*EduLine: Journal of Education and Learning Innovation* *ISSN: 2775-6173 (online)*
*Vol. 3 No. 2 (2023)*
https://doi.org/10.35877/454RI.eduline1674

# Teachers' Teaching Practices and Students' Self-Concept in Relation To Problem-Solving Performance

Shaira Faye T. Bohol[a,*] & Genelyn R. Baluyos[b]

[a]*Department of Education, Division of Ozamiz City, Philippines*
[b]*Misamis University, Ozamiz City, 7200, Philippines*

**Abstract**

The teachers' teaching practices and the students' self-concept play a vital role in the performance of students in Mathematics. This study explored the extent of Mathematics teachers' teaching practices and the level of the students' self-concept toward mathematics in relation to problem-solving performance. It was conducted on a total of 111 Grade 10 students who participated in the limited face-to-face classes in all secondary schools in District 10 of the Division of Ozamiz City. This study employed a descriptive-correlational research design. Questionnaires and a problem-solving test were utilized in gathering the data that were analyzed and interpreted using Mean, Standard Deviation, Pearson Product-Moment Correlation Coefficient, and Stepwise Multiple Regression Analysis. Results showed that the Mathematics teachers' teaching practices were demonstrated to a great extent. The students have a fair level of learned self-concept, organized self-concept, and a good level of dynamic self-concept. However, the students' performance in problem-solving did not meet the expectations of the standards set by the DepEd. It was found that there was a significant relationship between the teachers' use of mathematical representations in teaching and the students' problem-solving performance in Mathematics. Furthermore, there was a significant relationship between students' dynamic self-concept and problem-solving performance. The use of mathematical representations of teachers and students' dynamic self-concepts were the predictors of students' problem-solving performance.

*Keywords:* dynamic self-concept, mathematical representations, problem-solving performance, students' self-concept, teachers' teaching practices

## 1. Introduction

Globally, educational systems have altered due to the emergence of the COVID-19 pandemic. It posed a monumental challenge to educational sectors to urgently and massively adapt all classes to distance learning (Dietrich et al., 2020). Teachers have greater responsibilities when education is faced with difficult situations that call for a radical shift from traditional to blended educational settings (Fungo-Fulo & Deri, 2022). Ebona (2020) asserted that teachers must be change agents and team players and cultivate students' motivations. However, the challenges that the education sector faces during the setup of remote learning can be overcome by cooperation among the key individuals to provide quality education to the students despite the pandemic.

The need for change arises because decades-old methodologies cannot be utilized exclusively and effectively in today's educational practice (Gyöngyösi-Wiersum, 2021). Teachers are required to constantly modify their instruction to meet the students' needs (Gallagher et al., 2022), integrating meaningful tasks that promote thinking, reasoning, and active involvement with the subject (Litster et al., 2020). Moreover, teachers need to utilize various instructional strategies and supplementary approaches for students to understand the lessons and acquire fundamental mathematics skills (Mosimege & Winnaar, 2021; Arasomwan & Mashiy, 2021).

Pedagogical practices pertain to how lessons are conducted inside the classroom (Chia & Lim, 2020). However, since teaching is no longer limited in the classroom, mathematics teaching practices can be defined as what a teacher does to make mathematics meaningful to students (Antonio, 2020). Pedagogy is not confined to what can be observed; teachers have particular ideas, attitudes, and content knowledge that influence how they choose what to teach and how to deliver

* Corresponding author.
*E-mail address*: shariafaye.bohol@deped.gov.ph

it (Hardman, 2019). Teachers’ teaching goal is for students to learn how to reason mathematically to validate and develop arguments in addition to learning the mathematical content (Delgado-Rebolledo & Zakaryan, 2020).

In Indonesia, the study of Simamora & Saragih (2019) on improving the problem-solving skills of students using guided discovery learning disclosed that students' problem-solving skills have improved after using the method. It demonstrates that incorporating local culture into Mathematics instruction is important to maximize students' learning outcomes. In addition, the approach of using realistic Mathematics education was also found to be effective in increasing students' mathematical belief, representation, and problem-solving skills. This method effectively inculcates students how to generate their ideas based on real-life scenarios or experiences (Yuanita et al., 2018). Also, the study by Childs and Glenn-White (2018) emphasized the importance of questions in unraveling mathematical tasks. Therefore, it is essential to include questions that lead to discussions beyond getting the correct answer to focus on making sense of the problem-solving process.

Another factor that may affect students' mathematics performance is their self-concept toward the subject. Mathematics self-concept refers to students' impressions of themselves regarding their mathematical abilities and skills and their enjoyment and interest in performing mathematical tasks (Delima & Cahyawati, 2021; Dehsheykh et al., 2021). Therefore, it is a vital factor in students' mathematical success (Peteros et al., 2019). It has a favorable and significant impact on students' mathematical thinking ability (Delima et al., 2018). Furthermore, self-concept is also needed to foster students' perception, self-confidence, and optimistic attitudes when solving mathematical problems. Thus, engaging students actively and stimulating their self-concept is necessary to achieve maximum mathematics learning outcomes (Sultra et al., 2019).

According to Orozco-Guzmán et al. (2020), students' self-concept toward mathematics learning is related to performance. What directly determines students' success is the feeling of having competencies to understand mathematics contents, not the feeling of difficulty with the subject. Comparably, the study conducted by Tan (2019) looked at the level of students' self–concept as a moderating variable in their problem-solving. The result shows that the stronger self–concept of students, the higher their performance in problem-solving.

Problem-solving is an integral element of the mathematics curriculum for students of all grade levels (Hodgen et al., 2018). It is considered the primary goal of the mathematics curriculum to develop students' problem-solving skills and enable them to apply to well-defined problem-solving scenarios or systems of equations (McFeetors & McGarvey, 2019). Like many other aspects of mathematics learning, performance in problem-solving has been linked to various general cognitive means such as working memory capacity and cognitive skills (Verschaffel, 2020).

In the Philippines, it cannot be denied that mathematics is still one of the subjects that young Filipinos struggle with (Capuno et al., 2019). In mathematics achievement, students in the country are consistently surpassed by youngsters in other countries (Punzalan & Buenaflor, 2017). Based on the results of the recently completed Trends in International Mathematics and Science Study (TIMSS) in 2019, the Philippines was ranked last among 58 participating countries in mathematics. And in 2018, according to the Programme for International Student Assessment (PISA), the Philippines also placed second-lowest among 79 countries in mathematical literacy (Bernardo, 2020). Furthermore, according to the World Economic Forum's Global Competitiveness Report for 2016-2017, the country ranks 79th out of 138 participating countries in mathematics education quality (Capuno et al., 2019). As a result, to address this kind of learning issue, students should be allowed to solve contextual problems so that they can work to solve them and integrate personal experiences into their learning process (Bakait et al., 2021; Puspitawati et al., 2018).

Despite the advent of studies relating to various teaching approaches in mathematics and their anticipated effect on students' performance, particularly in problem-solving, only a few were conducted on students' mathematics self-concept relating to students' problem-solving performance. Also, after a thorough literature review, no studies have been found relating to teachers' extent of teaching practices, the level of the students' mathematics self-concept, and their influence on students' problem-solving performance amid the pandemic. Hence, the conduct of this study.

Due to this abrupt change brought by the pandemic, students found it challenging to learn, particularly in mathematics (Meniano & Tan, 2022). In particular, during the implementation of the learning modalities, mainly in District 10 in the Division of Ozamiz City, teachers have observed that some students are not performing well in mathematics. In fact, during the first quarter of the School Year 2021-2022, out of 837 junior high school students, 170 or 20 percent of students acquired fairly satisfactory ratings in their learning progress and achievement in Mathematics. Therefore, exploring important factors contributing to students’ performance in the subject, such as teachers’ teaching practices and students’ mathematics self-concept, is vital.

This study determined the teachers' teaching practices and the level of the students' self-concept toward Mathematics in relation to the problem-solving performance of Grade 10 students in the Division of Ozamiz City. The study answered the following questions:

1) What is the teacher's extent of teaching practices in terms of establishing mathematics goals to focus learning, implementing tasks that promote reasoning and problem solving, using and connecting mathematical representations, facilitating meaningful mathematical discourse, posing purposeful questions, building procedural fluency from conceptual understanding, supporting productive struggle in learning mathematics, and eliciting and using evidence of student thinking?
2) What is the level of the students' self-concept toward Mathematics as learned, organized, and dynamic concept?
3) What is the students' problem-solving performance in Mathematics?
4) Is there a significant relationship between the teacher's teaching practices and the students' problem-solving performance in Mathematics?
5) Is there a significant relationship between the students' self-concept toward Mathematics and problem-solving performance in Mathematics?
6) What are the predictors of the students' problem-solving performance in Mathematics?

## 2. Literature Review

The quality of mathematics education frequently relies on teachers' experience, professional development, knowledge, and skills (Wardat et al., 2022). With this, mathematics teachers need to have apparent and effective teaching practices to promote effective mathematics learning.

