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The Mediating Effect of Social-Emotional Learning Skills on the Relationship between Project-Based Learning and Engagement in Science among Grade 10 Students in Tagum City

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Abstract: This study examined the mediating effect of social-emotional learning (SEL) skills in the relationship between project-based learning (PBL) and student engagement in science. A descriptive-correlational research design was employed. There were 179 Grade 10 respondents from four public secondary schools in the South District, Division of Tagum City, who were selected through simple random sampling. This study used two adopted questionnaires and one researcher-made questionnaire. Mean, Pearson r, standard deviation, regression analysis, and the Sobel test were used as statistical tools. The results revealed significant relationships among project-based learning, student engagement, and social-emotional learning skills. Social-emotional learning skills partially mediate the relationship between project-based learning and student engagement in science. The results highlight the importance of project-based and social-emotional learning for student engagement and suggest that strengthening these skills in science education would further enhance it. The development of the curriculum and teaching methods for implementing it with students is needed so that teachers can maximize project-based and social-emotional learning to strengthen students' engagement.

Keywords: Science Education, project-based learning, social-emotional learning skills, student engagement, descriptive-correlational design, mediation analysis, Tagum City

I. INTRODUCTION

Student engagement is vitally important for effective learning, especially in science, where abstract or particularly complex concepts sometimes pose challenges for learners. According to Wong and Liem (2022), this means that engagement is viewed as the appropriate counterpart to the student's work role, representing the student's active participation in learning activities. However, despite its importance, engagement in science remains a significant issue in many classrooms today. Student disengagement from science education has become increasingly worrying globally. This concern is exemplified by continued low achievement in science in Malaysia [26]. Malaysian students were ranked only 460th in science, well below the global benchmark of 500, according to the 2019 Trends in International Mathematics and Science Study (TIMSS) [33]. Furthermore, the consistently low academic performance of Filipino students in the Philippines reflects a significant concern regarding their engagement in science learning. Filipino students often struggle to establish a deep connection with scientific topics and experience low interest, motivation, and self-confidence in the discipline [27].

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Similarly, Senina and Manguilimotan (2025) conducted a study in Davao de Oro found that 60% of students are disengaged, and within that group, 55% were identified as minimally active in classroom participation during science activities. In that same study, 30% of the students completed only the required tasks for acceptance, while the remaining 20% submitted nothing.

While several studies have examined project-based learning and student engagement [2], project-based learning and social-emotional learning [42], and social-emotional learning and engagement [16], limited research has investigated the mediating role of social-emotional learning in strengthening the relationship between project-based learning and student engagement in science. The persistent disconnection of students in science classrooms, where traditional teaching separates theoretical concepts from students' daily lives and emotions, prompted the conduct of this study.

This research was designed to examine the mediating effect of social-emotional learning skills on the relationship between project-based learning and student engagement in science among Grade 10 students in the South District of Tagum City. This study narrowly measured PBL, SEL skills, and engagement using validated questionnaires and simple random sampling. It did not include other grade levels, subject areas, private schools, or qualitative data such as interviews or classroom observations. Thus, findings are limited to the specified context and cannot be generalized beyond it.

II. MATERIALS AND METHODS

This quantitative study used a descriptive-correlation design, an approach that uses numerical data and statistical analysis to determine relationships among variables and draw conclusions about phenomena under study [34]. The respondents in this study were Grade 10 learners from public secondary schools in the South District of Tagum City Division, enrolled in the School Year 2025-2026. The target population consisted of 324 Grade 10 learners. The researcher employed simple random sampling, in which each learner had an equal chance of being selected as a respondent. Using Slovin's formula with a 0.05 margin of error and a 95% confidence level, a sample size of 179 learners was determined. There were 28 learners from School A (Barangay Busaon), 39 learners from School B (Barangay Bincungan), 92 learners from School C (Barangay Madaum), and 20 learners from School D (Barangay Liboganon).

Two survey questionnaires and one researcher-made questionnaire were intentionally selected to address the research questions of the study. All research instruments were evaluated by experts in the field to ensure their validity and reliability. The first tool was the Project-Based Learning Instrument, a research-made questionnaire based on the developed study by Krajcik and Shin (2014). This 20-item instrument focuses on the key characteristics of Project-Based Learning (PBL), with 7 items on active participation, 7 on collaboration, and 6 on applied knowledge. The items were reviewed and approved by a panel of experts. The reliability of the Research-Made Questionnaire on Project-Based Learning was evaluated using Cronbach's alpha. The overall Cronbach's alpha was 0.733, indicating excellent internal consistency of the instrument. Meanwhile, Student Classroom Engagement (SCE) Scale questionnaire developed by Reeve (2011) incorporates the behavioral, cognitive, emotional, and agentic engagement dimensions. It comprises 5 items, each dedicated to the behavioral, cognitive, emotional, and agentic engagement domains, for a total of 20 items. The Cronbach's alpha coefficients for behavioral, cognitive, emotional, and agentic engagement were computed as .786, .847, .775, and .769, respectively. Both questionnaires had five-point Likert scale, respondents rated their level of agreement with each statement, where 1 indicated "strongly disagree" and 5 represented "strongly agree." Lastly, the Washoe County School District Social and Emotional Competency Assessment (WCSD-SECA) is a self-report measure based on the CASEL 5 domains that assesses student SEL competencies (WCSD, 2018). The WCSD-SECA census includes a four-point Likert-type scale for students to rate the difficulty of each statement, from 1 (very difficult) to 4 (very easy). This is a 27-item questionnaire with the following dimensions: six items for self-awareness, five for social awareness, five for self-management, six for relationship skills, and five for responsible decision-making. The instrument demonstrated strong psychometric properties, including content validity and reliability ($\alpha = 0.735$).

