

The Use of Metacognitive Driven Inquiry- Based Learning Approach and Its Effect on Learning Autonomy and Students' Performance

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Abstract— The purpose of this study was to explore how extensively Grade 7 Science teachers implemented the Metacognitive-Driven Inquiry-Based Learning (MD-IBL) method in their classrooms. Additionally, it aimed to evaluate students' performance in science, focusing on their written and reflective work. Moreover, the study sought to investigate the significant relationship between the teachers' application of the MD-IBL approach and the degree of learning independence demonstrated by Grade 7 students. On the other hand, the descriptive method of research was utilized in this study. A questionnaire was formulated and given to sixty-four (64) respondents, who were selected purposively as the Grade 7 students of Caidal National High School. The researcher-made questionnaire is composed of 3 parts: The extent of Grade 7 Science Teacher use of Metacognitive Driven Inquiry-Based Learning Approach, Level of Learning Autonomy of Grade 7 students, and the students' performance in Science. The findings revealed that the level of Metacognitive-Driven Inquiry-Based Learning (MDIBL) was high in terms of guided inquiry, scaffolding, feedback, metacognitive strategies, self-assessment, strategy reflection, enhanced learning outcomes, deeper understanding, improved problem-solving, independence, self-directed learning, and adaptability. Teachers actively used these techniques to support students in developing scientific understanding, and students showed strong engagement in these areas. However, there is potential to further enhance metacognitive techniques to better regulate students' learning. The level of students' learning engagement was high across cognitive, behavioral, social, and emotional dimensions, with students actively participating in discussions, completing tasks, collaborating, and finding meaning in their learning. However, some students still showed moderate confidence in inquiry and questioning, signifying the need for strategies to encourage more open expression. The level of students' metacognitive awareness was high in terms of planning, monitoring, evaluating, and regulating learning. Students are actively engaged in these processes, but there is room to strengthen self-regulation practices for greater independent learning. The relationship between the MDIBL approach and students' learning autonomy was found to be weak, with little to no statistical significance. This suggests that other factors, such as intrinsic motivation, prior knowledge, and classroom environment, may have a greater influence on learning autonomy than the instructional approach alone. The effect of the MDIBL approach on students' performance was significant in terms of written tasks but not in reflective outputs. While the approach improved performance on written tasks, it did not significantly influence reflective thinking, indicating the need for additional strategies to promote deeper reflection. The study of Metacognitive-Driven Inquiry-Based Learning (MDIBL) underscores its strengths and areas needing enhancement. To boost MDIBL's effectiveness, educators should broaden their teaching methods by incorporating diverse techniques

that encourage self-regulation, such as think-aloud strategies. Moreover, utilizing technology can provide personalized feedback, aiding metacognitive growth. Fostering a classroom atmosphere that promotes open expression and values every student's input can help address moderate confidence in inquiry and questioning. Lastly, encouraging reflective thinking through journals and structured reflection sessions can deepen comprehension and improve educational outcomes. Implementing these suggestions can significantly refine the MDIBL approach, ultimately enhancing student engagement and independence.

I. INTRODUCTION

The improvement of students' scientific literacy has become the primary goal of science education (American Association for the Advancement of Science, 1993; Department of Education, 2016).

Metacognition is the consciousness and control of one's cognitive processes in the context of learning, according to Stanton, J. D., et al. (2021). Robust metacognitive abilities significantly influence student learning outcomes and overall performance. Although metacognitive skills can evolve through sustained practice, numerous students find it challenging to actively participate in metacognitive activities. Defines metacognition as the ability to organize, monitor, and alter cognitive processes (Norman, 2016). Metacognition also involves the ability to think about task execution and choose and use the best methods for intercultural communication.

Societal demands have significantly evolved over the years. We must consider our students and the obstacles they may face. To guarantee that our students possess the necessary skills to address future challenges and requirements, it is imperative to implement teaching methods that promote analytical thinking, self-reflection, exploration, collaboration, effective communication, and investigation. Inquiry-based learning (IBL) represents a pedagogical approach that prioritizes the learner, utilizing substantial tasks such as case studies, projects, and investigations to provide context for the educational experience (Avsec & Kocijancic, 2016). Students are anticipated to collaborate in problem-solving, develop analytical skills and assess compromises.

Reeve (2016) defines autonomy support as providing education in a classroom that meets students' autonomy needs and educator-student relationships. Educators' behavior and opinions help detect, nurture, and improve students' intrinsic drive. Reeve (2016) states that promoting autonomy involves

affirming and clarifying the learning process, classroom atmosphere, and teacher-student interaction. Engaging with students' perspectives and delivering varied learning experiences, motivating them, appreciating their opinions, clarifying objectives, and communicating subtly enhance autonomy in decision-making.

Students' academic performance or achievement indicates how well a student, educator, or institution met their educational goals. Continuous assessment or GPA is used to assess (Tadese, Yeshaneh, & Mulu, 2022). Classroom assessment collects and interprets student knowledge and skills (DepEd Order 31, s. 2020). Assessing students' development based on curriculum and teaching provides fairness, precision, and reliability. Effective evaluation methods measure students' capacities and encourage self-directed learning (DepEd Order 8, s. 2015).

In this note, The research conducted analyzed the impacts of metacognitive-driven inquiry-based methods on Grade 7 science performance and answered research questions. It included: The extent of Grade 7 Science Teacher use of Metacognitive Driven Inquiry-Based Learning Approach, students' written and reflective science performance, and the significant relationship between teacher use and student learning autonomy.

1.1 Statement of the Problem

Problem/s which were addressed by the research

The use of a metacognitive-driven inquiry-based learning method and its impact on the reflective practice and learning autonomy of seventh-grade students at Unisan, Quezon, an enhancement program, were examined in this study.