Creating clear goals for students' mathematics learning and placing those goals in context is vital in Mathematics teaching. The goals drive instructional decisions within learning progressions (Whipple, 2019). As such, the teacher must clearly provide the students' learning goals and objectives (Ingram et al., 2018) and must have the skill to identify appropriate methods and strategies based on the material delivered to meet the learning goals (Pohan et., 2020). Whereas, according to Albay (2020), the best way to teach important mathematics concepts and procedures is to use problem-solving activities that involve students pondering the important mathematical concepts and techniques they must learn. However, as stated by Attard and Holmes (2020), students' mathematics learning is improved when teachers apply several blended learning approaches by providing many points of entry to learning experiences that are more closely suited to individual learning demands and devoid of classroom temporal limitations.

Mathematical representations are also encouraged in the teaching process for students to get a deeper knowledge of mathematical concepts and procedures and apply them as problem-solving tools (Whipple, 2019). Mathematical representation refers to using diagrams, illustrations, models, graphs, actual objects, and contextual scenarios to explain mathematical concepts (Santia & Sutawidjadja, 2019). Some key applications of mathematical representations involve linking learning with students' interests and experiences (Desai et al., 2021). In addition, promoting discussion among students is important to establish a shared knowledge of mathematical concepts by assessing and contrasting student ideas and arguments (Whipple, 2019). Mathematics learning entails mathematical understanding, activities, and discourse such as describing, defending, and arguing (Erath et al., 2021).

On the other hand, posing purposeful questions could be utilized by teachers to examine and enhance students' thinking and sense-making on vital mathematical concepts and linkages (Whipple, 2019). Varied questions have different demands, which must assess in light of the greater implications that such questions provide to students' mathematics learning (DeJarnette et al., 2020). With this, teachers must possess good questioning skills. The teacher needs to know how to ask thought-provoking questions and give feedback (Ingram et al., 2018).

Students' mathematics learning is influenced by their prior procedural and conceptual knowledge (Achmetli et al., 2019). Promoting procedural fluency on a baseline of conceptual knowledge allows students to become skilled at employing procedures creatively as they address contextual and mathematical problems over time (Whipple, 2019). In addition, conceptual and procedural knowledge is necessary for students to complete mathematical tasks or solve problems (Vanscoy, 2019; Nahdi & Jatisunda, 2020).

Effective mathematics teaching gives students opportunities and supports to engage in constructive struggle as they engage with mathematical ideas and relationships, individually and collectively (Whipple, 2019). Given this, the teacher must ensure a comfortable learning atmosphere by giving students all the support they need, monitoring their progress, and positively responding to their questions and answers (Ingram et al., 2018). Conversely, eliciting students' ideas to concepts and explanation of their solutions to various problems is essential in enhancing their understanding of the lessons (Cranston, 2020; Jansen, Berk & Meikle, 2017). Teachers need to use evidence of student thought to evaluate progress toward mathematical knowledge and alter instruction in ways that promote and expand learning (Whipple, 2019).

Another factor contributing to students' mathematics learning is students' self-concept in the subject. Self-concept is a complex construct that organizes self-perception into a hierarchical structure with global and specific components. It comprises domain-specific components, such as mathematical, literacy, and peer and teacher-related facets (Dapp & Roebers, 2018). Furthermore, it predicts students' subsequent performance (Marsh et al., 2022).

Self-concept is the sum of a learned, organized, and dynamic system of an individual's acquired beliefs, attitudes, beliefs, and analytical judgments about themselves (Wehrle & Fasbender, 2019). Individuals' ideas of themselves are reflected in learned self-concepts, which are subjective and not always based on truth. Past experiences and aspirations about future goals influence these impressions (Lamar et al., 2019). It is organized or structured in that students categorize and relate a large amount of knowledge they have about themselves (Vispoel, 2021). Also, self-concept is dynamic and ever-changing. And change can take place when students mix current beliefs with old ones. When students are presented with a new idea that contradicts their current beliefs about themselves, they are forced to reconcile the new idea with their existing beliefs (Lamar et al., 2019).

The study by Shanley et al. (2019) revealed that students' mathematics self-concept (MSC) has declined throughout Junior High School. In addition, results state that third-grade students' MSC is related to their performance in third grade and back to their kindergarten level. In another study, Lee and Kung (2018) used longitudinal data to investigate math self-concept and achievement. The study used a sample of 1,211 Taiwanese students in seventh grade. The findings revealed that mathematics self-concept has long-term impact on students' achievement.

Problem-solving is also a key aspect of mathematics teaching and learning. It refers to any target-directed cognitive activity sequence (Robertson, 2016), which does not have a clear method of solution (Chapman, 2015) and involves multiple processes (Fernandez et al., 2015). It requires plenty of teacher preparations before actual learning happens inside the classroom. Therefore, teachers' efforts have to be made to guarantee that traditional chalk and talk teaching methods are replaced with activity-based methods in the classroom. If not, students will continue to struggle with solving mathematical problems (Olaniyan & Govender, 2018).

In Tagum City, primarily at Pandapan Integrated School, it has been noted that Junior High School students do poorly in Mathematics, particularly in Algebra. For example, during the National Achievement Test, Grade 9 students got an average score of 79 in the SY 2016-2017 and 78 in the SY 2017- 2018. Liboganon Integrated School also faces a similar difficulty; the Grade 9 students got an average of 79 percent in the first quarter and 81 percent in the second quarter, SY 2017-2018 (ANA, 2018).

Problem-solving skill is one of the key purposes of learning mathematics. It is described as an individual's ability to manage a problem (Ince, 2018). It is a vital skill that everyone should master, not simply because most real-life scenarios will involve problems that require to be solved, but also because problem-solving can boost analytical power and help solve difficulties in various settings (Zamnah, 2021). Moreover, the skill in problem-solving helps students learn, relate, and apply mathematical concepts (Maulyda et al., 2019).

One of the powerful mathematical problem-solving models is Polya's problem-solving method. The method consists of understanding or solving difficulties, creating plans, carrying out the plan, and reflecting. Yustiana, Kusmayadi and Fitriana (2021) used this method, and their findings demonstrated that students with strong mathematical skills could complete all stages of Polya's problem-solving. In contrast, students who are capable of completing the stages of understanding the problem, creating plans, and carrying out the plan are categorized as students with good mathematical skills. Conversely, students are categorized as having low mathematical skills when they can only complete the first stage.

## 3. Research Method and Materials

This study employed the descriptive-correlational research design. Descriptive research aims to provide a detailed description of people, occasions, or circumstances by examining subjects as they are in reality (Siedlecki, 2020). Whereas, correlational research is a non-experimental research method that explores the degree to which the measurable variables are related (Seeram, 2019). This research design was considered appropriate in determining the teachers' teaching practices and the level of students' self-concept toward Mathematics in relation to the problem-solving performance of Grade 10 students in the Division of Ozamiz City.

This study was conducted in the secondary schools under District 10 of the Division of Ozamiz City, namely, Labinay National High School, Jacinto Nemeño Integrated School, Sinusa Integrated School, and Tabid National High School. These schools are located in rural barangays in the City. Both Labinay National High School and Sinusa Integrated School are already located at the boundary between Tangub City and Ozamiz City.

All public secondary schools in District 10 are categorized as small schools except Tabid National High School, which is considered a medium school. Labinay National High School was founded in 1964 and has a total of 191 Junior High School students, SY 2021-2022. In contrast, Jacinto Nemeño Integrated School was founded in 1935 with 76 junior high school students for SY 2021-2022. In contrast, Sinusa Integrated School was founded in 1959 with 156 total junior high school students. Lastly, Tabid National High School was founded in 2001 with 440 junior high school students.

Amid the pandemic, the said schools adopted blended distance learning, conducting face-to-face classes and printed modular learning. However, to stop the spread of the COVID-19 virus, only those willing and fully vaccinated students were allowed to participate in the face-to-face classes. The rest of the students continued to adopt printed modular distance learning.

The respondents of the study were composed of 111 Grade 10 Junior High School students from the District 10 of the Division of Ozamiz City. A simple random sampling technique was employed in determining the respondents. There were 31 Grade 10 students from Labinay National School who participated in the study, 31 students from Sinusa Integrated School, 30 students from Tabid National High School, and 19 students from Jacinto Nemeño Integrated School. Raosoft Sample Size Calculator was utilized to determine each school's sample size. The selection of the respondents was based on the following criteria: 1) Grade 10 students enrolled in the SY 2021-2022; 2) students who participated in face-to-face classes; and 3) students who gave their full consent as respondents of the study.

This study used the following instruments:

a) Mathematics Teaching Practices Scale

This questionnaire was modified and adapted from NCTM’s Catalyzing Change in High School Mathematics (2018). This was used to determine Mathematics teachers’ teaching practices which the students rated. The instrument consists of 8 constructs, namely: establishing mathematics goals to focus on learning, implementing tasks that promote reasoning and problem solving, using and connecting mathematical representations, facilitating meaningful mathematical discourse, posing purposeful questions, building procedural fluency from conceptual understanding, supporting productive struggle in learning mathematics, and eliciting and using evidence of student thinking. The instrument had a total of twenty-five statements.

The instrument used a four-point Likert scale, and underwent a pilot test to selected Grade 10 students who were excluded as respondents for the study for reliability. It yielded a Cronbach’s Alpha Coefficient of 0.73, making the instrument reliable for use.

