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Influence of STEAM (Science, Technology, Engineering, Arts and Mathematics) Integration and Teaching Approaches on Pupils' Engagement

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Abstract

This study examined how teachers' STEAM integration and English teaching approaches influenced the learning engagement of Grade 3 pupils in selected public elementary schools in the Division of Butuan City during the school year 2025–2026. Anchored on Kolb's (1984) Experiential Learning Theory, Fredricks, Blumenfeld and Paris' (2004) Student Engagement Theory, and Bandura's Social Cognitive Theory, the study employed a descriptive-correlational research design. Data were gathered from 200 Grade 3 pupils through structured survey questionnaires measuring STEAM integration, English teaching approaches, and pupils' behavioral, emotional, and cognitive engagement. The instruments were validated, pilot-tested, and analyzed using descriptive statistics and multiple regression analysis. Findings revealed that teachers' STEAM integration in English classes was highly implemented, with an overall mean of 4.22, while English teaching approaches were also rated high, with an overall mean of 4.36. Pupils' learning engagement was likewise high, with an overall mean of 4.45. Regression results showed that STEAM integration and teaching approaches significantly influenced learning engagement, $F(2, 197) = 67.529$, $p < .001$, explaining 40.1% of the variance. Teaching approaches emerged as the stronger predictor. The study concluded that well-designed interdisciplinary and learner-centered English instruction supports pupils' active participation, positive learning attitudes, and cognitive involvement. The study aligns with SDG 4 by supporting inclusive, equitable, and quality education through improved classroom instruction. Its sustainability impact lies in strengthening educational, technological, and institutional practices that promote engaging, innovative, and responsive learning environments.

Keywords: Behavioral Engagement, English Teaching Approaches, Grade 3 Pupils, Learning Engagement, Public Elementary Schools, STEAM Integration, Sustainability

1. Introduction

Science, Technology, Engineering, Arts and Mathematics (STEAM) integration in elementary education provides an interdisciplinary approach that connects scientific inquiry, digital competence, engineering design, creativity, and mathematical reasoning. In English lessons, this study examines how teachers' STEAM integration and English teaching approaches influence pupils' behavioral, affective, and cognitive engagement. The study responds to classroom observations of passive and inactive learners in selected public elementary schools in the Division of Butuan City by exploring how integrated and learner-centered instruction may promote more meaningful participation, motivation, and understanding.

1.1 STEAM Integration and English Teaching Approaches in Public Elementary Learning

STEAM education equips young learners with competencies needed for 21st-century learning. Science develops understanding of the natural world (Demir et al., 2022), Technology prepares learners for digital participation (Lu et al., 2022), Engineering strengthens design-based problem-solving, Arts promotes creativity and self-expression (Johnson et al., 2022), and Mathematics supports logical and analytical thinking (Cunningham et al., 2021). When these areas are integrated, instruction becomes more connected to real-life learning and helps pupils develop problem-solving, creativity, and innovation. Effective STEAM integration requires a shift from traditional instruction to hands-on, inquiry-based, collaborative, and experiential learning. These approaches allow pupils to explore, experiment, and create, making learning more meaningful and responsive to their needs (Lee et al., 2021). Since engaged pupils are more likely to understand and retain lessons (Wang et al., 2023), active participation, curiosity, persistence, and classroom interaction are essential to meaningful learning (Chen et al., 2023). Globally, education systems increasingly support interdisciplinary learning to prepare pupils for complex, technology-rich environments. Integrated STEAM programs promote creativity, critical thinking, collaboration, motivation, problem-solving, and persistence (OECD, 2021; UNESCO, 2022; Li & Wang, 2024). Post-pandemic learning gaps also show the need for blended STEAM activities that can re-engage learners more effectively than lecture-based remediation (Gonzalez et al., 2023; Patel & Robinson, 2025). In the Philippines, learner-centered and competency-based instruction is supported by the DepEd K to 12 Curriculum Framework, related memoranda, DepEd

Order No. 31, s. 2013-013, DepEd policy updates (2022-2025), and the DepEd Policy Framework (2012-2017). However, gaps in science and mathematics performance and uneven adoption of innovative practices remain evident across school contexts (Reyes & dela Cruz, 2023; DepEd, 2024; Santiago et al., 2024; Quezon City Division Report, 2025).