The researcher secured permission to conduct the study at St. Mary's College of Tagum Incorporated, obtained ethical clearance from the Research Ethics Committee, and received endorsement from the Dean of the Graduate School. Participants were randomly selected and informed about the study's nature, objectives, significance, and their rights and safety. The questionnaire was administered by the researcher, after which the data were processed and analysed. All data were securely stored for three years and subsequently disposed of in accordance with ethical guidelines.

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The study employed appropriate statistical tools to analyse and interpret data on project-based learning, student engagement, and social-emotional learning skills. Descriptive statistics such as the mean and standard deviation were used to summarize the data and describe the distribution of scores across variables. The mean was utilized to represent the central tendency of responses, while the standard deviation measured the variability of scores in relation to the mean. Pearson's r was employed to examine the relationship among project-based learning, student engagement, and social-emotional learning skills. Furthermore, mediation analysis was conducted to examine whether social-emotional learning skills mediate the relationship between project-based learning and student engagement. The Sobel test was used to determine the significance of the indirect effect of the independent variable on the dependent variable through the mediating variable.

III. RESULTS AND DISCUSSION

Table I
Level of Project-Based Learning in terms of Active Participation

	Items	SD	Mean	Descriptive Equivalent
1.	I take part in every step of the project-based learning activity	0.77	4.23	Very High
2.	I get the chance to be a leader during project tasks	0.95	3.83	High
3.	Project-based learning encourages me to actively participate in science class discussions	0.75	4.19	High
4.	I am encouraged to think deeply and find solutions to the problems I work on.	0.81	4.21	High
5.	I share my ideas and listen to my classmates in group discussions	0.75	4.48	Very High
6.	I ask questions to understand the project better	0.71	4.46	High
7.	I help my team complete the project	0.67	4.62	Very High
Category Mean		**0.77**	**4.29**	**High**

The level of project-based learning in terms of active participation has a category mean value of 4.29. this value falls within the descriptive equivalent of high. This means that project-based learning in terms of active participation is present in most instances. Additionally, the small standard deviation (SD = 0.77) signifies low variability. This uniformity indicates that most students shared a highly similar perception of active engagement in PBL. Their individual ratings were very close to the overall average.

The study suggests that creating interactive, collaborative settings through Project-Based Learning is the real mechanism that compels students to engage actively. This is consonant with Zhou's (2023) claim that hands-on learning methods allow students to take ownership of their educational experiences through engagement with real-world challenges that demand skills, imaginative thinking, and decision-making. Also, Kurt et al. (2021) noted that student community participation in the scientific arena has the potential to be one of the factors that can deepen understanding and further their interests. Not only does it drive active participation and critical thinking among learners, but it also motivates them.

Table II
Level of Project-Based Learning in terms of Collaboration

	Items	SD	Mean	Descriptive Equivalent
1.	Project-based learning helps us collaborate effectively with my classmates during science activities	0.75	4.22	High
2.	It helps our team work together to achieved share goals in science	0.70	4.45	High
3.	In science projects, we share ideas and give feedback to each other	0.75	4.40	High

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4.	We divide tasks fairly so everyone has something to do	0.82	4.28	High
5.	Project-based learning enhances my communication skills during group science activities	0.77	4.31	High
6.	Project-based learning encourages our team to value everyone's ideas and opinions during group discussions	0.79	4.31	High
7.	We work together to solve problems and stay focused on our goals	0.75	4.50	Very High
Category Mean		**0.76**	**4.35**	**High**

Collaboration within the project-based learning framework registered a mean score of 4.35, corresponding to a high descriptive rating. This suggests that students consistently engaged in meaningful collaborative practices rather than simply dividing tasks. The relatively low standard deviation (SD = 0.76) indicates limited variability in responses. Such consistency implies that students shared similar perceptions regarding the collaborative nature of their learning experiences.

