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The Mediating Effect of Study Skills on the Relationship between Mathematical Beliefs and Teaching Method of Secondary School Teachers

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ABSTRACT

The study investigated how study skills mediated the relationship between teachers' mathematical beliefs and teaching methods. It employed a survey method and a descriptive correlational design. Using a stratified random sampling technique, 306 teachers from public secondary schools in Davao Region were chosen as study participants. The data were gathered using a standardized instrument. Further, mean, standard deviation, Pearson's Moment-Product Correlation and path analysis were used to analyze the data collected to achieve the study objectives. The study's findings showed that although teaching methods, mathematical belief and study skills all had distinct mean scores, they all fell within the high descriptive threshold. It wasalso discovered that a strong correlation exists between study skills, teaching methods and mathematical beliefs. Conversely, study skills partially mediate the association between mathematical ideas and teaching methods. The researcher recommends that schools may conduct activities that enhance the study skills of teachers; hence improving their teaching method.

Keywords:education, mathematics teachers, mathematics belief,teaching method,study skills,mediating effect, Philippines

INTRODUCTION

Concerns about problems of mathematics education at primary, secondary, and post-secondary school levels are not new. Before, UNESCO started paying attention to these stages of studying mathematics education. Since then, various publications, such as articles, books, reports, policies, etc., have been documented. In addition to this effort, other vital systems like the Program for International Student Assessment (PISA), and the Trends in International Mathematics and Science Study (TIMSS), among others, have been monitoring the effectiveness of educational systems in various countries. For example, the results that were summarized by TIMSS on the 'Classroom Teaching Limited by Students Not Ready for Instruction' showed a direct relationship between the degree to instruction and the teaching methodologies were limited by students not ready for education and students' average achievement (Mullis et al., 2020).

Mathematics is a universal and significant subject with attributes par excellence. The teachers of other issues can use Math to explain other matters. The drive for meaningful learning in mathematics teaching is reflected through the construction of the learning environment, the choice of teaching approaches, and guiding the teaching-learning process to the student's commitment to working together

and furthering learning outcomes. Teachers who have mastered effective policies and strategies in teaching mathematics can help increase students' mathematical knowledge and improve math outcomes (Koskinen &Pitkaniemi, 2022).

A good teacher is critical to the successful implementation of any curriculum. This means that teacher preparation focusing on competence-based education and student-centered learning should be part of programs. Still, more deliberate efforts must be made to orient practicing teachers to reach a critical mass of the teaching force (Tilya et al., 2019). A shortfall in the student's knowledge of mathematics means that the goal may need to be realized, hence the need to improve teaching methods to solve the problem of poor performance in the subject (Oribhabor, 2020). Moreover, there still needs to be more fragmentation and superficiality problems in front-line teachers' mathematics teaching methods. The reason was that general system theory was not rooted in the mathematics teaching method (Yi et al., 2019). Darling-Hammond and colleagues (2021) stressed that teaching mathematics in a changing world means that the curriculum and instruction or teaching method must change to reflect the needs of the subject, the child, and society.

In relation to this, the UNESCO Institute for Statistics (2017) has created an awareness campaign on the importance of acquiring mathematical education in the community, especially for teens and children (Azid et al., 2020). According to Hammack and colleagues (2019), mathematics teachers must have a solid background in discipline and curriculum and understand how their students develop and learn. Thus, mathematics teachers must ensure that the next generation appreciates the subject and uses it proudly to their advantage rather than accepting failure with misdirected pride. Moreover, Moreno-Guerrero and colleagues (2020) emphasize that nowadays, education requires changes in the teaching and learning processes by implementing innovative and motivating pedagogical actions due to the current needs in society.

Although mathematics has been taught and learned for millennia, only in the past century or so have the nature and quality of teaching and learning mathematics been studied severely (Pari Condori 2020).

Based on the *Teaching and Teachers Journal (2019)*, teacher competence, like pedagogical content knowledge, self-efficacy, and teaching enthusiasm, were positively related to students' interest, and self-efficacy was positively associated with student achievement (Fauth et al., 2019). Papadakis and colleagues (2017) stress that the teaching method using realistic mathematical education contributed significantly to developing mathematical competence in young children. In addition, Al Seyabi (2020), in his study *Values and Disposition of Omani Novice Teachers as Perceived by the School Principal and Assistant Principal*, emphasizes that having extensive knowledge of the subject matter and the competencies to teach it effectively is not adequate if teachers do not have the "right" dispositions to help them perform their job effectively.

A moderately positive relationship was detected between self-directed study skills and lifelong learning tendencies (Tekkol& Demirel, 2018). One can create a beneficial study environment through study skills and practice self-management, time management, and stress management. Although there is no formula for becoming an effective mathematics teacher, successful teaching requires a caring individual interested in both the field of mathematics and the development of students (Brashier 2020). Thus, this study was significant as Al Seyabi (2020) pointed out the importance of conducting regular programs and workshops that address values and dispositions, preferably organized by teachers so that they take a more active part.

The relevance of teachers; affective aspects in education has been highlighted (Chen, Huang & Yin 2019; Erfanian, Gaskin and Ghasemy2021). However, evidence of how teachers' perceptions impact their teaching method was limited. Also, research has yet to directly examine the association of teachers' study skills with the relationship between mathematical beliefs and teaching methods. In the local context, the researcher has yet to encounter a study addressing the three conditions of mathematical ideas, study skills, and teaching methods. This study contributes to the body of knowledge on the importance of being optimistic when teaching, and it helps any academic institution deal with challenges relating to teachers' productivity at work (Alam 2022; Jimenez, McLean & Taylor 2019). The outlined scenario persuaded the researcher to investigate whether teachers' study skills mediate the relationship between their mathematical beliefs and teaching methodologies, as doing so could help the study's intended beneficiaries succeed and adapt to changes in their respective schools, leading to the creation of new knowledge.