1.2 Related Literature on STEAM Integration, English Instruction, and Pupils' Engagement

Learning engagement is a multidimensional construct involving behavioral, emotional, and cognitive participation. Fredricks, Blumenfeld, and Paris (2004) explain that behavioral engagement refers to participation and involvement in tasks, emotional engagement involves interest and positive responses to learning, and cognitive engagement refers to deep thinking, strategy use, and self-regulation. In this study, pupils' engagement is similarly viewed through behavioral, emotional, and cognitive dimensions (Wang et al., 2021; Skinner et al., 2022; Greene et al., 2020). Motivation is also central to engagement because it influences whether pupils begin, continue, and complete learning tasks (Schunk, Pintrich, and Meece, 2022). STEAM integration has been associated with improved engagement and academic performance (e.g., Bybee, 2013; Quigley & Herro, 2016; Kang, 2019). In the Philippine setting, DepEd (2024) promotes learner-centered and holistic learning through the MATATAG curriculum framework. Teacher expectations and classroom relationships further influence participation, compliance, and persistence (Dela Cruz & Santos, 2021; Wang, Chow, and Li, 2020), while reflective practice strengthens cognitive engagement and adaptability in language learning (Tupas, 2021). STEAM integration responds to the need for interdisciplinary learning in a globalized and technology-driven society. UNESCO (2023) highlights the importance of technology and interdisciplinary education, while Bybee (2021) explains that the shift from STEM to STEAM addresses the need for creativity and broader learner engagement. Engineering and Arts support communication, design thinking, and creative problem-solving (Wendell & Rogers, 2023), but implementation challenges remain, especially in Philippine public schools where ICT access, resources, and teacher preparedness remain concerns (Llego, 2024). The reviewed literature also emphasizes the value of connecting literacy with STEAM. Cognitive, social, and emotional development are interconnected (Darling-Hammond et al., 2022), and reading and writing can serve as tools for scientific inquiry (Akerson, 2020). Teachers recognize the benefits of interdisciplinary instruction but may face challenges related to time, curriculum flexibility, and professional development (Gondao and Paglinawan, 2025). Disciplinary literacy, vocabulary, and comprehension also support pupils' ability to understand scientific and technical concepts (Shanahan & Shanahan, 2020; Nagy & Townsend, 2021; Snow, 2017). Technology further strengthens STEAM and English instruction when used meaningfully. Mayer's (2021) cognitive theory of multimedia learning emphasizes that students learn better from words and pictures than from words alone. Digital tools and multimedia resources, including Science A-Z (2024), the National Geographic Society (2024), and DepEd learning resources (DepEd, 2024), support multimodal learning. However, technology integration requires infrastructure, equity, curriculum alignment, and teacher digital pedagogy (UNESCO, 2023; OECD, 2022; Voogt & Knezek, 2022). Project-based learning, audiovisual tools, and ICT-supported instruction may improve inquiry, metacognition, interdisciplinary learning, and student engagement (Krajcik & Shin, 2023; Goh & Vandergrift, 2021; Caballes and Torres, 2023; Domingo, 2024; Llego, 2024). Engineering, Arts, and Mathematics also enrich STEAM-based learning. Engineering supports real-world problem-solving, design, literacy, and communication (Bybee, 2021; English & King, 2022; Wendell & Rogers, 2023; Krajcik & Shin, 2023; Duke & Roberts, 2023; Nagy & Townsend, 2021; Snow, 2017; OECD, 2023; UNESCO, 2023; DepEd, 2024). Arts integration strengthens creativity, cultural responsiveness, literacy, and multiple forms of expression (Bresler, 2021; Donahue & Stuart, 2022; DepEd, 2024; Tan, 2022). Mathematics integration supports inclusion, language development, conceptual understanding, and real-world application, especially when instruction uses language support, authentic contexts, and functional communication (UNESCO Global Education Monitoring Report, 2020; Walsh & Baynham, 2021; Rittle-Johnson, Fyfe, and Loehr, 2020; Desiatin & Mendoza, 2021). English teaching approaches in this study include reading and literature, writing, and language arts integration and assessment. Effective reading instruction depends on explicit strategies, comprehension monitoring, and metacognitive support (Peng et al., 2024; Reed et al., 2022). Writing improves through structured, targeted, and accessible instruction (Graham et al., 2018; Rodgers & Loveall, 2023). Integrated reading and writing tasks strengthen literacy because pupils connect comprehension with written production (Lee, 2022). Formative assessment, feedback, drafting, revision, and digital writing tools further support literacy development (Skar et al., 2022; Smith, Rowland, & Lowrey, 2023).

1.3 Global, National, and Local Context of STEAM-Based English Learning

At the global level, STEAM integration reflects the need for interdisciplinary, creative, and technology-rich education that prepares learners for future work and real-world problem-solving (UNESCO, 2023; OECD, 2022; OECD, 2023). At the national level, Philippine education reforms such as the MATATAG curriculum and Digital Rise Program support ICT use, digital literacy, learner-centered instruction, and STEAM integration (DepEd, 2024). However, implementation remains affected by resource gaps, ICT access, teacher preparedness, and curriculum constraints (Llego, 2024; Tan, 2022; Gondao and Paglinawan, 2025). At the local level, this study is situated in selected public elementary schools in the Division of Butuan City during the school year 2025-2026. It focuses on public elementary learners in English lessons and examines teachers' STEAM integration, their use of reading and literature, writing, and language arts integration and assessment, and pupils' behavioral, affective, and cognitive engagement. The study is grounded in observed pupil passivity and seeks to determine whether STEAM-based and learner-centered English instruction can improve engagement.

1.4 Theoretical and Conceptual Basis of STEAM Integration, Teaching Approaches, and Learning Engagement

This study is anchored on Kolb's (1984) Experiential Learning Theory, which emphasizes learning through concrete experience, reflection, conceptualization, and experimentation. STEAM education reflects this theory through hands-on experimentation, design processes, and project-based tasks (Morris, 2020; Katz-Buonincontro & Anderson, 2022). Dewey (1997) also supports meaningful learning through experience and active participation. Fredricks, Blumenfeld and Paris (2004) Student Engagement Theory guides the study by explaining that meaningful learning requires behavioral, cognitive, and emotional engagement. Bandura's Social Cognitive Theory further supports the study by linking environment, personal factors, and behavior. In this context, teaching strategies serve as environmental factors that may influence pupils' self-efficacy and engagement (Schunk & DiBenedetto, 2020; Luo et al., 2021). Conceptually, the first independent variable is STEAM Integration, composed of Science, Technology, Engineering, Arts, and Mathematics (Demir et al., 2022; Lu et al., 2022; Henriksen et al., 2021; Liao et al., 2022; Cunningham et al., 2021). The second independent variable is teaching approaches, composed of reading and literature, writing, and language arts integration and assessment. The dependent variable is pupils' learning engagement, measured through behavioral, affective/emotional, and cognitive domains (Wang et al., 2021; Skinner et al., 2022; Greene et al., 2020). The study assumes that STEAM integration and English teaching approaches may make lessons more tangible, creative, relevant, and interactive, thereby improving pupils' engagement (Harris & de Bruin, 2023; Costantino, 2021; Luo et al., 2021; Wu & Anderson, 2022).

