's cognitive component, resulting in a consistent relationship between the two components. Cheung (2011) mentioned that a student with a positive attitude toward a subject, on the other hand, will be motivated to succeed in that subject because they believe they are capable of doing so.

Similarly, this study's findings align with Recber et al. (2018). They found a statistically significant but weak correlation between mathematics attitude and mathematics achievement. They explored the relationship between secondary school students' mathematical attitudes and mathematics achievement. A random sample of seventh graders was followed for six years until they reached the 12th grade. Students completed achievement tests on necessary skills in algebra, geometry, and quantitative reasoning and an attitude survey on mathematics. Analysis of the data shows that prior attitude does not strongly predict academic achievement.

Notably, the significant correlation between confidence in mathematics and academic achievement supports the proposition of Van der Bergh (2013), who posited that students with high self-confidence are more likely to believe in their abilities and be successful in mathematics learning, thereby overcoming the fear of failing in mathematics. Additionally, as suggested by Belin (2016),

boosting learners' self-confidence can help students perform better throughout their schooling and achieve greater success in mathematics.

Significance of the Influence of Online Teaching Competencies and Attitude towards Mathematics on the Academic Achievement in Geometry

The regression analysis result is presented in table 5 showing the significant predictors of mathematics achievement. Among the two independent variables included in the regression analysis, only the attitude towards mathematics is found to have a significant influence to the academic achievement in geometry ($p<0.05$).

Table 5. Significance of the Influence of Online Teaching Competencies and Attitude towards Mathematics on Academic Achievement in Geometry

Individual Influence	**Academic Achievement in Geometry of Grade 10 Learners**			
	Beta Coefficients (β)	t	P-value	Remarks
Online Teaching Competencies	-0.08	-1.11	0.270	Not Significant
Attitude towards Mathematics	0.23	3.25	0.000	Significant

Combined Influence

P :

R = 0.20)10

R^2 = 0.04

F = 5.28

In particular, the attitude towards mathematics has positive standardized beta coefficient value of 0.23. This means that for every unit increase in the attitude towards mathematics, there is a corresponding increase of 0.23 in the academic achievement in geometry.

The result of this study is consistent with what Sirmaci (2010) found out when he investigated the relationship between students' attitudes and their performance in mathematics using the Mathematics Attitude Scale. Sirmaci found that students' attitudes were positively correlated with their performance in mathematics. It was revealed that there was a significant association between the

attitudes of the students towards mathematics and their performance in mathematics. Learners who think less of their mathematical ability tend more to attribute their mathematical successes to luck and their failures to lack of ability, whereas those who consider themselves to be good at mathematics attribute their success to their ability. In addition, the findings are in agreement with what Mutawah and Fateel (2018) found, which was that a positive and significant correlation existed between an individual's attitude toward mathematics and their

academic achievement. This suggests that the attitudes that students have about mathematics are vital for succeeding in the field of mathematics.

Lastly, the findings were apparent in the result of the regression analysis where 4 percent of the variance of the academic achievement is explained by the online teaching competencies and attitude in mathematics in the model as indicated by $r^2 = 0.04$. This implies further that 95.6 percent of the variation can be attributed to other factors aside from what have been included in this study.

Best Fit Model of the Academic Achievement in Geometry

The hypothesized model in standardized estimates is presented in figure 3. It shows the standardized direct effect of the exogenous variables on the academic achievement in Geometry. As shown in the model, the amount of variance explained by the combined influence of online teaching competencies and attitude towards mathematics was 6 percent. Meanwhile, the model illustrates a significant direct effect of attitudes towards mathematics on academic achievement (β=.23, $p<0.05$). It can be gleaned that online teaching competencies has no direct significant effect on the academic achievement in geometry (β= - 0.08, $p>0.05$), while attitude towards mathematics has significant effect on the academic achievement (β=.23, $p<0.05$).

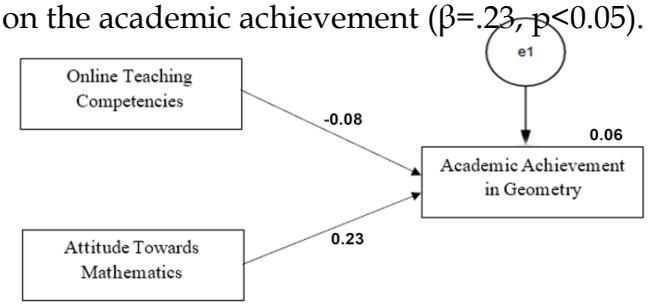

Figure 3. Hypothesized Model on Academic Achievement in Geometry in Standardized Estimates

Table 6.Measures of the Hypothesized Model

INDEX	CRITERION	MODEL FIT VALUE	Interpretations
CMIN/DF	< 2	32.90	Does not meet the criterion
P-value	> 0.05	0.00	Does not meet the criterion
GFI	> 0.95	0.92	Does not meet the criterion
NFI	> 0.95	0.24	Does not meet the criterion
TLI	> 0.95	-1.37	Does not meet the criterion
CFI	> 0.95	0.21	Does not meet the criterion
RMSEA	< 0.05	0.37	Does not meet the criterion
PCLOSE	> 0.05	0.00	Does not meet the criterion

Consequently, the goodness of fit measures of the hypothesized model are presented below in figure 3 which are as follows: Chi-Square/Degrees of Freedom (CMIN/DF), Goodness of Fit Index (GFI), Normed Fit Index (NFI), Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), and Root Mean Square of Error Approximation (RMSEA). In addition, all of the indices of the measures

of the hypothesized model are not able to meet the set criteria. Hence, it supports that the hypothesized model is considered as a poor fit model.