The findings demonstrate that the high level of collaboration observed in this study reflects the practical application of Social Constructivist Theory. Through working together to solve authentic problems, students do not simply consume information but actively co-construct scientific knowledge. This collaborative construction requires the use of social-emotional skills identified in the mediation model, highlighting that in a PBL environment, social competence and cognitive growth are closely interconnected. In public schools in Tagum City, this high level of collaboration appears as a natural tendency for students to support one another, viewing science projects not merely as academic tasks but as shared responsibilities to ensure group success. Similarly, Larson (2020) noted that PBL unites students from diverse learning backgrounds through collaborative tasks that mirror the cooperative nature of scientific work. Engaging in activities such as reading and utilizing materials further deepens students' understanding of scientific principles and processes. Moreover, Jalinus et al. (2020) emphasized that project-based learning is an effective instructional approach that enhances participation by presenting authentic problems requiring cooperation, thereby enriching students' learning experiences.

Table III
Level of Project-Based Learning in terms of Application of Knowledge

	Items	**SD**	**Mean**	**Descriptive Equivalent**
1.	Project-based learning helps me apply and understand new science concepts through hands-on projects	0.78	4.13	High
2.	Through Project-based learning, I make sense of science concepts by applying them in real-world tasks	0.78	4.07	High
3.	The projects help me use what I learn in real life	0.76	4.36	High
4.	It makes me more curious and interested in exploring science topics further	0.82	4.19	High
5.	Project-based learning motivates me to take responsibility for my own learning in science	0.76	4.22	High
6.	Project-based learning helps me see how science lessons relate to real-life situations	0.78	4.36	High
Category Mean		**0.78**	**4.22**	**High**

The application of knowledge in project-based learning produced a mean of 4.22, which falls under the descriptive classification of high. This reflects those opportunities to apply learned concepts were present in most learning situations. With a standard deviation of 0.78, response dispersion was minimal. This pattern shows that students' evaluations of knowledge application were closely grouped around the central mean.

The findings suggest that project-based learning plays a crucial role in students' educational experiences, not as a trend but as a meaningful approach that enables the application of academic knowledge in real-world

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contexts. Duke et al. (2020) found that hands-on learning promotes deeper understanding by sustaining active engagement. Rather than passively receiving information, students working on projects demonstrate greater engagement and comprehension as they apply theory to practice while developing problem-solving and decision-making skills. Similarly, Blumenfeld et al. (1991) emphasized that passive instructional approaches tend to result in surface learning, whereas project-based work allows students to explore scientific concepts more deeply, thereby enhancing knowledge, motivation, and overall understanding.

Table IV
Summary on the Level of Project-Based Learning of Students

	Indicators	SD	Mean	Descriptive Equivalent
1.	Active Participation	0.77	4.29	High
2.	Collaboration	0.65	4.36	High
3.	Application of Knowledge	0.78	4.22	High
Overall Mean		**0.73**	**4.29**	**High**

The composite measure of project-based learning obtained a category mean of 4.29, interpreted descriptively as high. This indicates that the PBL approach was generally implemented across instructional activities. The standard deviation of 0.73 demonstrates low variability among responses. Hence, students' perceptions of PBL implementation were largely uniform and centered near the average score.

The findings highlight the importance of the three dimensions of project-based learning—active engagement, collaboration, and application of acquired knowledge—in supporting students' academic development. These results are consistent with Liu and Zuo (2022), who emphasized that effective project-based learning in science enhances subject mastery while simultaneously developing scientific reasoning skills essential for future careers. Similarly, Juuti (2021) underscored the vital role of peer learners, or "Learner-friends," in successful PBL implementation, noting that their commitment to interdependent cooperation in completing projects strengthens individual learning experiences and fosters a collaborative environment where each member's contributions are valued.

Table V
Level of Student Engagement in terms of Behavioral Engagement

	Items	SD	Mean	Descriptive Equivalent
1.	When I'm in this science class, I listen very carefully	0.81	4.27	Very High
2.	I pay attention in my science class	0.77	4.23	Very High
3.	I try hard to do well in this science class	0.75	4.26	Very High
4.	In my science class, I work as much as I can	0.80	4.28	Very High
5.	When I'm in this class, I participate in class discussions	0.83	4.16	High
Category Mean		**0.79**	**4.24**	**Very High**

Behavioral engagement recorded a mean score of 4.24, categorized as very high. This finding reflects students' consistent and active participation in classroom tasks and activities. The standard deviation (SD = 0.79) suggests only slight variation in responses. Therefore, most students rated their behavioral involvement at levels closely aligned with the overall mean.

These findings align with the studies of Cents-Boonstra et al. (2021) and Zhang (2023), which emphasize that emotional factors directly influence behavioral engagement, as students' emotional states significantly shape school attendance and task commitment. For instance, students who perceive activities as engaging or enjoyable tend to participate more actively, whereas those who experience anxiety or fear of failure may disengage. This underscores the importance of fostering classroom environments that support both emotional and behavioral engagement to enhance motivation and participation.