1.5 Research Gap and Rationale for Examining Pupils' Engagement in English Lessons

Although studies support STEAM integration and learner-centered English teaching approaches, limited research has examined their combined influence on pupils' learning engagement in elementary English classrooms, particularly in the local context. Existing literature shows that STEAM promotes creativity, collaboration, critical thinking, communication, and problem-solving, while English teaching approaches strengthen reading, writing, language development, and formative assessment. However, the relationship among STEAM integration, teaching approaches, and behavioral, affective, and cognitive engagement remains insufficiently explored among public elementary learners. This study was conducted to address this gap by examining whether teachers' STEAM integration and English teaching approaches significantly influence pupils' learning engagement. Using a descriptive-correlational design, the study focuses on selected public elementary schools in the Division of Butuan City and seeks to provide evidence on how these variables interact in English instruction.

1.6 Alignment of STEAM-Based English Instruction with Relevant Sustainable Development Goals (SDGs)

This study aligns primarily with Sustainable Development Goal 4 (SDG 4), which promotes inclusive and equitable quality education and lifelong learning opportunities for all. By examining STEAM integration and English teaching approaches, the study supports the improvement of instruction that promotes active learning, creativity, collaboration, communication, problem-solving, and meaningful engagement among public elementary learners. The study also connects with innovation and digital learning because STEAM includes Technology and Engineering, while the literature emphasizes ICT integration, multimedia learning, digital literacy, and the DepEd Digital Rise Program. These links support educational, technological, and inclusive learning goals, but only within the scope of improving classroom teaching and pupil engagement.

1.7 Importance of the Study to Educational, Technological, and Institutional Sustainability

The study contributes to educational sustainability by supporting teaching practices that may improve pupil engagement, participation, and lifelong learning. It may help teachers design English lessons that combine STEAM tasks with reading, writing, language arts integration, and assessment. It may also benefit pupils by providing more meaningful and enjoyable learning experiences that develop curiosity, creativity, communication, problem-solving, and self-confidence. The study also supports institutional and technological sustainability by providing school administrators and teacher education institutions with evidence for STEAM initiatives, professional development, and curriculum improvement. Overall, the study connects education, technology, creativity, literacy, and learner engagement, contributing to a more responsive and innovative model of instruction for public elementary classrooms.

2. Material and methods

2.1 Research Design

This study employed a descriptive-correlational research design to investigate the relationship among three main variables: STEAM integration in English teaching, pedagogical approaches, and engagement of public elementary school pupils. Creswell (2014) states that correlational research is a quantitative method used to measure the strength of relationships between two or more variables without manipulating them. Survey questionnaires were used to gather data and identify meaningful patterns among the variables. Descriptive statistics were used to describe the baseline levels of STEAM integration, teaching approaches, and learner engagement, while multiple regression analysis was used to determine the predictive influence of STEAM integration and teaching approaches on pupils' engagement.

2.2 Locale of the Study

The study was conducted in selected public elementary schools in the Division of Butuan City during the school year 2025–2026. A pilot test of the research instruments was conducted in a selected school in the Southwest District of Butuan City Division before the actual data collection.

2.3 Respondents of the Study

The respondents of the study were 200 Grade 3 pupils from public elementary schools in the Division of Butuan City for the school year 2025–2026. The respondents participated by answering structured survey questionnaires designed to gather their perceptions of classroom STEAM integration, teachers' instructional methods, and their levels of behavioral, emotional, and cognitive engagement during English classes.

2.4 Sample and Sampling Procedure

The study used random selection to identify 200 Grade 3 pupils from the selected public elementary schools. Inclusion and exclusion criteria were applied to ensure the appropriateness and consistency of the sample. Included participants were officially enrolled Grade 3 pupils, regularly attended English classes, were able to answer the survey questionnaire with minimal assistance, had parental or guardian consent, and gave assent to participate. Excluded were pupils who were not officially enrolled in Grade 3, had irregular attendance, were absent during data collection, had conditions that could affect their ability to understand or answer the instruments even with support, refused to participate, or lacked parental or guardian permission.