As such, the researcher explored other hypothesized model that would best fit the academic achievement in Geometry. Further, the goodness of fit measures of the standardized estimates with the corresponding set criterion for each index of the respecified model are presented below figure 4 which are namely: : (GFI, NFI, TLI, and CFI > .95), CMIN/DF <2, P-value and PClose >0.05, and RMSEA <0.05. Furthermore, each index meets the set criterion for best fit model. Thus, the standardized estimate of the respecified model supports that it is the best fit model on academic achievement in Geometry. This supports the idea of Arbuckle and Wothke (1999) that normed fit index (NFI), goodness of fit index (GFI), incremental fit Index (IFI), and comparative fit index (CFI) should be close to 0.95.

Moreover, figure 4 portrays the direct effect of the online teaching competencies on academic achievement in the hypothesized model is not significant (β= -.08, p>0.05), The direct effect arrow on academic achievement in geometry has been deleted, and an indirect effect arrow for attitude toward mathematics has been added. The amount of variance explained by the direct effect of attitude toward mathematics and the indirect effect of online teaching competencies was 4 percent, as indicated in the respecified model. The direct relationship between online teaching competencies and attitude toward mathematics is indicated by the direct effect arrow. This path was considered in the study of the data uncovered three themes. Teachers influenced students' mathematical comprehension and attitudes by how they taught mathematics, by ensuring that pupils understood mathematics, and through their personalities. In particular, students reported that they understood and enjoyed mathematics when their teachers had fun and interesting lessons, had the students actively engaged in the classroom, showed the students how the mathematics they were learning was relevant to their lives, taught at a relatively slow pace, assisted students outside of the classroom, cared about their students, and were enthusiastic about mathematics and teaching mathematics.

Further, this finding is parallel with the result of the study by Etuk et al. (2013). They used 640 students to investigate the relationship between how students perceive their teachers' competency in terms of knowledge of Mathematics content, communication ability, use of appropriate teaching strategies, teachers' classroom management skills, and students' attitude toward mathematics, showed that students' perceptions of their teachers' knowledge of mathematics contents, communication ability, teaching methods, and classroom management skills significantly correlate with their attitude toward mathematics. Students' attitudes toward mathematics tend to be negative when they perceive their teachers' characteristics negatively.

Furthermore, the direct and indirect effects of the exogenous variables on academic achievement. This result conforms to several pieces of literature on

the significant relationship between the attitude towards mathematics and academic achievement (Pekrun et al., 2017; Sanchal & Sharma, 2017).

Moreover, this best fit model supports Walberg's (1981) Theory of Educational Productivity which explains the relationship between learning variables and student's educational productivity or outcomes. According to Walberg's theory of academic achievement, there are three immediate categories of variables affecting educational productivity: *characteristics of the students* (ability, motivation, and age); *instruction* (quality and quantity); and *environment* (classroom climate, home environment, peer group and media exposure). The said theory further elaborates the articulation of attitude reflective of the students' motivation to become productive (Walberg, Fraser, & Welch, 1986). This is very evident in this study where the attitude towards mathematics was found to have significant direct effect on the academic achievement in geometry and the indirect effect of the online teaching competencies to the academic achievement as mediated by the attitude towards mathematics.

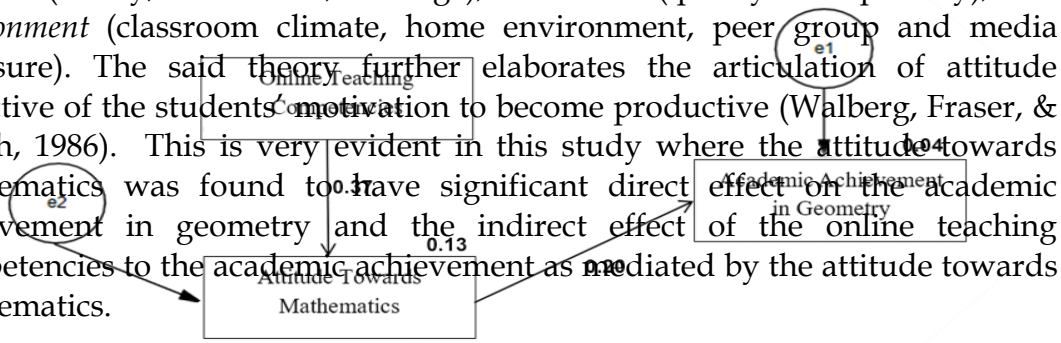

Figure 4. Best Fit Model on the Academic Achievement in Geometry in Standardized Estimates

Table 7.Measures of the Respecified Mode

INDEX	CRITERION	MODEL FIT VALUE	Interpretations
CMIN/DF	< 2	1.24	meets the criterion
P-value	> 0.05	0.27	meets the criterion
GFI	> 0.95	1.00	meets the criterion
NFI	> 0.95	0.97	meets the criterion
TLI	> 0.95	.98	meets the criterion
CFI	> 0.95	.99	meets the criterion
RMSEA	< 0.05	.03	meets the criterion
PCLOSE	> 0.05	.39	meets the criterion

This research still has limitations so it is necessary to carry out further research on this topic.

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