In determining the teachers’ mathematics teaching practices, the following scale was used:

| **Responses** | **Continuum** | **Interpretation** |
|---|---|---|
| 4 – Always (A) | 3.25 – 4.0 | Very Great Extent (VGE) |
| 3 – Often (O) | 2.50 – 3.24 | Great Extent (GE) |
| 2 – Sometimes (S) | 1.75 – 2.49 | Less Extent (LE) |
| 1 – Never (N) | 1.0 – 1.74 | Least Extent (LtE) |

b) Self-Concept Questionnaire

This questionnaire was adapted from Peteros et al. (2019). The instrument was used to determine the level of the students’ Mathematics self-concept. It has three constructs: learned, organized, and dynamic self-concept. Each construct has ten statements. The instrument underwent a pilot test using selected Grade 10 students who were excluded as respondents. The test yielded the Cronbach’s Alpha Coefficient of 0.92, which is considered reliable.

In determining the students’ self-concept toward Mathematics, the following scale was used:

| **Responses** | **Continuum** | **Interpretation** |
|---|---|---|
| 4 – Strongly Agree (SA) | 3.25 – 4.0 | Very Good (VG) |
| 3 – Agree (A) | 2.50 – 3.24 | Good (G) |

| | | |
|---|---|---|
| 2 – Disagree (D) | 1.75 – 2.49 | Fair (F) |
| 1 – Strongly Disagree (SD) | 1.0 – 1.74 | Poor (P) |

c) Problem-solving Skills Test

The instrument is a researcher-made test. It is composed of five problems for five points each, with a total of twenty-five points. The instrument was used to determine the students' problem-solving skills. The research instrument involved various problems in polynomials, which were already covered in the second quarter of the academic year. Also, an analytic rubric was included to ensure a valid, consistent, and accurate evaluation of students' solutions. The rubric consists of five (5) scoring scales or levels. The instrument underwent a pilot test to selected Grade 10 students who were excluded as respondents for the study for reliability. It yielded the Cronbach's Alpha Coefficient of 0.80, which is considered reliable.

In determining the students' performance in problem-solving, the following DepEd grading scheme was used:

| **Score Range** | **Remarks** |
|---|---|
| 21 – 25 | Outstanding (O) |
| 19-20 | Very Satisfactory (VS) |
| 17-18 | Satisfactory (S) |
| 15-16 | Fairly Satisfactory (FS) |
| 14 and below | Did not meet expectations (DnME) |

Before conducting the study, the researcher asked for approval from the Dean of the Misamis University Graduate School, then from the Schools Division Superintendent. After the approval, the researcher prepared a letter of permission for the school head, then an informed consent from the parents/guardians of the participants. Finally, the researcher personally asked for the assistance of the Grade 10 Mathematics teachers in the participating schools for the conduct of the study to the target respondents. After taking the five-item test in problem-solving, the respondents were given the questionnaires to measure the teachers' extent of teaching practices and the level of the students' self-concept in Mathematics. The data gathered were tallied, analyzed, and interpreted using the Minitab Application Software.

In upholding the ethical aspect of this study, the researcher solicited the voluntary participation of the respondents. She informed the respondents of the purpose of the study and assured them that their participation would not harm them in any way. The researcher prioritized respect for the respondents' dignity. She also ensured the protection of the respondents' privacy, adequate confidentiality of research data, and anonymity of the students and teachers involved. Furthermore, she avoided deception and exaggeration about the research's aims and objectives; and declared no affiliations, funding sources, and potential conflicts of interest. Any communication about the research was done with transparency, and she avoided any misleading information and misinterpretations of primary data findings. Finally, the researcher asked the respondents to sign the informed consent as proof of their willingness to participate.

The study used the following tools in analyzing the data gathered with the use of Minitab Software:

*Mean* and *Standard Deviation* were used in determining the extent of teachers' teaching practices, the level of the students' self-concept toward Mathematics, and performance in problem-solving.

*Pearson Product Moment Correlation Coefficient* was used in exploring the significant relationship between the extent of teachers' teaching practices, the level of the students' self-concept toward Mathematics, and their problem-solving performance.

*Stepwise Multiple Regression Analysis* was utilized in identifying the constructs or variables that may predict singly or in combination with the students' problem-solving performance.

## 4. Results and Discussion

### *4.1. Teacher's Extent of Teaching Practices*

Table 1 shows the great extent of Mathematics teachers' teaching practices as rated by the respondents (M=2.96, SD=0.77). However, among the teachers' practices, posing purposeful questions (M=3.02, SD=0.80) and supporting productive struggle in students' mathematics learning stand out from the survey (M=3.10, SD=0.83). The finding implies that the teachers' approach to posing thought-provoking questions and offering support and scaffolding greatly impacted the students' mathematics learning. Such support includes allowing them enough time to connect with mathematical concepts, which helps them foster perseverance and identity formation, and providing scaffolding to facilitate their progress on difficult tasks, communicate care, and boost their self-confidence.

Childs and Glenn-White (2018) believe that students gain knowledge by discussing ideas with others, hearing others' thoughts, and having others offer feedback on their methods to solve problems. Posing purposeful questions help direct students to various mathematical problems during individual and group discussions. This is crucial to guide discussions away from focusing solely on students getting the right answer and toward ones centered on understanding the problem-solving process.

Supporting productive struggle includes allowing learning time in accordance with the needs of students. It is said to be integral in fulfilling full understanding and connection with mathematics concepts (Prihantini et al., 2021). Students best learn when given the freedom to create their links between mathematical concepts (Ingram et al., 2020). When students learn to comprehend the relationships between mathematical concepts, they will understand mathematics more quickly and have more opportunities to build their mathematical skills (Kenedi et al., 2019).

Students also need scaffolding in learning mathematics concepts, particularly difficult ones. Scaffolding is an integral approach for bridging the gap between what students can achieve on their own and what they can manage with the help or supervision of others (Dagoc & Tan, 2018). According to Vygotsky's sociocultural theory, students have to be given scaffolding in understanding concepts and doing mathematical tasks until they can do them independently (Prihantini et al., 2021). Thus, teachers' support and ability to utilize adequate teaching strategies play an important role in students' chances of mathematical success (Gage et al., 2018; Mazana et al., 2019).

Teachers are encouraged to include questions in the discussion that calls for students' explanation and contemplation of mathematical tasks. It is best that teachers maintain a positive atmosphere inside the classroom by showing appreciation and highlighting key elements of students' responses and mathematical approaches. Posing purposeful questions can help students create significant mathematical connections and enable teachers to determine what students already know and accommodate classes to fit different levels of knowledge. Furthermore, teachers have to give students scaffolding to feel supported in their learning. When students feel supported and continuously given encouragement to do various tasks, they most likely feel less struggle and develop confidence and independence in learning mathematics concepts and solving problems.

All other variables were also found to be of a great extent, namely, establishing mathematics goals to focus learning, implementing tasks that promote reasoning and problem solving, using and connecting mathematical representations, building procedural fluency from conceptual understanding, and eliciting and using evidence of student thinking. Establishing goals in the teaching process has a significant role in student mathematics learning. Learning goals serve as a guide in the discussion, and it also sets high expectations to students. Saiyad et al. (2020) asserted that students tend to perform well when teachers establish goals and set high expectations as it provides them with specific standards for the type and quality of work required to complete learning tasks proficiently and on time.

Moreover, providing students with various tasks that promote reasoning and problem solving is necessary for strengthening their feeling of agency and mathematical identity. Such tasks include activities that offer various paths to achievement, demand reasoning, problem-solving and modeling, and activities pertinent to students' culture and language experiences. In comparison, the approach of using and connecting mathematical representations refers to the utilization of illustrations, diagrams, graphs, models, real objects, and other visual representations in teaching mathematical concepts. While the teaching practice of building procedural fluency from conceptual understanding has been found to help students understand and adopt a positive attitude toward mathematics by connecting understanding with procedural proficiency. The result entails that the practice has reduced students' arithmetic anxiety and has helped them develop mathematical meaning by linking knowledge with procedural fluency.

On the other hand, how teachers elicit and use evidence of student thinking has also been found effective in students' mathematics learning. This approach encourages a larger spectrum of students to participate in mathematical discussions with their classmates and the teacher by promoting a learning culture where mistakes and errors are recognized as significant thinking opportunities. Furthermore, by implementing the practice of facilitating meaningful discourse, students can have the chance to share ideas and clarify understandings, create arguments and express their solutions to various mathematical tasks.

The great extent of the teachers' teaching practices implies extra effort from teachers to reach the optimum scale. Mathematics teachers need to take more actions to help the students become more engaged in lessons, especially in the new normal delivery wherein limited face-to-face is implemented. It can be understood that teachers are still neophytes in the practice; however, when teachers do their best, from planning mathematics lessons to using different Mathematics strategies and assessing learning outcomes, students might see this practice to a very great extent. Thus, teachers have to employ various classroom activities to cater to learners with various needs and differences. Proper alignment of lesson outcomes to the lesson activities and assessment tasks, and providing constant support to learners despite struggles may be of great help.