The study's main objective was to determine the mediating effect of study skills on the relationship between mathematical beliefs and teaching methods of secondary school teachers. It aimed to determine the following: to determine the level of mathematical beliefs of secondary school teachers in terms of the field of mathematics, teaching mathematics, and mathematical practices; to characterize the teaching method of secondary school teachers, cooperative learning, communication and study skills, problem-based learning, technology-aided instruction, manipulatives, models, and multiple representations, and direct instruction; to ascertain the level of study skills towards the teaching method of secondary school teachers; to determine the significant relationship between mathematical beliefs and teaching methods, mathematical beliefs and study skills, and study skills and teaching methods; and to determine the significance of the mediating effect of study skills on the relationship between mathematical beliefs and teaching method of teachers**.**

The null hypotheses were tested at a 0.05 level of significance. There was no significant relationship between mathematical beliefs and teaching method, mathematical beliefs and study skills, and teaching method and study skills. There was no mediating effect of study skills on the relationship between mathematical beliefs and the teaching method of secondary school teachers.

Mathematics teachers tend to hold diverse beliefs about the nature of mathematics and a constructivist view of mathematics teaching and learning, and they are inclined to report that their teaching is inquiry-oriented (Yang et al. 2020). Moreover, beliefs about teaching do not directly dictate what teachers do. Still, teachers draw upon their cultural beliefs as a normative framework of values and goals to guide their teaching. Teachers' beliefs and values concerning effective mathematics teaching influence their instructional practice (Xie & Cai, 2018).

Efforts to measure teacher self-efficacy beliefs have been built upon the theories of Albert Bandura (Riggs et al., 2018). Also, it was believed that educational change would happen only if the teachers critically reflected on their beliefs and accordingly changed their teaching behaviors to meet the new reforms (Xie & Cai, 2018). Wijesundera and colleagues (2021) pointed out that teachers with professional qualifications in teaching have better mathematics beliefs than teachers without professional qualifications.

Mathematics was typically considered the most objective and logical of academic disciplines. However, it has been widely acknowledged that mathematical thinking is not purely logical reasoning but is heavily influenced by affective features (Hannula 2020). Butler and colleagues (2019) said that

improving mathematics education was an issue that arises periodically in the media and is the object of frequent, sometimes contradictory, policy efforts and academic endeavors.

To promote the sustainable development of inclusion in mathematics education, scholars need to connect and interrelate the operationalization and meanings of inclusion in both society and mathematics classrooms (Roos, 2019). In addition, Umit (2018) pointed out that teachers' beliefs were somewhat transformed in favor of using technology and that using constructivist ideas in their mathematics teaching and learning can be attained through technology. Thus, the relationship between beliefs and intended teaching practice was complex, and social issues influenced teachers' pedagogical decisions.

Today, the mathematics of general secondary education needs to be reviewed based on the principle of personality-oriented learning. At the same time, it was required that every teacher of mathematics possess the skills necessary for the correct and effective use of modern teaching aids (Barakaev, M., Shamshiyev, A., O'rinov, X., Abduraxmonov, D., &Ismatov, N, 2020). Paulo Freire and Amlcar Cabral's orientation of social struggles as pedagogical suggests that when teachers are involved in community issues and efforts, they develop some of the necessary political and pedagogical knowledge to teach critical mathematics or any subject (Gutstein, 2018).

In relation to this, mathematics education is fundamentally about stirring students into mathematical practices (Grootenboer& Groves, 2018). Dogruer& Akyuz (2020) stress that an inquiry-based learning environment must be created for students to engage in argumentation. Also, the student's understanding improved when learning concepts simultaneously with argumentation and dynamic geometry software. The focus on digital tools plays a vital role in shaping mathematical meanings and transforming the mathematical practices of learners and teachers (Hoyles 2018).

Additionally, Bendegem (2018) stressed that the study of mathematical practices and the mainstream philosophy of mathematics need not be antagonistic but rather are to be seen as mutually beneficial. A curriculum of mathematical methods was required for human flourishing, where the focus was on mathematical practices rather than predominantly on knowledge (Gootenboer et al., 2021). Also, students must engage in explicit substantive mathematics practices to develop positive mathematical identities (Grootenboer& Groves, 2018).

Relatively, Safapour and colleagues (2019) stressed out that teaching effectiveness assessment methods have demonstrated that most students prepared by this method must absorb the course content up to the expected value. The problem-solving skills in simulation and case studies are perceived as similar but more effective than in lectures. This also means that skill-based and affective learning outcomes are a new approach for comparative studies in this literature (Farasashi&Fajeddin, 2018).

Mathematics educators have always known that there is a prescribed mathematics curriculum to be taught and have constantly been challenged to find creative ways to unpack and restructure the curriculum to help students engage and, consequently, learn mathematics(Leonard, 2019). Correspondingly, a change in approach is needed in the field of education. Thus, the move from "traditional" educational methods towards experience-oriented and cooperative teamwork-based education that considers the characteristics of the digital generation is a must to address (Kövecses-Gsi, 2018).

The implications for innovation in teaching methods and further research are suggested to popularize more cooperative learning for better learning outcomes (Tran 2019). Also, collaborative learning improves students' communication skills and enables them to build their teamwork and

problem-solving skills (Munir et al., 2018). Furthermore, schools are required to create a better learning environment that is more cooperative to avoid unfair competition among students in the classroom and, as a result, improve the student's academic ability.

Mathematical Communication Skills (MCS) refer to the ability to arrange and link mathematical thinking through communication, communicate logical and clear mathematical thinking to others, analyze and assess the mathematical thinking and strategies used by others, and use mathematical language to express mathematical ideas correctly. This means that mathematics teachers should teach mathematics and stimulate the students' mathematical communication skills through creative and innovative learning activities (Rohid et al., 2019). Triana and colleagues (2019) emphasize that teachers must apply the learning by providing students with opportunities to present their mathematical ideas. Students should master communication skills in mathematics to involve themselves in the mathematics learning process (Hartinah et al., 2019). Thus, problem-solving and mathematical communication are essential skills needed in learning mathematics.

Some changes occur in the traditional classroom dynamics by introducing digital technology, especially in settings where it has not been previously used (Dele-Ayaji et al., 2019). Computer-aided instruction has a more effective influence positively on the attitude of the students towards lessons in comparison with the traditional method in the fields of physics, chemistry, biology, and mathematics education (Yesilyurt et al., 2019). Coleman (2019) stressed that combining the activities with technology support provides an accessible model for guiding teachers to use evidence from task-based interactions with learners to support instructional decisions. Furthermore, there was clear clarity on the effects of technology-aided instruction in teaching mathematics in the areas related to the presentation of the lesson, as a motivational tool, in classroom activities, and on students' learning outcomes.

