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Development of an Instructional Design in Promoting Metacognitive Teaching and Learning in the Department of Education

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Abstract This dissertation study documented the metacognitive strategies used in teaching and learning in Junior High School. It also endeavored to discover the Instructional Leaders' support in utilizing varied approaches and developing an instructional design/framework for promoting metacognition among our Teachers and Leaders. This study used qualitative research with 60 respondents from Malabog National High School in the district of Albay. The study's findings revealed that mathematics teachers used varied metacognitive strategies in teaching and learning in Junior High School. The Instructional leaders utilized different support activities in the metacognitive strategies: classroom observations, extra-curricular activities, training and seminars, and mentoring/coaching. The data input in the study was from observation notes, interview transcripts, and related literature. It is concluded that the process used in teaching and learning provided an overview of how teachers practice metacognitive strategies. The leaders supported implementing various metacognitive learning activities to improve the mode of instruction and transfer of learning to the students. The study proposes the Jigsaw model of the metacognitive approach in secondary mathematics classrooms.

Keywords: *metacognition, metacognitive strategies, metacognitive learning environment, metacognitive knowledge, metacognitive skills, and teaching strategies*

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1. Introduction

Mathematics is emphasized in education systems worldwide, from kindergarten to college, due to its practical applications in daily life, such as grocery shopping and problem-solving.

The Philippines implemented an educational reform called the K to 12 Program in 2013, which aimed to improve the country's education system by providing students with more instructional time in various subjects. The K-12 math curriculum in the Philippines emphasizes critical thinking and problem-solving skills and is tailored to Filipino learners' abilities, processes, beliefs, and attitudes.

Modern classrooms are designed to be flexible and accommodating to technology and different learning styles. To establish a learning environment fit for the 21st century, teachers must think outside traditional classroom settings and implement metacognitive strategies.

The classrooms of today are considerably dissimilar from those of the past. Teachers frequently work alongside students in addition to talking in front of them. Therefore, students only sometimes sit in rows of desks.

Every student has the luxury of having a laptop at many schools, especially private institutions. Ideally, today's learning environments must reflect the flexibility of space, time, people, and technology and welcome the variety of places, ideas, and people that the modern world demands.

However, there is no way to create a learning environment fit for the twenty-first century. Thinking outside the confines of the traditional classroom and the school day will enable teachers to create spaces that encourage learning anytime and anywhere.

Moreover, one way to boost the classroom environment is by practicing metacognitive strategies. Metacognition, or "thinking about thinking" [1], has been a focus of study by researchers and educators in the past forty years and has been proven beneficial in classroom settings regardless of the subject matter taught by teachers. The present research is underpinned by the practice of metacognition set in Mathematics learning environments if teachers practice metacognitive strategies and assessments to cater to the needs of 21st-century learners.

Moreover, the context of the present study identifies the type of learning environment fostered by Mathematics teachers and how the current curriculum supports the promotion of metacognition in classrooms.

The present study revealed how school managers and supervisors implored conscious practice of metacognition among teachers to foster metacognitive teaching in Mathematics education.

This concept of "metacognition" as "thinking about thinking." has gained significant attention from scholars and is supported by a vast body of literature.

Metacognitive skills are essential for active learning, critical thinking, reflective judgment, problem-solving, and decision-making. Those with solid metacognitive abilities are more likely to think critically and make better decisions. [2]

Improved metacognitive abilities also drive individuals to learn and manage their emotions, enabling them to handle challenging situations and conflicts more effectively.

Teachers play a crucial role in developing metacognitive awareness among students. They should receive training on promoting metacognitive skills and administering metacognitive strategies to improve performance significantly.

Teachers are responsible for teaching students metacognitive skills through direct instruction and being role models of the strategy [3]

Teachers can and should play a significant role in fostering discussion on metacognitive awareness. Teachers should be trained in promoting metacognitive skills and how to handle the administration of metacognitive strategies, which can improve performance considerably. It is the responsibility of teachers to teach students skills in metacognition. To become successful, the teacher must provide direct instruction about how the strategies can be used, or the teacher takes the role of a role model of the strategy [4].

