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Graphic Organizer Materials on Self-Directed Learning Readiness (SDLR) and Content Mastery in Science: A Photovoice Approach

Kimberly Leorito^{1*}, Allan Leorito¹

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ABSTRACT

In today's fast-changing world, education systems globally are shifting toward learner-centered approaches that emphasize autonomy, critical thinking, and lifelong learning. Mastering self-directed learning and science content is crucial for students to keep pace with global scientific developments and actively contribute to solving real-world problems. Studying materials like graphic organizers and photovoice empowers learners to visualize their thinking, reflect on their learning journey, and take ownership of their growth in science. These tools not only enhance understanding of complex scientific concepts but also foster the independent learning skills needed to succeed in modern, dynamic educational environments worldwide. This study examines the Self-Directed Learning Readiness (SDLR) and Science content mastery of Grade 10 students, the effect of using graphic organizers and the Photovoice approach, and teachers' evaluations of the developed learning materials. Using the ADDIE model. Findings disclose that students indicate moderate to high SDLR, excelling in motivation and task management but struggling with seeking help and structured learning. Despite strong SDLR, Pearson correlation analysis implies no significant relationship with Science content mastery, advocating that other elements control academic performance. However, the intervention significantly increased Science mastery, increasing from average mastery to moving towards mastery in post-tests. A statistical analysis proved the use of the intervention. Teachers rated the Photovoice-based materials highly acceptable, particularly for engaging students and promoting critical thinking. Content accuracy and up-to-date information require improvement. Photovoice analysis highlights self-growth, identity, uncertainty, cognitive biases, and truth-seeking, underscoring the importance of self-awareness and critical thinking. This study contributes to instructional material development by creating lesson exemplars using graphic organizers and the Photovoice approach to enhance SDLR and Science mastery.

INTRODUCTION

Learners' independent learning ability is crucial for academic success in the 21st century. Yet, Filipino students continue to struggle, with consistently low Science scores reflecting challenges in self-directed learning and a lack of resources that hinder the development of critical science process skills. In conflict-affected countries, the loss of education hinders sustainable peace and slows recovery, with setbacks exacerbated by low self-learning motivation (Concern Worldwide US, 2023). Globally, the COVID-19 pandemic exposed challenges in education delivery, widening the digital divide, especially in low-income countries, and deepening inequalities (UNESCO, 2020). Political instability, poor infrastructure, and limited resources further restrict effective education, undermining efforts to provide equal opportunities for all learners (UNICEF, 2021).

Taking the context of the Philippines today, significant disruptions such as the COVID-19 outbreak (Lopez, 2020), high heat indexes (Sevillano, 2024), and typhoons (Laqui, 2024) often lead to the suspension of in-person classes to ensure student safety, prompting a shift to asynchronous or alternative learning modalities. The ongoing uncertainty about the future instills fear and apprehension among students, parents, and educators.

This shift in the Philippines has exposed the strengths and challenges of 28.5 million learners (Dizon, 2020). Some adapt well to the flexible format, while others struggle without traditional routines and schedules. This transition highlights the varying levels of preparedness and the need for tailored support to meet diverse learning needs (Isla, 2023). Nonetheless, many Filipino secondary students are not prepared to guide their learning; some struggle to juggle their family obligations with their studies (Luci-Atienza, 2021).

Self-directed learning (SDL) poses challenges even for motivated learners, as it involves setting goals, preparing, evaluating progress, and adjusting strategies, requiring various cognitive and metacognitive skills. Although self-directed learning (SDL) is essential for 21st-century success, students' readiness varies, with high school students increasingly embracing independent learning styles (Shaikh, 2013; Carlson, 2015).

Moreover, it is particularly relevant as Filipino students have consistently performed poorly in international assessments like TIMSS and PISA, especially in Science (Schleicher, 2019). Despite improvement efforts, the Philippines remains low in global science education competitiveness, with proficiency levels stagnating from 2018 to 2022 (Fuente, 2019; PISA, 2022).

¹ Department of Education, Region XII, Division of Sultan Kudarat, Philippines

*Corresponding author's e-mail: kimberly.umadhay@deped.gov.ph

Locally, Antong Integrated school recorded mean percentage scores of Grade 10 learners for school years 2021-2022, 2022-2023, and 1st 2023-2024 of 51.05, 50.55, and 50.31 in science, respectively, significantly below the anticipated 75 percent average for the academic year (School Reports, 2022, 2023 & 2024). Key challenges include students' difficulty learning independently and addressing resource limitations, such as inadequate textbooks and labs, while emphasizing science process skills, which is crucial for fostering scientific literacy (Gultepe, 2016).

Hence, there is a need to develop materials that enhance independent learning and science education. Graphic organizers, for example, have been proven effective for over 25 years in improving long-term information retention (Marlett, 2019). Despite their success in classrooms (Balasundram & Karpudewan, 2020; Bucayong, 2019), their impact on students' self-efficacy and self-directed learning in science remains underexplored.

Research gaps include the effects of graphic organizers on self-directed learning readiness and cognitive mastery, particularly in goal setting, progress evaluation, and strategy adjustment, which warrant further investigation. Additionally, limited studies, both locally and globally, have explored the effectiveness of graphic organizers in enhancing self-directed learning and improving cognitive mastery.

The above information motivates the researcher to study developing graphic organizer materials to improve self-directed learning readiness (SDLR) and content mastery in the science District of Lutayan for School Year 2024-2025.

Statement of the Problem

This study develops a lesson exemplar utilizing the photovoice approach and graphic organizer materials to improve Self-Directed Learning Readiness (SDLR) and content mastery in science in the District of Lutayan. It answered the following questions:

What is the level of Self-Directed Learning Readiness (SDLR) in Science of Grade 10 students in terms of

1. Self-control domain;
2. Self-management domain; and,
3. Desire for learning domain?

What is the level of content mastery in Science of Grade 10 students during pretest and posttest?

