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Learning Strategies and Engagement Skills of Science, Technology, Engineering, and Mathematics (STEM) Students in Practical Research

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Abstract — Essential learning strategies and productive student engagement skills can be seen as the glue that holds together all aspects of student learning and growth. This study aims to determine the relationship between the learning strategies and engagement skills of Science, Technology, Engineering, and Mathematics (STEM) students in Practical Research in Hilongos National Vocational School during School Year 2024-2025. More so, this utilized descriptive-correlational design employing the use of a questionnaire to gather data on the profile, learning strategies and level of engagement skills of grade 12 students. Data were analyzed and statistically treated with frequency, percentages, mean, standard deviation, and Pearson r. Results revealed that grade 12 STEM students were of late-adolescent age, mostly female, single, and most students resided in the Municipality of Hilongos, Leyte. STEM students mainly are outstanding in terms of their academic performance, learning strategies ratings and the highest overall ratings for their level of engagement skills. It demonstrates exceptional achievement in research-oriented coursework.

Furthermore, no significant relationship was found between STEM students' profile and their academic performance. This finding supports the effectiveness of the educational environment in providing equitable opportunities for academic achievement regardless of age, gender, or residential location. However, high positive correlations between learning strategies, academic performance, and engagement skills. This finding suggests that learning strategies and engagement skills mutually reinforce each other, creating a positive cycle that enhances educational experiences and outcomes. Thus, it is suggested that it include qualitative components to provide deeper understanding of students' experiences with learning strategies and engagement in Practical Research coursework.

Keywords — Academic performance, Engagement Skills, Learning Strategies, Practical Research, STEM students

I. Introduction

Effective learning strategies and strong student engagement are crucial for successful education. Actively engaged students learn better, retain information, and develop positive attitudes. A variety of teaching methods—including active learning, collaboration, and personalized instruction—foster engagement and improve learning outcomes. By using diverse strategies and cultivating engagement skills, educators create a dynamic learning environment that prepares students for success.

In the advanced world of science, technology, engineering, and mathematics (STEM), applying different learning strategies is essential specifically in the research curriculum. Learning strategy is any approach to instruction in which all students are asked to engage in the learning process. Active learning strategy stands in contrast to "traditional" modes of instruction in which students are passive recipients of knowledge from an expert. Active learning strategies can take many forms and be executed in any discipline. Commonly, students engage in small or large activities centered on writing, talking, and problem solving, or reflecting **(**Arthur, et al, 2021**)**.

Educators are challenged to identify the best educational practices to retain and engage learners in the learning process. Learning environments may influence student engagement using different active learning strategies in the classroom (Popkess & McDaniel, 2020). Student engagement occurs when students make a psychological investment in learning and try hard to learn what school offers. They take pride not simply in earning the formal indicators of success (grades), but in understanding the material and incorporating or internalizing it in their lives. It is increasingly seen as an indicator of successful classroom instruction, and as a valued outcome of school reform (Frederick, et al. 2021**)**.

Engaging in active learning strategies prepares students for the interconnected, interdisciplinary nature of real-world STEM applications. This approach provides students with a wealth of perspectives that deepen their understanding and develop essential soft skills, such as communication, problem-solving, and collective decision-making. The Republic Act No. 10533, more commonly known as the Enhanced Basic Education Act of 2013, mandated in Section5 that the curriculum shall use pedagogical approaches such as constructivism, inquiry-based, reflective, collaborative, and integrative. The law is supported by DepEd Order No. 21, s. 2019 on Policy Guidelines on the K to 12 Basic Education Program to ensure that schools implement these learner-oriented approaches to support the new K to 12 curriculums. Teachers were instructed to adopt strategies and learning opportunities that foster active learning, cooperative learning, collaboration, exploration, contextualization, and relevant.

However, while the importance of active learning strategies is recognized, there's a need for more research on how to effectively incorporate them into classrooms and assess their impact on student engagement. Even when strategies are effective, there may be a gap in understanding how to implement them effectively, leading to inconsistent results. This study aims to determine

the relationship between the learning strategies and engagement skills of Science, Technology, Engineering, and Mathematics (STEM) students in Practical Research in Hilongos National Vocational School during School Year 2024-2025.