Specifically, this sought to answer the following:

1. To what extent do Grade 7 Science Teachers use Metacognitive Driven Inquiry-Based Learning Approach in terms of:
 - 1.1 Guided Inquiry;
 - 1.1.1 Scaffolding; and
 - 1.1.2. Feedback?
 - 1.2 Metacognitive Strategies in Inquiry:
 - 1.2.1. Self-Assessment; and
 - 1.2.2. Strategy Reflection?
 - 1.3 Enhanced Learning Outcomes:
 - 1.3.1. Deeper Understanding; and
 - 1.3.2. Improved Problem-Solving?
 - 1.4 Fostering Independence:
 - 1.4.1. Self-Directed Learning; and
 - 1.4.2. Adaptability?
2. What is the level of learning autonomy of Grade 7 students in terms of:
 - 2.1 Self-Direction;
 - 2.2 Self-Regulation;
 - 2.3 Motivation; and
 - 2.4 Resource Utilization?
3. What is the students' performance of Grade 7 students in terms of:
 - 3.1 Written Output; and
 - 3.2 Reflective Output?

4. Is there a significant relationship between the Metacognitive Driven Inquiry-Based Learning Approach and the learning autonomy of Grade 7 students?
5. Is there a significant effect on the Learning Approach and the students' performance in Grade 7?

II. METHODOLOGY

Descriptive method of research was utilized in this study. A questionnaire was formulated and given to sixty-four (64) respondents, who were selected purposively as the Grade 7 students of Caigdal National High School. The researcher-made questionnaire is composed of 3 parts: The extent of Grade 7 Science Teacher use of Metacognitive Driven Inquiry-Based Learning Approach, Level of Learning Autonomy of Grade 7 students, and the students' performance in Science.

III. RESULTS AND DISCUSSION

This part presents the different results and discusses the results from treating the data gathered in this study. All specific questions in Chapter 1 under the statement of the problem were answered in this chapter, supported by tables. It presents the data gathered about the significant relationship between the extent to which Grade 7 Science Teachers use Metacognitive Driven Inquiry-Based Learning Approach and the Learning autonomy of Grade 7 students. In particular, the study sought to address the following:

Extent do Grade 7 Science Teachers use Metacognitive Driven Inquiry-Based Learning Approach

This research examines the "Metacognitive Driven Inquiry-Based Learning Approach" (MD-IBL), utilizing guided inquiry and metacognition to enhance learning and foster student independence. MD-IBL consists of four essential components: Guided Inquiry, Metacognitive Strategies in Inquiry, Improved Learning Outcomes, and Independence. Guided Inquiry presents students with research topics, allowing them to select and apply their methods, fostering critical thinking and problem-solving abilities. Metacognitive strategies enable students to contemplate their thinking processes, create learning tasks, track understanding, and evaluate their advancement, fostering self-regulation. Exploration and self-awareness enhance learning outcomes and understanding. Promotion of Independence highlights self-directed learners capable of managing their educational paths.

This research investigates the extent to which seventh-grade science educators implement MD-IBL. Participants filled out a standardized survey containing statements regarding each aspect of the MD-IBL strategy. Mean scores and standard deviations were used to quantify the results for each statement. These statistical measures highlight the variability in educator implementation and practices. Implementation levels were classified using verbal descriptors: "Strongly Agree," "Agree," "Moderate Agree," "Disagree," and "Strongly Disagree." The tabular data offers a clear evaluation of MD-IBL implementation in seventh-grade science classes.

TABLE 1. Extent of Grade 7 Teacher use Metacognitive Driven Inquiry-Based Learning Approach in terms of Guided Inquiry as to Scaffolding

Statements	Mean	SD	Remarks
SCAFFOLDING			
I believe that my teacher's use of guided inquiry through scaffolding has effectively supported my engagement and critical thinking in science lessons.	4.64	0.48	Strongly Agree
I believe that my teacher's implementation of guided inquiry with scaffolding has encouraged me to reflect on and actively monitor my understanding and learning process during science activities..	4.64	0.48	Strongly Agree
I believe that my teacher's approach to guided inquiry with scaffolding is easy to implement and adapt within the Grade 7 Science MATATAG curriculum.	4.63	0.49	Strongly Agree
I believe that my teacher's guided inquiry approach allows us, as students, to engage in metacognitive-driven and inquiry-based strategies that enhance our learning experience in the classroom	4.78	0.42	Strongly Agree
I believe that my teacher's guided inquiry through scaffolding has significantly improved our understanding and retention of science concepts as students.	4.56	0.50	Strongly Agree
Weighted Mean	4.65	0.48	

Based on the table above, the grade 7 students' feedback on their experiences with guided inquiry and scaffolding in science classes shows a notably positive view of these teaching methods. The consistently high mean scores, between 4.56 and 4.78, show that students "strongly agree" on the effectiveness of their teacher's guided inquiry and scaffolding techniques. The weighted mean of 4.65 and a standard deviation of 0.48 indicate strong consensus among students and little variation in their responses.

The results indicate that guided inquiry and scaffolding have notably improved student engagement, critical thinking, and metacognitive skills in science education. Students indicated that these methods enhanced their grasp and memory of scientific concepts while promoting active engagement in their learning processes. These strategies align well with the Grade 7 Science MATATAG curriculum, highlighting their adaptability and effectiveness in the classroom.

Student feedback emphasizes the value of using guided inquiry and scaffolding in science teaching to enhance learning and encourage student independence. Creating an environment that encourages students to reflect, question, and actively engage with the material can improve the learning experience and outcomes in science education.

According to Chen's (2020) study, digital materials are utilized as scaffolding to enhance English as a Foreign Language (EFL) acquisition in an autonomous setting. This study identified incremental shifts in students' perceptions and utilization of digital resources as support for their EFL learning, characterized by a recursive rather than a linear process. The participants' comprehension was enhanced by the utilization of additional digital resources to facilitate their language development. Their autonomy was also enhanced in this process.