Is there a significant relationship between the level of Self-Directed Learning Readiness (SDLR) and content mastery in Science of Grade 10 students?

Is there a significant difference between the level of content mastery during the pretest and post-test in Science of Grade 10 students?

What is the level of evaluation of teachers on the lesson exemplar utilizing the photovoice approach and graphic organizer materials being developed in terms of:

1. content quality of the learning materials;
2. format quality of the learning material;

3. Presentation and organization of the learning material; and,

4. Accuracy and up-to-date information in the learning material?

What photovoice analysis reflects students' ideas?

LITERATURE REVIEW

Concept of Self-Directed Learning

Self-regulated learning (SRL) is a way of learning that helps learners complete predefined learning goals, typically set for a specific course. Like self-directed learning (SDL), SRL involves strategies such as critical thinking, elaboration, and monitoring the learning process. However, SRL and SDL differ because SDL involves more long-term processes, often spanning an entire course, and translates into a broader attitude toward learning (Sandars & Walsh, 2016). SRL focuses on short-term goals related to course-specific learning, while SDL is a long-term process that shapes learners' overall approach to learning (Zimmerman, 2015). According to Schunk and Greene (2017), SRL is more structured and goal-oriented, while SDL is driven by personal motivation and autonomy.

Stone (2016) argues that self-directed learning, driven by students' interests and curiosity, enhances motivation. This strategy allows students to explore and play with ideas, making them active participants in their learning process. Research supports that when students are given the autonomy to direct their learning, it fosters engagement, deeper understanding, and intrinsic motivation (Järvelä & Hadwin, 2015; Reeve, 2015).

Moreover, SDL is one of the innovative learning models based on constructivism, which focuses on student activities in the learning process. Additionally, self-access contexts, which emphasize various types of support like self-access resources and learning strategies, further facilitate student learning and enhance SDL (Yamaguchi *et al.*, 2012). This aligns with the work of Lutz and Ropohl (2017), who argue that integrating environmental resources with self-directed learning fosters deeper engagement and mastery in subjects like biology.

Zimmerman (2015) argues that self-regulated learning is an active, goal-oriented process in which learners employ strategies to plan, monitor, and reflect on their learning. This significantly contributes to academic success. Boekaerts (2016) also highlights the role of self-regulation in learning, noting that learners who can effectively regulate their learning process can better adapt to challenges and achieve greater academic outcomes.

Self-directed learners accept the freedom to learn what they consider important for themselves. Moreover, self-directed learners acquire abilities in time management, stress management, assignment preparation, exam preparation, and note-taking (Khat, 2017). Self-directed learning is necessary for students and workers to remain lifelong learners. In midwifery and nursing, there is an increased need for professional nurses to update their knowledge, become autonomous, think independently,

and make their own assumptions and decisions. Thus, the education literature has increasingly paid attention to self-directed lifelong learning, which is considered a critical educational goal (Steward, 2007).

Self-Directed Learning Readiness Scale (SDLRS)

The Self-Directed Learning Readiness Scale (SDLRC) developed by Fisher *et al.* (2001) was adapted into Turkish by Şahin and Erden (2009). A 52-item scale was used in this study.

The Self-Directed Learning Readiness Scale (SDLRS), developed by Fisher *et al.* (2001) and adapted by Şahin and Erden (2009), evaluates a learner's readiness for self-directed learning through three key domains: self-control, self-management, and desire for learning. In self-control, learners' ability to regulate their emotions and behaviors is crucial for staying focused and persistent toward their goals (Garrison, 1997). The self-management domain refers to the ability to plan, organize, and monitor one's learning process, which Knowles (1975) identifies as essential for learners to take responsibility and manage their educational journey.

The desire for learning domain is centered on intrinsic motivation, where learners' interest and drive to acquire knowledge play a critical role in self-directed learning (Deci & Ryan, 2000). Highly motivated and engaged learners are likelier to take the initiative in their learning and continue pursuing knowledge independently. Together, these domains offer a comprehensive measure of a learner's readiness for self-directed learning, helping educators identify areas for improvement and support in fostering independent learners (Fisher *et al.*, 2001; Şahin & Erden, 2009).

Effects of Self-Directed Learning

Jaleel (2017) stated that the learning experience is better if students learn while they can control their learning or are self-directed learners. Curriculum implementers should have prepared learners, which is difficult to predict, so self-directed learning becomes more essential for 21st-century learners. According to Wang and Tsai (2015), self-directed learning fosters deeper engagement and promotes lifelong learning, allowing students to take ownership of their educational journey, thereby improving their overall learning outcomes.

Kayacan and Ektem's (2014) study proved that self-directed learning significantly affects students' self-directed learning content. Based on the post, the experimental group's level of self-directed proficiency was significantly higher than that of other groups. Similarly, Chen *et al.* (2015) found that students in self-directed learning environments show improved learning outcomes as they are more engaged and take greater responsibility for their academic success.

Fyall (2016) stated that participants varied in their acceptance of others' knowledge claims and use of information for self-directed learning. Self-directed learning enables learners to construct knowledge,

integrate new ideas, and develop deeper understanding. Zimmerman (2015) also emphasized that self-regulated learning involves learners actively constructing meaning and taking responsibility for their learning process.

Turan and Ko (2018) emphasized the importance of individuals being aware of their metacognitive abilities for effective daily learning. Education aims to cultivate individuals who continuously develop their skills and ideas, enhancing their readiness and self-efficacy. Similarly, Schunk (2015) highlighted that metacognitive awareness is essential for learners to regulate their learning process and build confidence in their abilities.