The findings of the study are of great help for ***Educators.*** The findings of the study will provide valuable information for teachers and help them to provide new ways of teaching their students. It empowers them to create engaging, inclusive, and successful learning environments, fostering deeper understanding and critical thinking for students. ***Future Researchers.*** This study plays a crucial role in identifying and refining effective learning strategies, ultimately leading to better educational outcomes and improved academic performance for students by providing evidence-based insights for educators and policymakers. ***Learners***. The findings of the study will provide the students with valuable insights and techniques to improve their academic performance. It empowers learners to optimize their learning processes, improve retention, and enhance their academic performance and overall knowledge acquisition. ***Parents.*** It empowers them to support their children's academic success, foster a positive learning environment, and understand their child's individual learning needs. ***Policymakers***. It significantly influences learning strategies and student engagement by setting policies, allocating resources, and fostering collaboration, ultimately shaping educational environments and impacting student outcomes. ***School Administrators.*** It enables them to create a supportive environment that fosters student learning and achievement, improves instructional practices, and ultimately leads to a more effective and successful school.

This study determined the relationship between the learning strategies and engagement skills of Science, Technology, Engineering, and Mathematics (STEM) students in Practical Research 2 in Hilongos National Vocational School during School Year 2024-2025. The research explores the impact of various learning strategies on student engagement and learning outcomes, considering factors such as teaching methods, cultural differences, and resource constraints. Data was collected through questionnaires from at least 29 students randomly selected from twelve classes across five sections, totaling 145 participants. The study aims to understand how these factors influence learning and identify strategies to improve student engagement and learning outcomes

Literature Review

The economic development of a country has bought changes in the mechanism of education. With the shift from the traditional form of education to the modern form, the need of introducing practicality and making concepts understandable has emerged. This led to the introduction of a new concept called pedagogy. Pedagogical practices are being used nowadays in the educational institutions for improving the learning skill of students and increasing the level of engagement and participation of students.

Pedagogy is a term that represents the teacher's efforts, approaches, and strategies that are used to influence the learning of others. Focusing on the stated theories, empirical studies, evidence-based research, political aspects, individual or group reflections, community requirements and expectations, and involving educator's expertise or experience; the pedagogy defines the art of building the educational curriculum (activities, interactions, routines, experiences, and planned or unplanned events) (Whiteside, 2017). The pedagogical approach of teaching was classified into four parts i.e., Behaviorism, Constructivism, Social constructivism, and Liberationism. Among these approaches' behaviorism was a teacher-centric approach which uses direct instruction or lecture-based teaching mechanism for educating students. Constructivism pedagogy is a reflection or experience-based mechanism wherein following the student-centric approach, methods like inquiry-based learning, or project work; are used for education.

Social constructivism is a combination of teacher and student-centric approach wherein the principle of teaching was that sound learning need collaboration between teacher and students. Following the group-based methods of studying, the social constructivism pedagogy worked on building the interaction between the educator and learner. Liberationism, the last pedagogy is a student-centric approach wherein democracy is maintained in the class, and educators along with students discover the subjects that are needed to be studied (Westbrook et al., 2013; Tes, 2018). Based on the focus of the educational institution respective pedagogical approach is applied in the teaching mechanism.

Student engagement refers to the investment of effort, time, and other resources by students and educational institutions to provide the optimal experience and enhance the learning possibility (Trowler, 2010). Being considered as the indicator of personal development and learning, engagement of students helps in straightforwardly deriving the desired outcomes, grades, and satisfaction. Lack of engagement of students not only affects their academic capabilities but also influences their social functioning. A high rate of student disengagement leads to low academic achievement, a high dropout rate, high unemployment, social exclusion, low income, crime engagement and health issues (Hancock and Zubrick, 2015; Olson and Peterson, 2015).