2.5 Research Instrument

The researcher used three survey questionnaires to collect quantitative data on the level of teachers' STEAM integration in English teaching, the pedagogical aspects of STEAM integration, and pupils' engagement in STEAM-integrated English lessons. The STEAM integration questionnaire was modified from the conceptualization of STEAM as an integrative approach proposed by Yakman and Lee (2012), where Science, Technology, Engineering, Arts, and Mathematics are integrated with English in meaningful learning activities. The questionnaire indicators were selected based on literature and empirical studies related to STEAM integration, teaching approaches, and learner engagement. The instruments were content validated and face validated by experts in education and research methodology. They were also pilot-tested to establish validity and reliability. The panel's comments, corrections, and suggestions were incorporated into the revised instruments. The pilot data were analyzed for internal consistency using Cronbach's Alpha Coefficient before the actual data collection. Confirmatory Factor Analysis was also used to examine construct validity. The analysis covered the constructs of Science Integration, Technology Integration, Engineering Integration, Arts Integration, Mathematics Integration, Behaviorist Approach, Constructivist Approach, Humanist Approach, Behavioral Engagement, Emotional Engagement, and Cognitive Engagement. The retained items showed acceptable factor loadings and supported the fit of the indicators to their respective latent constructs. The analysis also showed meaningful relationships among the constructs, strengthening the coherence of the conceptual framework. The model fit was assessed using several indices, including CMIN/DF, Comparative Fit Index, Standardized Root Mean Square Residual, Root Mean Square Error of Approximation, and PClose. The results indicated excellent model fit, supporting the construct validity of the variables measured. The fit indices were interpreted using established cutoff criteria from Hu and Bentler (1999). These findings confirmed that the instruments were adequate for measuring the study variables and suitable for further statistical analysis. The survey used a standard 5-point Likert scale ranging from 5, interpreted as Always or Very High, to 1, interpreted as Never or Very Low. The scale allowed pupils to report their experiences and perceptions regarding STEAM integration, teaching approaches, and learning engagement.

2.6 Data Gathering Procedure

Before data collection, the researcher followed the research ethics guidelines of Lourdes College. After the instruments were validated, a certificate of compliance was obtained from the institution's Research Ethics Committee. This ethical clearance allowed the researcher to secure formal approval from the Butuan City Schools Division Superintendent to conduct the study in public elementary schools in Butuan City. Approval was also obtained from the school heads of the participating schools. After securing the required permissions, the researcher met with the participants, introduced the study, explained its goals, and discussed its possible benefits to school stakeholders. Participants were given printed informed assent forms explaining the purpose of the study and possible psychological or social risks. They were informed that participation was voluntary, that they could withdraw at any time without consequences, and that their identities and responses would be kept confidential and anonymous to the greatest extent possible. The survey was administered in a relaxed and natural setting to encourage authentic responses. After completion, each participant received a token of appreciation for their time and cooperation.

2.7 Data Analysis Techniques

The gathered data were analyzed using descriptive and inferential statistics. Frequency, mean, percentage, and standard deviation were used to describe the levels of STEAM integration, teaching approaches, and pupils' learning engagement for the first three research problems. Regression analysis was used for the fourth research problem to determine which indicators of STEAM integration and teaching approaches, either separately or combined, significantly influenced pupils' learning engagement. Before regression analysis, the assumptions of normality of residuals, linearity, homoscedasticity, and absence of multicollinearity were checked to ensure the validity and suitability of the statistical results.

2.8 Ethical Considerations

The study observed the ethical principles of the Belmont Report: Respect for Persons, Beneficence, and Justice. In 1979, the Belmont Report was issued by the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research and has remained a cornerstone of human subject research. Consistent with these principles, participants were given sufficient information to decide whether to participate, and their participation remained voluntary. Respect for persons was observed by protecting the autonomy and dignity of the pupils. Informed assent from the pupils and informed consent from their parents or guardians were secured before participation. Beneficence was observed by designing the research instruments and procedures to minimize possible psychological, emotional, or academic discomfort. Data collection was conducted in a safe and supportive classroom setting. Justice was observed by selecting participants fairly based on the inclusion criteria, ensuring that eligible pupils had equal opportunity to participate and that no group was unduly burdened or excluded from the possible benefits of the research.

3. Results and Discussion

3.1 Teachers' STEAM Integration in English Classes

3.1.1 Science Integration in English Classes

The participants assessed their teachers' integration of Science in English classes as high, with an overall mean of 4.23 and a standard deviation of 0.48. Most participants rated the integration as high at 67.50%, while 21.00% rated it very high. Among the indicators, watching science videos and explaining what was learned in English obtained the highest mean of 4.43, followed by reading about growth, movement, and change with a mean of 4.24, discussing plants, animals, and weather with a mean of 4.22, and using science words such as "life cycle," "evaporation," and "magnet" with a mean of 4.04. These results indicate that teachers frequently integrate scientific concepts into English instruction through videos, discussions, readings, and vocabulary development. This supports interdisciplinary learning because pupils use English to describe observations, formulate ideas, and communicate scientific understanding. The finding is supported by evidence that English lessons embedded with scientific inquiry develop both language proficiency and analytical thinking (Education Bureau, 2024). It also aligns with Akerson (2020), who noted that interdisciplinary language arts and science learning strengthens scientific reasoning and literacy. The use of videos further supports Mayer (2021), while multimedia resources such as Science A-Z (2024), National Geographic Society (2024), and DepEd (2024) show how visual and interactive materials can promote science and language learning. Contextualized science topics also support retention and transfer of learning (Darling-Hammond et al., 2022; Bransford et al., 2000), while informational texts and science vocabulary strengthen literacy and comprehension (Shanahan & Shanahan, 2020; Fang & Schleppegrell, 2010; Nagy & Townsend, 2021).