Self-directed learning fosters motivation through interactive learning, critical thinking, and problem-solving, making it an effective strategy for teachers to enhance student motivation in 21st-century education (Mahzan, 2018). Deci and Ryan (2015) noted that self-directed learning aligns with intrinsic motivation, driving learners to engage more deeply with the learning process. Deyo *et al.* (2011) assessed the relationship between readiness for self-directed learning, academic performance, and laboratory course resources. They found that while readiness is linked to self-directed learning habits, it may not be essential for learning foundational knowledge if students are given clear instructions. However, the role of readiness in more complex learning remains unclear. Similarly, Knowles (2015) emphasized that self-directed learning readiness is crucial for advanced learning but may be less critical for basic tasks.

Previous studies, such as that of Tekkol and Demirel (2018), have shown that self-directed learning is linked with upper-level thinking skills such as creativity, problem-solving, and critical thinking. Certain studies have also shown that academic success is closely related to self-directed learning. Self-directed learning significantly and directly impacts students' cognitive presence (Geng *et al.*, 2019).

Aysec *et al.* (2019) highlighted that metacognitive perspectives, awareness, and interpersonal skills are key in design thinking. They also emphasized that embracing risk and uncertainty is vital for advancing creative design behavior. Likewise, Brown *et al.* (2015) suggested that metacognitive skills and managing uncertainty are essential for fostering creativity in design processes.

Tekkol and Demirel (2018) found that while self-directed learning skills did not vary by school, year of study, or income, factors like gender, field of study, academic success, and aspirations for graduate education significantly impacted them. They concluded that self-directed learning skills in undergraduates are closely linked to lifelong learning tendencies. Cakir *et al.* (2019) also found that academic motivation and career goals influenced students' self-directed learning abilities.

Kayacan and Ektem (2019) found that a self-directed learning program improved students' competency and clinical practice satisfaction. Additionally, biology laboratory practices supported by self-regulated learning strategies significantly enhanced students' readiness for

self-directed learning and their attitudes towards science experiments. According to Wang and Tsai (2019) showed that self-regulated learning strategies in laboratory settings positively impacted students' self-directed learning readiness and their engagement with scientific tasks.

Abdullah *et al.* (2019) found that cognitive abilities significantly impact academic performance, especially in science, shaping future career and educational prospects. Zhang *et al.* (2019) highlighted that cognitive skills are key determinants of academic success in science-related fields.

Khodabandehlou *et al.* (2023) confirmed that learners using self-directed learning (SDL) strategies, particularly metacognitive ones, outperformed those with teacher-directed learning. Du (2023) also showed that SDL portfolio projects effectively enhanced language learners' knowledge, metacognitive skills, and motivation. Similarly, Zhang *et al.* (2023) highlighted the positive impact of SDL on students' language learning outcomes.

A recent study found that medical students excelled in most SDL skills but needed improvement in time management and interpersonal communication, particularly in oral presentations. They also struggled to find appropriate learning resources. Students emphasized the need for focus, motivation, stress management, effective time management, and resource-searching abilities for successful SDL. They suggested that events promoting active participation could enhance SDL, especially if held regularly, and that SDL evaluation could motivate students. Students also believed that teachers should act as facilitators, mentors, and evaluators (Bhandari *et al.*, 2020; Smith *et al.*, 2019).

Perception of Students to Self-Directed Learning

Experiential learning can motivate learners by encouraging educational responsibility (Sears, 2016). Students use their experiences to understand and form concepts, becoming lifelong learners. Key conditions for self-directed learning include: the belief that education is the student's responsibility, providing unlimited learning opportunities, the influence of gadget culture (such as computers and mobile games), and the role of adults as facilitators rather than judges, supporting a democratic and age-diverse learning environment (Miller *et al.*, 2019). Self-directed learning can improve students' readiness (Saeid & Eslaminejad, 2016). Many educational institutions assess readiness based on performance, potential, and self-directed learning, making it crucial to understand its role in evaluating learners' preparedness (Williams & Zhang, 2024).

Educators not only diagnose learners' needs but also enhance students' self-efficacy. Kidane *et al.* (2014) found that self-directed learning prepares learners for lifelong learning. Students should move away from teacher-centered approaches, allowing them to choose suitable learning strategies. Learning should focus less on lecture content and exams, as these do not support self-directed learning (Taylor & Brown, 2022)

Du (2013) found that students preferred laboratory self-learning, which enhanced their self-efficacy and contributed to variations in self-directed learning. Harris and Smith (2022) and Zhang and Lee (2022) reported similar findings, highlighting the positive impact of self-directed learning on students' autonomy and motivation.

Self-Directed Learning Environments

Self-directed learning has been shown to improve student achievement, problem-solving, and collaborative skills (Kriner *et al.*, 2015). While much research has focused on adult learning, studies have also explored self-directed learning in K-12 settings (Giannakos *et al.*, 2016). In self-directed learning, responsibility shifts from the teacher to the learner, emphasizing the importance of learner control and active involvement in the process (Boyer & Usinger, 2015). Johnson and Lee (2022) also emphasized the increasing importance of self-directed learning in modern classrooms.

Wang and Zhang (2022) highlighted the need for greater learner involvement to ensure the success of self-directed learning. These findings have been attributed to the increased presence of certain dimensions of Paulsen's model of cooperative freedoms allowed by such instructional design (Yüksel & Geban, 2015).

Science Education in the Philippines

Science in the Philippines has been characterized by tight funding, inadequate scientific infrastructure (Gibson *et al.*, 2018), and limited research capability (Lacanilao, 2013). In a country where survival is a daily struggle (Schelzig, 2005), promoting science as relevant remains challenging. In 2020, 26.5% of the population, including 10 million women, lived below the poverty line (UNDP, 2020).

Science as a career has often been perceived as expensive and unlinked to employment (Navarro & McKinnon, 2020). Similarly, Dela Cruz and Reyes (2024) found that curriculum delivery and teacher development challenges continue to hinder the growth of science education. Garcia and Santos (2024) also identified the need for curriculum reforms to align science education with career opportunities better.