Teachers must act as metacognitive role models for their students if they want to promote this skill in them. More openly acknowledging the learning process inherent in teaching would enable them to model the ups and downs of lifelong learning and facilitate the dispositions that ought to be the cornerstone of professional practice.

1. Simplify the language: The text contains complex terms and phrases that need help understanding. Simplifying the language could make the text more accessible to a wider audience. 2. Provide more concrete examples: While the text provides some general information about metacognition and its benefits, including more concrete examples of how teachers can incorporate metacognitive strategies in their classrooms would be helpful. 3. Use headings and subheadings: The text covers much ground, and breaking it up with headings and subheadings could make it easier to read and follow. It also helps readers quickly find information that is relevant to their interests.

Through metacognition, established methods in the classroom can impede the teaching and learning of mathematics. Although metacognitive mathematics training should be prepared, the presented technique should specifically enhance the monitoring and regulation of students' thinking when dealing with mathematical problems [5].

One overlooked topic in school policy and practice is teaching with metacognition.

Therefore, training metacognitive individuals—those who think, act, take a stand, and judge based on reasons—has become a crucial concern in the emergence of autonomous learners.

Literature indicates that teachers' choices regarding planning, classroom arrangement, and daily routines were influenced by a teacher's comprehension of metacognitive methods. As a result, a teacher's knowledge of metacognition may impact how metacognitive practices and interactions are developed in lessons and routines.

According to this study, coordinated efforts to enhance metacognitive methods and classroom discussions will benefit teachers' own practical experience.

Teachers must act as role models and provide instruction on metacognitive strategies to promote metacognition in their students.

In mathematics education, metacognitive training should focus on enhancing students' monitoring and regulation of their thinking when solving math problems. A study in the Philippines identified five main processes involved in using metacognitive skills for problem-solving in mathematics: understanding the problem, planning solution strategies, executing the plan, and checking the process.

Researchers have recognized the importance of incorporating metacognition in education, and teachers need to integrate it into their instruction and assessment. The study aims to identify the metacognitive environment in teaching and learning mathematics and establish leadership and management practices to promote its practice in mathematics education. Mathematics education leaders recognize the need for a relevant and engaging learning environment for students and are championing metacognitive teaching and learning in the Department of Education.

The metacognition study in junior high school mathematics classrooms can benefit educators in several ways. It can help them design instructional practices that promote practical problem-solving skills and deeper learning, identify their students' most effective metacognitive strategies, and contribute a more substantial evidence base for using metacognition in education. These benefits can lead to more targeted and compelling student learning experiences, promoting better educational outcomes.

Hopefully, this attempt would lead one to fully realize the students' strengths and weaknesses in the subject. When these are realized, the researcher expects to offer recommendations to help the students develop their metacognitive skills in Mathematics. Junior High School Mathematics is sequential. Skills and competencies acquired through varied metacognitive strategies are essential for learners to adjust and pass their succeeding subjects easily.

This presupposes that, as much as possible, they should master the skills needed and fully grasp the concepts and principles involved in the primary mathematics subject.

Metacognition is crucial in math. Students can monitor and control their thoughts by journaling and documenting while solving problems. Contrary to common assumptions, mathematics is a topic that requires critical thinking, problem-solving, and creativity. It is not just about memorization and meticulously following methods and algorithms [6]. Problem solvers must know what they are doing and why they are doing it and can control these processes. Problem-solving is working towards a goal for which a solution is only sometimes apparent.

The concept of metacognition has long been a central issue in education. Research has emphasized its significance in the curriculum and the need for teachers to incorporate metacognition in instruction and assessment. The context of the present study identifies the metacognitive environment in teaching and learning Mathematics and establishes leadership and management practices to promote its practice in Mathematics education.

The findings of this study are of utmost importance to the junior high school students, teachers, and school administrators concerned and, for the former to change their habit patterns and for the latter to assist students better, change their teaching plans and metacognitive strategies to help learners to the fullest in attaining their ambitions.

An adequate foundation in mathematics is essential in the *"Development of an Instructional Design In Promoting Metacognitive Teaching and Learning in the Department of Education."*

This study may serve as the basis for school administrators and educators in planning and preparing an instructional framework for promoting metacognition among teachers and leaders.