3.1.2 Technology Integration in English Classes

The participants assessed their teachers' technology integration in English classes as high, with an overall mean of 4.05 and a standard deviation of 0.62. More than half of the participants rated it high at 56.50%, while 26.00% rated it very high. The highest-rated practice was the use of animated or interactive English lessons with a mean of 4.22, followed by using tablets or computers to make stories, slides, or posters with a mean of 4.01. Listening to recorded stories or lessons using speakers or headphones obtained the lowest mean of 3.91 but was still described as often practiced. The findings show that teachers frequently use digital resources to make English lessons more engaging and multimodal. Technology supports language learning by providing visual, auditory, and interactive experiences that may improve comprehension and participation. This finding is supported by Wang (2024), who stated that technology is an important part of English language teaching because it expands learning opportunities and encourages engagement. It is also consistent with the Department of Education's goal of strengthening digital literacy through the Digital Rise Program and MATATAG curriculum (Department of Education, 2024). The use of multimedia is aligned with Mayer's (2021) Cognitive Theory of Multimodal Learning and with inclusive education practices in the Philippine context (Llego, 2024). Technology-rich project-based learning also supports critical thinking, creativity, and interdisciplinary competence (OECD, 2022; Krajcik & Shin, 2023), while audio-assisted learning supports listening and comprehension (Vandergrift & Goh, 2012). Overall, the result reflects the global trend of linking technology, literacy, and content learning (UNESCO, 2023; Voogt & Knezek, 2022).

3.1.3 Engineering Integration in English Classes

The participants assessed their teachers' integration of Engineering in English classes as high, with an overall mean of 4.31 and a standard deviation of 0.49. The majority rated this area high at 61.00%, while 29.50% rated it very high, and no participants rated it low or very low. The highest-rated indicator was learning to follow step-by-step directions in English, with a mean of 4.58 and a description of always. Other indicators were also rated often, including following English instructions to build classroom materials with a mean of 4.24, connecting English lessons to real-life topics such as riding a jeepney or building a house with a mean of 4.24, and explaining how simple machines work using words such as "push" and "pull" with a mean of 4.19. The results suggest that Engineering integration is strongly evident in English instruction through procedural literacy, hands-on tasks, real-life examples, and problem-solving activities. These practices help pupils connect language learning with design, construction, and practical reasoning. This finding supports Laksmiwati et al. (2024), who demonstrated that engineering design within STEAM promotes interdisciplinary thinking and authentic communication. It also aligns with English & King (2022), who emphasized that engineering design challenges improve literacy and interdisciplinary competence, and Wendell & Rogers (2023), who noted that early engineering experiences develop the communication of technical concepts. The use of step-by-step directions supports procedural literacy and cognitive organization (Bybee, 2021; Duke & Roberts, 2023), while project-based engineering activities support engagement and collaboration (OECD, 2023; Krajcik & Shin, 2023). The use of engineering vocabulary in real-world contexts is also supported by Nagy & Townsend, 2021; Snow, 2017 and UNESCO (2023).

3.1.4 Arts Integration in English Classes

The participants assessed their teachers' integration of Arts in English classes as high, with an overall mean of 4.24 and a standard deviation of 0.54. Most respondents rated this area high at 57.00%, while 27.50% rated it very high. The highest-rated indicator was drawing pictures about stories to support understanding, with a mean of 4.42. Acting out stories or scenes followed with a mean of 4.31, describing colors, shapes, and designs using English words had a mean of 4.21, and using coloring apps for English lessons had a mean of 4.02. All indicators were described as often practiced. The findings indicate that Arts integration is a visible and regular feature of English instruction. Teachers use drawing, dramatization, visual design, coloring applications, and descriptive language to help pupils understand texts and express ideas creatively. This suggests that English lessons are enriched through creative and expressive approaches rather than limited to traditional literacy activities. The finding is supported by Huang et al. (2025), who found that combining picture books and STEAM activities improved learners' motivation, creativity, and English language outcomes. It also aligns with Bresler (2021), who emphasized the role of arts in multimodal learning, and Donahue & Stuart (2022), who explained how arts support language learning through expression, imagination, and meaningful communication. The integration of Arts is also consistent with the DepEd (2024) K-to-12 and MATATAG curriculum frameworks. However, limited resources and facilities may affect the full implementation of arts-based approaches (Tan, 2022). Overall, the findings support the value of arts-based approaches in improving motivation, engagement, and learning experiences (Niemi & Multisilta, 2021; Upitis, 2022).

3.1.5 Mathematics Integration in English Classes

The participants assessed their teachers' Mathematics integration in English classes as high, with an overall mean of 4.23 and a standard deviation of 0.52. A total of 54.00% of the participants rated it high, while 36.00% rated it very high, showing that 90.00% perceived Mathematics integration as regularly practiced. The highest-rated indicator was comparing sizes, lengths, or amounts and describing them in English, with a mean of 4.30. This was followed by learning English words about money, saving, and spending with a mean of 4.26, explaining math answers using English sentences with a mean of 4.24, talking about patterns and sequences with a mean of 4.22, and writing stories using time words with a mean of 4.14. These results indicate that teachers integrate Mathematics into English lessons through vocabulary, comparison, sequencing, measurement, time expressions, and explanation of answers. This practice helps pupils develop both numeracy and language skills. Education Bureau (2024) explained that Mathematics integration in English promotes numeracy through authentic communication involving data interpretation, measurement, sequencing, pattern recognition, and problem-solving. The result is also consistent with Philippine education priorities on functional literacy and numeracy in the K to 12 and MATATAG curriculum frameworks (DepEd, 2024), as well as earlier curriculum integration efforts (DepEd, 2016; Bautista & Santos, 2019). Mathematics-language integration supports conceptual understanding and problem-solving, while language plays an important role in mathematical reasoning, especially for multilingual learners (Clements et al., 2021; Moschkovich, 2015). The findings also support the value of real-world mathematical contexts and functional language use (Rittle-Johnson et al., 2020; Desiatin & Mendoza, 2021), although meaningful integration requires explicit language support and well-designed tasks (Walsh & Baynham, 2021; UNESCO, 2020).