Fredericks, et al (2014) describe three main dimensions of student engagement as the following: Behavioral Engagement: this covers students' participation in lessons, such as attendance and concentration levels, as well as their involvement in social aspects of learning, and whether they engage with extracurricular activities. Affective Engagement: this covers students' feelings, especially towards the subject or course they are studying, teacher, peers, overall academic experience, and whether they feel the lessons have value. Cognitive Engagement: this covers students' motivation and investment in own education. It also includes the extent to which they take ownership of own learning, can self-regulate, and wish to pursue personal educational goals. Only in the presence of all three forms of engagement, student learning can be optimized.

The pedagogical model was framed to describe the activities which teacher perform to provide more practical learning experience to students by engaging them in intellectually

challenging work. This learning cycle is characterized into five forms: Engage, Explain, Explore, Evaluate, and Elaborate (Department of Education and Training, 2018). Based on these domains, some of the strategies that are commonly used for implementing pedagogical learning model are as follows:

Under this strategy, the teachers present students with tasks which not only challenge the available skills of students but also support them in investigating unknown aspects, generating questions about them, gathering all relevant information, and developing new perspectives and ideas. This strategy helps in navigating student learning and expanding preconceived perspectives and critical thinking (Victoria, 2018).

Peer learning refers to a strategy wherein students not only learn from educators but also with each other, in both formal as well as informal ways. Under this instructional teaching mechanism, people belonging to similar group tend to work together and help each other for gaining some knowledge. Activities like classroom discussions, blogs, or online discussion forums, are example of peer learning strategies. This form of teaching not only provide the information to the students about the education related concepts but also improve the social cognitive skills (Wessel, 2015; Paul et al., 2018).

Under this strategy collaborative relationships are built i.e., students are motivated to work together and learn. Activities like role play, group research, problem-based, and project-based strategies are done through which students are divided into different groups and are given task of performing the respective activity. This strategy not only build the social interaction skill of student but also develop the teamwork-based skills (Camarinha-matos, et al., 2019).

Game based learning strategy refers to the method wherein using the gaming principals, teachers try to engage students and make them learn the new things. Linking the games with the learning, educators try to motivate students for learning. Minecraft Education, Kahoot, Quizlet, Scrabbles, and some board games are some of the game-based learning methods used for improving knowledge of research students. This strategy helps in creating fun environment for studying along with providing opportunity to have practical implementation of knowledge (Torrente et al., 2011; Pho and Dinscore, 2015). All these strategies help students in exploring new concepts, building connection with others, and having practical knowledge. Providing an opportunity to have more or personal and social interaction, pedagogical approach helps in promoting emotional, behavioral, and cognitive engagement.

II. Methodology

The methodology section details a descriptive correlational research design to determined the relationship between the learning strategies and engagement skills of Science, Technology, Engineering, and Mathematics (STEM) students in Practical Research 2 in Hilongos National

Vocational School during School Year 2024-2025. The study involved 145 students selected using stratified random sampling.

Research Design: This study empployed a descriptive correlational research design to determine the relationship between learning strategies and engagement skills among the public secondary senior high school learners in Practical Research 2 class. The research design was thought to be the most useful in fulfilling the objectives and goals of this study. Descriptive correlational research design is a research approach that aims to describe the relationship between two or more variables without manipulating them. It focuses on observing how variables naturally relate in the real world, rather than establishing a cause-and-effect relationship. This type of research is used to identify characteristics of a group or explore associations between different variables. (McCombs, 2023).

Sample of the Study: The method used was stratified random sampling to ensure that students across different sections in Grade twelve were adequately represented. The sample was stratified by section, and then random samples was selected from each stratum. The sample size will depend on the number of students in each section. The participants of this study were graduating from Senior High School in the STEM track in Hilongos National Vocational School, School Year 2024-2025. The participants were enrolled in the STEM track of Senior High School at HNVS. Students on other tracks apart from STEM were included in this study. The researchers collaborate with the school administration and teachers to identify the eligible participants for the study. The respondents of the questionnaires are one hundred forty-five (145) students from the five sections of Grade 12- STEM in HNVS.