TABLE 2. Extent of Grade 7 Teacher use Metacognitive Driven Inquiry-Based Learning Approach in terms of Guided Inquiry as to Feedback

Statements	Mean	SD	Remarks
FEEDBACK			
I believe that my teacher's use of guided inquiry through feedback helps us, as students, to redirect our learning and create a more engaging learning environment.	4.64	0.48	Strongly Agree
I believe that my teacher's guided inquiry with feedback helps us, as students, to adjust our learning and foster a more interest in engaging ourselves in science experiments.	4.69	0.47	Strongly Agree
I believe that my teacher's use of guided inquiry with feedback in inquiry-based learning assists us, as students, in developing stronger problem-solving skills.	4.66	0.48	Strongly Agree
I believe that my teacher's guided inquiry with feedback effectively promotes students' reflection on their own thinking processes during science activities.	4.77	0.43	Strongly Agree
I believe that my teacher's guided inquiry with feedback helps us, as students, refine our scientific understanding and enhances our engagement in class.	4.67	0.47	Strongly Agree
Weighted Mean	4.68	0.47	

Table 2 shows a significant level of the Metacognitive-Driven Inquiry-Based Learning Approach regarding Feedback, with a grand mean of $M = 4.68$ and $SD = 0.47$. This indicates that teachers successfully incorporate feedback during guided inquiry to aid student learning, boost engagement, and foster a deeper grasp of scientific concepts.

Teachers widely agree that feedback serves to correct misconceptions and encourages students to reflect on their thinking, promoting metacognitive awareness. Guided inquiry allows feedback to assist students in modifying their learning strategies, enhancing their scientific reasoning, and developing better problem-solving skills, leading to a more engaging and student-focused science classroom.

This suggests that regularly utilizing feedback in a metacognitive inquiry framework can greatly enhance student engagement, critical thinking, and independent learning. It fosters a thoughtful, question-driven classroom environment that promotes academic growth and the development of skills for lifelong learning.

A study conducted by Kim (2014) focused on the implementation of effective feedback practices to facilitate self-directed learning. To facilitate students' self-directed learning skills during the early stages of their reflective journal writing process, the findings demonstrated that the utilization of explicit assessment criteria on reflective practice and varied ongoing feedback mechanisms was crucial.

The results shown in Table 3 indicate that the Metacognitive-Driven Inquiry-Based Learning Approach is very effective in terms of Metacognitive Strategies in Inquiry, notably in Self-Assessment. The grand mean of the approach is 4.62, and the standard deviation is 0.49. It appears from this that teachers can successfully incorporate self-assessment strategies into inquiry-based learning to enhance the students' capacity for reflective thinking and metacognitive development.

There is a prevailing consensus among educators that self-assessment is a useful instrument for motivating pupils to analyze and contemplate their understanding of scientific

subjects. It is also clear to students that self-assessment provides them with the resources and suggestions necessary to evaluate their inquiry processes and identify areas in which they could improve. This approach not only helps students develop a more profound understanding of scientific methods and procedures, but it also enhances their ability to establish objectives and monitor their progress throughout their scientific investigations.

TABLE 3. Level of Grade 7 Teacher use Metacognitive Driven Inquiry-Based Learning Approach in terms of Metacognitive Strategies in Inquiry as to Self-Assessment

Statements	Mean	SD	Remarks
SELF-ASSESSMENT			
I believe that my teacher's use of metacognitive strategies in inquiry through self-assessment consistently motivates us, as students, to evaluate and reflect on our understanding of scientific concepts.	4.59	0.50	Strongly Agree
I believe that my teacher's metacognitive strategies in inquiry through self-assessment provide us, as students, with tools or prompts that help us evaluate our inquiry process and identify areas where we can improve.	4.50	0.50	Strongly Agree
I believe that my teacher's metacognitive strategies in inquiry through self-assessment help us, as Grade 7 students, develop a deeper understanding of scientific processes and methods.	4.64	0.48	Strongly Agree
I believe that my teacher's metacognitive strategies in inquiry through self-assessment help us, as students, improve our metacognitive skills during science inquiry activities.	4.66	0.48	Strongly Agree
I believe that my teacher's metacognitive strategies in inquiry through self-assessment give us, as students, opportunities to set goals and monitor our progress during science investigations.	4.69	0.47	Strongly Agree
Weighted Mean	4.62	0.49	

This indicates that the utilization of metacognitive processes, particularly self-assessment, has the potential to improve students' self-awareness and goal-setting abilities, resulting in a learning experience that is more suited to the individual and reflective. It encourages student autonomy in learning, which in turn improves academic performance and metacognitive skills, which are essential for education that continues throughout one's life.

According to the findings of Ambrose et al. (2014), one of the most important aspects of self-regulated learning is the capacity of students to assess the speed at which they are making progress toward the completion of a task. The students have a more developed capacity to assess their own development throughout the course. Self-assessment is a method that encourages the utilization of metacognition, which is a vital component of learning that is determined by the learner. Specifically, this is the reason why this particular incident took place.

Table 4 illustrates a significant level of the Metacognitive-Driven Inquiry-Based Learning Approach concerning Metacognitive Strategies in Inquiry, particularly in Strategy Reflection, which has a grand mean of $M = 4.66$ and a standard deviation of $SD = 0.47$. This suggests that educators successfully incorporate strategic reflection into inquiry-based

learning, prompting students to participate in critical self-reflection to enhance their comprehension of scientific concepts and inquiry abilities.

TABLE 4. Level of Grade 7 Teacher use Metacognitive Driven Inquiry-Based Learning Approach in terms of Metacognitive Strategies in Inquiry Strategy Reflection

STRATEGY REFLECTION			
I believe that my teacher's metacognitive strategies in inquiry through strategy reflection encourage us, as students, to reflect on our own understanding of scientific concepts after each lesson.	4.75	0.44	Strongly Agree
I believe that my teacher's metacognitive strategies in inquiry through strategy reflection allow us, as students, to benefit from discussing our reflections on strategies to improve our inquiry skills in Science.	4.53	0.50	Strongly Agree
I believe that my teacher's metacognitive strategies in inquiry through strategy reflection regularly encourage us, as students, to reflect on our own understanding and strategies during inquiry-based activities in science.	4.69	0.47	Strongly Agree
I believe that my teacher's metacognitive strategies in inquiry through strategy reflection enhance our understanding of scientific concepts as students.	4.63	0.49	Strongly Agree
I believe that my teacher's metacognitive strategies in inquiry through strategy reflection frequently encourage us, as students, to evaluate our inquiry strategies after completing a science project or experiment.	4.72	0.45	Strongly Agree
Weighted Mean	4.66	0.47	

It is widely acknowledged that educators' implementation of strategy reflection encourages continuous contemplation of learners' grasp of scientific ideas following each class, while also facilitating conversations on enhancing inquiry techniques. Students are regularly motivated to contemplate their learning throughout science activities, which improves their understanding of the material and their capacity to hone their inquiry methods. Assessing strategies post-experiment enhances analytical abilities and cultivates a more introspective and strategic approach to learning.