**Table 1.** Teacher's Extent of Teaching Practices (n= 111)

| Constructs | Mean | SD | Interpretation |
|---|---|---|---|
| Establishing Mathematics Goals to Focus Learning | 2.89 | 0.77 | To a Great Extent |
| Implementing Tasks That Promote Reasoning and Problem Solving | 2.91 | 0.77 | To a Great Extent |
| Using and Connecting Mathematical Representations | 2.88 | 0.75 | To a Great Extent |
| Facilitating Meaningful Mathematical Discourse | 2.92 | 0.73 | To a Great Extent |
| Posing Purposeful Questions | 3.02 | 0.80 | To a Great Extent |
| Building Procedural Fluency from Conceptual Understanding | 2.94 | 0.74 | To a Great Extent |
| Supporting Productive Struggle in Learning Mathematics | 3.10 | 0.83 | To a Great Extent |
| Eliciting and Using Evidence of Student Thinking | 2.98 | 0.74 | To a Great Extent |
| Overall Practices | 2.96 | 0.77 | To a Great Extent |

*Note:* Practices Scale: 3.25-4.0 (To a Very Great Extent); 2.50-3.24(To a Great Extent);1.75-2.249(To a Less Extent);1.0-1.74(To a Least Extent)

### *4.2. Level of the Students' Self-Concept toward Mathematics*

Overall, it can be said that students have a fair self-concept toward Mathematics (M=2.47, SD = 0.60). However, this suggests that students have a somewhat poor self-concept with regard to understanding and doing mathematical tasks (Table 2). In particular, results show that students perceived their learned self-concept and organized self-concept towards mathematics as fair (M=2.47, SD=0.60) and (M=2.44, SD=0.60), respectively. This finding means that students found it hard to learn mathematics and obtain good grades. They did not feel confident in doing mathematical tasks. However, results revealed that students tend to perceive themselves to have a good level of dynamic self-concept (M=2.50, SD=0.60). Having a good perception of dynamic self-concept denotes that students believe mathematics is vital to their future success, indicating that they value the subject in their lives as it will benefit their future endeavors. Furthermore, they believe they can apply their learning in class to their everyday life. Students also feel that if they work hard enough, they can practically complete all mathematics tasks.

Situmorang, Sipayung, and Silaban (2020) clarified that having a negative self-concept means that students are responsive to criticism, sensitive to praise, hypercritical, feel that they are despised by classmates, and are apprehensive about competition. Moreover, based on the study of Bringula et al. (2021) regarding students' mathematics concept and challenges faced during the pandemic, negative notions in mathematics from students themselves is said to be influenced by the current transition in the educational setting from traditional face-to-face classes to blended distance learning. The findings are the viable factors of students' poor perceptions of themselves because limited face-to-face classes have recently been implemented in the Division of Ozamiz City

Teachers play a vital role in molding students' mathematics self-concept. Mathematics teachers are encouraged to put some extra effort into promoting students to feel more confident about their competence in doing mathematics. Using appropriate learning tasks and assessments and contextualizing lessons based on students' experiences and culture may help boost students' self-concept and achieve significant learning outcomes in Mathematics. When lesson activities fit students' learning styles and problems are made where they can relate to and understand, students may be more engaged in the discussion and can easily find the value of the lessons. When students learning needs are addressed, students become more courageous to persevere in learning the mathematics concepts and carrying out mathematics activities.

**Table 2.** Level of the Students' Self-Concept toward Mathematics (n= 111)

| Constructs | Mean | SD | Interpretation |
|---|---|---|---|
| Learned Concept | 2.47 | 0.60 | Fair |
| Organized Concept | 2.44 | 0.60 | Fair |
| Dynamic Concept | 2.50 | 0.60 | Good |
| *Overall Self Concept* | 2.47 | 0.60 | Fair |

*Note:* Practices Scale: 3.25-4.0 (Very Good); 2.50-3.24(Good); 1.75-2.249(Fair);1.0-1.74(Poor)

### *4.3. Students' Problem-Solving Performance in Mathematics*

Table 3 shows the students' performance in problem-solving. The problems involved various tasks in polynomials, which were covered in the second quarter guided by DepEd's Most Essential Learning Competencies (MELCs). It was revealed that most of the students, or 83 out of 111 students, obtained a performance that was not meeting expectations. In contrast, 19 of the students got a fairly satisfactory performance. Also, only 10, 3, and 5 students got satisfactory, very satisfactory, and outstanding performance, respectively. The study disclosed that the students' problem-solving performance did not meet expectations prescribed by the DepEd (M= 12.13). The results suggest that students lack the knowledge of the lessons covered and skills in problem-solving.

The inability of students to solve problems can be associated with their lack of understanding of the concept and no experience solving problems during mathematics classes (Son & Fatimah, 2020; Sari, 2019). However, problem-solving is one of the mathematical abilities that students have to master. It is the process of arriving at logical conclusions based on facts and information from multiple sources. Therefore, teachers need to engage students in various problem-solving tasks because if they will not be engaged in the process of thinking while learning, probably, they may only receive memory and may not comprehend the core or concept of the subject (Pohan et al., 2020).

The problem-solving test consists of five items involving polynomials. In the first item, students were required to factor the given polynomial. In the second item, they were required to simplify the polynomial function with the given value of x. And for items three and four, students were asked to find the roots of the polynomials. Finally, students were asked to solve the given word problem in the last item. In addition, the students solved the problems following Polya's step-by-step problem-solving process. However, referring to students' solutions, they have difficulty simplifying polynomials and solving the word problem. The most common errors of students were the inability to represent problems, inaccuracy of solutions, incorrect final answers, and absence of conclusions.

Mathematical problem-solving has to reflect real-world scenarios. Employing mathematics to solve real-life problems may help enhance students' motivation and comprehension of various mathematical concepts. Thus, students' performance in the problem-solving test demands teachers to put an extra effort in intensifying students' engagement with various authentic mathematical problems to ensure that they understand the lessons taught and become confident in solving them. Utilization of authentic problems in teaching may improve students' problem-solving performance.

**Table 3.** Students' Performance in Mathematics (n = 111)

| Performance | Frequency | Percentage |
|---|---|---|
| Outstanding (21-25) | 5 | 4.17 |
| Very satisfactory (19-20) | 3 | 2.50 |
| Satisfactory (17-18) | 10 | 8.33 |
| Fairly satisfactory (15-16) | 19 | 15.83 |
| Did not meet expectations (14 and below) | 83 | 69.17 |
| Mean Performance | 12.13- Did not Meet Expectations | |

*Note:* Performance Scale : Outstanding (21-25); Very Satisfactory (19-20); Satisfactory (17-18); (15-16); Did not meet expectations (14 and below)

### *4.4. Relationship between the Teachers' Teaching Practices and the Students' Problem-Solving Performance*

The Pearson Product-Moment Correlation Coefficient was used to see if there was a significant relationship between the teachers' teaching practices and the students' problem-solving performance in mathematics. As shown in Table 4, there was no significant relationship between the variables, except between using and connecting mathematical representations and students' problem-solving performance ($r = 0.89$, $p=0.04$). The p-value was less than 0.05 level of significance, indicating that the null hypothesis was rejected. The finding implies that among the variables, only the use and connection of mathematical representations significantly impacted the students' problem-solving performance.

Results suggest that the teachers' extent of using and connecting mathematical representations in teachings, such as utilizing diagrams, graphs, pictures, equations, real objects, and real-life scenarios, has a significant positive relationship to students' problem-solving performance. It implies a very strong correlation and is significant at a 95 percent confidence level. This indicates that the greater the teachers' extent in using and connecting representations in Mathematics teaching, the more likely the students' performance in problem-solving becomes better.

Mathematical representation conveys mathematical concepts in various ways, including diagrams, symbols, drawings, languages, models, graphs, and real objects (Santia & Sutawidjadja, 2019). Students can easily understand and can accurately solve problems when mathematical representations are used (Cooper et al., 2018). However, when using the approach of multiple representations, teachers select appropriate materials to achieve more effective mathematics learning (Kusumaningsih & Herman, 2018).

The results suggest that students were visual learners and learn best when provided visual representations of the problems before moving on to the solutions. Various forms of mathematical representation allow students to comprehend mathematical ideas or concepts and analyze problems. Thus, employing different mathematical representations is necessary to deepen students' understanding of the concepts and become proficient in solving problems. Using and connecting representations in problem-solving may greatly influence the students' performance in Mathematics.

**Table 4.** Relationship between the Teachers' Teaching Practices and the Students' Problem- Solving Performance

| Constructs | *r* value | Relationship Strength | *p* value | Remarks |
|---|---|---|---|---|
| Establishing Mathematics Goals to Focus Learning and Performance | 0.07 | Very Weak | 0.34 | Not Significant |
| Implementing Tasks that Promote Reasoning and Performance | 0.02 | Very Weak | 0.75 | Not Significant |
| Using and Connecting Mathematical Representations and Performance | 0.89 | Very Strong | *0.04 | Significant |
| Facilitating Meaningful Mathematical Discourse and Performance | 0.09 | Very Weak | 0.17 | Not Significant |
| Posing Purposeful Questions and Performance | 0.09 | Very Weak | 0.20 | Not Significant |
| Building Procedural Fluency from Conceptual Understanding and Performance | 0. 09 | Very Weak | 0.20 | Not Significant |
| Supporting Productive Struggle in Learning Mathematics and Performance | 0. 09 | Very Weak | 0.20 | Not Significant |
| Eliciting and Using Evidence of Student Thinking and Performance | 0.06 | Very Weak | 0.42 | Not Significant |

*Note:* Relationship Strength Scale: 1.00 (Perfect); 0.80-0.99 (Very Strong); 0.60-0.79 (Strong); 0.40-0.59 (Average); 0.20-0.39 (Weak); 0.01-0.19 (Very Weak); 0.00 (No Relationship)

Probability Value Scale: **$p<0.01$ (Highly Significant); *$p<0.05$ (Significant); $p>0.05$ (Not significant)

### *4.5. Relationship between the Students' Self-Concept toward Mathematics and the Problem-Solving Performance*

The Pearson Product-Moment Correlation Coefficient was used in determining the relationship between the students' self-concept toward mathematics and their problem-solving performance. In Table 5, the data revealed no significant relationship between learned self-concept and problem-solving performance ($r=0.11$, $p = 0.23$), as well as between organized self-concept and problem-solving performance ($r=0.11$, $p = 0.25$). However, students' dynamic self-concept ($r = 0.79$, $p = 0.02$) with strong correlation strength is highlighted as significant at a 95 percent confidence level, which means that the null hypothesis is rejected. The result implies that dynamic self-concept is higher for those students with better performance in Mathematics problem-solving.