According to Aro (2016), students in the Philippines expressed concerns about the disconnect between classroom teaching and assessment tasks in science. Similarly, Pascua and Dela Cruz (2021) found that Filipino students struggled to apply science concepts to real-life situations, suggesting that the teaching materials and methods used in the classroom may not sufficiently meet the learning needs of the students.

Further, there has been a discrepancy in how science is taught in the classroom and how it is communicated outside the classroom (Navarro & McKinnon, 2020). Science education stresses memorizing facts instead of conceptual understanding. This issue is also reflected in the study by Santiago *et al.* (2024), which highlights how traditional rote learning in the Philippines limits students' ability to apply scientific concepts in real-world

situations. Similarly, Mendoza and Cruz (2024) emphasize that relying on memorization rather than fostering deep understanding hinders students' critical thinking and problem-solving abilities in science education.

Moreover, the assessment or grading procedures have not matched or reflected the student's learning (Bernardo *et al.*, 2008). In fact, in 2003, the DepEd revised the grading procedures used by teachers (Bernardo *et al.*, 2008), allowing students to pass science subjects without thoroughly gaining their curricular goals. In other words, students have been given credit for success for which they did not work.

In this regard, a critical range is adolescence, when students' aspirations concerning science are formed (DeWitt & Archer, 2015), while learners at this age often lack motivation (Archer *et al.*, 2017). As a contradiction, complex science learning, especially hands-on, is impossible without the individual motivation to contribute to determining the problem to solve factual knowledge and finding resources to use (by prior learning skills) while constantly adjusting one's attention (Francom, 2010).

High-quality science education inspires creativity and guides students toward science careers (Kaptan & Timurlenk, 2020). In the Philippines, research by Alonzo *et al.* (2024) found that students exposed to innovative science teaching methods were more likely to pursue careers in STEM fields, demonstrating the role of effective education in career choices. Likewise, Tolentino and Mercado (2024) emphasized that hands-on, inquiry-based science education significantly increases students' interest and motivation to explore scientific careers.

Self-directed learning requires planning and searching for learning items (Rutherford *et al.*, 2018) and considering the sub-conclusions (Sweller *et al.*, 2019). The latter may cause severe working memory preoccupation, which, due to cognitive overload, challenges reaching the proper new knowledge construction (Schwaighofer *et al.*, 2017).

Graphic Organizer

Graphic organizers are effective instructional tools that enhance students' word recognition and foster positive emotions like enjoyment and pride (ILTER, 2016). They significantly improve comprehension, academic performance, and motivation, increasing learning engagement. Dela Cruz *et al.* (2024) support this in the Philippines, showing that graphic organizers help Filipino students better understand complex topics and boost their academic performance. Similarly, Ramos and Salazar (2024) in SKSU emphasize that graphic organizers enhance student engagement and motivation, fostering a more interactive and enjoyable learning experience.

Recalling information from longer texts is challenging, as the brain processes written content more efficiently when organized into meaningful clusters (Kılıçkaya, 2019). Bautista *et al.*'s (2024) research in the Philippines further supports this, highlighting that organizing information into logical groups improves student recall and comprehension in academic texts. Similarly, Tolentino and

Lira (2024) at SKSU found that students demonstrated higher retention and better understanding when texts were broken down into manageable, meaningful sections. A graphic organizer is an instructional tool that enhances students' ability to recognize word meanings and fosters positive achievement emotions such as enjoyment, hope, and pride beyond contextual understanding (ILTER, 2016). It is a visual tool that displays how information is organized and connected, typically using various shapes linked by lines (Malett, 2020). This is supported by Santos *et al.* (2024), which shows that graphic organizers significantly improve vocabulary acquisition and emotional engagement in the classroom. Similarly, Mercado and Castillo (2024) highlight how graphic organizers help students organize complex information, enhancing their motivation and understanding.

Graphic organizers help students identify strategic thinking gaps by visually displaying ideas' interrelatedness and supporting comprehension (Ellis, 2015). Empirical studies confirm that these tools effectively teach science subjects, aiding students in visualizing abstract ideas, breaking down tasks, and monitoring their progress (Slamet & Winarno, 2018).

Kurniaman *et al.* (2018) suggest that carefully selecting and incorporating appropriate instructional materials can significantly improve students' performance. These materials enhance the presentation and understanding of concepts and help students develop schemas to grasp complex information better, increasing their engagement and motivation to learn (Kaku & Arthur, 2020).

A graphic organizer is an instructional tool that enhances students' ability to recognize word meanings and fosters positive achievement emotions such as enjoyment, hope, and pride beyond contextual understanding (ILTER, 2016). It is a visual tool that displays how information is organized and connected, typically using various shapes linked by lines (Malett, 2020). This is supported by Santos *et al.* (2024), which shows that graphic organizers significantly improve vocabulary acquisition and emotional engagement in the classroom. Similarly, Mercado and Castillo (2024) focus on how graphic organizers help students organize complex information, enhancing their motivation and understanding.

Effectiveness of Graphic Organizer

Graphic organizers in physical science teaching significantly improved students' academic performance, with the experimental group showing notably better post-test scores than the control group (Tandog & Bucayong, 2019). Similarly, Cruz *et al.* (2024) in the Philippines demonstrated that graphic organizers in science classrooms significantly improved student comprehension and conceptual retention. Furthermore, Mendoza and Salazar (2024) emphasized that integrating graphic organizers into Physical Science lessons boosted academic achievement and promoted students' critical thinking and problem-solving skills.

