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TEACHERS' TECHNOLOGY-BASED INSTRUCTION AND LEARNING ENGAGEMENT OF SENIOR HIGH SCHOOL LEARNERS: FOUNDATION FOR AN EDUCATION 5.0-INSPIRED INSTRUCTIONAL PROGRAM

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ABSTRACT

The article examines the difficulty of students enrolled in a master's 2 in criminology to write an Technology-based instruction plays a pivotal role in modern education by equipping teachers with tools to enhance learning engagement among learners. This study aimed to determine the teachers' technology-based instruction and the learning engagement of senior high school learners at Subic National High School, Subic District, Schools Division of Zambales during the School Year 2024-2025. Using a descriptive-correlational design, the study involved 131 Grade 12-ICT learners and their teachers through total population sampling. Data were gathered using a validated researcher-made questionnaire with reliability coefficients of α = .956 for technology-based instruction and α = .937 for learning engagement. Results revealed that learner-respondents were predominantly 17 years old, male, with two siblings, a monthly family income of ₱20,000 to ₱39,999, guided by college-educated learning facilitators, and spent 2.0 to 2.9 hours studying daily. Teachers' technology-based instruction was moderately observed in terms of teaching competence, resources, activities, and approaches, while learners were moderately engaged behaviorally, emotionally, cognitively, and socially as perceived by their teachers. Significant differences were observed in teachers' technology-based instruction when analyzed against the learners' profile variables, including age, sex, number of siblings, monthly family income, learning facilitators' education, and study hours. A weak negative and non-significant correlation was found between teachers' technology-based instruction and learners' engagement. These findings led to the development of an Education 5.0-inspired instructional program aimed at enhancing technology-based teaching practices and fostering greater learner engagement. This study contributes to the research world by providing a model for aligning Education 5.0 principles with instructional strategies to address the evolving needs of 21st-century learners.

Keywords: Technology-Based Instruction, Learning Engagement, Senior High School Learners, Education 5.0, Instructional Program.

1. INTRODUCTION

In the digital age, integrating technology into education has become pivotal for enhancing learning experiences and engagement among learners. The study explores the impact of technology-driven teaching methods on the engagement levels of senior high school learners. This research aims to understand how the adoption of advanced technological tools influences learners' participation and learning outcomes. By investigating these dynamics, the study seeks to lay the groundwork for developing an innovative Education 5.0-inspired instructional program that aligns with contemporary educational needs and technological advancements.

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In synthesis, technology-based instruction has emerged as a powerful tool in enhancing learner engagement across various educational contexts. The integration of digital platforms, mobile applications, and artificial intelligence fosters an environment conducive to active learning, self-paced progress, and increased motivation. Studies, such as those by Collins (2021), Canonizado (2024), and Wahyudin (2024), underscore the role of constructivist, learner-centered approaches in driving engagement and participation in learning. These studies suggest that when learners interact with digital tools designed to promote autonomy and critical thinking, they are more likely to exhibit higher levels of involvement and enthusiasm. Similarly, Seitnazarov and Mambetkarimov (2024) discuss the importance of designing high-quality digital resources tailored to subject-specific needs, particularly in fields like STEM, where visual and interactive elements are integral to comprehension and sustained engagement.

However, despite the positive outcomes associated with technology-based instruction, several barriers impede its full potential in fostering educational engagement. Socioeconomic factors, limited technical access, and cultural differences present significant challenges, especially in diverse classroom settings. Morachat and Seechaliao (2024) and Canonizado (2024) highlight that learners from underprivileged backgrounds often face restricted access to essential technological resources, which can undermine the equity of digital learning. Furthermore, Pradana et al. (2024) address how cultural barriers and lack of exposure to digital tools can affect teacher confidence, particularly among preservice teachers who may lack experience with technology-driven pedagogies. Such challenges underscore the need for multifaceted teacher competencies, including digital literacy and socio-emotional skills, as noted by Gonzalez-Fernandez et al. (2024) and Rahimi (2023), who advocate for the adoption of TPACK (Technological Pedagogical Content Knowledge) frameworks in teacher training programs to enhance their effectiveness in managing modern, digitally infused classrooms.

Education 5.0, while transformative, demonstrated both potential and challenges, requiring strategic planning and collaborative efforts to mitigate its weaknesses and threats, maximize its strengths, and seize opportunities for impactful, equitable, and future-ready education.

2. STATEMENT OF THE PROBLEM

This study determined the teachers' technology-based instruction and learning engagement of senior high school learners at Subic National High School, Subic District, Schools Division of Zambales during the School Year 2024-2025.

Specifically, it sought to answer the following questions:

1. How can the profile of the learner-respondents be described in terms of:
    1.1. age;
    1.2. sex;
    1.3. number of siblings;
    1.4. monthly family income;
    1.5. highest educational attainment of learning facilitator; and
    1.6. daily number of hours spent studying at home?
2. As perceived by the learner-respondents, how can the teachers' technology-based instruction be described in terms of:
    2.1. teaching competence;
    2.2. teaching resources;
    2.3. teaching activities; and

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2.4. teaching approaches?

3. As perceived by their teachers, how can the learning engagement of the learners be described in terms of:

3.1. behavioral engagement;
3.2. emotional engagement;
3.3. cognitive engagement; and
3.4. social engagement?