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Table VI
Level of Student Engagement in terms of Cognitive Engagement

	Items	SD	Mean	Descriptive Equivalent
1.	When I study science, I try to connect what I am learning with my own experiences	0.81	4.16	High
2.	I try to make all the different ideas fit together and make sense when I study for this class	0.77	4.07	High
3.	When doing work for my science, I try to relate what I'm learning to what I already know	0.74	4.10	High
4.	I make up my own examples to help me understand the important concepts I study in this class	0.81	4.20	Very High
5.	I can explain geological phenomena using scientific concepts	0.77	3.84	High
Category Mean		**0.78**	**4.07**	**High**

Cognitive engagement yielded a mean rating of 4.07, which corresponds to a high descriptive level. This indicates that students frequently invested effort in understanding and processing learning materials. The accompanying standard deviation (SD = 0.78) reflects limited spread in responses. As such, students' self-assessments of their cognitive involvement were concentrated near the average value.

The findings emphasize the importance of cognitive engagement in promoting students' active participation in the learning process. This is consistent with Zong (2024), who asserted that cognitive engagement involves the use of sophisticated learning strategies by students who are willing to invest time and effort to achieve deep conceptual understanding rather than superficial learning. Research further indicates that cognitive engagement directly influences learning outcomes, which are essential for academic success. Similarly, Barlow (2020) explained that the depth of cognitive engagement is reflected in how strategically a student approaches a problem or task, noting that students who actively and consciously engage with learning materials achieve more than those who participate passively.

Table VII
Level of Student Engagement in terms of Emotional Engagement

	Items	SD	Mean	Descriptive Equivalent
1.	I let my teacher know what I need and want	0.81	4.12	High
2.	I let my teacher know what I am interested in	0.81	4.25	Very High
3.	During this class, I express my preferences and opinions	0.75	4.41	Very High
4.	During class, I ask questions to help me learn	0.78	4.20	Very High
5.	When I need something in this class, I'll ask the teacher for it	0.76	4.14	High
Category Mean		**0.78**	**4.22**	**Very High**

Emotional engagement generated a mean score of 4.22, falling within the very high descriptive range. This outcome signifies sustained interest and positive emotional involvement in academic tasks. The relatively small standard deviation (SD = 0.78) indicates consistency in responses. Most students therefore reported emotional engagement levels that closely approximated the overall mean.

This conclusion demonstrates that emotional engagement can be altered by contextual and social elements - contact with one another, with teachers, and the nature of the learning tasks – making it one of the most significant features in the construction of productive learning environments. In a study conducted by Edward (2020), findings revealed that the emotionally involved students have a greater zest and pleasure in their academic activities. Such favorable emotions have links to increased contentment with education but also have roots for better academic outcomes [29]. Emotional engagement would contribute in two different dimensions; positively facilitating attitudes to school and indirectly, through relationships with behavioral and cognitive engagement, influencing academic achievement [14] [28].

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Table VIII
Level of Student Engagement in terms of Agentic Engagement

	Items	SD	Mean	Descriptive Equivalent
1.	I let my teacher know what I need and want	0.93	3.88	High
2.	I let my teacher know what I am interested in	0.89	3.87	High
3.	During this class, I express my preferences and opinions	0.80	3.97	High
4.	During class, I ask questions to help me learn	0.88	4.12	High
5.	When I need something in this class, I'll ask the teacher for it.	0.79	4.20	Very High
Category Mean		**0.86**	**4.00**	**High**

The level of student participation in terms of agentic engagement obtained a category mean of 4.00. This value falls within the descriptive equivalent of High, indicating that agentic engagement was evident in most instances. Furthermore, the standard deviation (SD = 0.86) reflects low variability in responses. This limited dispersion suggests that students' ratings were closely clustered around the mean, demonstrating a high degree of consistency in their perceptions of their agentic involvement.

These findings imply that students frequently exercised initiative in their learning by contributing ideas, expressing preferences, and actively influencing instructional processes rather than remaining passive recipients of information. This interpretation aligns with Xu et al. (2023), who emphasized that active learning within agentic engagement involves students articulating their learning preferences, posing questions, setting goals, and requesting clarification. Similarly, Reeve (2011) explained that students who demonstrate agentic engagement take responsibility for shaping their learning environment and foster collaborative relationships with peers and instructors, thereby enriching the overall educational experience.

Table IX
Summary on the Level of Student Engagement in Science

	Indicators	SD	Mean	Descriptive Equivalent
1.	Behavioral Engagement	0.79	4.24	Very High
2.	Cognitive Engagement	0.78	4.07	High
3.	Emotional Engagement	0.78	4.22	Very High
4.	Agentic Engagement	0.86	4.00	High
Overall Mean		**0.80**	**4.13**	**High**

The computed mean score for student engagement in science was 4.13, which corresponds to a High descriptive rating. This indicates that students generally demonstrated strong involvement in science-related learning activities. The associated standard deviation (SD = 0.80) suggests minimal dispersion in responses, signifying a high level of agreement among participants. The clustering of scores around the mean reflects a consistent perception of engagement across the group.