The research study was performed in two phases, namely, the observation phase and the interview phase. The data were analyzed using codes and themes, and the triangulation of qualitative and quantitative data was carried out to ensure the validity of the results.

Ethical considerations were necessary, and the participants' confidentiality and well-being were guaranteed.

1.1. Framework

In this study, as shown in Figure 1, the theory of metacognition is anchored on the different views of educators, psychologists, researchers, and theorists who made significant contributions to the study of thinking and cognitive processes.

Before introducing "metacognition," theorists such as John Dewey, Lev Vygotsky, and Jean Piaget studied metacognition-related cognitive processes.

They emphasized self-monitoring, self-regulation, and the influence of social interactions on cognitive development. These theories suggest that learners can identify what they understand or do not understand and adjust their beliefs based on what is accurate, and develop a personal ability to understand their environment.

Recent research has proposed a more dynamic view of metacognition, emphasizing metacognitive processes' interactive and situated nature. Most models of metacognition agree that metacognitive strategies are essential for effective learning and problem-solving.

Flavell coined the term metacognition in the seventies of the last century. In his article in 1976, the term metacognition was first used. He recognized that metacognition consisted of both monitoring and regulation aspects of cognition.

Flavell described metacognition as humans' awareness in processing various cognitive learning processes. In a simpler context, metacognition is "thinking about thinking." The concept of metacognition centers on how an individual understands and controls his thinking process; it is when people take charge of their learning.

The two forms of Metacognition were established [3]. First, it is manifested in being knowledgeable about our learning abilities. It is the awareness of how to meet our needs to accomplish learning tasks and cope with different situations. Conversely, the second form of Metacognition involves self–regulatory processes. This includes strategies to solve problems effectively and contemplate one's next move, looking after the effectiveness of our actions, and reflecting on the specific strategy we can use to facilitate learning. The knowledge of cognition and regulation of cognition is what we now know as the forms of Metacognition.

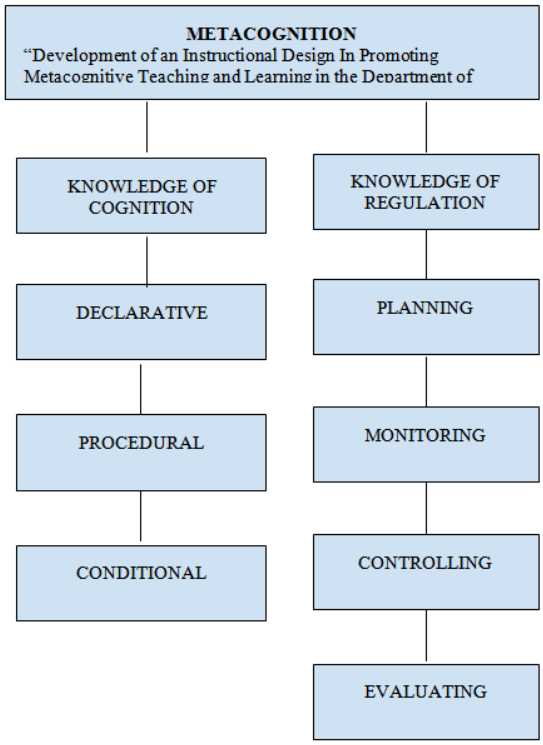

Figure 1. Theoretical Paradigm

Educational systems across the globe provide an extensive effort to transform traditional instructional practices and work beyond the boundaries of the narrow classroom setting. Education researchers worked extremely hard to explore and find new measures to integrate teachers and students in the K-12 spectrum. Vast literature proved that Metacognition is a powerful tool in promoting classroom engagement and empowers students to take charge of their learning.

Promoting Metacognition can be a highly effective practice in improving Mathematics learning environments. The present generation requires not just assessing the metacognitive capacities of students; instead, assessing with Metacognition is more necessary. The metacognitive capacities of students should not be based on self–report instruments and standardized tests; instead, the results of practicing Metacognition should be the basis of the learning progress.

It shows the relationship between the components of Metacognition. This shows that metacognitive integration is maximized with the knowledge of cognition and regulation.