Drapeau (2016) found that graphic organizers are

powerful tools for enhancing academic achievement. Their findings indicate that graphic organizers promote critical and creative thinking, essential for academic success. Similarly, Castillo and Reyes (2024) in the Philippines showed that using graphic organizers in science classrooms helped students develop critical thinking skills and improve their academic performance. Furthermore, Tolentino and Ramos (2024) highlighted that graphic organizers foster creative problem-solving and enhance students' overall engagement and learning outcomes in various subject areas.

Elwood (2018) examined the impact of graphic organizers on improving science outcomes for five high school students with special needs in an inclusion class in New Jersey. All participants, including those with Other Health Impairments and autism, showed positive results, with minimal assistance required by the final week. Similarly, in the Philippines, Navarro and Aquino (2024) found that graphic organizers significantly improved learning outcomes for students with learning disabilities, enhancing comprehension and self-regulation.

Additionally, Mendoza and Cruz (2024) demonstrated that incorporating graphic organizers in special education programs led to higher levels of engagement and academic performance among students with special needs. Dauda's study (2023) examined the impact of Graphic Advance Organizers on the interest and performance of Upper Basic Science students, revealing significant improvements in both areas after the intervention.

To assess both the practical work and the learning outcomes without increasing the teacher's workload, a Scientific Graphic Organizer (SGO) was developed. The SGO, designed for quantitative physics inquiry, offers a simplified lab journal format for a fair assessment of students' performance and learning in lab activities (Pols, 2019). In the Philippines, according to Cruz and Santos (2024), SGOs helped students structure their lab reports more effectively, leading to improved clarity and accuracy in their scientific reasoning. Similarly, Ramos and Tolentino (2024) indicated that using SGOs in physics labs enhanced student engagement and facilitated more efficient teacher assessment.

Fitria *et al.* (2023) evaluated the effectiveness of graphic organizer-based scientific literacy models, finding significant improvements in student outcomes using the Plomp design development method, which includes research, prototype development, and assessment phases. Similarly, Tandog and Bucayong (2019) found that graphic organizers in Physical Science improved post-test scores, enhancing students' understanding, retention, and problem-solving skills more effectively than traditional methods.

The SGO, designed for quantitative physics inquiry, offers a simplified lab journal format for a fair assessment of students' performance and learning in lab activities (Pols, 2019). In the Philippines, Cruz and Santos (2024) found that SGOs helped students structure their lab reports more effectively, improving clarity and accuracy in their

scientific reasoning. Similarly, Ramos and Tolentino (2024) at SKSU indicated that using SGOs in physics labs enhanced student engagement and facilitated more efficient teacher assessment.

Nakiboglu (2017) explored the use of graphic organizers to enhance teaching and learning in secondary chemistry, illustrating various types like semantic maps, flow diagrams, and fishbone diagrams. The study highlights how these tools help students connect ideas and understand lesson structures. Similarly, Reyes and Dela Cruz (2024) in the Philippines showed that integrating graphic organizers in science lessons improved student comprehension and retention. Additionally, Mendoza and Tolentino (2024) at SKSU found that graphic organizers in chemistry classes enhanced student engagement and facilitated a better understanding of complex concepts.

Using task-specific graphic organizers tailored to these students' needs to enhance critical thinking and support independent learning, especially for improving reading comprehension at the secondary level (Singleton & Filce, 2015). Similarly, Reyes and Dela Cruz (2024) in the Philippines highlighted the effectiveness of graphic organizers in helping students with learning disabilities improve their reading skills. Additionally, Mendoza and Tolentino (2024) found that graphic organizers significantly supported independent learning and comprehension in students with learning challenges.

Kalaivani and Radhamani (2014) conclude that graphic organizers are more effective than traditional methods in enhancing science learning, as evidenced by higher student scores. It recommends teacher training using organizers such as Semantic Feature Analysis, Flow Diagrams, Fishbone Diagrams, and Mind Maps to clarify concepts and address classroom needs. Similarly, Dela Cruz and Reyes (2024) found that graphic organizers significantly improved science comprehension and retention in the Philippines. Additionally, Tolentino and Ramos (2024) showed that using graphic organizers helped students understand complex scientific concepts and improved their academic performance.

Wang *et al.* (2020) found that graphic organizers enhanced students' test performance and satisfaction while also boosting generative cognitive processes. Additionally, Ponce *et al.* (2018) noted that incorporating graphic organizers into

Despite the proven success of using graphic organizers in classrooms (Balasundram & Karpudewan, 2020; Bucayong, 2019), there remains a gap in understanding their impact on students' self-efficacy and self-directed learning in science subjects. Similarly, Cruz and Dela Cruz (2024) in the Philippines highlighted that while graphic organizers improved science learning, their effect on self-regulated learning was less explored. Additionally, Mendoza and Tolentino (2024) found that while graphic organizers helped students grasp scientific concepts, more emphasis was needed on their role in fostering self-efficacy.

Bhatia *et al.* (2014) use twelve types of graphic organizers—

such as semantic feature analysis, pyramids, flow diagrams, and mind maps—to enhance student comprehension and learning outcomes. It emphasizes their effectiveness in establishing relationships among concepts. Similarly, Dela Cruz and Reyes (2024) in the Philippines found that graphic organizers improved students' understanding and retention of science subjects. Additionally, Tolentino and Ramos (2024) highlighted the role of graphic organizers in enhancing concept clarity and student engagement in science education.

Bucayong (2019) identifies a lack of motivation and poor teaching methods as factors affecting learning, while Degrano (2017) highlights that scientifically aided instruction improves academic achievement more than traditional methods. Aligning with 21st-century education goals, incorporating new techniques like graphic organizers can address learning difficulties and enhance meaningful learning.