4. Is there a significant difference between the teachers' technology-based instruction as perceived by the learner-respondents and their profile when grouped accordingly?

5. Is there a significant correlation between the teachers' technology-based instruction as perceived by the learner-respondents and their learning engagement as perceived by their teachers?

6. What Education 5.0-inspired instructional program can be developed to enhance the teachers' technology-based instruction and learning engagement of senior high school learners?

3. METHODS AND MATERIALS

This study determined the teachers' technology-based instruction and learning engagement of senior high school learners at Subic National High School, Subic District, Schools Division of Zambales during the School Year 2024-2025. A descriptive-correlational research design was employed, with data collected, classified, summarized, and analyzed using percentages and means. The study involved 131 Grade 12-ICT learners and their teachers came from four sections, utilizing total population sampling to involve all Grade 12-ICT learners of the identified schools. A researcher-designed questionnaire served as the primary data collection tool, targeting dimensions of the teacher's technology-based instruction and learning engagement of senior high school learners. The instrument demonstrated excellent reliability, as confirmed by Cronbach's Alpha values for the teachers' technology-based instruction ($\alpha = 0.96$) and learning engagement of senior high school learners ($\alpha = 0.94$). Statistical analyses, including the Kruskal-Wallis Test and Spearman Rho Correlation, were used to test the study's hypotheses.

4. RESULTS AND DISCUSSIONS

4.1. Profile of the Senior High School Learners

4.1.1. Age

Table 1

Frequency and Percentage Distribution of the Profile of the Senior High School Learners in terms of Age

Age	Frequency	Percentage
17 years old	50	38.17
18 years old	46	35.11
19 years old	16	12.21
20 years old	6	4.58
21 years old	13	9.92
Total	**131**	**100.00**

Table 1 displays the frequency and percentage distribution of the profile of the senior high school learners in terms of age, showing that the majority of learners were 17 years old (38.17%),

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followed by 18 years old (35.11%). The remaining age groups, 19, 20, and 21 years old, accounted for a combined 26.71% of the total 131 learners.

These findings implied that most learners were within the expected age range for senior high school, indicating a typical academic progression. However, the presence of older learners suggested that some may have experienced delays in their education, which could have required additional support or intervention strategies.

The results aligned with the findings of Mokwena and Setshego (2021), which similarly found that most senior high school learners were concentrated in the 17-18 age range. This consistency reinforced the notion that the age distribution of senior high school learners tended to follow a predictable pattern across different studies.

4.1.2. Sex

Table 2

Frequency and Percentage Distribution of the Profile of the Senior High School Learners in terms of Sex

Sex	Frequency	Percentage
Male	83	63.36
Female	48	36.64
Total	**131**	**100.00**

Table 2 presents the frequency and percentage distribution of the profile of the senior high school learners in terms of sex, showing that the majority of learners were male (63.36%), while females comprised 36.64% of the total 131 learners.

These findings implied that there was a higher representation of male learners in senior high school, which may have reflected broader societal trends or gender-related factors in educational participation. The relatively lower percentage of female learners suggested potential barriers to their enrollment or retention, warranting further investigation.

The results were consistent with the findings of Amoah (2024), which also reported a higher proportion of male learners in their senior high school sample. This pattern suggested that gender distribution in senior high school was generally skewed towards males, a trend observed across multiple studies.

4.1.3. Number of Siblings

Table 3

Frequency and Percentage Distribution of the Profile of the Senior High School Learners in terms of Number of Siblings

Number of Siblings	Frequency	Percentage
No sibling	9	6.87
1 sibling	16	12.21
2 siblings	43	32.82
3 siblings	18	13.74
4 siblings	15	11.45
5 siblings	18	13.74
6 siblings and above	12	9.16
Total	**131**	**100.00**

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Table 3 illustrates the frequency and percentage distribution of the profile of the senior high school learners in terms of number of siblings, showing that the largest group of learners had two siblings (32.82%), followed by those with one sibling (12.21%) and those with five siblings (13.74%). A total of 9.16% of learners had six or more siblings, with 6.87% reporting no siblings.

These findings implied that a majority of learners came from families with a small to moderate number of siblings, which could have influenced their educational support systems and resources. The relatively low percentage of learners with no siblings or with large families suggested that the size of the family might not have been a major determinant in learners' educational experience in this sample.

The results aligned with the findings of Song and Nfu (2023), which also found that the majority of senior high school learners came from families with two to three siblings. This similarity reflected a consistent trend in family sizes among senior high school learners across different studies.

4.1.4. Monthly Family Income

Table 4

Frequency and Percentage Distribution of the Profile of the Senior High School Learners in terms of Monthly Family Income

Monthly Family Income	Frequency	Percentage
P19,999 and below	30	22.90
P20,000 to P39,999	49	37.40
P40,000 to P59,999	32	24.43
P60,000 to P79,999	10	7.63
P80,000 to P99,999	7	5.34
P100,000 to P119,999	2	1.53
P120,000 and above	1	0.76
Total	**131**	**100.00**

Table 4 features the frequency and percentage distribution of the profile of the senior high school learners in terms of monthly family income, showing that the majority of learners came from families earning between P20,000 and P39,999 monthly (37.40%), followed by those from families earning P19,999 and below (22.90%). Smaller percentages of learners came from families with higher incomes, with only 1.53% coming from families earning P100,000 to P119,999 and 0.76% from families earning P120,000 and above.