1.2. Conceptual Framework

Researchers have focused on this concept in the past forty years, and while assessing Metacognition is challenging for several reasons, the positive effect on students of its practice was documented.

Reflected in Figure 2, Metacognition is a crucial aspect of mathematics education, allowing learners to develop self-awareness of their thinking processes and control their cognitive strategies. Metacognitive skills in mathematics include planning and monitoring problem-solving, employing problem-solving strategies, and evaluating solutions for accuracy and completeness.

By facilitating the transfer of learning from one problem to another. Metacognitive strategies encourage students to reflect on their own thinking. Understanding the learning process gives students more control over what they learn. It also improves personal self-regulation ability and controls one's learning motivation. Parents and school administration should support learners' metacognition. Parents should supplement students with home activities and encourage students to think metacognitively. The administrators should support students and teachers through programs and policies promoting a metacognitive environment and safe learning.

Moreover, the framework of metacognition should be the basis for teachers improving their metacognitive knowledge and strategies. Given the vast literature supporting the claims of the effectiveness of metacognitive practices, the present study sought to devise a way of monitoring and fostering a metacognitive environment, specifically in Mathematics classrooms.

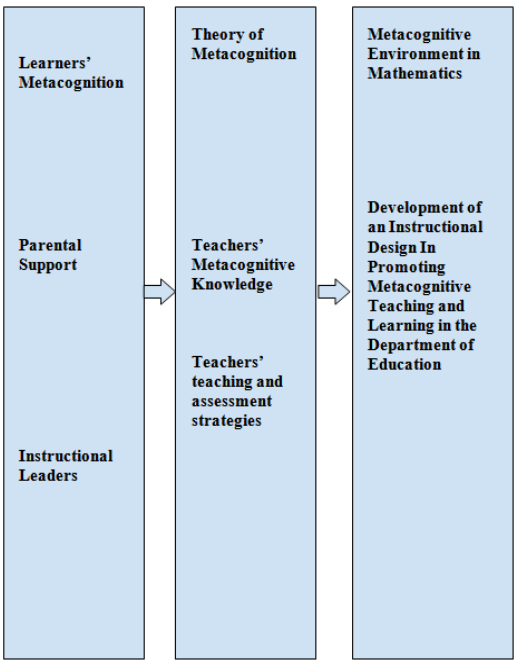

Figure 2. Conceptual Paradigm

More than just assessing students' metacognitive environment is further dictated by the influence of teachers, students, external stakeholders, and administrators, as presented in Figure 2.

Metacognitive strategies encourage students to reflect on their own thinking. Understanding the learning process gives students more control over what they learn. It also improves personal self-regulation ability and controls one's learning motivation. Parents and school administration should support students' Metacognition Metacognition. Parents should supplement students with home activities and encourage students to think metacognitively. The administrators should help students and teachers through programs and policies promoting a metacognitive environment and safe learning. Moreover, the framework of Metacognition Metacognition should be the basis for teachers improving their metacognitive knowledge and strategies. Given the vast literature supporting the claims of the effectiveness of metacognitive practices, the present study sought to devise a way of monitoring and fostering a metacognitive environment, specifically in Mathematics classrooms.

2. Objectives of the Study

This study explored the metacognitive environment in a Mathematics classroom of a junior high school and related the implications of the findings to the leadership and management practices in Mathematics education.

Specifically, this sought to achieve the following objectives:

1. Document the metacognitive strategies used in teaching and learning in Junior High School.
2. Determine the Junior High School Instructional Leaders' sense of support in utilizing the metacognitive strategies.
3. Develop an instructional design/framework for promoting Metacognition Metacognition among our Teachers and Leaders.

3. Materials and Methods

This study adapted the contextual and descriptive research design. The study's primary data sources were junior high school mathematics teachers and their purposefully chosen mathematics classrooms and instructional leaders. The primary sources of data collection for the study were survey questionnaires and a semi-structured interview for data follow-up. Thematic analysis was used to examine the qualitative data obtained through the questionnaire and interview.