The result indicates that having a positive concept of the importance and advantages of learning mathematics in everyday life and pursuits in the future contributes to students' performance in problem-solving. This notion calls for teachers to strengthen students' dynamic self-concept toward mathematics to enhance their competence in solving mathematical problems. Dynamic self-concept pertains to how students value mathematics and perceive the subject in terms of its importance in their daily and future undertakings, learning other disciplines, and improving retention capabilities. However, these students' perspectives regarding mathematics can alter depending on the situation.

Pesu et al. (2018) argued that students' self-concept is directly related to their performance. In the same way, as noted by Peteros et al. (2019), when students are inclined to believe that mathematics is an easy-to-learn subject, they are likely to have excellent performance and pass the subject. Conversely, when students feel that they hate mathematics and find it difficult to learn, they will probably have poor performance and fail the subject. Birchall (2018) further stated that mathematics can become a hated subject when students go to more advanced topics. Therefore, teachers have to do their best to develop a positive self-concept of students toward mathematics, especially since it was found to have a long-term impact on students' mathematics performance (Lee & Kung, 2018).

Notably, the findings highlight the necessity of considering promoting students' self-concept levels to increase their problem-solving performance in mathematics. Thus, teachers need to make every effort to help students develop a positive concept in the subject. Cultivating students' motivation can be a great approach. Making each classroom discussion fun and interesting can make students enjoy learning and become more engaged in the class. When students feel motivated and enjoy the lesson, they become confident and optimistic about learning mathematics and doing various mathematical tasks.

**Table 5.** Relationship between the Students' Self-Concept toward Mathematics and their Problem-Solving Performance

| Constructs | *r* value | Relationship Strength | *p* value | Remarks |
|---|---|---|---|---|
| Learned Concept and Performance | 0.11 | Very Weak | 0.23 | Not Significant |
| Organized Concept and Performance | 0.11 | Very Weak | 0.25 | Not Significant |
| Dynamic Concept and Performance | 0.79 | Strong | 0.02* | Significant |

*Note:* Relationship Strength Scale: 1.00 (Perfect); 0.80-0.99 (Very Strong); 0.60-0.79 (Strong); 0.40-0.59 (Average); 0.20-0.39 (Weak); 0.01-0.19 (Very Weak); 0.00 (No Relationship)

Probability Value Scale: **$p<0.01$ (Highly Significant); *$p<0.05$ (Significant); $p>0.05$ (Not significant)

### *4.6. Predictors of Students' Problem-Solving Performance in Mathematics*

The statistical result shown in Table 6 suggests that teachers' extent of using and connecting mathematical representations ($\beta = 1.28$, $p=0.00$) and students' dynamic self-concept ($\beta = 1.83$, $p=0.03$) are significant predictors of students' problem-solving performance. Furthermore, the finding suggests that the more teachers use and connect mathematical representation in teaching, the better is the students' problem-solving performance. Also, the more students perceive mathematics as advantageous and beneficial in learning and future undertakings, the more they strive to do better in mathematics, particularly in solving problems.

The result of the regression equation suggests that when teachers' use of mathematical representations in teaching increases by a unit, students' problem-solving scores are predicted to increase by 1.28. Additionally, for every unit increase in students' dynamic self-concept, their problem-solving scores also increase by 1.83. The variation of teachers' practices and students' self-concept is explained by using and connecting mathematical representations and dynamic self-concept for only 82.20 percent ($r2 = 82.20$). The finding suggests that teachers' mathematical representations and students' dynamic self-concept account for 82.20 percent of students' mathematics achievement, whereas other factors not included in the study account for 17.80 percent. The 82.20 finding implies that the variables in the study were viable factors for students to be fully competent in mathematics.

The result is related to Marsh et al. (2020), which state that a stronger dynamic self-concept is closely associated with improving students' mathematics performance. And from the study of Hoogland (2018) on the use of primarily depictive mathematical representation of the problems states that students may perform more effectively on problems having a close to actual representation than on word problems. Effective learning demands using varied innovative teaching and instructional approaches that encourage students to participate in the learning process, establish competencies, and academically reach their full potential (Gibbs & McKay, 2021). Promoting students' mathematics self-concept is also an essential factor in students' mathematical success (Kaskens et al., 2020).

Mathematics teachers need to ensure that in the teaching-learning process, multiple representations of knowledge through the use of different contexts and experiences will be employed. They have to see to it that the representations used by teachers in mathematics relate to the lesson outcomes and help students become competent in solving word problems. Integrating innovative and interactive teaching strategies encourages students to engage in the lessons actively and address real issues inside the classroom. Additionally, as Mathematics teachers, motivating and positioning students' minds at the start of the lesson help the students become dynamic, thus making them think faster and more focused. Motivation and instilling the value of mathematics concepts are also necessary as they could make a big difference in overcoming students' mathematics difficulties. And encourage learners to feel comfortable and happy learning the subject.

**Table 6.** Predictors of the Students' Problem-Solving Performance in Mathematics

| Predictors | Coef (β) | SE Coef | t- value | p-value |
|---|---|---|---|---|
| (Constant) | 2.84 | 0.18 | 1.92 | 0.00 |
| Using and Connecting Mathematical Representations | 1.28 | 0.09 | 3.04 | **0.00 |
| Dynamic Concept | 1.83 | 0.10 | 2.21 | *0.03 |
| Adjusted $r^2$ | 82.20% | | | |
| F value | 180.06 | | | |
| p-value | 0.00 | | | |
| Problem Solving Performance = 2.84 + 1.28 Representation + 1.83 Dynamic Concept | | | | |

## 5. Conclusion and Recommendations

Based on the findings, the following conclusion are drawn:

1) Teachers have employed apparent and different teaching practices to promote effective mathematics learning.
2) The students developed a positive dynamic self-concept towards mathematics and, in the process of developing a positive self-concept as learned and organized concepts in Mathematics.
3) Students had poor performance in the Mathematics problem-solving test.
4) Using mathematical representations that link students' interests and experiences is an effective strategy and practice in teaching problem-solving.
5) Students' ability to adapt new concepts, ideas, and techniques helped them solve mathematical word problems.
6) The students' problem-solving performance in Mathematics is equated with the teachers' extent of teaching practices of using and connecting mathematical representations and the students' dynamic self-concepts in the subject.

Based on the findings and conclusion of the study, the following are the recommendations.

1) Mathematics teachers have to attend seminars and workshops related to teaching mathematics in the new normal setup. This will help teachers gain experience, knowledge, and skills from planning lesson outcomes to delivering and assessing learning outcomes.
2) Teachers have to use varied motivational strategies and techniques in teaching so students can develop positive concepts in mathematics. This makes mathematics lessons fun and welcoming for students to feel comfortable

while learning. Allowing learners to reflect as they solve word problems may also help them attain positive concepts in Mathematics.

3) Teachers may use different problem-solving strategies that are aligned with the learners' style in solving word problems. Learners have to be given remedial instructions to improve their poor performance in solving word problems in Mathematics.
4) Teachers have to use various mathematical representations to explore scenarios when solving problems. These include diagrams, illustrations, models, graphs, actual objects, and contextual scenarios. This will make students easily comprehend the problems and solve them proficiently.
5) Teachers have to introduce varied techniques in presenting and solving word problems because learners are adaptive to new ways of problem-solving. With the dynamic concepts of learners, they explore and learn as they discover new concepts and ideas in solving word problems in Mathematics.
6) Future researchers have to conduct another research study that explores the factors that affect the students' problem-solving performance in Mathematics.