These findings implied that most learners belonged to middle-income families, with a relatively smaller proportion coming from lower or higher-income households. The distribution suggested that financial constraints might have influenced learners' access to resources, which could have impacted their educational experiences and outcomes.

The results were consistent with the findings of Rosali et al. (2024), which also reported that the majority of learners in senior high school came from middle-income families, earning between P20,000 and P40,000 per month. This indicated that the economic profile of senior high school learners tended to align with broader income trends in similar studies.

4.1.5. Highest Educational Attainment

Table 5

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Frequency and Percentage Distribution of the Profile of the Senior High School Learners in terms of Highest Educational Attainment of Learning Facilitator

Highest Educational Attainment of Learning Facilitator	Frequency	Percentage
Elementary Graduate	10	7.63
High School Graduate	40	30.53
College Graduate	59	45.04
MA Graduate	17	12.98
EdD/PhD/DPA/DBA Graduate	5	3.82
Total	**131**	**100.00**

Table 5 features the frequency and percentage distribution of the profile of the senior high school learners in terms of highest educational attainment of learning facilitator, showing that the majority of learning facilitators were college graduates (45.04%), followed by high school graduates (30.53%). Smaller proportions of facilitators had completed graduate studies, with 12.98% holding a Master's degree and 3.82% having a Doctoral or higher degree.

These findings implied that the majority of learning facilitators had attained at least a college degree, which suggested a relatively high level of academic qualification among those involved in senior high school education. However, the presence of facilitators with only a high school education or lower highlighted potential areas for professional development and training to improve educational quality.

The results were consistent with the findings of Reyes et al. (2022), which also found that most learning facilitators in senior high schools held college degrees, followed by those with high school or graduate-level education. This consistency indicated that the educational background of learning facilitators in senior high schools tended to reflect broader trends in educational qualifications.

4.1.6. Daily Number of Hours Spent Studying at Home

Table 6

Frequency and Percentage Distribution of the Profile of the Senior High School Learners in terms of Daily Number of Hours Spent Studying at Home

Daily Number of Hours Studying at Home	Frequency	Percentage
Less than 1.0 hour	29	22.14
1.0 to 1.9 hours	31	23.66
2.0 to 2.9 hours	36	27.48
3.0 to 3.9 hours	20	15.27
4.0 to 4.9 hours	4	3.05
5.0 hours and above	11	8.40
Total	**131**	**100.00**

Table 6 shows the frequency and percentage distribution of the profile of the senior high school learners in terms of daily number of hours spent studying at home, showing that the majority of learners studied for 2.0 to 2.9 hours daily (27.48%), followed by those who studied between 1.0 to 1.9 hours (23.66%). Smaller groups of learners spent more or less time studying, with only 8.40% studying 5.0 hours or more per day.

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These findings implied that most learners dedicated a moderate amount of time to studying at home, which may have suggested a balanced approach to academic work outside school hours. However, the relatively low percentages of learners studying for extended periods indicated that further encouragement might have been needed to foster more consistent study habits among some learners.

The results aligned with the findings of Yuliana and Raharjo (2021), which also reported that the majority of senior high school learners spent between 1 to 3 hours per day studying at home. This consistency suggested that the daily study habits of learners were similar across different senior high school contexts, highlighting common patterns in time management and study behavior.

4.2. Teachers' Technology-Based Instruction as Perceived by Senior High School Learners

4.2.1. Teaching Competence

Table 7

Mean Rating and Interpretations of the Teachers' Technology-Based Instruction as Perceived by Senior High School Learners in terms of Teaching Competence

Item	Indicators	Mean Rating	Interpretation
1	My teachers use technology to explain lessons clearly.	2.92	Moderately Observed
2	My teachers provide digital activities that help me understand the topic better.	2.90	Moderately Observed
3	My teachers know how to use different online tools to make learning fun.	2.80	Moderately Observed
4	My teacher encourages us to use educational apps to practice what we learn.	2.77	Moderately Observed
5	My teachers guide us in using the internet safely for research and learning.	3.01	Moderately Observed
6	My teachers integrate videos and animations to help us understand complex concepts.	2.90	Moderately Observed
7	My teachers use interactive online quizzes to check my understanding of the lessons.	2.82	Moderately Observed
8	My teachers are patient when teaching us how to use new technology tools.	2.88	Moderately Observed
9	My teachers provide timely feedback on our online assignments and projects.	2.87	Moderately Observed
10	My teachers adapt their teaching methods when using technology to meet our learning needs.	2.89	Moderately Observed
	General Mean Rating	**2.88**	**Moderately Observed**

Table 7 exhibits the mean ratings and interpretations of the teachers' technology-based instruction as perceived by senior high school learners in terms of teaching competence. The mean ratings ranged from 2.77 to 3.01, with a general mean rating of 2.88, all of which were interpreted as "Moderately Observed."

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The indicator with the highest mean rating was "My teachers guide us in using the internet safely for research and learning," with a mean rating of 3.01, indicating that learners moderately observed their teachers' efforts in guiding them on internet safety. This suggested a relatively strong focus on responsible online behavior and digital literacy in the teaching practices.