4. Results and Discussion

A. METACOGNITIVE STRATEGIES USED IN TEACHING AND LEARNING JUNIOR HIGH SCHOOL MATHEMATICS

Strategy 1. Problem-Solving Strategy 2. Graphic Organizers/Diagrams Strategy 3. Think Aloud Strategy 4. Journal Writing Strategy 5. Note-Taking Strategy 6. Autonomous Learning Strategy 7. Group Work Strategy 8. Self-Evaluation

Student learning styles vary widely, requiring teachers to consider variations in teaching strategies. The present study reveals the varied metacognitive practices utilized by Mathematics teachers in the research and must compare the current and desired state of learning. In this

process, the student can plan, judge, and monitor, which may also involve self–regulation and reflection.

B. JUNIOR HIGH SCHOOL INSTRUCTIONAL LEADERS' SENSE OF SUPPORT IN UTILIZING METACOGNITIVE STRATEGIES

A high-quality educational environment for students and staff is fostered in schools by effective leadership. By acquiring the essential abilities required of school leaders, leaders at all levels in the educational system may help with this. Having a helpful instructional leader can make all the difference for a teacher. Teachers want their instructional leaders' assurance that they have their best interests at heart. An instructional leader's primary responsibility includes offering consistent, collaborative teacher support. The foundation of the connection between a teacher and an instructional leader must be trusted. It takes a long time to establish this kind of relationship. To build these relationships, an instructional leader must gradually get to know each teacher's strengths and flaws.

Through observation, data collection, and coaching toward better instructional leadership practices, instructional leaders provide direction and instructional supervision to teachers. The table below presents the level of awareness and support of instructional leaders to teachers in fostering a metacognitive learning environment.

The table shows the support activities that exhibit the instructional leaders' sense of support in promoting metacognitive strategies. Through classroom observations, extracurricular activities, training and seminars, and mentoring/coaching, instructional leaders can show support in fostering a metacognitive learning environment.

C. DEVELOPMENT OF INSTRUCTIONAL DESIGN/FRAMEWORK FOR PROMOTING METACOGNITION AMONG OUR TEACHERS AND LEADERS

Figure 3 presents the conceptual framework for developing instructional design/framework for promoting Metacognition among teachers and leaders utilizing the Input-Process-Output (IPO) model. The primary data sources are observation notes and interview transcripts from the participants. The data input in the study is from observation notes, interview transcripts, and related literature.

In research, observation is a data collection method that involves observing individuals and events or taking note of physical traits while they occur.

For the study participants, the observation occurred twice throughout one grading period. The researcher also interviewed the participants to confirm the occurrences during the observations.

Moreover, an interview was conducted with the participants to validate the events that transpired during observation. An interview is a qualitative method that uses questions to gather information. Two or more persons participate in interviews, one of them is the interviewer who asks the questions.

The interviews provided in-depth discussion with the participants in their classroom practices and a sense of support with the metacognitive practices.

In addition, the related literature and studies may provide secondary data to validate the study's findings. Screening and analyzing related literature and data gathering involves the second key stage of the IPO model. The related literature and studies are evaluated through selection criteria based on their relevance to metacognition and metacognitive practices.

Table 3. Instructional Leaders' Sense of Support in Utilizing Metacognitive Strategies

Support Activities	Instructional Leaders' Sense of Support In Utilizing Metacognitive Strategies
Classroom Observation	Instructional Leaders' conduct quarterly classroom observations for feedback and assessment of the needs of teachers and the classroom.
Extra-Curricular Activities	Instructional leaders support extra-curricular activities that foster metacognition and promote other attributes needed for students' and teachers' improvement.
Training and Seminars trainings	Teachers are supported to attend and seminars to improve pedagogy and acquire new strategies for teaching.
Mentoring/Coaching	Instructional land provide mentoring leaders are aware of the metacognitive strategies teachers practice and provide mentoring and coaching to continue the best practices in classrooms and areas that needs improvement.