This suggests that integrating strategic reflection into science education boosts students' metacognitive awareness, enabling them to cultivate the ability to self-evaluate, track their progress, and modify their approaches. This method enhances comprehension while fostering a more engaging, thoughtful, and learner-focused educational atmosphere.

Table 5 shows that the Metacognitive-Driven Inquiry-Based Learning Approach is widely used in terms of Metacognitive Strategies in Inquiry, particularly in Deeper Understanding, with a grand mean of $M = 4.64$, $SD = 0.48$. This means that teachers effectively stress deeper comprehension in their teaching methods, hence improving students' ability to absorb scientific concepts and apply them to real-world situations.

There is widespread agreement that teachers' emphasis on hands-on science activities considerably contributes to students' understanding of scientific topics. Furthermore, students understand that this technique improves their capacity to apply scientific information to real-world problems while also developing critical thinking and analytical skills. The

emphasis on deeper learning also helps students retain material longer and increases their enthusiasm and motivation to pursue science.

TABLE 5. Level of Grade 7 Teacher use Metacognitive Driven Inquiry-Based Learning Approach in terms of Metacognitive Strategies in Inquiry as to Deeper Understanding

Statements	Mean	SD	Remarks
DEEPER UNDERSTANDING			
I believe that my teacher's focus on enhanced learning outcomes through deeper understanding helps us, as students, better grasp scientific concepts when we participate in hands-on science activities.	4.56	0.50	Strongly Agree
I believe that my teacher's emphasis on enhanced learning outcomes through deeper understanding allows us to apply scientific knowledge more effectively to real-world situations, improving our problem-solving skills.	4.64	0.48	Strongly Agree
I believe that my teacher's approach to enhanced learning outcomes through deeper understanding encourages us to develop critical thinking and analytical skills that improve our learning in science.	4.63	0.49	Strongly Agree
I believe that my teacher's strategies for enhanced learning outcomes through deeper understanding help us retain information better and remember it longer than when we learn superficially.	4.67	0.47	Strongly Agree
I believe that my teacher's focus on developing enhanced learning outcomes through deeper understanding makes us more engaged, motivated, and excited about learning science.	4.72	0.45	Strongly Agree
Weighted Mean	4.64	0.48	

This means that focusing on deeper knowledge in science education not only enhances students' problem-solving abilities and long-term retention but also creates a more engaging and inspiring learning environment. This strategy helps students acquire the cognitive skills required for academic achievement while also providing them with the ability to apply scientific information outside of the classroom.

According to Cappetta and Paolino (2014), students who have a deeper comprehension of the material are more likely to be motivated by their internal motivation. When learners have a greater comprehension of the meaning and applicability of what they are learning, they are more likely to take initiative and interact with the subject independently. This indicates that learners are more likely to take initiative. In a concrete sense, this promotes the concept of autonomy.

Table 6 shows that the Metacognitive-Driven Inquiry-Based Learning Approach is widely used in terms of Metacognitive Strategies in Inquiry, particularly Improved Problem-Solving, with a grand mean of $M = 4.63$, $SD = 0.48$. This suggests that teachers might effectively improve learning results by including problem-solving skills in scientific instruction.

Students overwhelmingly agree that this technique improves their understanding of scientific concepts, aids in information retention, and fosters teamwork and communication skills during inquiry-based activities. The highest-rated item ($M = 4.73$) emphasizes how problem-solving activities considerably boost student enthusiasm to

interact with science topics. Furthermore, students believe that engaging in such events gives them more confidence in undertaking scientific inquiries.

TABLE 6. Level of Grade 7 Teacher use Metacognitive Driven Inquiry-Based Learning Approach in terms of Metacognitive Strategies in Inquiry as to Improved Problem Solving

IMPROVED PROBLEM-SOLVING			
I believe that my teacher's focus on enhanced learning outcomes through improved problem-solving helps us, as students, to understand scientific concepts better when we use effective problem-solving strategies.	4.61	0.49	Strongly Agree
I believe that my teacher's emphasis on enhanced learning outcomes through improved problem-solving allows us to retain scientific knowledge more effectively when we participate in problem-solving exercises.	4.64	0.48	Strongly Agree
I believe that my teacher's approach to enhanced learning outcomes through improved problem-solving improves our collaboration and communication skills, helping us solve problems in science more efficiently.	4.59	0.50	Strongly Agree
I believe that my teacher's focus on enhanced learning outcomes through improved problem-solving increases our motivation to learn science when we are encouraged to join problem-solving activities.	4.73	0.45	Strongly Agree
I believe that my teacher's strategies for enhanced learning outcomes through improved problem-solving boost our confidence in conducting scientific inquiries and experiments when we actively engage in problem-solving tasks.	4.58	0.50	Strongly Agree
Weighted Mean	4.63	0.48	

This means that focusing on enhanced problem-solving within a metacognitive framework helps students become more self-sufficient, motivated, and strategic learners. It improves cognitive and interpersonal abilities, resulting in a more dynamic, engaging, and efficient science learning environment.

This research draws an alignment on the findings of research conducted by Baars, Wijnia, and Paas (2017), Emphasizing that exploring the connections among emotional states (specifically, the Positive Affect and Negative Affect Scale), types of motivation (both autonomous and controlled), mental effort, self-regulated learning skills, and the effectiveness in problem-solving when engaging with biology problems in an online learning context that emphasizes self-regulation. The findings from this investigation indicated that negative emotions, incorrect self-evaluations during the posttest, and increased perceptions of mental effort during the posttest were inversely related to problem-solving performance following self-directed learning.