Well-designed technology-aided instruction programs can sharply improve productivity in delivering education (Muralidharan et al. 2019). Serin (2020) pointed out that in the applications of technology-aided education based on a behavioral approach, the traditional lecturing method was supported, and the students' motivation was enhanced. The implementation of problem-based learning had a strong positive effect, significantly upgrading mathematical critical thinking skills (Suparman et al., 2021). Furthermore, teachers should pay attention to time management to be as efficient as possible because problem-based learning requires considerable time. Also, students should think more critically to improve their ability to solve mathematical problems during the learning process in class (Yolanda, 2019).

The overall implementation of problem-based learning had a very high positive effect, significantly enhancing higher-order thinking skills in mathematics learning (Suparman et al., 2021). Learning materials oriented on problem-based learning met the effective criteria and improved mathematical problem-solving and metacognition abilities (Siagan et al., 2019). Furthermore, students performed more actively in all phases of problem-based learning; they were more creative and self-confident and could communicate and work together to solve problems (Hendriana et al., 2018).

Developing the ability to use and select appropriate representations and make transformations between representations was essential in mathematics education (Ulusoy &Incikabi, 2019). With the wealth of technological applications, teachers can expand that model to include "moving pictures" using technology, thus linking concrete representations to their still-picture counterparts (Johnson, 2018). Pires and colleagues (2019) pointed out that the use of tangible manipulatives led to a positive impact on children's mathematical abilities.

Mathematical manipulatives are artifacts used in mathematics education. They are handled to explore, acquire, or investigate mathematical concepts or processes and perform problem-solving activities drawing on perceptual evidence (Bartoloni et al., 2020). Also, tangible interactive material increases action possibilities and may contribute to a deeper understanding of core mathematical concepts (Pires et al., 2019). In this type of teaching, teachers present a problem and directly proceed to offer a solution, providing little or no opportunity for students to think about the solution (Kablan et al., 2019). Also, Kulasegaram and colleagues (2018) stressed that sequencing discovery learning before direct instruction improved transfer performance in simulation-based skills training.

The direct instruction approach has been widely used in higher education, and many studies revealed that this improved students' knowledge. This method delivered the subject through face-to-face interaction with the lecturers and materials deliberately sequenced and taught explicitly (Winarno et al., 2018). Consequently, the direct instruction method can be sufficient for the students to solve routine problems successfully (Kablan et al., 2019).

Study skills are a definable entity; it is valuable for every subject; they can be embedded, and it helps students succeed in their subjects (Richards & Pilcher, 2023). Sera and colleagues (2019) stressed that study skills courses improve students' self-assessment of skills and attitudes associated with success in education. Early identification of students who will benefit from further development of study skills is essential in implementing related intervention programs, mainly when they are delivered as part of individualized, targeted student support services (Villarreal et al., 2018). Naqvi and colleagues (2018) stress that most students need more fundamental study skills, such as critical and creative thinking, time management, and test preparation.

Reading comprehension is essential to succeeding in school and actively participating in society. The ability to understand text was facilitated by text structures that encourage readers' abilities to locate, organize information, and recall main ideas (Agius et al., 2021). Furthermore, textbooks play an essential role for teachers in choosing methods, content, and educational goals. Most teachers use textbook content to prepare lessons, indicating textbooks' influence over lesson content (Voj& Rusek, 2022). Balan and colleagues (2019) pointed out that those who have developed the habits of reading academic and non-academic materials build their comprehension of concepts, critical thinking skills, and verbal fluency and ultimately have better educational outcomes.

An adequate level of linguistic complexity in learning materials is crucial for learning. The implication for school textbooks was that reading complexity should differ systematically between grade levels and between higher and lower tracks, in line with what can be called the systematic complexification assumption (Berendes et al., 2018). Ghaffar and his colleagues stressed that the help material in the books focuses mainly on a small set of subskills like scanning, skimming, and past tense. It was recommended that the teachers, students, and curriculum developers improve the help material in the books.

The development of note-taking skills means that listening performance was also significantly improved. It was undeniable that taking good notes positively affected listening performance (Nam et al., 2020). Guided notes can also be an appropriate way of teaching mathematics, but on their own, they cannot make the pedagogical intentions of the lecturer more apparent to the student (Ionne & Miller, 2019). Taking notes by hand may improve how to encode material and result in higher-quality external storage when studying for quizzes (Crumb et al., 2020). Thus, taking good notes was linked to success in education (Artz et al., 2020).

Study habits contribute significantly to the development of knowledge and perceptual capacities. Thus, there was a need to plan learning time effectively and follow the schedule (Omole, 2022). Seminars, workshops, and training programs should be arranged to raise awareness about good study habits among students (Khan et al., 2021).

Math facts must be committed to memory to learn more complex concepts (Baker & Cuevas, 2018).Though creativity, creative teaching, creative learning, creative evaluation, and other skills are essential, memorization can still play a critical role in learning and brain development (Hoque, 2018). Furthermore, Liu and colleagues (2020) stress that early learning and memorization are fundamental phenomena in high-dimensional classification tasks and even in simple linear models. Also, academic success improves substantially if math fundamentals are moved into memory just before they are needed (Nelson, 2018). Thus, memorizing things is as essential for exercising the brain as physical activity is for exercising the body.

Effective time management was associated with more fantastic academic performance and lower anxiety levels; however, many find it hard to balance studies and their day-to-day lives (Adams & Blair, 2019). Pepe and Bozkurt (2018) elaborated that planning time properly has a positive effect on academic success, and having insufficient planning work and time would usually spend time on tasks that are not worth the benefit. Similarly, individuals who could schedule their lectures performed better than those who could not, meaning that time management skill was essential to success (Baker et al., 2019).

With this in view, Afsaneh and colleagues (2019) stress that poor time management, planning, and organizational skills, as well as a deficit in regulating emotions, may harm general self-efficacy and parental sense of competence. Also, time management skills should be encouraged to enhance performance and decrease academic stress levels (Rani & Sharma, 2018). In project-based learning, Santoso and colleagues (2020) emphasize that improving time management increases critical and creative thinking skills.