## References

Achmetli, K., Schukajlow, S., & Rakoczy, K. (2019). Multiple solutions for real-world problems, experience of competence and students' procedural and conceptual knowledge. *International Journal of Science and Mathematics Education*, *17*(8), 1605-1625. Retrieved on March 6, 2022 from https://link.springer.com/article/10.1007/s10763-018-9936-5

Albay, E. M. (2020). Towards a 21st Century Mathematics Classroom: Investigating the Effects of the Problem-Solving Approach Among Tertiary Education Students. *Asia-Pacific Social Science Review*, *20*(2). Retrieved on March 5, 2022 from https://tinyurl.com/2k22277z

Alwi, A. (2020). Problem-Based Learning (PBL) as an Assessment Tool in Science Education: A Systematic Review with Exemplars. *Learning Science and Mathematics*, *15*(December), 102-to. Retrieved on May 3, 2022 from https://myjms.mohe.gov.my/index.php/lsm/article/view/9909

ANA, E. D. S. (2018). *LEARNER-CENTERED ENVIRONMENT AND ALGEBRAIC SKILLS OF STUDENTS IN INTEGRATED SCHOOLS OF TAGUM CITY* (Doctoral dissertation, St. Mary's College). Retrieved on December 2, 2021 from https://tinyurl.com/386br5np

ANTONIO, J. S. DEVELOPMENT AND VALIDATION OF MATHEMATICSTEACHING PRACTICES SCALE. Retrieved on May 10, 2022 from https://bit.ly/3aJGMgt

Arasomwan, D. A., & Mashiy, N. J. (2021). Early childhood care and education educators' understanding of the use of music-based pedagogies to teach communication skills. *South African Journal of Childhood Education*, *11*(1), 1-12. Retrieved on May 2, 2022 from https://bit.ly/3PDBodP

Attard, C., & Holmes, K. (2020). An exploration of teacher and student perceptions of blended learning in four secondary mathematics classrooms. *Mathematics Education Research Journal*, 1-22. Retrieved on June 16, 2022 from https://link.springer.com/content/pdf/10.1007/s13394-020-00359-2.pdf

Ayllón, M. F., Gómez, I. A., & Ballesta-Claver, J. (2016). Mathematical thinking and creativity through mathematical problem posing and solving. *Journal of Educational Psychology-Propósitos y Representaciones*, *4*(1), 195-218. Retrieved on May 2, 2022 from https://tinyurl.com/ybo8cjn6

Bakait, M., Masri, R., & Awi, M. (2021). Development of SPARE Method by Integrating the Project-Based Learning and Realistic Mathematics Education for Mathematics Learning. *Review of International Geographical Education Online*, *11*(4), 918-927. Retrieved on May 2, 2022 from https://bit.ly/3cmtSpd

Bernardo, J. (2020). PH ranks last among 58 countries in grade 4 math, science: Study. ABS-CBN News. Retrieved on May 23, 2022 from https://bit.ly/3uQ6dUj

Birchall, R. S. (2018). The Teacher's Role in Students' Math Anxiety. *Learning to Teach*, *7*(1). Retrieved on June 4, 2022 from https://openjournals.utoledo.edu/index.php/learningtoteach/article/view/257

Bringula, R., Reguyal, J. J., Tan, D. D., & Ulfa, S. (2021). Mathematics self-concept and challenges of learners in an online learning environment during COVID-19 pandemic. *Smart Learning Environments*, *8*(1), 1-23. Retrieved on June 10, 2022 from https://link.springer.com/content/pdf/10.1186/s40561-021-00168-5.pdf

Capuno, R., Necesario, R., Etcuban, J. O., Espina, R., Padillo, G., & Manguilimotan, R. (2019). Attitudes, Study Habits, and Academic Performance of Junior High School Students in Mathematics. *International Electronic Journal of Mathematics Education*, *14*(3), 547-561. Retrieved on April 28, 2022 from https://bit.ly/3chEIg7

Chia, H. M., & Lim, C. S. (2020). Characterising the pedagogical practices in mathematics lessons among selected malaysian primary schools. *The Mathematics Enthusiast*, *17*(1), 307-323. Retrieved on May 10, 2022 from https://bit.ly/3IHKXpN

Childs, K. J., & Glenn-White, V. (2018). Posing Purposeful Questions through Making Sense of Mathematical Tasks. *SRATE Journal*, *27*(2), 11-17. Retrieved on May 11, 2022 from https://files.eric.ed.gov/fulltext/EJ1186143.pdf

Cooper, J. L., Sidney, P. G., & Alibali, M. W. (2018). Who benefits from diagrams and illustrations in math problems? Ability and attitudes matter. *Applied Cognitive Psychology*, *32*(1), 24-38. Retrieved on June 4, 2022 from https://onlinelibrary.wiley.com/doi/abs/10.1002/acp.3371

Cranston, L. (2020). EXPLORING STRATEGIES TO SUPPORT PRIMARY STUDENTS'COMMUNICATION OF MATHEMATICAL THINKING–FROM THEORY TO PRACTICE. *Gazette-Ontario Association for Mathematics*, *58*(3), 23-27. Retrieved on May 3, 2022 from https://bit.ly/3aJ43PL

Dagoc, D., & Tan, D. A. (2018). Effects of metacognitive scaffolding on the mathematics performance of grade 6 pupils in a cooperative learning environment. *International Journal of English and Education*, *7*(4), 378-391. Retrieved on June 10, 2022 from http://ijee.org/yahoo_site_admin/assets/docs/31danis.28573226.pdf

Dapp, L. C., & Roebers, C. (2018). Self-concept in kindergarten and first grade children: A longitudinal study on structure, development, and relation to achievement. *Psychology*, *9*(7), 1605-1629. Retrieved on June 16, 2022 from https://boris.unibe.ch/121509/

Dehsheykh, M. N., Hafezi, F., & Bozorgi, Z. D. (2021). The mediating role of mathematics self-concept in the association of self-esteem and classroom environment perceptions with math anxiety in students. *Int J Health Life Sci*, *7*(3), e117368. Retrieved on April 27, 2022 from https://bit.ly/3uUpPqp

DeJarnette, A. F., Wilke, E., & Hord, C. (2020). Categorizing mathematics teachers' questioning: The demands and contributions of teachers' questions. *International Journal of Educational Research*, *104*, 101690. Retrieved on May 3, 2022 from https://www.sciencedirect.com/science/article/abs/pii/S0883035520317961

Delgado-Rebolledo, R., & Zakaryan, D. (2020). Relationships between the knowledge of practices in mathematics and the pedagogical content knowledge of a mathematics lecturer. *International Journal of Science and Mathematics Education*, *18*(3), 567-587. Retrieved on June 16, 2022 from https://link.springer.com/article/10.1007/s10763-019-09977-0

Delima, N., & Cahyawati, D. (2021). Students' mathematics self-concept, mathematics anxiety and mathematics self-regulated learning during the Covid-19 pandemic. *Jurnal Pendidikan Matematika*, *15*(2), 103-114. Retrieved on April 27,2022 https://tinyurl.com/yvc8h8e5

Delima, N., Rahmah, M. A., & Akbar, A. (2018, November). The analysis of students' mathematical thinking based on their mathematics self-concept. In *Journal of Physics: Conference Series* (Vol. 1108, No. 1, p. 012104). IOP Publishing. Retrieved on April 27, 2022 from https://iopscience.iop.org/article/10.1088/1742-6596/1108/1/012104

Dietrich, N., Kentheswaran, K., Ahmadi, A., Teychené, J., Bessière, Y., Alfenore, S., ... & Hébrard, G. (2020). Attempts, successes, and failures of distance learning in the time of COVID-19. *Journal of Chemical Education*, *97*(9), 2448-2457. Retrieved on February 10, 2021 from https://pubs.acs.org/doi/abs/10.1021/acs.jchemed.0c00717

Ebona, J. D. (2020). Key roles of teachers in new normal education. Retrieved on July 2, 2022 from https://bit.ly/3IHLc4b

Erath, K., Ingram, J., Moschkovich, J., & Prediger, S. (2021). Designing and enacting instruction that enhances language for mathematics learning: A review of the state of development and research. *ZDM–Mathematics Education*, *53*(2), 245-262. Retrieved on May 3, 2022 from https://link.springer.com/content/pdf/10.1007/s11858-020-01213-2.pdf

Fernández-Alonso, R., Suárez-Álvarez, J., &Muñiz, J. (2015). Adolescents' homework performance in Mathematics and science: Personal factors and teaching practices. *Journal of Educational Psychology*, *107*(4), 1075. Retrieved on May 2, 2022 from https://tinyurl.com/ybcfoz8v

Fungo-Fulo, A., & Deri, R. A. Lived Experiences of Mathematics Teachers in Modular Distance Learning Modality Amid Pandemic. Retrieved on July 2, 2022 from https://uijrt.com/articles/v3/i4/UIJRTV3I40021.pdf

Gage, N. A., Scott, T., Hirn, R., & MacSuga-Gage, A. S. (2018). The relationship between teachers' implementation of classroom management practices and student behavior in elementary school. *Behavioral disorders*, *43*(2), 302-315. Retrieved on June 3, 2022 from https://journals.sagepub.com/doi/abs/10.1177/0198742917714809

Gallagher, M. A., Parsons, S. A., & Vaughn, M. (2022). Adaptive teaching in mathematics: A review of the literature. *Educational Review*, *74*(2), 298-320. Retrieved on April 22, 2022 from https://www.tandfonline.com/doi/abs/10.1080/00131911.2020.1722065

Gibbs, K., & McKay, L. (2021). Differentiated teaching practices of Australian mainstream classroom teachers: A systematic review and thematic analysis. *International Journal of Educational Research*, *109*, 101799. Retrieved on June 12, 2022 from https://www.sciencedirect.com/science/article/abs/pii/S0883035521000690