Table 7 shows that the Metacognitive-Driven Inquiry-Based Learning Approach is particularly effective at fostering independence through self-directed learning, with a grand mean of $M = 4.61$ and $SD = 0.49$. This indicates that professors effectively inspire students to take initiative and responsibility for their own learning, hence increasing independence and autonomy in science education.

Students highly believe that their teacher's assistance and supervision encourage students to engage in self-directed activities, identify effective tactics, and gain confidence in

their ability to study independently. The highest-rated item ($M = 4.77$) implies that self-directed learning boosts motivation and passion for science by making it more fascinating and personally meaningful.

TABLE 7. Level of Grade 7 Teacher use Metacognitive Driven Inquiry-Based Learning Approach in terms of Fostering independence as to Self-Directed Learning

Statements	Mean	SD	Remarks
SELF-DIRECTED LEARNING			
I believe that my teacher's approach encourages me to take initiative in my learning by engaging in self-directed activities, which helps me become more independent and responsible for my educational journey.	4.45	0.50	Strongly Agree
I believe that my teacher's guidance helps me identify and use effective learning strategies when working on self-directed learning tasks, enhancing my autonomy and critical thinking skills.	4.56	0.50	Strongly Agree
I believe that my teacher's support in providing opportunities for self-directed learning helps me gain confidence in my ability to learn independently and take charge of my learning experiences.	4.66	0.48	Strongly Agree
I believe that my teacher's use of self-directed learning activities motivates me and makes me more enthusiastic about learning science because they make the subject more interesting and relevant.	4.77	0.43	Strongly Agree
I believe that my teacher's encouragement to set goals and evaluate my own progress helps me reflect on my learning and understand how I can improve and achieve better results	4.63	0.49	Strongly Agree
Weighted Mean	4.61	0.49	

This means that encouraging self-directed learning within a metacognitive framework not only improves students' critical thinking and goal-setting abilities but also fosters a learning environment that promotes lifelong learning, autonomy, and sustained academic success.

Lee and Mori's 2020 study shows how reflective methods as teaching tactics affect pupils' self-directed learning skills in university second language courses. The findings from the survey revealed that reflective practices played a crucial role in predicting SDL competencies. Out of the three reflective practices—collaboration, self-reflection, and peer feedback—collaboration emerged as the most important factor influencing SDL competencies.

Table 8 shows that the Metacognitive-Driven Inquiry-Based Learning Approach is particularly effective in Fostering Independence through Adaptability, with a grand mean of $M = 4.71$ and $SD = 0.45$. This indicates that teachers effectively assist students in developing the flexibility and resilience required to modify their thinking and learning techniques, so encouraging greater independence in science education.

Students firmly believe that their professors' supervision encourages them to adapt to new obstacles, explore alternate problem-solving ways, and take responsibility for their learning. The highest-rated item ($M = 4.75$) emphasizes that adapting to new obstacles with teacher assistance considerably improves students' capacity for self-directed learning and independent inquiry.

This means that building adaptability in a metacognitive learning environment provides students with critical lifelong learning abilities, including resilience, strategic thinking, and autonomy. These abilities are critical for success not only in science but also in navigating an ever-changing academic and real-world environment.

TABLE 8. Level of Grade 7 Teacher use Metacognitive Driven Inquiry-Based Learning Approach in terms of Fostering independence as to Adaptability

Statements	Mean	SD	Remarks
ADAPTABILITY			
I believe that my teacher's guidance helps me adapt my thinking strategies to become more independent and take ownership of my learning.	4.72	0.45	Strongly Agree
I believe that my teacher's use of different teaching methods that fit my learning style helps me grow and become more independent.	4.67	0.47	Strongly Agree
I believe that my teacher's support in adapting to new challenges in science helps me develop skills to engage in self-directed learning, making me more flexible and independent.	4.75	0.44	Strongly Agree
I believe that my teacher's encouragement strengthens my resilience and adaptability when I face challenges in my scientific studies, building my independence and problem-solving abilities.	4.72	0.45	Strongly Agree
I believe that my teacher's guidance in adjusting my problem-solving strategies helps me explore new approaches, which makes me more independent in scientific inquiry	4.70	0.46	Strongly Agree
Weighted Mean	4.71	0.45	

Cerino (2021) emphasizes the significance of a supportive learning environment in promoting independence. A well-structured and encouraging environment helps students develop the self-regulation and problem-solving skills needed for independent learning. This supportive context is essential for promoting metacognitive strategies, as it allows students to practice self-assessment, monitor their progress, and adjust their approaches when necessary.

Level of Learning autonomy of Grade 7 students

In this study, the level of Learning autonomy of Grade 7 students refers to Self-Direction, Self-Regulation, Motivation, and Resource.

The following tables show the statement, mean, and standard deviation, remarks and verbal interpretation from the perspectives of respondents.

TABLE 9. Level of Learning autonomy of Grade 7 students in terms of Self-Direction

My School Head...	Mean	SD	Remarks
I take the initiative to start my own learning projects or study sessions without needing reminders from my teachers.	4.56	0.50	Strongly Agree
I am able to work independently in my science activities without constant supervision	4.69	0.47	Strongly Agree
I seek sources of information and other resources that are relevant to my scientific learning goals	4.67	0.47	Strongly Agree
I take initiative with my learning and search for challenges in science	4.59	0.50	Strongly Agree
I define my personal learning objectives and target deadlines for my science homework.	4.81	0.39	Strongly Agree
Weighted Mean	4.67		
SD	0.47		
Verbal Interpretation	Very High		

As presented in Table 9, there is a very high level of learning autonomy among Grade 7 students in terms of Self-Direction, with a grand mean of $M = 4.67$, $SD = 0.47$. This indicates that students demonstrate strong independence in managing their learning, taking initiative in their studies, and actively engaging in self-directed learning practices.

There is strong agreement that students proactively start their study sessions, work independently on science activities, and seek relevant learning resources to enhance their scientific knowledge. Furthermore, they take responsibility for setting personal learning objectives and deadlines, which strengthens their ability to self-regulate and sustain motivation in learning science.