The findings implied that while teachers were integrating technology in various aspects of teaching, there was room for further improvement in fully utilizing digital tools to enhance learner learning. The moderately observed ratings across most indicators highlighted the need for continued efforts in improving the effectiveness of technology-based instruction.

These findings aligned with the previous study by Jiang (2023), which also emphasized the need for teachers to improve their use of technology in teaching to meet learners' diverse learning needs. Both studies highlighted a trend where technology integration was present but still required refinement to reach higher levels of effectiveness.

4.2.2. Teaching Resources

Table 8

Mean Rating and Interpretations of the Teachers' Technology-Based Instruction as Perceived by Senior High School Learners in terms of Teaching Resources

Item	Indicators	Mean Rating	Interpretation
1	My teachers use digital books to help me learn.	2.76	Moderately Observed
2	My teachers provide online videos that explain the lessons well.	2.93	Moderately Observed
3	My teachers use educational websites for additional learning materials.	2.87	Moderately Observed
4	My teachers share interactive presentations that make lessons more interesting.	2.92	Moderately Observed
5	My teachers provide downloadable worksheets for me to practice.	2.92	Moderately Observed
6	My teachers use online games to make learning fun and engaging.	2.66	Moderately Observed
7	My teachers provide links to useful online articles related to my lessons.	2.93	Moderately Observed
8	My teachers use digital tools like graphs and charts to show data clearly.	2.89	Moderately Observed
9	My teacher provides me with access to learning apps that I can use at home.	2.82	Moderately Observed
10	My teachers use online simulations to help me understand real-world problems.	2.79	Moderately Observed
	General Mean Rating	**2.85**	**Moderately Observed**

Table 8 depicts the mean ratings and interpretations of the teachers' technology-based instruction as perceived by senior high school learners in terms of teaching resources. The mean

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ratings ranged from 2.66 to 2.93, with a general mean rating of 2.85, all of which were interpreted as "Moderately Observed."

The indicator with the highest mean rating was "My teachers provide online videos that explain the lessons well," with a mean rating of 2.93, indicating that learners moderately observed their teachers' effective use of video resources to explain lessons. This reflected the importance of visual media in enhancing learners' understanding of the content.

The findings suggested that while teachers were using various digital resources in their instruction, the use of online games and some other digital tools might have required more attention to increase engagement and improve learning outcomes. The moderately observed ratings indicated that there was still room for expanding the variety and effectiveness of the technology-based teaching resources.

These findings were consistent with the study by Dewanti et al. (2021), which also found that while the use of technology in teaching was evident, it was not always fully optimized to support learner learning. Both studies underscored the need for teachers to diversify and enhance their use of digital resources to create a more engaging and effective learning environment.

4.2.3. Teaching Activities

Table 9

Mean Rating and Interpretations of the Teachers' Technology-Based Instruction as Perceived by Senior High School Learners in terms of Teaching Activities

Item	Indicators	Mean Rating	Interpretation
1	My teachers create interactive online quizzes to test my knowledge.	2.83	Moderately Observed
2	My teachers use group activities online to help me work together.	2.81	Moderately Observed
3	My teachers assign digital projects that allow me to be creative.	2.86	Moderately Observed
4	My teachers conduct virtual field trips to explore new topics.	2.73	Moderately Observed
5	My teachers organize online discussions where I can share my ideas.	2.82	Moderately Observed
6	My teachers use educational games to make learning more exciting.	2.60	Moderately Observed
7	My teachers provide problem-solving activities using digital tools.	2.79	Moderately Observed
8	My teachers use multimedia presentations to make my lessons more interesting.	2.90	Moderately Observed
9	My teachers set up online experiments to help me learn science concepts.	2.73	Moderately Observed
10	My teachers encourage me to participate in online storytelling activities.	2.73	Moderately Observed
	General Mean Rating	**2.78**	**Moderately Observed**

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Table 9 outlines the mean ratings and interpretations of the teachers' technology-based instruction as perceived by senior high school learners in terms of teaching activities. The mean ratings ranged from 2.60 to 2.90, with a general mean rating of 2.78, all of which were interpreted as "Moderately Observed."

The indicator with the highest mean rating was "My teachers use multimedia presentations to make my lessons more interesting," with a mean rating of 2.90, indicating that learners moderately observed their teachers' use of multimedia presentations to enhance lesson engagement. This suggested that multimedia tools were effectively contributing to making lessons more dynamic and interesting.

The findings suggested that while teachers were incorporating various technology-based activities, certain activities such as educational games and virtual field trips might have needed further integration to maximize learner participation and engagement. The moderately observed ratings indicated that technology-based teaching activities were still evolving and might have benefited from more frequent and diverse use.

These findings aligned with the study by Anderson et al. (2022), which also identified the need for more comprehensive integration of interactive and creative online activities in teaching practices. Both studies highlighted the importance of diversifying teaching activities to foster greater learner interaction and creativity in a digital learning environment.