Teacher math anxiety relates to a reduction in process-oriented (as opposed to ability-oriented) teaching practices, which in turn predict students' perceptions of teachers' mindsets. Ramirez and colleagues (2018) emphasize that math-anxious teachers and their use of particular teaching strategies can shape students' math achievement and their perceptions of their teacher's beliefs about math. Also, Teachers' math anxiety has been found to play a role in their student's math achievement. This relationship was partially mediated by the students' perception that their teacher believes not everyone can be good at math and was not explainable by teachers' usable knowledge to teach mathematics (Ramirez et al., 2018). Furthermore, Seyabi (2020) emphasizes that equipping teachers with values and dispositions has become an essential part of the conversation about effective teaching, and teacher preparation programs are increasingly expected to integrate tendencies into their agenda.

To show the significance of study skills in the relationship between the prevalence of mathematical beliefs and their teaching method, Kim and colleagues (2018) found in their study that there was a relationship between background knowledge and methodological ideas. Thus, study skills and epistemological beliefs affect academic performance indirectly and through academic self-efficacy. (Ashrafzade et al. 2020).

Further, Luitel (2020) stressed that a mathematics curriculum guided by emancipatory interest and beneficial interest promotes the counter-hegemonic vision of teaching and learning mathematics and might develop critical consciousness. Critical consciousness embedded mathematics curriculum

helps students and teachers to unpack the cultural nature of mathematics education and taken-for-granted assumptions about teaching and learning through critical pedagogy.

This study adapted the constructivism by Jean Piaget (1896). This philosophical framework or theory of learning believes that humans construct meaning from current knowledge structures. Moreover, this study is anchored to cognitive psychology by Ulric Neissar (1967), a branch of psychology that studies mental processes, including how people think, perceive, remember, and learn. Additionally, the "interest-driven creator theory," or IDC theory, of Tak Wai Chan and colleagues (2018) supports this study which states that an individual, when driven by interest, is engaged in knowledge creation.

Shown in Figure 1 is the conceptual model showing the relationships between the variables. The independent variable is the mathematical belief, the dependent variable is the teaching method, and the mediating variable is study skills.

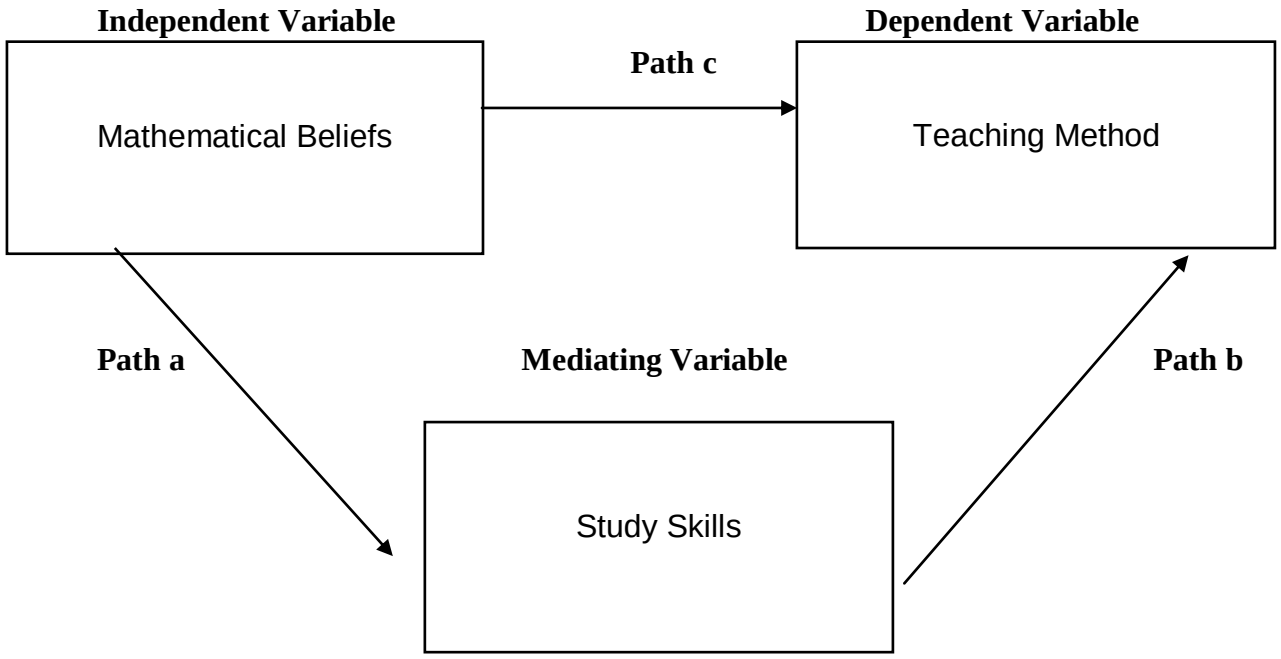

Figure 1: Conceptual Framework

Mathematical beliefs, the independent variable, comprise the following indicators:
Field of mathematics, teaching mathematics, and mathematical practices. The field of mathematics refers to the belief in mathematics as a subject area. Teaching mathematics refers to the belief in how to teach mathematics appropriately. Mathematical practices refer to the teacher's means or manner of teaching mathematics.

On teaching method, the dependent variable comprises the following indicators: cooperative learning, communication, and study skills, problem-based learning, technology-aided instruction, manipulatives, models, multiple representations, and direct instruction. Collaborative learning is an approach that motivates students to work together in small groups to accomplish a common objective. Communication and study skills are the ability to convey a message to the students effectively and efficiently. Problem-based learning is a teaching method in which the complex real-world promotes student learning. Technology-aided instruction is a method that uses technology as the main feature of teaching. Manipulatives, models, and multiple representations are the means of providing physical and

virtual math concepts. Direct instruction means the teacher stands in front of a classroom and presents the information.

Lastly, study skills, the mediating variable comprise the following indicators: reading textbooks, taking notes, studying, memorizing, and time management. Study skills pertain to the approaches someone needs to acquire in order to study and learn efficiently and effectively.

The study framework served as a guide to determine the relationship between the independent variable (mathematical beliefs, Path a) and the dependent variable (teaching method, Path b), as well as the relationship between the independent variable (mathematical beliefs, Path A), mediating variable (study skills, Path C), and dependent variable (teaching method, Path B). Likewise, it serves as a map if the mediating variable (study skills) has a mediating effect on both the independent variable (mathematical beliefs) and the dependent variable (teaching method).