3.1.6 Overall Extent of STEAM Integration in English Classes

Overall, teachers' STEAM integration during English lessons was assessed as high, with an overall mean of 4.22 and a standard deviation of 0.38. Engineering Integration obtained the highest mean of 4.31, followed by Arts Integration with 4.24, Science Integration and Mathematics Integration with 4.23, and Technology Integration with 4.05. All areas were interpreted as high extent, showing that participants consistently perceived interdisciplinary integration across all STEAM components in English instruction. The results imply that English instruction is highly interdisciplinary, with teachers using

Science, Technology, Engineering, Arts, and Mathematics to make language learning more contextualized and content-rich. The higher mean for Engineering may reflect the emphasis on problem-solving and design-based learning, while the lower mean for Technology may indicate challenges related to access to digital resources, internet connectivity, and ICT infrastructure (Llego, 2024). Engineering and hands-on activities are aligned with experiential learning (Kolb, 2015; Wendell & Rogers, 2023), while the overall integration supports critical thinking, inquiry, and interdisciplinary collaboration. This finding is consistent with UNESCO's vision of integrated education that promotes cross-disciplinary learning, creativity, and problem-solving (UNESCO, 2023). The integration of Art with Science and Mathematics also supports creative expression and conceptual understanding (Henriksen 2020, Perignat & Katz-Buonincontro 2019), while the Philippine K to 12 and MATATAG curricula support contextualized and learner-centered learning (DepEd, 2024).

3.2 Teachers' English Teaching Approaches

3.2.1 Reading and Literature Teaching Approaches

The participants assessed teachers' reading and literature teaching approaches as high, with an overall mean of 4.42 and a standard deviation of 0.46. Most respondents rated these practices as always at 50.50% and often at 45.00%, showing that 95.50% perceived reading and literature approaches as regularly implemented. The highest-rated indicator was teachers helping pupils understand the stories they read, with a mean of 4.62 and a description of always. Reading real stories and books and teacher read-aloud modeling both obtained a mean of 4.43, while reading stories connected to home and community life obtained a mean of 4.32. Small-group discussion about books had the lowest mean of 4.31, although it was still described as often. The findings show that teachers strongly support comprehension, authentic reading, read-aloud modeling, contextualized materials, and learner discussion. Literature-based instruction is viewed as meaningful because it develops reading comprehension, language proficiency, interpretation, and critical thinking. Del Rosario (2024) emphasized that literature instruction develops interpretative skills and deepens understanding of language in context, while Amin (2023) found that literature learning improves language competence, appreciation of diverse perspectives, and critical analysis. The use of contextualized and authentic reading materials is consistent with DepEd's literacy direction and with the MATATAG Curriculum (DepEd, 2023; Bernardo, 2022). However, the relatively lower score for small-group sharing suggests that collaborative literary discussions could be strengthened to deepen comprehension, peer interaction, and appreciation of different perspectives.

3.2.2 Writing Teaching Approaches

The participants assessed teachers' writing teaching approaches as high, with an overall mean of 4.32 and a standard deviation of 0.51. Most respondents rated these practices as often at 58.00%, while 30.50% rated them always, showing that 88.50% perceived writing instruction as regularly implemented. The highest-rated indicator was teaching different kinds of texts such as stories, reports, and opinions, with a mean of 4.40. Writing about personal thoughts, feelings, and ideas and writing about topics from other subjects both obtained a mean of 4.30. Teacher modeling of writing in front of the class obtained the lowest mean of 4.26, although it remained within the often category. These results indicate that writing instruction is a regular part of English teaching and includes genre-based writing, personal expression, interdisciplinary writing, and teacher modeling. Writing instruction helps pupils develop functional and academic literacy, especially when they are exposed to different purposes and audiences. Zohbie and Bhowmik (2024) reported that genre-based writing instruction supports English learners by helping them understand the structure and language of different text types, while Shapaka (2025) emphasized that teacher strategies improve writing performance and academic achievement. The findings also support constructivist and interdisciplinary practices in DepEd classrooms, where pupils connect writing with personal experiences, community issues, and other learning areas. However, the lower rating for teacher modeling suggests the need for more explicit demonstration of how writing is planned, drafted, revised, and improved.

3.2.3 Language Arts Integration and Assessment

The participants assessed teachers' Language Arts Integration and Assessment as high, with an overall mean of 4.33 and a standard deviation of 0.51. Most respondents rated these practices as often at 55.00%, while 33.00% rated them always. The highest-rated indicator was checking reading progress regularly, with a mean of 4.43. Using test results and classroom work to improve academic performance followed with a mean of 4.38. Using stories and writing activities to help pupils understand feelings and learn obtained a mean of 4.34, while respecting home language and culture and using them in English class obtained the lowest mean of 4.18. The findings indicate that teachers regularly monitor reading progress, use assessment data, integrate stories and writing activities, and apply culturally responsive practices. Integrated language arts instruction allows pupils to use reading, writing, speaking, listening, and viewing skills in meaningful contexts, while assessment provides feedback for learning. Campos-Marces (2025) demonstrated that innovative and technology-assisted language assessments provide feedback that improves language arts instruction and proficiency. The result also shows that socio-emotional learning is supported through literature and writing, particularly when pupils reflect on feelings and experiences. However, the lower score for home language and culture suggests that culturally responsive and multilingual teaching is present but not fully maximized. In the Philippine context, this may be affected by resource limitations, multiple learner dialects, and the use of English as a medium of instruction, even though DepEd continues to promote contextualized and inclusive pedagogies.