4.2.4. Teaching Approaches

Table 10

Mean Rating and Interpretations of the Teachers' Technology-Based Instruction as Perceived by Senior High School Learners in terms of Teaching Approaches

Item	Indicators	Mean Rating	Interpretation
1	My teachers use interactive activities online to make learning fun.	2.82	Moderately Observed
2	My teachers guide me through virtual experiments to learn science better.	2.76	Moderately Observed
3	My teachers create storytelling activities using digital tools to enhance my creativity.	2.79	Moderately Observed
4	My teachers conduct online group work so I can learn to collaborate.	2.80	Moderately Observed
5	My teachers organize digital scavenger hunts to make learning more exciting.	2.68	Moderately Observed
6	My teachers assign research tasks where I use the internet to find information.	2.93	Moderately Observed
7	My teachers set up online debates to help me express my thoughts clearly.	2.65	Moderately Observed
8	My teachers use digital storytelling to help me learn history and culture.	2.73	Moderately Observed
9	My teachers provide online puzzles and games that challenge my thinking skills.	2.60	Moderately Observed

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10	My teachers encourage me to participate in virtual art and music activities.	2.75	Moderately Observed
	General Mean Rating	**2.75**	**Moderately Observed**

Table 10 highlights the mean ratings and interpretations of the teachers' technology-based instruction as perceived by senior high school learners in terms of teaching approaches. The mean ratings ranged from 2.60 to 2.93, with a general mean rating of 2.75, all of which were interpreted as "Moderately Observed."

The indicator with the highest mean rating was "My teachers assign research tasks where I use the internet to find information," with a mean rating of 2.93, indicating that learners moderately observed their teachers' use of research tasks to help them utilize the internet effectively for learning. This highlighted the significance of developing learners' research and information literacy skills through digital tools.

The findings implied that while various technology-based teaching approaches were being applied, there was potential to further enhance the engagement and effectiveness of certain approaches, such as online debates and digital storytelling. The moderately observed ratings suggested that teachers could increase their focus on interactive and collaborative digital activities to further enrich the learning experience.

These findings were consistent with the study by Haarala-Muhonen et al. (2023), which also emphasized the moderate use of digital tools and activities in teaching approaches, with some areas requiring more consistent application. Both studies underscored the importance of refining and expanding the use of digital teaching approaches to better support learner creativity, collaboration, and critical thinking.

4.3. Learning Engagement of the Senior High School Learners as Perceived by Their Teachers

4.3.1. Behavioral Engagement

Table 11

Mean Rating and Interpretations of the Learning Engagement of the Senior High School Learners as Perceived by Their Teachers in terms of Behavioral Engagement

Item	Indicators	Mean Rating	Interpretation
1	My learners participate actively in online class discussions.	3.00	Moderately Engaged
2	My learners complete their digital assignments on time.	2.83	Moderately Engaged
3	My learners join virtual group activities and contribute ideas.	2.82	Moderately Engaged
4	My learners use educational apps regularly to practice new skills.	2.95	Moderately Engaged
5	My learners ask questions and seek help during online classes.	2.92	Moderately Engaged
6	My learners are engaged in online quizzes and games to review lessons.	2.81	Moderately Engaged

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7	My learners follow instructions carefully in technology-based activities.	2.95	Moderately Engaged
8	My learners participate in online peer feedback sessions.	2.82	Moderately Engaged
9	My learners use digital tools to track my progress in assignments.	2.85	Moderately Engaged
10	My learners attend all scheduled virtual classes and participate fully.	2.92	Moderately Engaged
	General Mean Rating	**2.89**	**Moderately Engaged**

Table 11 summarizes the mean ratings and interpretations of the learning engagement of senior high school learners as perceived by their teachers in terms of behavioral engagement. The mean ratings ranged from 2.81 to 3.00, with a general mean rating of 2.89, all of which were interpreted as "Moderately Engaged."

The indicator with the highest mean rating was "My learners participate actively in online class discussions," with a mean rating of 3.00, indicating that learners were moderately engaged in participating during online discussions. This suggested that learners were somewhat active in verbal interactions in virtual class settings, which was a positive sign of engagement in the learning process.

The findings suggested that while learners were moderately engaged in various online learning activities, there was room for improvement, especially in areas such as participation in quizzes and games and consistent use of digital tools for tracking progress. The moderately engaged ratings indicated the need for further strategies to enhance learner participation and interaction.

These findings aligned with the study by Sugden et al. (2021), which also observed that while learners were engaged in online activities, the level of engagement varied and could benefit from more targeted efforts to encourage active participation. Both studies highlighted the need for teachers to develop more engaging digital activities to foster higher levels of learner involvement and learning engagement.

4.3.2. Emotional Engagement

Table 12

Mean Rating and Interpretations of the Learning Engagement of the Senior High School Learners as Perceived by Their Teachers in terms of Emotional Engagement

Item	Indicators	Mean Rating	Interpretation
1	My learners feel excited about using technology in my lessons.	2.98	Moderately Engaged
2	My learners enjoy participating in online activities and projects.	2.81	Moderately Engaged
3	My learners feel proud when I achieve good results in digital assignments.	2.95	Moderately Engaged
4	My learners are motivated to learn when technology makes lessons interesting.	2.91	Moderately Engaged

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5	My learners feel confident when using digital tools for their schoolwork.	2.90	Moderately Engaged
6	My learners experience happiness when they receive positive feedback on their online work.	2.95	Moderately Engaged
7	My learners feel engaged when the lessons use interactive technology.	2.97	Moderately Engaged
8	My learners are enthusiastic about participating in virtual discussions and forums.	2.79	Moderately Engaged
9	My learners feel connected to their classmates during online group activities.	2.96	Moderately Engaged
10	My learners find learning more enjoyable when technology is used creatively.	2.93	Moderately Engaged
	General Mean Rating	**2.92**	**Moderately Engaged**

Table 12 demonstrates the mean ratings and interpretations of the learning engagement of senior high school learners as perceived by their teachers in terms of emotional engagement. The mean ratings ranged from 2.79 to 2.98, with a general mean rating of 2.92, all of which were interpreted as "Moderately Engaged."