This implies further that fostering self-direction in learning encourages students to become more responsible, self-motivated, and proactive learners. Developing autonomy in education not only enhances academic performance and critical thinking skills but also prepares students for lifelong learning by equipping them with the ability to independently acquire and apply knowledge in various contexts.

TABLE 10. Level of Learning autonomy of Grade 7 students in terms of Self-Regulation

My School Head...	Mean	SD	Remarks
I effectively manage my time when working on science assignments or projects without needing reminders from my teacher.	4.59	0.50	Strongly Agree
I set specific goals for my learning in science, which helps me stay focused and organized.	4.61	0.49	Strongly Agree
I regularly check my understanding of science concepts to see if I need to review or ask for help.	4.61	0.49	Strongly Agree
I keep trying different approaches instead of giving up when I encounter difficulties in science,	4.61	0.49	Strongly Agree
I take time to reflect on what I have learned in science and how I can improve my study habits.	4.77	0.43	Strongly Agree
Weighted Mean	4.64		
SD	0.48		
Verbal Interpretation			Very High

As presented in Table 10, there is a very high level of learning autonomy among Grade 7 students in terms of Self-Regulation, with a grand mean of $M = 4.64$, $SD = 0.48$. This indicates that students actively regulate their learning by setting goals, managing their time effectively, and employing reflective strategies to improve their academic performance.

There is strong agreement that students effectively manage their time, set specific learning goals, and regularly monitor their understanding of scientific concepts. Additionally, they exhibit perseverance in problem-solving and take the initiative to reflect on their learning experiences, which helps them enhance their study habits and approach challenges with resilience.

This implies further that cultivating self-regulation in learning empowers students to become more independent, disciplined, and proactive in their academic growth. Developing strong self-regulation skills not only improves academic performance and problem-solving abilities but also prepares students for lifelong learning, equipping them with

essential skills for adapting to various learning challenges in and beyond the classroom.

TABLE 11. Level of Learning autonomy of Grade 7 students in terms of Motivation

My School Head...	Mean	SD	Remarks
I am more motivated to learn science when the topics are interesting to me.	4.59	0.50	Strongly Agree
I set personal learning goals in science that motivate me to take more responsibility for my learning.	4.63	0.49	Strongly Agree
I feel more motivated to study science when I have choices in how I learn (e.g., projects, experiments).	4.75	0.44	Strongly Agree
I feel motivated to become more independent in my learning when I achieve success in science tasks.	4.67	0.47	Strongly Agree
I believe I can learn new scientific concepts on my own when I am motivated.	4.61	0.49	Strongly Agree
Weighted Mean	4.65		
SD	0.48		
Verbal Interpretation			Very High

As presented in Table 11, there is a very high level of learning autonomy among Grade 7 students in terms of Motivation, with a grand mean of $M = 4.65$, $SD = 0.48$. This suggests that students demonstrate a strong sense of motivation in their learning, particularly when they find science topics interesting, have autonomy in their learning choices, and experience success in their academic tasks.

There is a strong agreement that students are more engaged in learning science when they have the freedom to choose their learning methods, such as projects and experiments. Additionally, they set personal learning goals that drive them to take responsibility for their academic progress. The belief in their ability to learn new scientific concepts independently also reinforces their intrinsic motivation.

This implies further that fostering student motivation plays a crucial role in enhancing learning autonomy. When students are intrinsically motivated, they become more proactive, engaged, and persistent in their learning journey. Encouraging autonomy in learning through choice, goal-setting, and hands-on experiences can significantly improve their academic performance, critical thinking skills, and overall enthusiasm for science.

Students' motivation plays a critical role in determining their educational success and future outcomes. Despite its central importance, motivation has often been underemphasized in educational practice.

As presented in Table 12, there is a very high level of learning autonomy among Grade 7 students in terms of Resource Utilization, with a grand mean of $M = 4.66$, $SD = 0.54$. This indicates that students actively seek and utilize various learning materials to enhance their understanding of science concepts.

There is strong agreement that students regularly use diverse learning materials, including textbooks, videos, and online resources, to support their studies. They also take the initiative to explore different references, such as library books and educational websites, demonstrating a high level of independence in acquiring knowledge. Additionally, students effectively apply the information they gather from various

sources to complete their science assignments and projects. Notably, the use of technology resources, such as tablets and computers, plays a significant role in fostering independent learning.

TABLE 12. Level of Learning autonomy of Grade 7 students in terms of Resource Utilization

My School Head...	Mean	SD	Remarks
I regularly use various learning materials (like textbooks, videos, and online resources) to help me understand science topics better.	4.66	0.65	Strongly Agree
I like finding and using different resources (like library books or educational websites) to support my learning in science.	4.69	0.56	Strongly Agree
I utilize available resources to learn more independently without needing constant help from my teacher.	4.55	0.53	Strongly Agree
I effectively apply the information I find in various resources to complete my science assignments and projects.	4.56	0.50	Strongly Agree
I use technology resources (like tablets and computers) to learn more independently in my science class.	4.83	0.38	Strongly Agree
Weighted Mean	4.66		
SD	0.54		
Verbal Interpretation	Very High		

In addition, this suggests that one way to dramatically improve students' ability to study on their own initiative is to make available to them a wide variety of learning tools that are easily accessible. They are able to become more self-sufficient, resourceful, and involved in their scientific discovery when they are encouraged to make use of technology and other educational materials. Teachers can encourage students to create habits of lifelong learning and academic success by assisting students in the development of abilities in resource use.

TABLE 13. Level of Grade 7 students' performance in terms of Written Output

Score	Test		Descriptive Equivalent
	F	%	
65 – 80	56	87.50	Outstanding
49 – 64	8	12.50	Very Satisfactory
33 – 48	0	0.00	Satisfactory
17 – 32	0	0.00	Fairly Satisfactory
0 – 16	0	0.00	Did not meet Expectation
Total	64	100	
Weighted Mean	69.40		
SD	4.06		
Verbal Interpretation	Outstanding		

As presented in Table 13, the level of students' performance of Grade 7 students in terms of Written Output is at an outstanding level, with a weighted mean of $M = 69.40$, $SD = 4.06$. The majority of students (87.50%) scored within the Outstanding range (65–80 points), while 12.50% achieved a Very Satisfactory rating (49–64 points). No students fell into the Satisfactory, Fairly Satisfactory, or Did Not Meet Expectation categories.