The findings further reveal that engagement in science is reflected through behavioral, agentic, cognitive, and emotional dimensions, underscoring its integral role in student-centered instruction. Wong and Liem (2022) affirmed that engagement encompassing these multiple dimensions is positively linked to enhanced academic performance and sustained achievement over time. In addition, Thomas (2000) highlighted those instructional approaches promoting inquiry, authentic problem-solving, and collaboration cultivate deeper ownership of learning, thereby strengthening overall student engagement.

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Table X
Level of Social-Emotional Learning Skills of Students in terms of Self-awareness

	Items	SD	Mean	Descriptive Equivalent
1.	I know what my strength are	0.68	3.34	Very High
2.	I know when I am wrong about something	0.65	3.25	Very High
3.	I know when I can't control something	0.65	3.35	Very High
4.	I know the emotions I feel	0.56	3.55	Very High
5.	I know ways I calm myself down	0.65	3.45	Very High
6.	I know when my mood affects how I treat others.	0.64	3.55	Very High
Category Mean		**0.64**	**3.42**	**Very High**

The level of social-emotional learning in terms of self-awareness yielded a mean score of 3.24, which corresponds to a Very High descriptive rating. This indicates that self-awareness competencies were strongly manifested among the students. In particular, learners demonstrated the capacity to recognize their emotions, thoughts, and values, as well as understand how these internal states influence their behavior. The relatively low standard deviation (SD = 0.64) reflects minimal variability in responses, suggesting that students' ratings were tightly clustered around the mean. This consistency points to a shared perception of well-developed self-awareness skills across the group.

These findings highlight the foundational role of self-awareness in the learning process. The ability to identify personal strengths and areas for growth fosters self-esteem and nurtures a clear sense of purpose. Durlak's (2017) emphasized that strong self-awareness involves accurately integrating emotions, cognitions, and behaviours, which supports more adaptive functioning. Beyond personal reflection, this competency also carries social implications. Devine et al. (2012) argued that limited self-awareness may reinforce implicit biases, thereby influencing judgment and interpersonal relationships. Strengthening self-awareness, therefore, contributes not only to individual development but also to more equitable and constructive social interactions.

Table XI
Level of Social-Emotional Learning Skills of Students in terms of Social-awareness

	Items	SD	Mean	Descriptive Equivalent
1.	I know when someone needs help	0.65	3.35	Very High
2.	I know how my actions impact my classmates	0.63	3.31	Very High
3.	I learn from people with different opinions from mine	0.66	3.36	Very High
4.	I know what people may be feeling by the look on their face	0.67	3.35	Very High
5.	I know how to get help when I'm having trouble with a classmate	0.62	3.31	Very High
Category Mean		**0.65**	**3.34**	**Very High**

Results revealed an overall mean of 3.34 for social awareness, interpreted descriptively as Very High. Such a rating signifies that this competency is strongly manifested among the students. Response variability was minimal, as evidenced by a standard deviation of 0.65, indicating that individual ratings showed little deviation from the group average. This pattern demonstrates substantial agreement in students' self-evaluations.

This result underscores the importance of social awareness as a core component of social-emotional learning. Social awareness involves attentively listening to others, understanding diverse perspectives, and responding appropriately to the emotions and experiences of individuals from varied backgrounds. It encompasses empathy, perspective-taking, and the effective use of available social supports. Schonert-Reichl (2017) identified social awareness as a central dimension of SEL that must be intentionally integrated into both instruction and classroom practice. Furthermore, Gimbert et al. (2021) emphasized that educators should cultivate competencies extending beyond empathy to include respect for diversity and inclusive engagement throughout their

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professional preparation and practice. When these skills are reinforced, they foster a supportive learning environment in which students feel valued and understood, ultimately contributing to both academic progress and personal development.

Table XII
Level of Social-Emotional Learning Skills of Students in terms of Self-management

	Items	SD	Mean	Descriptive Equivalent
1.	I set goals for myself	0.65	3.53	Very High
2.	I finish tasks even if they are hard for me	0.65	3.37	Very High
3.	I plan so I can turn a project in on time	0.63	3.32	Very High
4.	I stay focused in class even when there are distractions	0.68	3.27	Very High
5.	I finish my projects without reminders	0.73	3.22	High
Category Mean		**0.67**	**3.34**	**Very High**

The computed mean for learners' self-management under the social-emotional learning framework was 3.34, which corresponds to a very high descriptive classification. This indicates that students strongly manifested competencies related to self-management. The associated standard deviation (SD = 0.67) reflects low variability, suggesting that responses were closely distributed around the mean. Such limited dispersion demonstrates a consistent pattern in learners' self-evaluations of their ability to regulate and manage their behaviors.