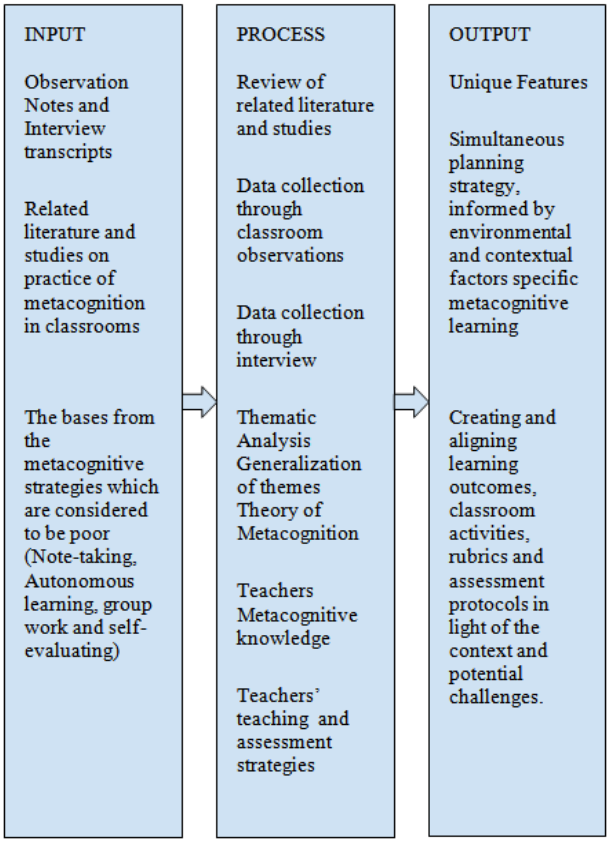

Figure 3. Development of instructional design/framework for promoting Metacognition among our Teachers and Leaders

Moreover, the data collection process through observations and interviews plays a significant role. Themes are generated based on observation notes and interview transcripts.

Finally, the output of the study is an instructional framework for promoting metacognition among teachers and leaders. One of the framework's key features is simultaneous planning strategies informed by environmental and contextual factors specific to metacognitive learning. In addition, creating and aligning learning outcomes, classroom activities, rubrics, and assessment protocols considering the context and potential challenges will be another key feature of the framework. The study proposes the Jigsaw model of metacognitive practice in secondary mathematics classrooms. Teachers' and leaders' metacognitive awareness must be considered. Teachers' metacognition knowledge has become crucial in developing an efficient learning environment where metacognitive practices are evident in instruction and assessment. Almost every facet of problem-solving is supported by metacognition. When students are given opportunities to monitor and manage their thoughts while problem-solving, they not only improve their metacognitive skills but may also solve the problem more successfully. Note that problem-solving is one of the keys to conceptual understanding of topics in mathematics.

The present study revealed the experiences and scenarios of an example of a learning environment that fosters metacognition. Teachers and the school support system composed of instructional and school leaders provide a strong foundation for promoting metacognitive practice. Given these, the present study designed a contextualized model of metacognition built under the evidence of metacognitive practice and the stakeholders' awareness of its importance and impact on students.