From a global perspective, this study will assist in determining the importance of having positive teachers in educating learners. This study would also help teachers globally to assess their mathematical beliefs, practices, and methods, as this would significantly affect their instruction in teaching Mathematics in modern times. As such, Haciomeroglu (2013) stressed that mathematical beliefs profoundly affect teachers' learning to teach mathematics and their potential to become effective teachers. Also, this study will examine the mediating development of teachers' study skills on the relationship between their mathematical beliefs and teaching method. Drew and Bingham (2017) pointed out that study skills provide direction on learning that will assist in the increased use of personal and professional development planning, continuing professional development, and work-based learning.

For teachers, this study can serve as a lens to show the importance of having a cheerful disposition in mathematics, leading to active engagement in teaching and, eventually, higher achievement. Noting the wellness of teachers in their profession and their psychological outlook will be the strength of this study. They will benefit from this, for the results will give them ample evidence and a self-assessment of the extent of their concerns as teachers. Because only a few studies focus on teachers' beliefs, other researchers might be interested in conducting the same analysis in other schools outside the research locale signified in this study. This way, the extent of knowledge that can be derived will be improved and strengthened.

METHOD

This section presents the different ways of the study, such as the research respondents, materials and instruments, and design and procedure.

Research Respondents

The respondents of this research study were 306 public secondary mathematics teachers in the division of Davao Occidental, Davao del Sur, and Davao City. There were one hundred forty-three respondents were from Davao City, 85 were from Davao Occidental, and 80 were from Davao del Sur. The number of study participants was deemed adequate at a .05 significance level. Mundfrom, Shaw and Ke (2005) argued that 50 are considered very poor, 100 as inferior, 200 as fair, 300 as good, 500 as very good, and 1000 as excellent. In this case, larger sample sizes minimize sampling error but at a slower rate than smaller sample sizes.

In addition, stratified sampling was employed in the selection of study participants. It is a sample population approach that divides the populace into divisions and randomly selects subunits from those divisions. Stratified sampling methods are often used when designing business, government, and social science surveys (Levy &Lemeshow, 2013). This sampling technique ensures that every unit in the population has an equal chance of getting selected for the study.

In this study, the first stratum was the level of education, namely a bachelor's degree, a master's degree, and a doctor's degree. The second stratum was the total number of years of teaching experience (0–10 years, 11–20 years, and 20+ years).Furthermore, the researcher's foremost consideration in deciding the participating entities was those Schools Division Offices with large populations. Also, for practical reasons, the Schools Division Office, where the researcher resided, and other neighboring Division Offices came into the picture. Considering the scope and limitation of the study, elementary teachers, private school teachers, and secondary teachers outside the Schools, as mentioned earlier' Division Offices were not considered participants in the study. The participant's participation was voluntary. The researcher also considered whether the participant was willing to provide continued follow-up and further data collection after their withdrawal from the intentional portion of the study. The refusal to participate will involve no penalty or loss of benefits. The participant may withdraw their consent and discontinue participation without liability.

The specified Schools Division Offices were under the Davao Region, officially designated as Region XI, an administrative region in the Philippines occupying the southeastern section of Mindanao. It represented 19.97% of the overall population of the Mindanao Island group or 4.81% of the entire population of the Philippines. Davao Occidental was geographically located at the southwestern tip of the Davao Region in Mindanao, from which its name was derived. It was initially part of the second district of Davao del Sur and covers 6.05% of the Davao Region's population. On the other hand, the province of Davao del Sur was bounded by Davao City to the north, Davao Occidental to the south-east, North Cotabato and Sultan Kudarat to the west, South Cotabato and Sarangani to the south-west, and Davao Gulf to the east. It represented 12.98% of the

Davao Region’s population. Lastly, Davao City was a coastal, highly urbanized city in the Davao Region and commonly grouped with the province of Davao del Sur. It serves as the regional center and represents 33.89% of the population of the Davao Region.

Materials and Instrument

A three-part questionnaire was utilized to gather the information needed for this study. The first one emphasizes the mathematical beliefs of secondary school teachers in mathematics, teaching mathematics, and mathematical practices. Meanwhile, the second part asserts that the teaching method utilized was measured through the following indicators: cooperative learning; communication and study skills; problem-based learning; manipulatives, models, and multiple responses; and direct instruction. Also the third part, which pertains to the study skills practiced by the teachers, was measured through the following indicators: reading textbooks, taking notes, studying, memorizing, and time management.

Becky's inquiries under the mathematical belief variable were patterned after Teacher Beliefs Toward Inquiry-Based Mathematical Instructional Strategies (2008). On the other hand, the teaching method questionnaire was developed by Matthew Steven Haas on the Influence of Teaching Methods on Student Achievement (2002). Lastly, the concern about study skills was adapted from Dennis H. Congosof theUniversity of Central Florida's Student Academic Resource Center (2011). To measure the

reliability, the survey questionnaire was validated by the experts. It yields an overall mean of 4.75, approximately five or excellent. Therefore, the survey questionnaire is perfect for actual administration. Afterward, a pilot testing of the validated survey questionnaire was conducted. The Cronbach Alpharesultof 0.972 for mathematical beliefs, 0.969 for teaching methods, and 0.961 for study skills. Since the result of alpha-Cronbach is more significant than 0.9, all the items in the three questionnaires are very reliable.

The instrument used was a Likert-type scale with five points for the simple answering of the respondents. 5 for strongly agree, 4 for agree, 3 for moderately agree, 2 for disagree, and 1 for strongly disagree. The responses were interpreted using the scale as follows: 4.20 – 5.00 with a descriptive level of very high and interpreted as the mathematical belief, study skills, and teaching method were always practiced; 3.40 – 4.19 with a descriptive level of tall and interpreted as the mathematical belief, study skills, and teaching method were often practiced; 2.60 – 3.39 with a descriptive story of moderate and integrated as the mathematical belief, study skills, and teaching method were sometimes practiced; 1.80 – 2.59 with a descriptive level of low and interpreted as the mathematical belief study skills, and teaching method was rarely practiced; and 1.00 – 1.79 with a descriptive level of very low and interpreted as the mathematical belief, study skills, and teaching method were rarely practiced.