Self-management is regarded as a critical component of SEL because it encompasses skills that individuals can consciously regulate and develop. Durlak et al. (2017) identified these competencies as including stress regulation, organizational skills, self-discipline, and intrinsic motivation. Similarly, CASEL (2023) emphasized that these foundational abilities support the attainment of both personal and collective goals. Self-management further involves adaptive strategies such as delaying gratification, managing stress effectively, controlling impulses, and sustaining perseverance in the face of challenges. However, Abrahams et al. (2019) noted that despite its conceptual clarity, self-management—along with broader social-emotional competencies—remains complex in terms of definition and measurement, as its dimensions may vary considerably. Such variability can contribute to challenges in accurate understanding and practical application.

Table XIII
Level of Social-Emotional Learning Skills of Students in terms of Relationship Skills

	Items	SD	Mean	Descriptive Equivalent
1.	I respect a classmate's opinions during a disagreement	0.67	3.44	Very High
2.	I get along with my classmates	0.65	3.31	Very High
3.	I share what I am feeling with others	0.75	3.21	High
4.	I talk to an adult when I have problems at school	0.82	3.11	High
5.	I welcome someone I don't usually eat lunch with	0.64	3.35	Very High
6.	I get along with my teachers	0.69	3.32	Very High
Category Mean		**0.70**	**3.29**	**Very High**

An overall mean of 3.29 was obtained for social-emotional learning competencies under the dimension of relationship skills. This value corresponds to a Very High descriptive rating, indicating that students strongly demonstrated interpersonal and relational skills. The standard deviation (SD = 0.70) suggests limited variability in responses, reflecting a narrow distribution of scores. This pattern signifies that students' self-perceived relationship competencies were largely aligned with the group average.

These findings highlight the importance of relationship skills in fostering constructive and respectful interactions. Mantz et al. (2018) emphasized that developing such competencies is fundamental to building

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meaningful personal and professional connections grounded in mutual understanding. Extending this perspective to the educational context, Gimbert et al. (2021) asserted that relationship skills enable both teachers and students to establish and sustain positive, healthy interactions within socially appropriate frameworks. Strengthening these competencies, therefore, contributes to a supportive learning environment conducive to collaboration and shared growth.

Table XIV
Level of Social-Emotional Learning Skills of Students in terms of Responsible Decision- Making

	Items	SD	Mean	Descriptive Equivalent
1.	I think about what might happen before making a decision	0.61	3.67	Very High
2.	I know what is right or wrong	0.62	3.53	Very High
3.	I think of different ways to solve a problem	0.58	3.44	Very High
4.	I say "no" to a friend who wants to break the rules	0.57	3.53	Very High
5.	I help to make my school a better place	0.61	3.53	Very High
Category Mean		**0.60**	**3.54**	**Very High**

The computed mean for learners' responsible decision-making under social-emotional learning was 3.54, corresponding to a Very High descriptive classification. This indicates that students demonstrated strong competencies in making thoughtful and constructive decisions. The standard deviation (SD = 0.60) reflects minimal dispersion, suggesting that responses were highly concentrated around the mean. Such a narrow spread of scores signifies substantial agreement among students regarding their responsible decision-making abilities.

This finding underscores the central role of prudent and reflective decision-making in the learning process. The influence of social-emotional learning extends beyond academic achievement to broader life outcomes, including health, well-being, and long-term success. Soto et al. (2021) observed that individuals with well-developed social-emotional competencies tend to perform better across academic, occupational, and interpersonal domains. Similarly, Collie (2020) emphasized that responsible decision-making involves regulating behavior toward goal attainment, managing emotions effectively, and maintaining positive relationships. Shi et al. (2022) further highlighted the importance of balancing emotional and cognitive development, while Schoon (2021) noted that integrating these competencies supports adaptability, creative problem-solving, and effective communication across diverse contexts.

Table XV
Summary on the Level of Social-Emotional Learning Skills of Students

	Indicators	SD	Mean	Descriptive Equivalent
1.	Self-Awareness	0.64	3.42	Very High
2.	Social-Awareness	0.65	3.34	Very High
3.	Self-Management	0.67	3.34	Very High
4.	Relationship Skills	0.70	3.29	Very High
5.	Responsible Decision Making	0.60	3.54	Very High
Overall Mean		**0.65**	**3.39**	**Very High**

The analysis revealed an overall mean score of 3.39 for students' social-emotional learning (SEL) skills, reflecting a high level of competence in this area. This indicates that students exhibited well-developed social-emotional abilities within the learning context. The standard deviation (SD = 0.65) suggests minimal variability in responses, meaning that individual ratings were closely clustered around the mean. Such limited dispersion demonstrates a strong level of consistency among students in their self-assessed social-emotional learning skills.

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This finding underscores the significance of social-emotional competencies in fostering both academic achievement and personal growth. Research has shown that students' social and emotional learning skills are essential for long-term success, particularly in addressing challenges within science-related settings [20]. Moreover, Chung et al. (2020) emphasized that the development of SEL skills enhances students' social-emotional growth and increases their engagement in academic tasks. Taken together, these findings indicate that integrating social-emotional learning into science education, particularly through the Problem-Based Learning (PBL) framework, constitutes an effective approach to improving student outcomes.