3.2.4 Overall Extent of English Teaching Approaches

Overall, teachers' teaching approaches were assessed as high, with an overall mean of 4.36 and a standard deviation of 0.41. Reading and Literature obtained the highest mean of 4.42, followed by Language Arts Integration and Assessment with 4.33 and Writing with 4.32. All areas were interpreted as high extent, indicating that English teachers regularly use reading, writing, assessment, and language arts integration in classroom instruction. The results show that English teachers align their practices with the MATATAG Curriculum's emphasis on foundational literacy, communication competence, critical thinking, and learner-centered instruction. The strong rating for Reading and Literature suggests that teachers prioritize reading comprehension and literary appreciation, while Writing may need additional support through explicit instruction, modeling, and varied writing tasks. The consistency of high ratings suggests that teachers use diverse and inclusive pedagogical practices that support engagement and learning progress (Bernardo, 2022). These include contextualized reading, process-oriented writing, collaborative discussions, formative assessments, and interdisciplinary integration (Flores & Dizon, 2021; DepEd, 2023). Despite challenges such as large class size, limited instructional resources, and varied learner abilities (David et al., 2022), the findings support the importance of effective literacy pedagogy in developing engagement, comprehension, and communication skills (OECD, 2019; DepEd, 2023; UNESCO, 2023).

3.3 Pupils' Learning Engagement in English Classes

3.3.1 Behavioral Engagement

The participants' behavioral engagement was assessed as high, with an overall mean of 4.47 and a standard deviation of 0.46. Most participants rated their engagement as often at 58.50%, while 38.00% rated it always, showing that 96.50% regularly demonstrated positive engagement behaviors. The highest-rated indicator was finishing homework and class assignments on time, with a mean of 4.58 and a description of always. Listening carefully and following teachers' instructions obtained a mean of 4.46, following classroom rules without reminders obtained a mean of 4.45, and bringing materials and keeping work organized obtained the lowest mean of 4.38. The results indicate that pupils generally show active participation, discipline, attentiveness, task completion, and classroom preparedness. The high behavioral engagement corroborates Pan (2023), who reported that supportive learning environments affect motivation and empowerment, leading to participation, effort, and task completion. However, behavioral engagement should not be limited to compliance or routine participation. Studies indicate that observable participation may exist even when intrinsic motivation or deep processing is limited if instruction depends mainly on compliance or rote practice (Fredricks et al., 2004). When behavioral engagement is combined with emotional involvement and cognitive strategy use, learning outcomes become stronger (Wang et al., 2020). Clear teacher expectations and feedback may support compliance and homework completion (Dela Cruz & Santos, 2021), but scaffolding, choice, and formative questioning are needed to strengthen deeper engagement.

3.3.2 Emotional Engagement

The participants' emotional engagement was assessed as high, with an overall mean of 4.44 and a standard deviation of 0.50. Half of the participants rated emotional engagement as often at 50.00%, while 42.50% rated it always. The highest-rated indicator was feeling a sense of belonging in class and school, with a mean of 4.52 and a description of always. Enjoying learning activities and feeling satisfied obtained a mean of 4.44, feeling proud of schoolwork and achievements obtained a mean of 4.42, and staying positive and trying again after mistakes obtained the lowest mean of 4.38. The findings show that pupils generally experience positive emotions toward learning, including belonging, enjoyment, pride, and resilience. Liu et al. (2023) found that teaching presence promotes affective engagement when learners perceive teachers as supportive and responsive. Emotional engagement also reflects pupils' connection to the classroom community and their willingness to continue learning despite challenges (Fredricks et al., 2004). Positive teacher-student relationships are important because learners gain confidence and enthusiasm when they feel respected and valued. The result also aligns with evidence that emotional engagement promotes motivation and persistence (Bond et al., 2020), while culturally responsive and inclusive pedagogies strengthen learners' connection to learning in the Filipino context (Mendoza & Javier, 2021). Socio-emotional skills are also important for modern learners (Schunk, Pintrich, & Meece, 2022).

3.3.3 Cognitive Engagement

The participants' cognitive engagement was assessed as high, with an overall mean of 4.44 and a standard deviation of 0.46. A total of 49.00% rated their cognitive engagement as very high, while 47.50% rated it high. The highest-rated indicator was thinking carefully about what they are learning and asking questions, with a mean of 4.61 and a description of always. Using good ways to study and learn new things obtained a mean of 4.50. Checking understanding and changing learning strategies obtained a mean of 4.37, trying hard on difficult tasks and sharing ideas even when unsure obtained a mean of 4.36, and making learning goals and planning how to reach them obtained a mean of 4.35. The findings show that pupils are mentally involved in English learning through questioning, study strategies, self-monitoring, persistence, and goal setting. Ramirez-Arellano (2024) found that motivation and metacognitive-cognitive strategies contribute to academic engagement. The high rating for asking questions suggests active processing and inquiry, which are important in language

learning (Greene, 2015). The indicators on study strategies, monitoring, persistence, and goal setting also suggest developing metacognitive awareness and self-regulated learning (Panadero, 2023). These findings align with the DepEd focus on 21st-century skills and with literature describing cognitive engagement as intentional mental effort, higher-order thinking, self-regulation, and strategic learning (Bond et al., 2020). Deep learning, persistence, and reflective strategies are also supported by Sinatra et al. (2015), Panadero (2023), Teng & Zhang (2022), and OECD (2023).