The statistical tools used in this study were the following: **Mean and Standard Deviation** were utilized to measure the level of mathematical beliefs, study skills, and teaching methods of public secondary mathematics teachers in the Province of Davao Occidental, Davao del Sur, and Davao City, as well as the distance between the data, gathered. **Pearson Product Moment Correlation (Pearson r)** to determine the relationship between the variables: mathematical beliefs, study skills, and teaching method of secondary school teachers. **Multiple Regression Analysis** to establish the influences of mathematical beliefs and study skills on the teaching method of secondary school teachers. **Path Analysis** to determine the mediating effect of study skills on the relationship between mathematical beliefs and teaching method was determined by this tool.

Design and Procedure

This study utilized a quantitative, non-experimental research design and correlation technique. The study also employed mediation analysis. Bhandari (2021) describes that quantitative research focuses on quantifying data collection and analysis. Accordingly, quantitative is derived from a deductive method that emphasizes the testing of theory. Empiricist and positivist philosophies influence it. Researchers conducting non-experimental research measure variables as they naturally occur in the real world.

Meanwhile, the correlational technique scrutinizes the degree of the association or relationship between two or more variables. Its strength lies in the correspondence between the two variables—whether it was consistent. The direction of the variables' relatedness can be positive or negative (Cook & Cook, 2008). Lastly, a mediation approach was also utilized in this study. MacKinnon and colleagues (2017) stated that a mediating variable transits the effect of an independent variable on a dependent variable. Mediating mechanisms translate how a stimulus leads to a response. This approach was essential for the aim of this study, which was to determine the mediating effect of study skills on the mathematical beliefs and teaching methods of secondary school teachers.

Looking for the appropriate questionnaire was the first step in this study. With the correct odds, the researcher could access standardized questionnaires that tackle each variable respectively. Next, a

list of requirements met was sent to the Office of the Dean of UM Professional Schools for endorsement to conduct the study at the DepEd Regional Office in Davao. Then, a set of requirements, including the duly signed permit to conduct the study, was submitted to the University of Mindanao Ethical Review Committee (UMERC). As such, a UMERC certification was issued for the actual administration of the study.

To have permission to conduct the study in the specified divisions in the region, the duly signed request letter to conduct the study was submitted to the Davao Regional Office. Once it is accepted and approved by the regional office, a copy of the approved letter and memorandum is issued to the Schools Division Offices of Davao Occidental, Davao del Sur, and Davao City. Afterward, a letter was issued by the Schools Division Superintendents to be addressed to the different secondary schools, and the survey schedule was identified. The researcher administered the survey to the respondents through an online platform. Because some areas cannot immediately access the internet, the study was conducted for several months. The researcher assures that the respondents were undoubtedly aware of the nature and purpose of the study. The confidentiality of their responses was also assured. Confidentiality and anonymity were upheld by addressing the respondents and ensuring they were willing to answer the survey questionnaire specified by the researcher. The researcher was seeing to it that the views and opinions of the respondents were dealt with with integrity, whether they chose to participate or not. Once the respondents had completed the questionnaires, the tabulated data was submitted for statistical processing. Results were displayed in tabular form, analyzed, and discussed.

The researcher observed full and robust adherence to ethical standards in the study. The University of Mindanao's research ethics committee examined this thesis. Then, as soon as the research ethics committee examined it, this thesis was approved and issued UMERC certification number UMERC-2022-274. The researcher also ensured to comply with the requirements from UMERC before the data collection. It must conform to the following norms: voluntary participation, privacy, confidentiality, informed consent process, recruitment, risks, benefits, biosafety, plagiarism, fabrication, falsification, conflict of interest, deceit, permission from organization/location, technology issues, and authorship.

RESULTS AND DISCUSSION

This section presents the results, interpretation, analysis, and discussion of findings. Results are presented in the following order: mathematical beliefs, teaching method, study skills, and correlation between mathematical beliefs, teaching method, and study skills of secondary school mathematics teachers.

Mathematical Beliefs

Shown in Table 1 are the data of the respondents on their levels of mathematical belief. The table revealed that it accumulated an overall mean score of 3.91 with a verbal interpretation of high. It indicates that the level of mathematical belief provided by the teachers is many times or often practiced with the standard deviation records of 0.545 suggests the homogeneity among the mathematical belief of teachers' responses.

Table 1.
Mathematical Belief

Indicators	**SD**	**Mean**	**Descriptive Level**
Field of Mathematics	0.607	4.01	High
Mathematical Practices	0.6	3.85	High
Teaching Mathematics	0.652	3.86	High
Overall	**0.545**	**3.91**	**High**

All indicators of mathematical belief are labeled as high; however, the belief in the field of mathematics obtained the highest mean score of 4.01 with a standard deviation of 0.607. It implies that the belief in the field of mathematics among public secondary mathematics teachers is many times or often practiced. Furthermore, teaching mathematics obtained a mean score of 3.86 with a standard deviation of 0.652. It also suggests that the belief in teaching mathematics is often practiced among public secondary mathematics teachers. The belief in mathematical practices resulted in a mean score of 3.85 with a standard deviation of 0.6, suggesting that public secondary teachers often practiced the belief in mathematical practices. This implies that mathematics teachers apply their practice relating to mathematical beliefs in instructing and teaching Mathematics. They use these beliefs and practices to teach the designated subject.

Further, it is aligned with the idea of Yang et al. (2020) that Mathematics teachers tend to hold diverse beliefs about the nature of mathematics and a constructivist view about mathematics teaching and learning, and they are inclined to report that their teaching was inquiry-oriented. In addition, it is aligned with the study's findings, which stated that ineffective classroom teaching practices lead to a lack of cognitive understanding of mathematics and increased mathematical mistakes among students. He also confirmed that this finding indicates that the effect of teachers' teaching performance on students' education accounts for 60% of the educational process, suggesting that one of the elements for the success of any reform project begins in the hands of teachers in the first phase (Butler et al., 2019; Cai & Xie, 2018; Mohamed, 2023).

The teachers perceived the level of mathematical belief provided by the teachers in mathematics as highly observed. It implies that the mathematical belief of secondary school teachers in public schools is many times and often practiced. In actual classroom scenarios, this implies that Mathematics teachers embed their practices relating to mathematical beliefs in creating instructions, activities, and assessments in teaching Mathematics.