Table XVI
Significance of the Relationship between the Variables

Variables Correlated	r-value	p-value	Decision on H_0	Decision on Relationship
Project-Based Learning and Engagement in Science	0.756	.001	Reject	Significant
Social-emotional Learning Skills and Engagement in Science	0.511	.001	Reject	Significant
Project-Based Learning and Social-emotional Learning Skills	0.540	.001	Reject	Significant

The test of the significance of the relationships among project-based learning (PBL), social-emotional learning (SEL) skills, and student engagement in science revealed statistically significant results. Project-based learning and student engagement obtained an r-value of 0.756 and a p-value of 0.001 ($p < .05$), while SEL skills and student engagement showed an r-value of 0.511 and a p-value of 0.001 ($p < .05$); thus, the null hypotheses were rejected. Additionally, PBL and SEL skills yielded an r-value of 0.540 and a p-value of 0.001 ($p < .05$), indicating a significant relationship. These findings suggest that higher levels of PBL and stronger SEL skills are associated with increased student engagement in science.

These findings align with prior research. Chung et al. (2020) asserted that project-based learning promotes active involvement in science instruction. Kilby (2022) likewise found that PBL enhances student motivation and supports social-emotional development. Furthermore, Mayer (2023) emphasized the pivotal role of social-emotional learning in maintaining student engagement, while Qu Liaojian et al. (2022) reported that SEL strengthens emotional preparedness and collaborative capacity during academic tasks. Jenaabadi and Azarian (2023) also established that SEL competencies serve as predictors of behavioral, cognitive, and emotional engagement. Additionally, Jagers et al. (2019) highlighted that embedding SEL in classroom instruction fosters emotional regulation and constructive classroom interactions, thereby supporting meaningful science learning experiences.

Table XVII
Steps in Mediation Analysis

Independent Variable	**Project-Based Learning**
Dependent Variable	**Student Engagement**
Mediating Variable	**Social-Emotional Learning Skills**
Step 1. Path C (IV and DV)	
Unstandardized Beta (B)	0.736
Standard Error (e)	0.062
p-value	<0.001
Step 2. Path B (MV and DV)	
Unstandardized Beta (B)	0.205
Standard Error (e)	0.080
p-value	0.011

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Step 3. Path A (IV and MV)	
Unstandardized Beta (B)	*0.416*
Standard Error (e)	0.049
p-value	<0.001
Step 4. Combined Influence of IV and MV on DV	
Project-Based Learning	
Unstandardized Beta (B)	0.736
Standard Error (e)	0.063
Standardized Beta	0.677
Part Correlation	0.570
Total R-square	0.586
Social Emotional Learning Skills	
Unstandardized Beta (B)	0.205
Standard Error (e)	0.081
Standardized Beta	0.146
Part Correlation	0.123
Total R-Square	0.586

Table 17 presents the results of the mediation analysis examining project-based learning (PBL) as a predictor of students' engagement in science, with social-emotional learning (SEL) skills serving as the mediating variable. Prior to analysis, the assumptions of normality and absence of multicollinearity were confirmed to be satisfied. Mediation analysis determines whether the effect of an independent variable on a dependent variable is transmitted through a third variable [30]. In this study, it was hypothesized that PBL positively predicts student engagement in science and that SEL skills mediate this relationship. A series of regression analyses was conducted: Path a represented the effect of PBL on SEL; Path b represented the effect of SEL on engagement; and Path c represented the direct effect of PBL on engagement when controlling for SEL. The indirect effect corresponded to the portion of the relationship transmitted through SEL, while the total effect reflected the sum of both direct and indirect effects.

The findings revealed that PBL significantly predicted student engagement ($\beta = 0.736$, $p < 0.05$; $B = 0.736$, $p < 0.001$). SEL skills also significantly predicted engagement ($\beta = 0.205$, $p < 0.05$; $B = 0.205$, $p = 0.011$), even after controlling for PBL, thereby meeting a key condition for mediation. Additionally, PBL significantly predicted SEL skills ($\beta = 0.416$, $p < 0.05$; $B = 0.416$, $p < 0.001$). When both PBL and SEL were entered simultaneously into the regression model, each remained a significant predictor of student engagement. The total coefficient of determination ($R^2 = 0.586$) indicates that approximately 59% of the variance in student engagement is explained by the combined influence of PBL and SEL skills.