The indicator with the highest mean rating was "My learners feel excited about using technology in my lessons," with a mean rating of 2.98, indicating that learners were moderately engaged in feeling excitement toward using technology in their lessons. This suggested that technology-based learning created a positive emotional response, motivating learners to engage with the content.

The findings suggested that while learners showed moderate emotional engagement with technology in learning, certain activities, such as virtual discussions and projects, may need more engaging elements to foster stronger emotional connections. The moderately engaged ratings reflected a need for more strategies to create positive emotional experiences in online learning environments.

These findings aligned with the study by Prayogo et al. (2023), which also found that emotional engagement in online learning was moderate, with learners feeling somewhat excited and motivated by the use of technology. Both studies highlighted the importance of integrating interactive and creative technology to enhance learners' emotional connection to their lessons and their overall engagement in learning.

4.3.3. Cognitive Engagement

Table 13

Mean Rating and Interpretations of the Learning Engagement of the Senior High School Learners as Perceived by Their Teachers in terms of Cognitive Engagement

Item	Indicators	Mean Rating	Interpretation
1	My learners think about the concepts when using digital tools for learning.	2.94	Moderately Engaged
2	My learners analyze information critically when working on online assignments.	2.92	Moderately Engaged

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3	My learners apply what they learn from technology-based lessons to solve problems.	2.95	Moderately Engaged
4	My learners question and explore new ideas during virtual class discussions.	2.87	Moderately Engaged
5	My learners use technology to research and gather information for their projects.	3.02	Moderately Engaged
6	My learners reflect on their learning progress and make adjustments as needed.	2.91	Moderately Engaged
7	My learners create and test hypotheses using digital simulations and tools.	2.93	Moderately Engaged
8	My learners integrate knowledge from different digital sources to understand topics better.	2.92	Moderately Engaged
9	My learners engage in problem-solving activities that require critical thinking.	2.95	Moderately Engaged
10	My learners use interactive learning platforms to enhance their understanding of complex ideas.	2.89	Moderately Engaged
	General Mean Rating	**2.93**	**Moderately Engaged**

Table 13 details the mean ratings and interpretations of the learning engagement of senior high school learners as perceived by their teachers in terms of cognitive engagement. The mean ratings ranged from 2.87 to 3.02, with a general mean rating of 2.93, all of which were interpreted as "Moderately Engaged."

The indicator with the highest mean rating was "My learners use technology to research and gather information for their projects," with a mean rating of 3.02, indicating that learners were moderately engaged in using digital tools for research and gathering information. This suggested that learners were making an effort to apply technology effectively for critical tasks like research, which supports their cognitive development.

The findings suggested that learners were moderately engaged in applying critical thinking and problem-solving skills when using technology, but there was still potential for enhancing deeper cognitive engagement. The moderately engaged ratings implied that more complex and challenging activities could be introduced to further stimulate learners' cognitive processes.

These findings aligned with the study by French et al. (2023), which also observed that while learners used technology to support their learning, there was room for improvement in fostering deeper cognitive engagement. Both studies emphasized the need to design technology-based tasks that encourage higher-order thinking, such as analysis, synthesis, and evaluation, to further enhance learners' cognitive engagement.

4.3.4. Social Engagement
Table 14

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Mean Rating and Interpretations of the Learning Engagement of the Senior High School Learners as Perceived by Their Teachers in terms of Social Engagement

Item	Indicators	Mean Rating	Interpretation
1	My learners collaborate with their classmates on group projects using online tools.	3.06	Moderately Engaged
2	My learners participate in online forums to share ideas and opinions with others.	2.92	Moderately Engaged
3	My learners provide feedback to their peers on their digital assignments.	2.91	Moderately Engaged
4	My learners join virtual study groups to discuss and understand lessons better.	2.99	Moderately Engaged
5	My learners communicate with me through online messages and discussions.	2.99	Moderately Engaged
6	My learners participate in collaborative online activities that involve teamwork.	2.87	Moderately Engaged
7	My learners share their project ideas with classmates and ask for their input.	3.07	Moderately Engaged
8	My learners attend virtual school events and activities to interact with their peers.	2.89	Moderately Engaged
9	My learners celebrate the achievements of their classmates on online platforms.	2.95	Moderately Engaged
10	My learners participate in peer-led online discussions to help each other learn.	3.02	Moderately Engaged
	General Mean Rating	**2.97**	**Moderately Engaged**

Table 14 displays the mean ratings and interpretations of the learning engagement of senior high school learners as perceived by their teachers in terms of social engagement. The mean ratings ranged from 2.87 to 3.07, with a general mean rating of 2.97, all interpreted as "Moderately Engaged."

The indicator with the highest mean rating was "My learners shared their project ideas with classmates and asked for their input," with a mean rating of 3.07, which suggested that learners were actively engaging in collaborative activities and seeking feedback from their peers. This highlighted the significance of peer collaboration in enhancing learners' social engagement, which was crucial for fostering teamwork and communication skills.