This outcome of mathematical beliefs highlights the idea of Xie and Cai (2021), who stated that a teacher's beliefs about mathematics form his or her conception of its nature. These beliefs, concepts, views, and preferences constitute the rudiments of a philosophy of mathematics, although, for some teachers, they may need to be developed and articulated into a coherent philosophy. Likewise, the result of this study is congruent with the study, which emphasized that teachers' beliefs about teaching and learning mathematics are heavily influenced by socialization in their profession and the teaching experience during their student period. Teacher beliefs and teaching practices dynamically influence

each other. One's beliefs are one of the factors influencing teaching practice in the classroom. The potential role of teachers' mathematical knowledge in teaching lies in improving teachers' mathematical beliefs and attitudes (Barakaev et al., 2020; Minarni et al., 2018; Muhtarom et al., 2019).

Teaching Method

Shown in Table 2 are the data on the teaching method level of teachers in selected divisions in the Davao Region, which accumulated an overall mean of 3.92 or a high level. The high level resulted in the high rating given by the respondents in all indicators. The indicator communication and study skills have the highest mean score of 4.09, followed by cooperative learning with a mean of 4.08, then by manipulatives, models, and multiple representations, direct instruction with a mean of 3.87, then problem-based learning with a mean score of 3.83, and lastly, the indicator technology-aided instruction has the lowest mean rating of 3.76, which are all described as high.

Table 2.

Teaching Method

Indicators	**SD**	**Mean**	**Descriptive Level**
Cooperative Learning	0.704	4.08	High
Communication and Study Skills	0.740	4.09	High
Technology-Aided Instruction	0.786	3.76	High
Problem-based Learning	0.727	3.83	High
Manipulatives,Models, and Multiple Representations	0.754	3.87	High
Direct Instruction	0.759	3.87	High
Overall	**0.603**	**3.92**	**High**

This implies that the teachers' responses to teaching methods were often manifested in cooperative learning, communication and study skills, technology-aided instruction, problem-based learning, manipulatives, models, multiple representation, and direct instruction. Meanwhile, communication and study skills have a more excellent mean score than cooperative learning. It indicates that teachers often practice communication and study skills.

The study's findings on the methodology of teaching mathematics, which shows the relative importance of general and profession-specific instructor characteristics for instructional quality, are consistent with this conclusion. Moreover, the teachers are required to use advanced pedagogical and new information technologies in the teaching process. Additionally, the quality of the educational process is guaranteed by the fact that teachers effectively use the conditions created under such modern requirements and organize lessons based on advanced pedagogical, information, and communication technologies (Baier et al., 2019; Mirzaxolmatovna, 2022). Moreover, the study's findings confirmed the result of this study which stressed that teaching effectiveness assessment methods have demonstrated that most students taught by this method need to absorb the course content up to the expected value. The problem-solving skills in simulation and case studies are perceived as similar but more effective than in lectures. This also means that skill-based and affective learning outcomes are a new approach for comparative studies in this literature (Farasashi&Fajeddin, 2018; Gutstein, 2018; Safour et al. 2019).

Study Skills towards Teaching Method

Displayed in Table 3 are the mean scores for the items of teachers' study skills, with an overall mean of 3.83, described as high. The high level could be attributed to the high rating given by the respondents in most of the items. This implies that the respondent's responses to the study skills were often manifested in most of the cases.

Table 3.

Study Skills

Indicators	**SD**	**Mean**	**Descriptive Level**
Reading Textbooks	0.737	3.87	High
Taking Notes	0.735	3.83	High
Studying	0.725	3.83	High
Memorizing	0.735	3.81	High
Time Management	0.740	3.83	High
Overall	**0.626**	**3.83**	**High**

The cited overall mean was the result gathered from the computed mean scores of all items of study skills. Respondents' responses are presented from highest to lowest, according to their mean value. These are as follows: 3.87 or High for reading textbooks, 3.83 or High for time management, 3.83 or High for studying, 3.83 or High for taking notes, and 3.81 for memorizing. The five indicators above show that teachers' study skills in mathematics are always evident.

The result of this study emphasizes the study of Sera and colleagues (2019) that study skills courses improve students' self-assessment of skills and attitudes associated with success in education. Moreover, Villarreal and colleagues (2018) stress that early identification of students who will benefit from further development of study skills is essential in implementing related intervention programs, mainly when they are delivered as part of individualized, targeted student support services (Villarreal et al. 2018).

Correlation between Mathematical Beliefs, Study Skills and Teaching Method

Presented in Table 4 is the relationship between mathematical beliefs, teaching methods, and study skills. By doing an in-depth analysis, the mathematical belief and teaching method gleaned an overall r-value of 0.654 with a p-value of <0.01 level. It indicates that the null hypothesis of no significant relationship between the teachers' mathematical beliefs and teaching methods is rejected. It implies that the mathematical belief of teachers affects their teaching method. On the other hand, the mathematical belief and study skills gathered an overall r-value of 0.607 with a p-value of <0.01 level. It indicates that the null hypothesis of no significant relationship between the teachers' mathematical beliefs and study skills is rejected. It suggests that mathematical beliefs affect the study skills of teachers.

Table 4.

Significance of the Relationship between Mathematical Beliefs, Study Skillsand Teaching Method

	Mathematical Belief	Teaching Method	Study Skill
Mathematical Belief	**1**	**.654****	**0.607****
Teaching Method	**.654****	**1**	**0.738****
Study Skill	**0.607****	**0.738****	**1**

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

The study skills and teaching method gleaned an overall r-value of 0.738 with a p-value of <0.01 level. It indicates that the null hypothesis of no significant relationship between the study skills and teaching method is rejected. It implies that the teachers' study skill will affect their teaching method.

According to Ramirez and colleagues (2018), math-anxious teachers and their use of particular teaching strategies can shape students' math achievement and their perceptions of their teacher's beliefs about math. Moreover, equipping teachers with values and dispositions has become an essential part of the conversation about effective teaching, and teacher preparation programs are increasingly expected to integrate dispositions into their agenda. Thus, study skills and epistemological beliefs affect academic performance indirectly and through academic self-efficacy (Ashrafzade et al., 2020; Al Seyabi et al., 2020; Umit, 2018).

Mediation Analysis

Exhibited in Table 5 is the mediation analysis of the three variables, namely mathematical belief, teaching methods, and study skills. Using Path Analysis, results show that path MB (X) to SS (M), SS (M) to TM (Y), and MB (X) to TM (Y) are significant with sign unchanged. Hence, SS partially mediates the relationship between MB and TM.