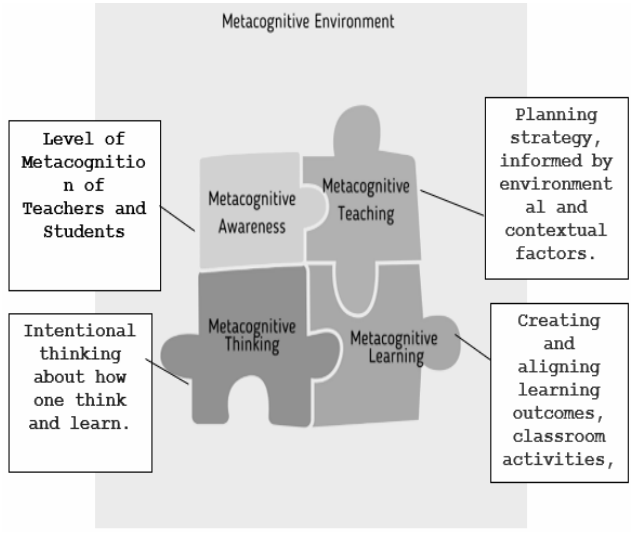

Figure 4. Jiqsaw Model of Metacognition

In a jigsaw strategy, a group becomes "experts" on a specific text or body of knowledge and then shares that material with another group. This strategy offers a way to help others understand and retain information while they develop their collaboration skills. Similarly, in the context of this study, if a teacher has strong *metacognitive awareness*, *metacognitive teaching* will be consciously practiced. *Metacognitive awareness* is the ability to recognize and regulate one's own thinking in real time. *Teachers with higher* levels of *metacognitive awareness have* improved learning capability and the ability to translate learning from professional perspectives, while teachers that lack an awareness of their own cognitive abilities will have difficulty adapting to the constantly evolving educational environment. A teacher's metacognitive awareness translates into practices in classroom teaching. Yet, teaching with metacognition is one of the most underserved areas in school policy and practice.

As a result, training metacognitive folks has become a critical concern in forming independent learners; those who think, act, take a stand and make decisions based on reasoning. Teachers must receive support through training and continuous professional development to foster metacognitive practices.

The teacher's metacognitive awareness and metacognitive teaching will resonate in creating a metacognitive environment for students. A metacognitive climate **is a "classroom culture grounded in metacognition"** where students are metacognitively for the **overarching learning experiences expected in specific contexts.**

Consequently, a metacognitive environment fosters metacognitive learning. Metacognitive learning involves

- allowing learners to know themselves as a learner,
- letting them know their strengths and weaknesses, and
- promoting metacognitive solid thinking amongst students.

Metacognitive knowledge allows one to investigate how a learner processes thoughts and feelings. This helps students identify how they study best. It also assists students in developing self-awareness abilities, which are vital as they age.

When students are trained to process their own learning, such that metacognitive knowledge is manifested, students' metacognitive thinking is fostered. Students who think metacognitively can recognize their cognitive talents, direct their learning, evaluate their performance, understand what caused their triumphs or failures, and learn new tactics. It can also assist kids in learning how to modify. This is because it improves their basic cognitive processes, such as memory, attention, prior knowledge activation, and the ability to solve or complete a task. It allows students to learn more swiftly and effectively, allowing them to make more progress.

The Jigsaw model of metacognition will be most effective when teachers know that they play an essential role in shaping their students' learning environment. Ultimately, the instructional and school leaders' role plays a significant factor in helping shape and foster a metacognitive climate.

5. Conclusions

The results concluded that the mathematics teachers used varied metacognitive strategies in teaching and learning in Junior High School, including problem-solving, graphic organizers/ diagrams, think-aloud, journal writing, note-taking, autonomous learning, group work, and

self-evaluation. The most frequently used assessment strategies were problem-solving, thinking aloud, graphic organizers, and journal writing. It is concluded that the least commonly used Strategies were note-taking, autonomous learning, group work, and self-evaluation. In addition, the documented metacognitive strategies used in teaching and learning provided an overview of how teachers in Junior High School practice metacognitive strategy.

The research study revealed that the Junior High School Instructional Leaders' sense of support in utilizing the metacognitive strategies were classroom observations, extra-curricular activities, training and seminars, and mentoring/coaching. It is concluded that the school leaders support implementing various metacognitive learning activities to improve the mode of instruction and transfer of learning to the students. The related literature and studies were evaluated through selection criteria based on their relevance to metacognition and metacognitive practices. Moreover, the data collection process through observations and interviews played a significant role. Themes were generated based on observation notes and interview transcripts.

From the result, the Jigsaw model of metacognition will be the most effective framework when teachers know that they play an essential role in shaping their students' learning environment. Ultimately the role of the instructional and school leaders plays a significant factor in helping shape and foster a metacognitive climate.

6. Recommendations

Based on the findings of this study, the following recommendations are forwarded:

1. Encourage teachers to consciously practice and utilize metacognitive strategies in teaching mathematics.
2. Strengthen the sense of support of instructional leaders to the conscious practice of metacognitive strategies and foster a metacognitive environment in teaching mathematics.
3. Regarding the output of the study, it is recommended that simultaneously planning strategies are informed by environment and contextual factors specific to metacognitive learning. In addition, creating and aligning learning outcomes, classroom activities, rubrics, and assessment protocols considering the context and potential challenges will be another key feature of the framework. The study proposes the Jigsaw model of metacognitive practice in secondary mathematics classrooms.

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