Procedures: The data collection process began with obtaining necessary ethical approvals from Northwest Samar State University (NWSSU), the Leyte Division Superintendent, District Supervisor, and school heads. Informed consent was obtained from teachers and parents/guardians of students, ensuring voluntary participation and protecting participant rights. Data were collected through a two-part questionnaire administered to students , assessing their profiles and the extent of their academic performance and also their learning strategies and engagement skills. Student academic performance data were obtained from school records. The questionnaires were administered at a time convenient to the teachers and students, minimizing disruption to their teaching schedules. Data collection involved careful coordination with school administrators to ensure smooth implementation and minimize any inconvenience to the participants. The use of a validated questionnaire with established reliability enhanced the quality and trustworthiness of the data collected.

Measures: An adopted survey questionnaire will be administered to determine the relationship between the learning strategies and engagement skills of Science, Technology, Engineering, and Mathematics (STEM) students in Practical Research 2 in Hilongos National Vocational School during School Year 2024-2025.

The original Learning Strategies for Students Questionnaire (CEA-U) byCabrera et al. (2007), is a self-administered questionnaire, whose aim is to gather information on learning strategies used by students during the study period. Students are asked to report the degree to which they use these strategies. It is a Likert-type scale with the following response format: 0 – not at all, 1 – slightly, 2 – sometimes 3– often and 4 – always. It consists of three subscales: learning strategies comprising 27 items, a reduced version of three scales in study. The questionnaire will be age-appropriate, aligning with the curriculum for each section, and will assess learning strategies indicators such as self-reinforcing, implication, positive associations, applicability and gradual approach.

Likewise, the Student Engagement in Schools Questionnaire (SESQ) demonstrates good reliability and validity, with studies showing high internal consistency (Cronbach's alpha) and robust test-retest reliability. Using Cronbach's alpha has shown high internal consistency, with values ranging from 0.82 to 0.93 for different subscales. The SESQ was developed by scholars from multiple countries, and items were drawn from existing research, increasing its content validity. The SESQ assesses student engagement through several subscales, including affective, behavioral, and cognitive engagement, as well as goal orientations, attributions, learning self-efficacy, and motivating instructional contexts. The questionnaire will be age-appropriate, aligning with the curriculum for each section, and will assess engagement indicators such as affective, behavioral, and cognitive engagement.

Data Processing: Data were analyzed using a variety of statistical techniques. Descriptive statistics (frequency, percentage, mean, standard deviation) were used to describe student profiles and their academic performance. Pearson correlation assessed the relationship between learning strategies and the level of engagement skills of the students. The use of multiple statistical techniques allowed for a thorough analysis of the data, providing a comprehensive understanding of the relationships between the variables under investigation. The choice of statistical methods was appropriate for the type of data collected and the research questions being addressed.

Ethical Considerations: The study prioritized ethical considerations throughout the research process. Informed consent was obtained from all participants (teachers and parents/guardians of students). Data were anonymized to ensure confidentiality and protect participant privacy. The study ensured that no student group was disadvantaged by the research procedures. The researchers adhered to ethical guidelines established by Northwest Samar State University and relevant research ethics boards. The ethical considerations implemented ensured the protection of participant rights and the integrity of the research process. The voluntary nature of participation was emphasized, and participants were informed of their right to withdraw at any time without penalty.

III. Results and Discussion

The results and discussion section analyzes the relationship between learning strategies and engagement skills of Science, Technology, Engineering, and Mathematics (STEM) students in Practical Research at Hilongos National Vocational School. The discussion addresses each research question identified in the study, examining the relationships between student profiles, learning strategies, engagement skills, and academic performance. The findings are presented in a logical sequence, prioritizing the most significant results.

1. No significant relationships were found between student profile variables (age, sex, residence/location) and academic performance, with correlation coefficients ranging from r=0.032 to r=0.079 and p-values consistently exceeding 0.05.