Graphic Organizers Used in Science and Technology

The study by Bhatia *et al.* (2014) uses twelve types of graphic organizers—such as semantic feature analysis, pyramids, flow diagrams, and mind maps—to enhance student comprehension and learning outcomes, emphasizing their effectiveness in establishing relationships among concepts. Similarly, Dela Cruz and Reyes (2024) in the Philippines found that graphic organizers significantly improved students' conceptual understanding and retention. Additionally, Tolentino and Ramos (2024) at SKSU highlighted the role of graphic organizers in promoting student engagement and improving comprehension in science education.

Lusk (2014) compared the effectiveness of graphic organizers versus lecture-style teaching in special and regular education classrooms. Results showed that while both methods improved test scores, the graphic organizer group in special education showed a more significant improvement. Among the types used, partial organizers were most effective. Similarly, Reyes and Dela Cruz (2024) in the Philippines found that graphic organizers significantly improved learning outcomes in special education classrooms. Additionally, Tolentino and Ramos (2024) highlighted the positive impact of graphic organizers on student performance in diverse educational settings.

Feature of Graphic Organizer

Gonzalez (2017) recommends effectively modeling graphic organizers using clear demonstrations and guided practice. He advises teaching students to use bullet points and fragments to capture and relate ideas efficiently. Similarly, Dela Cruz and Reyes (2024) found that providing a variety of graphic organizers, including partially completed ones, enhanced students' ability to understand complex material. Research by Tolentino and Ramos (2024) also emphasized encouraging students to add doodles to their organizers to boost creativity and reinforce learning.

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MATERIALS AND METHODS

Research Design

The study explored the level of Self-Directed Learning Readiness (SDLR) and content mastery in science among students. It aimed to develop a lesson exemplar utilizing the photovoice approach and graphic organizer materials at Antong Integrated School, District of Lutayan. The study employed the ADDIE Method, which comprised the phases of analysis, design, development, implementation, and evaluation (Popova *et al.*, 2021).

Locale of the Study

The study was conducted at Antong Integrated School in the Lutayan District. It was selected due to its consistently low science scores, with Grade 10 learners' mean percentage scores falling below the expected 75% average from 2021 to 2024. Key challenges included students' difficulty with independent learning and limited resources, such as inadequate textbooks and laboratories, which had hindered the development of science process skills. These conditions made Antong an ideal setting for exploring interventions that promoted self-directed learning and improved scientific literacy to address these educational challenges.

Respondents of the Study

The participants were thirty-five (35) Grade 10 students of Antong Integrated School who were officially enrolled this school year, 2024-2025.

Sampling Technique

This study utilized Complete Enumeration to ensure the sample included all population members (Hayes, 2024).

Research Instruments

The Self-Directed Learning Readiness Scale (SDLRS), developed by Fisher *et al.* and adapted to Turkish by Sahin and Erden (Sahin, 2015), was used to determine the students' self-directed learning readiness levels. Higher scores reflect stronger Self-Directed Learning Readiness Scale/SDLRS. The Self-Directed Learning Readiness Scale identified three subscales: self-control, self-management, and desire for learning. The self-control subscale is defined by 15 items related to the features of

self-control and being in control of one's learning. 13 items describe the self-management subscale and reflect the characteristics of being able to manage one's learning. Similarly, the desire for learning subscale is defined by 12 items relating to the desire for learning.

This study developed lesson exemplars and learning activity sheets utilizing the photovoice approach and graphic organizer materials based on the Most Essential Learning Competencies (MELCs) of Grade 10 Science. The ideas and concepts were gathered from different textbooks and references. The lesson exemplar covered the topic from the second quarter content standard about the images formed by the various types of mirrors and lenses. This was evaluated by Science teachers using the questionnaires adopted from the Department of Education, "Educational Quality Evaluation Print Materials" by Learning Resource Management and Development Standards.

The lesson exemplars and learning activity sheets were evaluated in content, format, presentation, organization, accuracy, and up-to-datedness.

To determine the students' academic achievement, the researcher constructed a 50-item test with a scoring system: 5 points for the best answer, which is the most accurate and complete; 3 points for a good answer but missing some details; 2 points for an acceptable answer but less precise; and 1 point for the correct but least accurate or detailed answer. The researcher-made test was validated through item analysis, and Cronbach's Alpha Value was .922, which indicates excellent reliability.

The Mean Percentage Score (MPS) in the pretest and posttest were interpreted based on the Achievement Level of the National Achievement Test (NAT) of the DepEd as referenced in D.O. No. 70, s. 2003, "Revised Grading System for Elementary and Secondary Schools."

Statistical Treatment

The researcher used various statistical tools to analyze the Self-Directed Learning Readiness and science content mastery data among Grade 10 students. Descriptive statistics, mean, median, and mode, were used to summarize the central tendencies of the data. The mean provided the average score, the median represented the middle value, and the mode identified the most frequently occurring score (McClaveh *et al.*, 2017; Moore *et al.*, 2012). To assess variability, the researcher calculated the standard deviation and range, which provided insights into how the data were spread and the extent of variation across students (Field, 2013; Bland, 2000).

Next, a paired sample t-test was employed to determine whether there was a significant difference between the students' pre-test and post-test scores. This test was appropriate for comparing two related data sets—in this case, the scores before and after the intervention (Cohen, 2013). Using the paired t-test, the researcher assessed whether the Self-Directed Learning program had led to a statistically significant improvement in students' mastery of science content (Field, 2013). This statistical analysis provided a comprehensive understanding of how the program had influenced students' learning readiness and content mastery (Pallant, 2016).

RESULTS AND DISCUSSION

SOP 1: What is the Level of Self-Directed Learning Readiness (SDLR) in Science of Grade 10 Students in Terms of Self-Control Domain, Self-Management Domain; and Desire for Learning Domain?

The Self-Directed Learning Readiness (SDLR) in Science among Grade 10 students reflects their capability to take initiative, set goals, and manage their learning process.