It is shown in Figure 2 that for every unit increase in Mathematical Belief, there is a 0.70 unit increase in M (SS). Also, for every unit increase in Study Skills, there is a 0.36 corresponding increase in Teaching Method. Moreover, for every unit increase in Mathematical Belief, there is a corresponding 0.52 unit increase in Teaching Method. In summary, following path MB-TM-SS, for every unit increase in Mathematical Belief, there is a 0.52 unit increase in Teaching Method. This implies that the Teaching Method of Teachers can be enhanced by mathematical belief but should pass through enhanced study skills. Hence, higher teachers' study skills mediate mathematical belief for enhanced teachers' teaching methods.

Table 5.

Mediation Analysis of the Three Variables: Partial Mediation

			Estimate	**S.E.**	**C.R.**	**P**	**Label**
MB	--->	SS	.697	.052	13.353	***	
SS	--->	TM	.521	.050	7.271	***	
MB	--->	TM	.361	.043	12.042	***	

Variances: (Group number 1 - Default model)

			Estimate	**S.E.**	**C.R.**	**P**	**Label**
OVMIV			.296	.024	12.349	***	
e1			.246	.020	12.349	***	
e2			.141	.011	12.349	***	

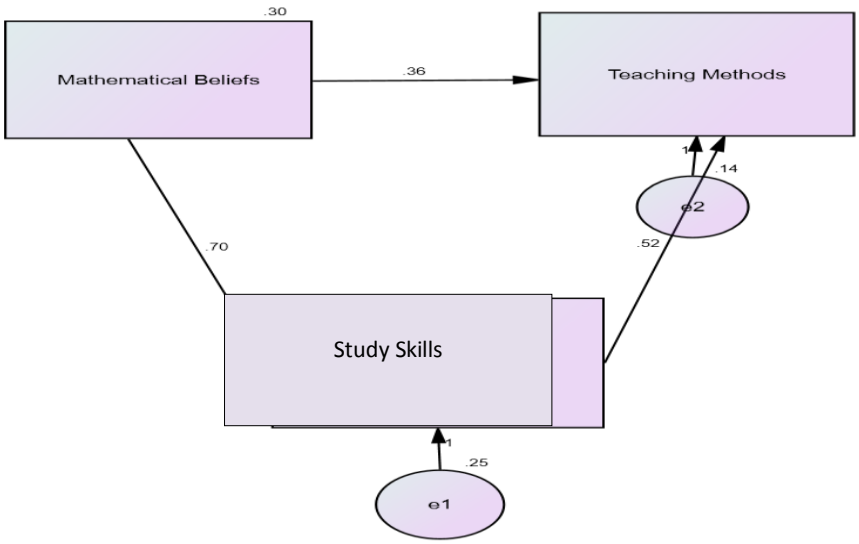

Figure 2. Mediation Model

The link between mathematical belief and study skills, as well as the path between study skills and teaching method, were both considered in the mediation analysis. The mediation analysis reveals that study skills in mathematics partially mediate the relationship between teachers' mathematical beliefs and teaching methods.

Furthermore, the current study showed that teachers' study skills influence their mathematical teaching method. Study skills in mathematics reinforce the relationship between mathematical belief and teachers' teaching methods.Thus, educators may help children develop good attitudes about mathematics and encourage them to study higher-level mathematics and seek jobs in the field.This result is congruent with the view of Dayupay et al. (2022) that higher performance results from enhanced study skills. Moreover, Cornick, Guy, and Beckford (2015) mentioned that study skills are a potential area for further improvement in learning.

CONCLUSION AND RECOMMENDATIONS

The researcher gleaned the following conclusions and recommendations based on the study's findings. The findings of this study confirm the assumptions about the mediating effect of study skills on the relationship between mathematical belief and teachers' teaching methods. The level of mathematical belief provided by teachers is high. Public secondary mathematics teachers have a relatively reasonable mathematical belief in terms of the field of mathematics, teaching mathematics, and mathematical practices. Thus, the researcher recommends that mathematical belief be maintained or even improved. Nevertheless, Mathematics Coordinators and School heads may provide activities to Mathematics teachers, specifically activities relating to their *Mathematics beliefs,* to further remind them and help them maintain or improve their beliefs and practices.

Meanwhile, the teachers' teaching method has a descriptive interpretation of high.
This means that level of teaching methods of mathematics teachers is often practiced. Furthermore, it also emphasizes that teachers significantly taught learners in terms of cooperative learning,

communication and study skills, problem-based learning, technology-aided instruction, manipulatives, models and multiple representation, and direct instruction. The researcher recommends that the DepEd may provide training on *Innovative and Contemporary Teaching Methods in Mathematics*, for this is crucial to help them update their pedagogical knowledge and promote lifelong learning among Mathematics teachers.

What's more, it is also essential that schools conduct activities that would ignite and cultivate a culture of Mathematics excellence among teachers. Also, conducting seminars on 21st Century teaching strategies and innovations in teaching methods and assessments may be helpful. The level of study skills as perceived by the teachers is high. It indicates that study skills are often evident in reading textbooks, taking notes, studying, memorizing, and time management.

Consequently, it was found that there is a significant relationship between the mathematical belief and teaching method of teachers, mathematical belief and study skills, and teaching method and study skills in mathematics. Therefore, it could be concluded in this study that all three variables have a significant relationship. In addition, the result on mathematical belief (x) to study skills (m), study skills (m) to teaching method (y), and mathematical belief (x) to teaching method (y) are significant with sign unchanged. Hence, study skills partially mediate the relationship between mathematical belief and teaching methods in teaching mathematics. Although the study skills in mathematics only have partial mediation, the mediator variable cannot explain the relationship between independent and dependent variables. Moreover, the findings provide evidence that the public-school teachers believed that mathematical beliefs are necessary for teachers' teaching methods. The mediation analysis suggests that teachers must strengthen their mathematical beliefs to achieve an effective teaching method for our students.

The researcher recommends that the Department of Education may provide seminars and training and closely monitor its implementation in order to increase our educators' proficiency and equip them to teach by raising the level of mathematical belief, teaching technique, and degree of study skills. Conducting activities that would regulate the mental and emotional well-being of teachers may significantly contribute to teachers' productivity and may increase their passion for teaching. On the other hand, future researchers should read the research findings to know how study skills mediate teachers' mathematical beliefs and teaching methods. They should also consider the application of research findings in their respective station to test the teaching method of teachers in mathematics.

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