This indicates that students demonstrate a high level of proficiency in their written outputs, showcasing their ability to effectively communicate scientific concepts, apply critical thinking skills, and present well-structured responses. The

results suggest that instructional strategies, such as metacognitive-driven inquiry-based learning, may have positively contributed to students' ability to organize, analyze, and express their ideas in written form.

Furthermore, maintaining this high level of performance requires continuous support through effective feedback, scaffolding techniques, and opportunities for further skill development. Encouraging students to engage in self-assessment, peer review, and reflective writing exercises may further enhance their scientific writing and reasoning skills, ultimately fostering lifelong learning and academic excellence.

Student performance in the 21st century is defined as the capacity of students to show and use fundamental skills and knowledge needed for professional competence and academic achievement.

TABLE 14. Level of Grade 7 Students Performance in terms of Reflective Output

Score	Output		Descriptive Equivalent
	Before		
	F	%	
58- 72	64	100.00	Outstanding
44 - 57	0	0.00	Very Satisfactory
30 - 43	0	0.00	Satisfactory
15 - 29	0	0.00	Fairly Satisfactory
0 - 14	0	0.00	Did not meet Expectation
Total	100	100	
Weighted Mean	62.80		
SD	2.83		
Verbal Interpretation	Outstanding		

As presented in Table 14, the level of students' performance of Grade 7 students in terms of Reflective Output is at an outstanding level, with a weighted mean of $M = 62.80$, $SD = 2.83$. Notably, 100% of the students scored within the Outstanding range (58–72 points), while no students fell into the Very Satisfactory, Satisfactory, Fairly Satisfactory, or Did Not Meet Expectation categories.

This result suggests that students excel in their ability to engage in reflective thinking, analyze their learning experiences, and express their insights effectively. The use of metacognitive-driven inquiry-based learning may have contributed to this strong performance, allowing students to critically assess their learning processes, articulate their thoughts, and connect scientific concepts to real-world applications.

Furthermore, the consistently high performance implies that students have developed self-awareness and a deeper comprehension of scientific principles through reflection. To sustain this level of achievement, educators may continue to integrate structured reflective exercises, provide guiding questions, and encourage self-evaluation in science learning. This approach can further enhance students' critical thinking, self-regulation, and lifelong learning skills.

Test of Relationship between the extent to which Grade 7 Science Teachers use Metacognitive Driven Inquiry-Based Learning Approach and the Learning Autonomy of Grade 7 students

To test the significant relationship between the extent to which Grade 7 Science Teachers use Metacognitive Driven Inquiry-Based Learning Approach and the Learning autonomy

of Grade 7 students in terms of Self-Directed, Self-Regulation, Motivation, and Resource, they were treated statistically using Real Statistics Data Analysis Tools using the Pearson product-moment correlation coefficient.

TABLE 15. Significant Relationship between the extent to which Grade 7 Science Teachers use Metacognitive Driven Inquiry-Based Learning Approach and the Learning Autonomy of Grade 7 students

Extent do Grade 7 Science Teacher use Metacognitive Driven Inquiry-Based Learning Approach		Learning autonomy of Grade 7 students			
		Self-Directed	Self-Regulation	Motivation	Resource
Guided Inquiry	Pearson	-0.0384	-0.0173	0.1164	0.1565
	Correlation	0.9775	0.5906	0.7394	0.8448
	Significance (2-Tailed)	64	64	64	64
	N				
Analysis		Not Sig	Not Sig	Not Sig	Not Sig
Metacognitive Strategies in Inquiry	Pearson	-0.1671	-0.1352	0.0269	0.0147
	Correlation	0.6301	0.9772	0.8307	0.7511
	Significance (2-Tailed)	64	64	64	64
	N				
Analysis		Not Sig	Not Sig	Not Sig	Not Sig
Enhanced Learning Outcomes	Pearson	-0.2000	-0.1271	0.0242	0.0008
	Correlation	0.6337	1.0000	0.8164	0.7425
	Significance (2-Tailed)	64	64	64	64
	N				
Analysis		Not Sig	Not Sig	Not Sig	Not Sig
Fostering Independence	Pearson	-0.0344	0.0817	0.1749	0.0570
	Correlation	0.9515	0.6098	0.7896	0.9052
	Significance (2-Tailed)	64	64	64	64
	N				
Analysis		Not Sig	Not Sig	Not Sig	Not Sig

Shown in Table 15 is the significant relationship between the extent to which Grade 7 Science teachers use the Metacognitive-Driven Inquiry-Based Learning (MDIBL) Approach and students' learning autonomy. The results include Pearson correlation coefficients, p-values, and sample size (N=64) for each relationship.

The findings indicate that no significant relationship exists between MDIBL and students' learning autonomy in terms of Self-Directed Learning, Self-Regulation, Motivation, and Resource Utilization. All computed correlation values fall within the "Very Weakly Positive" or "Very Weakly Negative" range, suggesting a negligible connection between these variables. The p-values for all correlations exceed 0.05, confirming the lack of statistical significance. While Fostering Independence, Guided Inquiry, and Metacognitive Strategies in Inquiry are essential in promoting student engagement, they do not appear to directly impact students' ability to learn autonomously. Similarly, Enhanced Learning Outcomes shows no significant correlation with any of the measured aspects of learning autonomy, implying that other factors may play a more substantial role in developing independent learning skills.

These results suggest that learning autonomy may be influenced by external factors such as intrinsic motivation, prior knowledge, classroom environment, or parental support, rather than solely by the teacher's instructional approach.

Although MDIBL encourages critical thinking and self-reflection, it may not be the primary driver of independent learning habits among students.