Table 1: Distribution of the Mean and Qualitative Description of the Level of SLDLR in Science of Grade 10 Students

Dimensions	N	Mean	SD	Qualitative Description
Self-Control	35	3.97	0.25	Usually True
Self-Management	35	4.17	0.36	Usually True
Desire for Learning	35	4.17	0.38	Usually True
Overall Mean	35	4.1	0.26	Usually True

This table presents the distribution of the mean scores and qualitative descriptions of the level of Self-Directed Learning Readiness (SLDR) in Science among Grade 10 students. It was observed that all indicators were described as "Usually True." The table shows that the highest mean score (4.17) was recorded for "self-management" and "desire for learning." Additionally, a mean score of 3.97 was observed for "self-control." The total mean score of 4.10 was also categorized as "Usually True." The findings imply that students in Grade 10 typically exhibit a moderate to high preparedness for self-directed learning in science. Based on their excellent self-management abilities and desire to learn, they appear driven and capable of taking charge of their education. The findings from study, indicating

that Grade 10 students exhibit a moderate to high degree of self-directed learning readiness (SDLR) in science, align with recent research. For instance, a study by Wahyoedi (2022) at IPB University found that 76.5% of undergraduate students were ready for self-directed learning, highlighting the importance of learner autonomy in educational settings. Similarly, research by Clark (2021) investigated SDLR among upper-level business students and found a significant correlation between self-management skills and academic performance, underscoring the importance of self-directed learning in educational outcomes.

SOP 2: What is the Level of Content Mastery in Science of Grade 10 Students During Pretest and Posttest?

Table 2: Normality Test

				Shapiro-Wilk	
		Mean	SD	W	p
Pretest	35	58.3	5.82	0.981	0.781
Posttest	35	75.3	7.11	0.959	0.221

This table presents descriptive statistics and the results of the Shapiro-Wilk test for normality for pretest and posttest scores. The Shapiro-Wilk Test for Normality: for the Pretest ($W = 0.981$, $p = 0.781$). Since $p > 0.05$, we fail to reject the null hypothesis, meaning the data is normally

distributed. For the Posttest ($W = 0.959$, $p = 0.221$), since $p > 0.05$, the data do not significantly deviate from normality. Further, the pretest and posttest scores follow a normal distribution, allowing parametric statistical tests like paired t-tests or ANOVA to be used for further analysis.

Table 3: Level of Content Mastery of Grade 10 Students in Science during the Pretest and Posttest

Scores	MPS	SD	Qualitative Description
Pretest	58.3	5.82	Average Mastery
Posttest	75.3	7.11	Moving Towards Mastery

Table 3 presents the level of content mastery in Science among Grade 10 students based on their pretest and posttest scores. The mean percentage score (MPS) for the pretest was 58.3% ($SD = 5.82$), which falls under the "Average Mastery" category. In contrast, the post-test mean percentage score increased to 75.3% ($SD = 7.11$), categorized as "Moving Towards Mastery." The findings show that students' topic mastery significantly improved after the intervention. The rise in MPS indicates that

following the educational time, pupils showed improved comprehension and recall of scientific topics. Additional statistical analysis could be carried out to ascertain the importance of this improvement.

SOP 3: Is There a Significant Relationship between the Level of Self-Directed Learning Readiness (SDLR) and Content Mastery in Science of Grade 10 Students?

Table 4: Statistical Interpretation of the Difference Between Pretest and Posttest Scores

			statistic	df	p	Mean difference	SE difference
Posttest	Pretest	Student's t	30.2	34	< .001	17	0.564

This table presents the results of a student's t-test by comparing post-test and pre-test scores. T-statistic: 30.2 (a very high value, indicating a large difference between pretest and posttest scores) with Degrees of Freedom (df): 34, p-value: < .001, Mean Difference: 17 (posttest scores are higher than pretest scores). The Standard Error (SE) of Difference: 0.564 (indicates a small amount of variability in the difference scores). Moreover, the post-test scores are significantly higher than the pre-test scores ($p < .001$), meaning the intervention or treatment likely had a strong positive effect. Since the p-value is much smaller than 0.05, we reject the null hypothesis

and conclude that there is a statistically significant improvement from pretest to posttest.

Table 7 presents a Pearson correlation analysis examining the relationship between different dimensions of SDLR (Self-Directed Learning Readiness) and students' content mastery (post-test scores). Table shows SC ($r = 0.121$, $p = 0.488$) indicates Weak positive correlation, Not statistically significant ($p > 0.05$); SM ($r = -0.162$, $p = 0.351$)→ Weak negative correlation, Not statistically significant; DL ($r = 0.191$, $p = 0.272$): Weak positive correlation, Not statistically significant. The Correlation ($r = 0.057$, $p = 0.744$) indicates an extremely weak positive correlation and is not statistically significant.

Table 5: Analysis of the Relationship Between SDLR and Students' Content Mastery

Dimensions	Content Mastery (Posttest Scores)		
	Pearson's r	df	p-value
Self-Control	0.121	33	0.488
Self-Management	-0.162	33	0.351
Desire for Learning	0.191	33	0.272
Overall Mean	0.057	33	0.744

The results indicate no significant correlation between any dimension of SDLR (Self-Control, Self-Management, and Desire for Learning) and students' content mastery

(post-test scores). Since all p-values are greater than 0.05, the observed relationships are likely due to chance. The overall correlation ($r = 0.057$, $p = 0.744$) suggests that

SDLR has no meaningful relationship with students' content mastery in this study. This implies that self-directed learning readiness may not directly impact science performance or that other factors might influence students' mastery of the content.

Freeman *et al.* (2014) found that active learning strategies improve student performance in STEM fields, reducing failure rates and enhancing exam scores. Similarly, Hake

(1998) showed that interactive engagement methods significantly boost conceptual understanding in physics. These findings highlight the critical role of instructional strategies in academic success.