Table XVIII
Mediating Effect of Social Emotional Learning Skills on the Relationship between Project-Based Learning and Student Engagement

Type of Mediation: Partial			
	Significant		
Sobel z-value	2.445N		*p*= **0.014**
95% Symmetrical Confidence Interval			
	Lower	0.017	
	Higher	0.154	
Unstandardized Indirect Effect			
	a*b	0.085	
	SE	0.035	

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Effect Size Measures			
	Standardized Coefficients		**R^2 measures** (Variance)
Total:	0.821	Mediator (SEL)	0.586
Direct:	0.736	Dependent (SE)	0.291
Indirect:	0.085		
Indirect to Total Ratio: 0.1035/ 10.35%	0.1035 or 10.35% of the total effect is mediated through SEL		

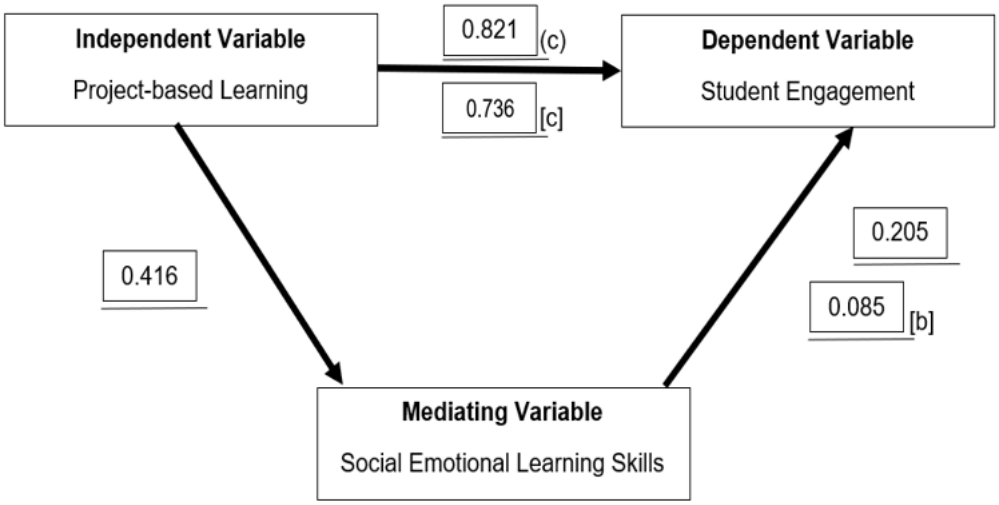

Figure 3. Sobel Test for the Significance of Mediation Effect

To further determine the significance of the mediation effect, a Sobel test was performed after establishing significant relationships across the three regression paths. According to Baron and Kenny (1986), partial mediation is present when the relationship between the independent and dependent variables remains statistically significant but is reduced in magnitude upon the inclusion of a mediating variable. Table 18 and Figure 3 illustrate the mediation results derived from the Sobel test, which was employed to ascertain whether the mediation was partial or full.

The findings indicate that incorporating Social-Emotional Learning (SEL) skills into the model reduced the direct effect of Project-Based Learning (PBL) on student engagement from 0.821 to 0.736, while the direct effect remained statistically significant ($p < .001$). The Sobel test further confirmed the presence of a significant indirect effect ($z = 2.445$, $p = 0.014$), thereby supporting partial mediation. The calculated indirect effect ($a \times b = 0.085$), obtained from the path coefficients of PBL to SEL ($a = 0.416$) and SEL to engagement ($b = 0.205$), provides additional evidence that SEL skills partially mediate the relationship between PBL and student engagement.

These results suggest that social-emotional learning skills function as a contributory mechanism through which project-based learning enhances student engagement. This outcome is consistent with the concept of partial mediation, wherein an independent variable influences a dependent variable both directly and indirectly through a mediating factor (James & Brett, 1984).

IV. CONCLUSION

Project-based learning among Grade 10 students in Tagum City occurred occasionally, yet student engagement was evident most of the time and social-emotional learning skills were highly apparent in science classrooms. Results revealed significant relationships among project-based learning, social-emotional learning skills, and student engagement. Project-based learning significantly predicted engagement ($B = 0.821$, $p < 0.001$) and social-emotional learning skills ($B = 0.205$, $p = 0.011$), while social-emotional learning skills significantly predicted engagement ($B = 0.416$, $p < 0.001$). Further analysis showed that social-emotional learning skills

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partially mediated the relationship between project-based learning and student engagement ($z = 2.445$, $p < 0.05$), although project-based learning also had a direct significant effect on engagement. These findings underscore the importance of integrating project-based learning and social-emotional learning skills to enhance student engagement in science.

V. RECOMMENDATION

Based on the findings of the study, several recommendations are proposed. Students are encouraged to actively participate in project-based learning not only to improve academic performance in science but also to strengthen their social-emotional learning skills, which significantly enhance engagement. Teachers are advised to intentionally integrate social-emotional learning within project-based learning by emphasizing collaboration, self-management, and reflective processes alongside scientific outputs. School administrators may support this integration through professional development initiatives, flexible learning structures, and adequate resources that promote sustained inquiry and collaborative work. DepEd officials may consider aligning science competencies with social-emotional learning standards and encouraging the structured implementation of project-based learning to address engagement concerns in science education. Finally, future researchers are encouraged to examine additional variables influencing student engagement and to conduct longitudinal and expanded studies to further validate and extend the present findings.

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