The findings indicated that while learners were moderately engaged in social interactions, further efforts might have been needed to increase participation in virtual social activities. This level of engagement suggested that integrating more diverse and interactive social activities could have further encouraged collaborative learning and peer relationships.

These findings were consistent with the study by Nasir et al. (2022), which also reported that learners engaged moderately in collaborative tasks using technology but suggested that greater emphasis on social learning could have improved the depth of their engagement. Both studies emphasized the role of peer interaction and collaborative learning in enhancing social engagement among learners.

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4.4. Difference Between the Teachers' Technology-Based Instruction as Perceived by Senior High School Learners and Their Profile

4.4.1. Age

Table 15

Difference Between the Teachers' Technology-Based Instruction as Perceived by Senior High School Learners and Their Profile in terms of Age

Groups	*MR*	*Eta squared (η^2)*	*H*	*df*	*p*	Decision
17 years old	40.40	.63	47.30	4	.000	Reject H_{01}
18 years old	92.99	(Large)				(Significant)
19 years old	66.94					
20 years old	59.75					
21 years old	70.69					

Table 15 examines the difference between the teachers' technology-based instruction as perceived by senior high school learners and their profile in terms of age. The table showed values for MR, eta squared (η^2), H, df, p, decision, and interpretation, with a significant difference across age groups as indicated by a p-value of .000, leading to the rejection of the null hypothesis (H_{01}).

The highest MR value was observed in the 18-year-old group at 92.99, indicating that this age group had the highest perception of technology-based instruction. The eta squared value of .63 for the 18-year-old group suggested a large effect size, meaning that the age variable accounted for a substantial portion of the variation in learners' perceptions.

These findings implied that the age of learners had a significant impact on their perceptions of technology-based instruction, highlighting the need for age-specific approaches in technology integration. The findings suggested that older learners might have had a more positive perception of technology in the classroom.

The present findings were consistent with previous research by Spencer and Temple (2021), which also noted that age played a significant role in learners' perceptions of technology-based instruction. This similarity reinforced the idea that age should have been considered when designing and implementing technology-driven teaching methods.

4.4.2. Sex

Table 16

Difference Between the Teachers' Technology-Based Instruction as Perceived by Senior High School Learners and Their Profile in terms of Sex

Groups	*MR*	*Eta squared (η^2)*	*H*	*df*	*p*	Decision
Male	57.92	.27	10.48	1	.001	Reject H_{01}
Female	79.98	(Large)				(Significant)

Table 16 interprets the difference between the teachers' technology-based instruction as perceived by senior high school learners and their profile in terms of sex. The values for MR, eta squared (η^2), H, df, p, decision, and interpretation showed significant differences between male and female learners, with a p-value of .001, leading to the rejection of the null hypothesis (H_{01}).

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The highest MR value was found in the female group at 79.98, suggesting that female learners perceived technology-based instruction more positively than male learners. The eta squared value of .27 for the female group indicated a large effect size, meaning that sex accounted for a considerable portion of the variance in learners' perceptions.

These findings implied that sex had a significant influence on how learners perceived technology-based instruction, with females showing more favorable perceptions. This highlighted the need for teachers to consider sex-based differences when implementing technology-driven teaching strategies.

The present findings aligned with previous research by Astalini et al. (2021), which also found significant differences in the perceptions of technology-based instruction based on sex. This consistency suggested that sex should have been taken into account when designing and delivering technology-enhanced learning experiences.

4.4.3. Number of Siblings

Table 17

Difference Between the Teachers' Technology-Based Instruction as Perceived by Senior High School Learners and Their Profile in terms of Number of Siblings

Groups	*MR*	*Eta squared (η^2)*	*H*	*df*	*p*	Decision
No sibling	81.83	.42	15.38	6	.017	Reject H_{01}
1 sibling	68.44	(Large)				(Significant)
2 siblings	48.56					
3 siblings	77.50					
4 siblings	80.73					
5 siblings	70.92					
6 siblings and above	70.33					

Table 17 analyzes the difference between the teachers' technology-based instruction as perceived by senior high school learners and their profile in terms of the number of siblings. The values for MR, eta squared (η^2), H, df, p, decision, and interpretation indicated significant differences across the number of siblings, with a p-value of .017, leading to the rejection of the null hypothesis (H_{01}).

The highest MR value was observed in the "No sibling" group at 81.83, suggesting that learners with no siblings had the highest perception of technology-based instruction. The eta squared value of .42 for the "No sibling" group indicated a large effect size, meaning that the number of siblings accounted for a considerable portion of the variance in learners' perceptions.

These findings implied that the number of siblings a learner had played a significant role in shaping their perception of technology-based instruction, with those with no siblings showing the most favorable perception. Teachers may have considered this factor when developing technology-driven teaching strategies to address the varying needs of learners based on their family structure.

The present findings aligned with previous research by Pakaja and Wafa (2021), which also found that family-related factors, such as the number of siblings, could influence learners' attitudes toward technology in the classroom. This suggested that the family environment should

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have been taken into consideration when designing and implementing technology-based learning approaches.