3.3.4 Overall Level of Pupils' Learning Engagement

Overall, pupils' learning engagement was assessed as high, with an overall mean of 4.45 and a standard deviation of 0.39. Behavioral Engagement obtained the highest mean of 4.47, while Emotional Engagement and Cognitive Engagement both obtained means of 4.44. These results show that pupils were actively involved in classroom activities, emotionally connected to learning, and cognitively engaged in processing English lessons. The findings confirm that learner engagement is multidimensional, involving behavioral, emotional, and cognitive aspects that contribute to learning outcomes (Bond et al., 2020). The high levels of engagement may be attributed to learner-centered DepEd frameworks such as the K to 12 and MATATAG curriculum, which promote active, inclusive, and meaningful learning experiences (DepEd, 2024). Emotional engagement may reflect positive classroom climates that support motivation, belonging, and achievement (Wang, Degol, & Henry, 2021), while cognitive engagement suggests the development of critical and creative thinking. The results are also consistent with literature showing that engagement supports academic outcomes and retention in education (Wong & Liem, 2022). Maintaining these levels requires continued teacher support, differentiated instruction, formative assessment, contextualized materials, professional learning, and sufficient resources.

3.4 Influence of STEAM Integration and Teaching Approaches on Pupils' Learning Engagement

The regression analysis showed that STEAM integration and teaching approaches significantly influenced pupils' learning engagement. The overall model was statistically significant, $F(2, 197) = 67.529$, $p < .001$, with $R = 0.638$, $R^2 = 0.407$, and adjusted $R^2 = 0.401$. This means that STEAM integration and teaching approaches together explained 40.1% of the variance in pupils' learning engagement, while the remaining 59.9% may be attributed to other factors not included in the model. The model equation was $LE = 0.33SI + 0.38TA + 1.40$. STEAM integration was a significant positive predictor of learning engagement, with $B = 0.33$, $t = 4.93$, $p < .001$, and $\beta = 0.322$. Teaching Approaches was also a significant positive predictor, with $B = 0.38$, $t = 6.18$, $p < .001$, and $\beta = 0.403$. Since both predictors were significant, the null hypotheses were rejected. The findings indicate that stronger STEAM integration and more effective teaching approaches are associated with higher learner engagement. STEAM integration offers authentic and real-life contexts that make learning meaningful and support emotional and cognitive engagement (Maricic & Lavicza, 2024). Boice et al. (2024) also found that STEAM-based teaching methods cultivate student interest and enthusiasm by integrating real-world situations. The positive effect of STEAM is consistent with the view that interdisciplinary and inquiry-based learning supports behavioral, emotional, and cognitive engagement. At the same time, teaching approaches had a stronger standardized effect than STEAM integration, suggesting that learner-centered strategies such as scaffolding, collaboration, differentiated instruction, inquiry-based learning, cooperative tasks, and reflective discussion may be especially important in sustaining engagement. These results are supported by Sarkar and Chakraborty (2024), Fasco et al. (2024), and Salvacion, who emphasized the value of innovative, active, personalized, and learner-centered teaching methods. The findings also align with Bruner's (1966) principle of guided discovery, Hattie (2023), UNESCO (2022), and Hattie, 2023 and others, which emphasize that meaningful content and effective pedagogy contribute strongly to engagement and achievement.

4. Conclusion & Recommendations

The study concluded that STEAM integration and teaching approaches were highly implemented in English instruction and significantly influenced pupils' learning engagement in selected elementary schools in the Butuan City Division. The findings showed that teachers consistently integrated Science, Technology, Engineering, Arts, and Mathematics into English lessons and used varied approaches in Reading and Literature, Writing, and Language Arts Integration and Assessment. Pupils also demonstrated high behavioral, emotional, and cognitive engagement, indicating active participation, positive learning attitudes, and deep involvement in learning tasks. Overall, the results emphasized that learner engagement is strongly shaped by the way instruction is designed and delivered, with teaching approaches identified as the strongest predictor of learners' engagement.

Teachers are encouraged to sustain and strengthen STEAM integration in English instruction by using interdisciplinary activities that promote creativity, critical thinking, and real-world application, while continuing to apply balanced approaches in Reading and Literature, Writing, and Language Arts Integration and Assessment. School leaders may provide professional development, instructional support, and resources that help teachers implement engaging and interdisciplinary practices. Curriculum developers may embed STEAM competencies, performance tasks, and learning standards in the English curriculum, while teacher education institutions may enhance pre-service training through courses and practicum experiences focused on STEAM integration and diverse teaching approaches. Future researchers may examine other variables related to learning engagement and use experimental or longitudinal designs to further validate the relationships

among STEAM integration, teaching approaches, and student engagement.

The study was limited to examining the relationship among STEAM integration, teaching approaches, and learning engagement among 200 elementary pupils in selected schools of the Butuan City Division for the school year 2025–2026. It used a descriptive-correlational design and survey questionnaires to measure the extent of STEAM integration, teaching approaches, and pupils' behavioral, emotional, and cognitive engagement. Other possible factors affecting learning engagement, such as technological access, classroom environment, and teacher competencies, were not directly examined, and causal relationships may require further validation through experimental or longitudinal research designs.

Compliance with ethical standards

The study followed the ethical principles of the Belmont Report, namely Respect for Persons, Beneficence, and Justice. Participants were provided sufficient information about the study, their participation was voluntary, and measures were observed to protect confidentiality, minimize possible risks, and ensure fair participant selection.

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