Gyöngyösi-Wiersum, E. (2021). Differentiated instruction not only for mathematics teachers. *Teaching Mathematics and Computer Science*, *19*(2), 163-182. Retrieved on April 22, 2022 from doi:http://dx.doi.org/10.5485/TMCS.2021.0526

Hardman, J. (2019). Towards a pedagogical model of teaching with ICTs for mathematics attainment in primary school: A review of studies 2008–2018. *Heliyon*, *5*(5), e01726. Retrieved on May 2, 2022 from https://www.sciencedirect.com/science/article/pii/S2405844019334620

Hayyulbathin, I., Winarni, R., & Murwaningsih, T. (2018). Modification Of Polya's Step To Solve Math Story Problem. *ICRIEMS*, 119-126. Retrieved on May 2, 2022 from https://bit.ly/3PriQNS

Hoogland, K., de Koning, J., Bakker, A., Pepin, B. E., & Gravemeijer, K. (2018). Changing representation in contextual mathematical problems from descriptive to depictive: The effect on students' performance. *Studies in Educational Evaluation*, *58*, 122-131. Retrieved on June 16, 2022 from https://www.sciencedirect.com/science/article/pii/S0191491X17303097

Ince, E. (2018). An Overview of Problem Solving Studies in Physics Education. *Journal of Education and Learning*, *7*(4), 191-200. Retrieved on May 2, 2022 from https://files.eric.ed.gov/fulltext/EJ1179603.pdf

Ingram, J., Sammons, P., & Lindorff, A. (2018). Observing Effective Mathematics Teaching: A Review of the Literature. *Education Development Trust*. Retrieved on May 3, 2022 from https://files.eric.ed.gov/fulltext/ED587049.pdf

Ingram, N., Holmes, M., Linsell, C., Livy, S., McCormick, M., & Sullivan, P. (2020). Exploring an innovative approach to teaching mathematics through the use of challenging tasks: a New Zealand perspective. *Mathematics Education Research Journal*, *32*(3), 497-522. Retrieved on June 10, 2022 from https://link.springer.com/article/10.1007/s13394-019-00266-1

Johnson, K. E., & Golombek, P. R. (2020). Informing and transforming language teacher education pedagogy. *Language Teaching Research*, *24*(1), 116-127. Retrieved on June 16, 2022 from https://journals.sagepub.com/doi/pdf/10.1177/1362168818777539

Kamari, A., Sofologi, M., Bonti, E., Kougioumtzis, G., & Theofilidis, A. (2020). Different Theoretical Perspectives on Specific Learning Difficulties in Mathematics. Implications for Special Educational Intervention and for Everyday School Practice": An overview study. Retrieved on May 2, 2022 from https://bit.ly/3zcw37L

Kaskens, J., Segers, E., Goei, S. L., van Luit, J. E., & Verhoeven, L. (2020). Impact of Children's math self-concept, math self-efficacy, math anxiety, and teacher competencies on math development. *Teaching and Teacher*

*Education*, *94*, 103096. Retrieved on June 12, 2022 from https://www.sciencedirect.com/science/article/abs/pii/S0742051X19320475

Kenedi, A. K., Helsa, Y., Ariani, Y., Zainil, M., & Hendri, S. (2019). Mathematical Connection of Elementary School Students to Solve Mathematical Problems. *Journal on Mathematics Education*, *10*(1), 69-80. Retrieved on June 10, 2022 from https://files.eric.ed.gov/fulltext/EJ1204804.pdf

Kunwar, R. (2020). Mathematics laboratory in school level education in Nepal: An overview. *International Journal of Science and Research (IJSR)*, *9*(9), 327-334. Retrieved on April 30, 2022 from https://tinyurl.com/ycktn5t4

Kurniawan, D. A., & Perdana, R. (2019). Investigation of problem based learning: process of understanding the concepts and independence learning on research statistics subject. *Humanities & Social Sciences Reviews*, *7*(5), 01-11. Retrieved on March 5, 2022 from https://core.ac.uk/download/pdf/268004545.pdf

Kusumaningsih, W., & Herman, T. (2018). Improvement Algebraic Thinking Ability Using Multiple Representation Strategy on Realistic Mathematics Education. *Journal on Mathematics Education*, *9*(2), 281-290. Retrieved on June 12, 2022 from https://files.eric.ed.gov/fulltext/EJ1194323.pdf

Lamar, M. R., Clemens, E., & Dunbar, A. S. (2019). Promoting Doctoral Student Researcher Development through Positive Research Training Environments Using Self-Concept Theory. *Professional Counselor*, *9*(4), 298-309. Retrieved on June 16, 2022 from https://files.eric.ed.gov/fulltext/EJ1237595.pdf

Lee, C. I. (2016). An appropriate prompts system based on the Polya method for mathematical problem-solving. *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(3), 893-910. Retrieved on May 2, 2022 from https://bit.ly/3RI6YIU

Lee, C. Y., & Kung, H. Y. (2018). Math self-concept and mathematics achievement: Examining gender variation and reciprocal relations among junior high school students in Taiwan. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(4), 1239-1252. Retrieved on June 3, 2022 from https://bit.ly/3o8z8PT

Litster, K., MacDonald, B., & Shumway, J. F. (2020). Experiencing active mathematics learning: Meeting the expectations for teaching and learning in mathematics classrooms. *The Mathematics Enthusiast*, *17*(2), 615-640. Retrieved on April 29, 2022 from https://scholarworks.umt.edu/tme/vol17/iss2/10/

Marsh, H. W., Parker, P. D., Guo, J., Pekrun, R., & Basarkod, G. (2020). Psychological Comparison Processes and Self–Concept in Relation to Five Distinct Frame–Of–Reference Effects: Pan–Human Cross–Cultural Generalizability over 68 Countries. *European Journal of Personality*, *34*(2), 180-202. Retrieved on June 16, 2022 from https://journals.sagepub.com/doi/abs/10.1002/per.2232

Marsh, H. W., Pekrun, R., & Lüdtke, O. (2022). Directional ordering of self-concept, school grades, and standardized tests over five years: New tripartite models juxtaposing within-and between-person perspectives. *Educational Psychology Review*, 1-48. Retrieved on May 3, 2022 from https://link.springer.com/article/10.1007/s10648-022-09662-9

Maulyda, M. A., Hidayati, V. R., Rosyidah, A. N. K., & Nurmawanti, I. (2019). Problem-solving ability of primary school teachers based on Polya's method in Mataram City. *Pythagoras*, *14*(2), 139-149. Retrieved on June 16, 2022 from https://bit.ly/3o97MJt

Mazana, Y. M., Suero Montero, C., & Olifage, C. R. (2019). Investigating students' attitude towards learning mathematics. Retrieved on June 3, 2022 from https://erepo.uef.fi/handle/123456789/7398

McFeetors, P. J., & McGarvey, L. M. (2019). Public perceptions of the basic skills crisis. *Canadian Journal of Science, Mathematics and Technology Education*, *19*(1), 21-34. Retrieved on November 8, 2021 from https://scihub.yncjkj.com/10.1007/s42330-018-0016-1

Meniano, K. R. C., & Tan, R. G. (2022). Challenges in Studying Mathematics Using Self-Learning Module During COVID-19 Pandemic. *American Journal of Educational Research*, *10*(4), 182-187. Retrieved on July 2, 2022 from https://bit.ly/3OdidX0

Mosimege, M., & Winnaar, L. (2021). TEACHERS' INSTRUCTIONAL STRATEGIES AND THEIR IMPACT ON LEARNER PERFORMANCE IN GRADE 9 MATHEMATICS: FINDINGS FROM TIMSS 2015 IN SOUTH AFRICA. *Perspectives in Education*, *39*(2), 324-338. Retrieved on May 2, 2022 from doi:http://dx.doi.org/10.18820/2519593X/pie.v39.i2.22

Mutekwe, E. (2018). Using a Vygotskian sociocultural approach to pedagogy: Insights from some teachers in South Africa. *Journal of Education (University of KwaZulu-Natal)*, (71), 58-72. Retrieved on May 4, 2022 from https://bit.ly/3RQA894

Nahdi, D. S., & Jatisunda, M. G. (2020). Conceptual understanding and procedural knowledge: A case study on learning mathematics of fractional material in elementary school. *Journal of Physics: Conference Series, 1477*(4). Retrieved on March 10, 2022 from doi:http://dx.doi.org/10.1088/1742-6596/1477/4/042037

Nickel, K. (2021). Math Fact Fluency Instruction. Retrieved on April 29, 2022 from https://nwcommons.nwciowa.edu/education_masters/290/

Olaniyan, A. O., & Govender, N. (2018). Effectiveness of polya problem-solving and target-task collaborative learning approaches in electricity amongst high school physics students. *Journal of Baltic Science Education*, *17*(5), 765. Retrieved on June 16, 2022 from https://bit.ly/3PsSzOQ

Orozco-Guzmán, M., Villanueva-Cantillo, J., Acuña, F. M., Castro, S. O., & Malo, E. S. (2020, March). Factors that promote positive attitudes towards mathematics in higher education students. In *Journal of Physics: Conference Series* (Vol. 1514, No. 1, p. 012027). IOP Publishing. Retrieved on April 30, 2022 from https://iopscience.iop.org/article/10.1088/1742-6596/1514/1/012027/meta