TABLE 16. Significant effect between the extent to which Grade 7 Science Teachers use Metacognitive Driven Inquiry-Based Learning Approach and the Performance of Grade 7 students

a. Dependent Variable: WRITTEN OUTPUT_OVERALL

ANOVA ^a					
Model	Sum of Squares	Df	Mean Square	F	Sig.
1 Regression	169.99	4	42.498	2.8845	0.0300
Residual	869.24	59	14.733		
Total	1039.2	63			

a. Dependent Variable: WRITTEN OUTPUT_OVERALL

b. Predictors: (Constant), GUIDED INQUIRY_OVERALL, METACOGNITIVE STRATEGIES IN INQUIRY_OVERALL, ENHANCED LEARNING OUTCOMES_OVERALL, FOSTERING INDEPENDENCE_OVERALL

Coefficients^a

Model	Standardized Coefficients	t	Sig.
	Std. Error	Beta	
1 (Constant)	12.946	101.36	7.8294 0.0000
GUIDED INQUIRY_OVERALL	2.0298	2.553	1.2578 0.2134
METACOGNITIVE STRATEGIES IN INQUIRY_OVERALL	2.6275	-	6.6224 2.5204 0.0144
ENHANCED LEARNING OUTCOMES_OVERALL	2.0412	-	0.4195 0.2055 0.8379
FOSTERING INDEPENDENCE_OVERALL	2.364	-	2.4066 -1.018 0.3128

b. Dependent Variable: REFLECTIVE OUTPUT_OVERALL

ANOVA^a

Model	Sum of Squares	Df	Mean Square	F	Sig.
1 Regression	19.099	4	4.7748	0.5813	0.6774
Residual	484.65	59	8.2144		
Total	503.75	63			

a. Dependent Variable: REFLECTIVE OUTPUT_OVERALL

b. Predictors: (Constant), GUIDED INQUIRY_OVERALL, METACOGNITIVE STRATEGIES IN INQUIRY_OVERALL, ENHANCED LEARNING OUTCOMES_OVERALL, FOSTERING INDEPENDENCE_OVERALL

Coefficients^a

Model	Unstandardized Coefficients	Std. Error	Standardized Coefficients	t	Sig.
1 (Constant)	92.06	9.6671	72.716	7.522	0.0000
GUIDED INQUIRY OVERALL	4.1614	1.5156	1.1287	0.7447	0.4594
METACOGNITIVE STRATEGIES IN INQUIRY OVERALL	1.885	1.9619	-2.0408	1.0402	0.3025
ENHANCED LEARNING OUTCOMES OVERALL	3.0079	1.5242	-0.0419	0.0275	0.9781
FOSTERING INDEPENDENCE_OVERALL	2.3505	1.7652	-1.1817	0.6694	0.5058

Test of Effect between the extent to which Grade 7 Science Teachers use Metacognitive Driven Inquiry-Based Learning Approach and the performance of Grade 7 students

To test the significant effect of the extent to which Grade 7 Science Teachers use Metacognitive Driven Inquiry-Based Learning Approach and the performance of Grade 7 students in terms of Written Output and Reflective Output, they were treated statistically using Real Statistics Data Analysis Tools using the Regression Analysis.

Shown in Table 16 is the significant effect of the Metacognitive-Driven Inquiry-Based Learning (MDIBL) Approach on the performance of Grade 7 students, as measured through written and reflective outputs. The results include ANOVA values, regression coefficients, and significance values (p-values) for each relationship (N = 64).

The findings indicate that the MDIBL approach plays a role in shaping students' written performance. Specifically, the use of Guided Inquiry, Metacognitive Strategies, Enhanced Learning Outcomes, and Fostering Independence influences students' ability to complete written tasks. However, while metacognitive strategies are designed to support learning, their implementation may require refinement to maximize their effectiveness.

In contrast, the results show that the MDIBL approach does not significantly impact students' reflective output. Despite the incorporation of inquiry-based strategies, students' ability to engage in reflective thinking may depend on other factors such as personal motivation, prior experiences, and classroom environment.

Overall, while the MDIBL approach supports the development of written performance, it does not have a direct impact on reflective outputs. To further enhance student learning, educators may need to adjust metacognitive strategies, encourage deeper reflection, and integrate more student-centered activities that foster both analytical and reflective thinking.

IV. CONCLUSION AND RECOMMENDATIONS

Based on the foregoing findings, the following conclusions were drawn.

The findings indicate that while MDIBL incorporates strategies such as Guided Inquiry, Metacognitive Strategies, and Fostering Independence, these do not significantly influence students' Self-Directed Learning, Self-Regulation, Motivation, or Resource Utilization. This suggests that learning autonomy is shaped by other external factors, such as intrinsic motivation, prior experiences, and classroom environment, rather than the instructional approach alone. These results highlight the need for additional interventions that foster student-driven learning initiatives and strengthen independent learning skills.

The null hypothesis, stating that there is no significant effect of the Metacognitive-Driven Inquiry-Based Learning (MDIBL) Approach on students' performance, is rejected. The study found that MDIBL significantly enhances students' written performance, particularly in structured tasks that involve Guided Inquiry, Metacognitive Strategies, Enhanced Learning Outcomes, and Fostering Independence. However,

its impact on reflective outputs is not significant, suggesting that student reflection is influenced by other factors, such as personal motivation, prior experiences, and classroom dynamics. These findings reinforce the effectiveness of MDIBL in improving written academic performance while also highlighting the need for additional strategies that enhance reflective thinking and deeper analytical engagement.

Based on the drawn conclusions, the following recommendations were proposed:

School administrators should implement continuous professional development programs focused on the Metacognitive-Driven Inquiry-Based Learning (MDIBL) Approach to enhance teachers' ability to foster student engagement, autonomy, and performance.

Teachers should integrate inquiry-based and metacognitive strategies into daily lessons to promote students' critical thinking, self-regulation, and independent learning.

Students should actively engage in self-reflection and inquiry-based activities to develop deeper learning autonomy and improve problem-solving skills.

Future researchers should conduct further studies on the long-term impact of the MDIBL approach across different subjects and grade levels to validate its effectiveness in enhancing student learning outcomes.

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