2. Highly significant positive correlations were found between learning strategies and academic performance across all dimensions (r=0.378 to r=0.506, p<0.01), with applicability (r=0.506) and implication (r=0.487) showing the strongest relationships.

3. Highly significant positive correlations were found between engagement skills and academic performance across all dimensions (r=0.512 to r=0.631, p<0.001), with cognitive engagement (r=0.631) showing the strongest relationship, followed by behavioral (r=0.548) and affective engagement (r=0.512).

4. No significant relationships were found between student profile variables (age, sex, residence/location) and learning strategies, with correlation coefficients ranging from r=0.053 to r=0.103 and p-values consistently exceeding 0.05.

5. No significant relationships were found between student profile variables (age, sex, residence/location) and engagement skills, with correlation coefficients ranging from r=0.054 to r=0.093 and p-values consistently exceeding 0.05.

6. Highly significant positive correlations were found between learning strategies and engagement skills across all dimensions (r=0.415 to r=0.587, p<0.001), with positive associations showing the strongest relationships with engagement dimensions (r=0.543 to r=0.587), followed by implication (r=0.485 to r=0.536), applicability (r=0.434 to r=0.502), self-reinforcing (r=0.423 to r=0.478), and gradual approach (r=0.415 to r=0.468).

IV. Conclusion

This study explored the relationship between learning strategies and engagement skills of Science, Technology, Engineering, and Mathematics (STEM) students in Practical Research at Hilongos National Vocational School. The findings offer several significant conclusions, highlighting the effectiveness of learning strategies and its impact on student engagement skills.

1. The demographic profile of STEM students in Practical Research 2 at Hilongos National Vocational School reveals a predominantly late-adolescent population with a slight female majority and most students residing in the immediate vicinity of the school. This profile represents a typical senior high school STEM population, providing a foundation for understanding the context in which learning strategies and engagement skills develop.

2. The outstanding academic performance of STEM students in Practical Research 2, with 92.41% achieving scores of 90-100, demonstrates exceptional achievement in research-oriented coursework. This high level of performance suggests effective educational practices that support student success in complex STEM research activities.

3. The very high ratings across all learning strategy dimensions indicate that STEM students have developed sophisticated approaches to learning that support their educational success. The slightly higher ratings for positive associations and applicability suggest strength in creating positive emotional connections with learning and recognizing the practical relevance of learning material.

4. The very high ratings across all engagement dimensions demonstrate strong student investment in the learning process. The slightly higher ratings for behavioral and cognitive engagement suggest particular strength in observable participation behaviors and mental investment in learning, which align with the demands of research-oriented coursework.

5. The absence of significant relationships between student profile variables and academic performance suggests that demographic factors do not determine academic success in Practical Research 2. This finding supports the effectiveness of the educational environment in providing equitable opportunities for academic achievement regardless of age, gender, or residential location.

6. The highly significant positive correlations between learning strategies and academic performance validate the importance of effective learning strategies for success in research-oriented STEM education. The particularly strong relationships for applicability and implication strategies highlight the importance of recognizing practical relevance and connecting new knowledge to existing understanding.

7. The highly significant positive correlations between engagement skills and academic performance, particularly for cognitive engagement, affirm the critical role of engagement in academic success. This finding underscores the importance of fostering deep mental investment in learning, alongside behavioral participation and affective connection, to promote achievement in research-oriented coursework.

8. The absence of significant relationships between student profile variables and learning strategies indicates that demographic factors do not determine the development of effective

learning approaches. This finding suggests that the educational environment successfully fosters learning strategy development across diverse student backgrounds.

9. The absence of significant relationships between student profile variables and engagement skills suggests that demographic factors do not determine student engagement. This finding supports the effectiveness of the educational environment in fostering engagement across diverse student backgrounds, promoting equity in educational experiences.

10. The highly significant positive correlations between learning strategies and engagement skills, particularly for positive associations, validate the intrinsic connection between effective learning approaches and student engagement. This finding suggests that learning strategies and engagement skills mutually reinforce each other, creating a positive cycle that enhances educational experiences and outcomes.

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