Pesu, L., Aunola, K., Viljaranta, J., Hirvonen, R., & Kiuru, N. (2018). The role of mothers' beliefs in students' self-concept of ability development. *Learning and Individual Differences*, *65*, 230-240. Retrieved on June 3, 2022 from https://www.sciencedirect.com/science/article/abs/pii/S1041608018300864

Peteros, E., Gamboa, A., Etcuban, J. O., Dinauanao, A., Sitoy, R., & Arcadio, R. (2019). Factors affecting mathematics performance of junior high school students. *International Electronic Journal of Mathematics Education*, *15*(1), em0556. Retrieved on April 28, 2022 from https://bit.ly/3PC5iyL

Phuntsho, U., & Dema, Y. (2019). Examining the Effects of Using Polya’s Problem-solving Model on Mathematical Academic Achievement and Analyzing Ability of the Fourth Grade Students. *Asian Journal of Education and Social Studies*, *5*(2), 1-8. Rertrieved on May 4, 2022 from https://tinyurl.com/3jseydxx

Pohan, A. M., Asmin, A., &Menanti, A. (2020). The effect of problem based learning and learning motivation of Mathematical problem solving skills of class 5 students at SDN 0407 Mondang. *Budapest International Research and Critics in Linguistics and Education (BirLE) Journal*, *3*(1), 531-539. Retrieved on March 5,2022 from https://bit.ly/3yMm7QT

Posamentier, A. S., & Smith, B. (2020). *Teaching Secondary School Mathematics: Techniques and Enrichment*. Retrieved on June 3, 2022 from https://www.worldscientific.com/doi/epdf/10.1142/9789811211423_0001

Prihantini, P., Rostika, D., & Hidayah, N. (2021, July). Solve the problem of learning fractions in mathematics trough scaffolding. In *Journal of Physics: Conference Series* (Vol. 1987, No. 1, p. 012027). IOP Publishing. Retrieved on June 10, 2022 from https://iopscience.iop.org/article/10.1088/1742-6596/1987/1/012027/meta

Punzalan, E. M. D., &Buenaflor, R. F. Modeling the relationship between the basic computational and problem-solving skills of Fourth-Year high school students in the Division of Zambales, Philippines. Retrieved on November 8, 2021 from http://www.ijern.com/journal/2017/January-2017/15.pdf

Puspitawati, R. P., Yuanita, L., Rahayu, Y. S., Indana, S., & Susiyawati, E. (2018). Two problem solving cycles to achieve learning outcomes of thinking skills and plant anatomy concept mastery. *Jurnal Pendidikan IPA Indonesia*, *7*(3), 312-321. Retrieved on March 4, 2022 from https://bit.ly/3uQ6IxF

Robertson, S. I. (2016). *Problem Solving: Perspectives from Cognition and Neuroscience*. Psychology Press. Retrieved on May 2, 2022 from http://tinyurl.com/yb3klzh5

Saiyad, S., Virk, A., Mahajan, R., & Singh, T. (2020). Online teaching in medical training: Establishing good online teaching practices from cumulative experience. *International Journal of Applied and Basic Medical Research*, *10*(3), 149. Retrieved on June 10, 2022 from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7534709/

Santia, I., & Sutawidjadja, A. (2019). Exploring Mathematical Representations in Solving Ill-Structured Problems: The Case of Quadratic Function. *Journal on Mathematics Education*, *10*(3), 365-378. Retrieved on June 4, 2022 from https://eric.ed.gov/?id=EJ1229913

Sari, V. T. A. (2019). STUDENTS'UNDERSTANDING ABILITY IN SOLVING ALGEBRAIC PROBLEMS. *Journal Of Educational Experts (JEE)*, *2*(2), 89-96. Retrieved on November 11, 2021 from https://bit.ly/3P7VxIZ

Schoenfeld, A. H., & Sloane, A. H. (Eds.).(2016). *Mathematical thinking and problem solving*.Routledge. Retrieved on May 2, 2022 from https://bit.ly/33pCUcB

Seeram, E. (2019). An overview of correlational research. *Radiologic technology*, *91*(2), 176-179. Retrieved on December 6, 2021 from http://www.radiologictechnology.org/content/91/2/176.extract

Shabani, K. (2016). Implications of Vygotsky's sociocultural theory for second language (L2) assessment. *Cogent education*, *3*(1), 1242459. Retrieved on May 2, 2022 from https://www.tandfonline.com/doi/full/10.1080/2331186X.2016.1242459

Shanley, L., Biancarosa, G., Clarke, B., & Goode, J. (2019). Relations between mathematics achievement growth and the development of mathematics self-concept in elementary and middle grades. *Contemporary Educational Psychology*, *59*, 101804. Retrieved on April 27, 2022 from https://www.sciencedirect.com/science/article/abs/pii/S0361476X19304096

Siedlecki, S. L. (2020). Understanding descriptive research designs and methods. *Clinical Nurse Specialist*, *34*(1), 8-12. Retrieved on July 16, 2022 from https://bit.ly/3yKKVbV

Simamora, R. E., & Saragih, S. (2019). Improving Students' Mathematical Problem Solving Ability and Self-Efficacy through Guided Discovery Learning in Local Culture Context. *International Electronic Journal of Mathematics Education*, *14*(1), 61-72. Retrieved on June 16, 2022 from https://eric.ed.gov/?id=EJ1227360

Situmorang, A. G., Sipayung, R., & Silaban, P. J. (2020). Hubungan Antara Konsep Diri dengan Hasil Belajar Siswa pada Siswa Sekolah Dasar. *Jurnal Basicedu*, *4*(4), 1358-1362. Retrieved on June 11, 2022 from https://jbasic.org/index.php/basicedu/article/view/547

Son, A. L., & Fatimah, S. (2020). Students' Mathematical Problem-Solving Ability Based on Teaching Models Intervention and Cognitive Style. *Journal on Mathematics Education*, *11*(2), 209-222. Retrieved on June 11, 2022 from https://eric.ed.gov/?id=EJ1252002

Sultra, W. S. R. Y., Usodo, B., & Pramudya, I. (2019, March). Self-Concept of Junior High School Student in Learning Mathematics. In *Proceedings of the International Conference on Mathematical Analysis, Its Applications and Learning 2018* (pp. 44-49). Sanata Dharma University Press. Retrieved on April 22,2022 from https://usd.ac.id/conference/icomaal/proceedings/783-006/

Tan, R. E. (2019). Academic self-concept, learning strategies and problem solving achievement of university students. *European Journal of Education Studies*. Retrieved on June 16, 2022 from https://www.oapub.org/edu/index.php/ejes/article/view/2467

Vanscoy, A. (2019). Conceptual and procedural knowledge: A framework for analyzing point-of-need information literacy instruction. *Communications in Information Literacy*, *13*(2), 164-183,164A. Retrieved on March 10, 2022 from doi:http://dx.doi.org/10.15760/comminfolit.2019.13.2.3

Verschaffel, L., Schukajlow, S., Star, J., & Van Dooren, W. (2020). Word problems in mathematics education: A survey. *ZDM*, *52*(1), 1-16. Retrieved on May 3, 2022 from https://link.springer.com/article/10.1007/s11858-020-01130-4

Vispoel, W. P. (2021). Integrating self-perceptions of music skill into contemporary models of self-concept. *Visions of Research in Music Education*, *16*(5), 33. Retrieved on June 16, 2022 from https://opencommons.uconn.edu/cgi/viewcontent.cgi?article=1789&context=vrme

Wardat, Y., Belbase, S., & Tairab, H. (2022). Mathematics Teachers' Perceptions of Trends in International Mathematics and Science Study (TIMSS)-Related Practices in Abu Dhabi Emirate Schools. *Sustainability*, *14*(9), 5436. Retrieved on May 10, 2022 from https://www.mdpi.com/2071-1050/14/9/5436/htm

Wehrle, K., & Fasbender, U. (2019). Self-concept. *Encyclopedia of Personality and Individual Differences. Springer Nature*. Retrieved on June 11, 2022 from https://bit.ly/3yKIvtR

Whipple, H., 2019. *Equitable Mathematics Teaching Practices Proficiency Scale*. [online] Education.vermont.gov. Retrieved on May 3, 2022 from https://bit.ly/3o6ECKX

Yuanita, P., Zulnaidi, H., & Zakaria, E. (2018). The effectiveness of Realistic Mathematics Education approach: The role of mathematical representation as mediator between mathematical belief and problem solving. *PloS one*, *13*(9), e0204847. Retrieved on May 10, 2022 from https://bit.ly/3clcv8i

Yustiana, Y., Kusmayadi, T. A., & Fitriana, L. (2021, March). The Effect Mathematics Disposition of Vocational High School Students on Mathematical Problem-Solving Ability. In *Journal of Physics: Conference Series* (Vol. 1808, No. 1, p. 012049). IOP Publishing. Retrieved on June 16, 2022 from https://iopscience.iop.org/article/10.1088/1742-6596/1808/1/012049/meta

Zamnah, L. N. (2021, June). Make questions as a stimulus for students to help them carry out their Polya's step in solving problems. In *Journal of Physics: Conference Series* (Vol. 1918, No. 4, p. 042099). IOP Publishing. Retrieved on May 2, 2022 from https://iopscience.iop.org/article/10.1088/1742-6596/1918/4/042099/meta