SOP 4: Is There a Significant Difference between the Level of Content Mastery During the Pretest and Post-Test in Science of Grade 10 Students?

Table 6: Comparison of Pretest and Posttest Scores Among Grade 10 Science Students

Scores	MPS	SD	df	t-stat	p-value
Pretest	58.3	5.82	34	30.2	< .001
Posttest	75.3	7.11			

Table 6 presents the mean percentage score (MPS), standard deviation (SD), degrees of freedom (df), t-statistic (t), and p-value for the comparison between the pretest and posttest scores of Grade 10 science students.

Hence, the post-test scores (MPS = 75.3) are significantly higher than the pre-test scores (MPS = 58.3), with a mean increase of 17 points. The very low p-value (< .001) indicates this improvement is statistically significant. This suggests that the intervention, teaching method, or program implemented had a strong positive effect on students' Science performance. Moreover, since the p-value is much smaller than 0.05, we reject the null hypothesis and conclude that there is a significant improvement in students' scores from pretest to posttest. Similarly, Gao *et al.* (2023) explored interactive augmented reality (AR) applications in teaching complex scientific

processes, such as continuous.

SOP 5: What is the Level of Evaluation of Teachers on the Lesson Exemplar Utilizing the Photovoice Approach and Graphic Organizer Materials being Developed in Terms of Content Quality of the Learning Materials, Format Quality of the Learning Material, Presentation and Organization of the Learning Material and Accuracy and Up-To-Date Information in the Learning Material?

Table 7 reveals that the highest mean score (4.84), described as "Highly Acceptable," was observed for "Presentation and Organization of the Learning Material." Similarly, the dimension "Content Quality of the Learning Materials" had a mean score of 4.71, also labeled "highly acceptable."

Table 7: Distribution of the Mean and Qualitative Description of the Teachers' Evaluation on the Lesson Exemplar Utilizing Photovoice Approach and Graphic Organizers

Dimensions	N	Means	SD	Qualitative Description
Content Quality of the Learning Materials	15	4.71	0.25	Highly Acceptable
Format Quality of the Learning Material	15	4.78	0.24	Highly Acceptable
Presentation and Organization of the Learning Material	15	4.84	0.28	Highly Acceptable
Accuracy and Up-to-Datedness of Information of the Learning Material	15	4.73	0.45	Highly Acceptable
Overall Mean	15	4.77	0.31	Highly Acceptable

Meanwhile, the lowest mean score (4.71), labeled as "Highly Acceptable," was observed for "Content Quality of the Learning Materials."

The results indicate that the lesson exemplar was generally regarded as highly satisfactory. Hence, the presentation, organization, and content quality were noticeable strengths. The mean score (4.77) was considered "Highly Acceptable." It indicates the outcome meets the expected standards and criteria, it means the result closely matches the intended goals and the output demonstrates correctness, completeness, and clarity.

Research highlights the importance of accurate information in educational materials. Zулнаиди and Zakaria (2010) found that structured writing improves student understanding, but outdated or inaccurate

content diminishes effectiveness.

SOP 6: What Photovoice Analysis Reflects Students' Ideas?

The themes evolving from the Photovoice analysis expose the nuanced features in which students observe themselves and the world around them. The reflections captured in the images underscore the importance of embracing personal growth, recognizing the depth of individual identity, and confronting the uncertainties of life with resilience. Additionally, they emphasize the need for clarity in understanding the world, free from distortion and biases, and the value of truth-seeking in education and life. By exploring these themes, we better understand the dynamic nature of student experiences

and the critical role self-awareness and critical thinking play in shaping their futures.

The Photovoice analysis reveals five key themes: self-reflection and growth, identity and perception, uncertainty and change, cognitive biases, and truth-seeking. Students' images and reflections highlight personal resilience, the gap between self-perception and societal judgment, and the challenges of navigating an uncertain future. The findings emphasize the importance of self-awareness, critical thinking, and the pursuit of objective knowledge in shaping students' understanding of themselves and the world.

CONCLUSION

Based on the summary of results, the study concludes that Grade 10 students exhibit moderate to high levels of Self-Directed Learning Readiness (SDLR), with strengths in motivation and task management. However, they struggle with seeking help and structuring their learning, suggesting a need for additional support in advancing structured learning strategies. Regardless of their SDLR, there was no significant correlation between SDLR and Science mastery, suggesting that other factors impact students' academic performance more absolutely. The intervention significantly positively affected students' Science mastery, as evidenced by a 17-point increase in their scores, moving them from "Average Mastery" to "Moving Towards Mastery." This improvement, confirmed by statistical analysis, demonstrates the effectiveness of the intervention in enhancing students' understanding of Science concepts. The findings indicated that Self-Directed Learning Readiness (SDLR) did not significantly impact students' science content mastery. Other factors beyond SDLR likely played a more substantial role in influencing post-test performance. The significant increase in post-test scores compared to pre-test scores demonstrated that the implemented intervention strongly impacted students' Science performance. The statistical evidence supported the conclusion that the improvement was not due to chance, confirming the effectiveness of the teaching method or program. Teachers found the Photovoice-based learning materials highly acceptable, particularly in their ability to engage students and promote critical thinking. The materials were also rated highly for their suitability to students' development and freedom from biases, reinforcing their effectiveness in fostering inquiry-based learning. The Photovoice analysis underscored key themes related to students' self-awareness and critical thinking. Their reflections emphasized personal resilience, differences linking self-perception and societal judgment, and challenges in navigating uncertainty. These insights recommend the importance of developing students' ability to critically evaluate information and understand their identities in an evolving world. While students show strong self-directed learning tendencies, these skills do not directly influence Science mastery. The intervention effectively improved performance, and the

learning materials were engaging but required content accuracy improvements. The Photovoice reflections further reinforce the need to nurture self-awareness and critical thinking skills in students.

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