4.4.4. Monthly Family Income

Table 18

Difference Between the Teachers' Technology-Based Instruction as Perceived by Senior High School Learners and Their Profile in terms of Monthly Family Income

Groups	*MR*	*Eta squared (η^2)*	*H*	*df*	*p*	Decision
P19,999 and below	70.65	.60	46.44	6	.000	Reject H_{01}
P20,000 to P39,999	41.50	(Large)				(Significant)
P40,000 to P59,999	99.19					
P60,000 to P79,999	69.00					
P80,000 to P99,999	62.29					
P100,000 to P119,999	60.25					
P120,000 and above	72.50					

Table 18 presents the difference between the teachers' technology-based instruction as perceived by senior high school learners and their profile in terms of monthly family income. The values for MR, eta squared (η^2), H, df, p, decision, and interpretation indicated significant differences across income groups, with a p-value of .000, leading to the rejection of the null hypothesis (H_{01}).

The highest MR value was observed in the P40,000 to P59,999 income group at 99.19, suggesting that learners from this income bracket had the highest perception of technology-based instruction. The eta squared value of .60 for the P40,000 to P59,999 group indicated a large effect size, meaning that monthly family income accounted for a substantial portion of the variance in learners' perceptions.

These findings implied that monthly family income significantly influenced learners' perceptions of technology-based instruction, with learners from higher income groups likely having more favorable perceptions. Teachers should have considered income-related factors when implementing technology-driven teaching strategies to better cater to the diverse needs of learners.

The present findings aligned with previous research by Ironsi (2022), which also identified a significant correlation between learners' socioeconomic status and their perceptions of technology-based instruction. This consistency highlighted the importance of considering family income when designing and delivering technology-enhanced learning experiences.

4.4.5. Highest Educational Attainment of Learning Facilitators

Table 19

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Difference Between the Teachers' Technology-Based Instruction as Perceived by Senior High School Learners and Their Profile in terms of Highest Educational Attainment of Learning Facilitators

Groups	*MR*	*Eta squared (η^2)*	*H*	*df*	*p*	Decision
Elementary Graduate	70.20	.58 (Large)	32.50	4	.000	Reject H_{01} (Significant)
High School Graduate	68.60					
College Graduate	78.56					
MA Graduate	23.41					
EdD/PhD/DPA/DBA Graduate	33.40					

Table 19 displays the difference between the teachers' technology-based instruction as perceived by senior high school learners and their profile in terms of the highest educational attainment of learning facilitators. The values for MR, eta squared (η^2), H, df, p, decision, and interpretation indicated significant differences based on the highest educational attainment, with a p-value of .000, leading to the rejection of the null hypothesis (H_{01}).

The highest MR value was observed in the college graduate group at 78.56, suggesting that learners perceived technology-based instruction most favorably when facilitated by college graduates. The eta squared value of .58 for the college graduate group indicated a large effect size, meaning that the highest educational attainment of learning facilitators accounted for a substantial portion of the variance in learners' perceptions.

These findings implied that the educational background of learning facilitators significantly influenced learners' perceptions of technology-based instruction, with higher educational attainment linked to more favorable perceptions. Teachers should have considered the educational qualifications of facilitators when implementing technology-driven teaching strategies to enhance learner engagement.

The present findings aligned with previous research by Cabling (2024), which also found that the educational attainment of teachers significantly affected learners' perceptions of teaching methods, including technology-based instruction. This suggested that the level of education of learning facilitators should have been considered when designing and delivering technology-enhanced learning experiences.

4.4.6. Daily Number of Hours Spent Studying at Home

Table 20

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Difference Between the Teachers' Technology-Based Instruction as Perceived by Senior High School Learners and Their Profile in terms of Daily Number of Hours Spent Studying at Home

Groups	*MR*	*Eta squared (η^2)*	*H*	*df*	*p*	Decision
Less than 1.0 hour	41.21	.39	19.51	5	.002	Reject H_{01}
1.0 to 1.9 hours	79.52	(Large)				(Significant)
2.0 to 2.9 hours	74.57					
3.0 to 3.9 hours	67.48					
4.0 to 4.9 hours	48.12					
5.0 hours and above	69.05					

Table 20 illustrates the difference between the teachers' technology-based instruction as perceived by senior high school learners and their profile in terms of the daily number of hours spent studying at home. The values for MR, eta squared (η^2), H, df, p, decision, and interpretation indicated significant differences across the study hour groups, with a p-value of .002, leading to the rejection of the null hypothesis (H_{01}).

The highest MR value was observed in the 1.0 to 1.9 hours group at 79.52, suggesting that learners who spent between 1.0 to 1.9 hours studying at home had the highest perception of technology-based instruction. The eta squared value of .39 for the 1.0 to 1.9 hours group indicated a large effect size, meaning that the number of hours spent studying at home accounted for a significant portion of the variance in learners' perceptions.

These findings implied that the amount of time learners spent studying at home significantly influenced their perceptions of technology-based instruction, with those who studied more having more favorable perceptions. Teachers should have considered the amount of time learners dedicated to study when implementing technology-based teaching strategies to better cater to learners' needs.

The present findings aligned with previous research by Schuler et al. (2021), which also found that the time spent on academic activities outside the classroom impacted learners' perceptions of learning methods, including technology-based instruction. This consistency highlighted the importance of considering study habits when designing and delivering technology-enhanced learning experiences.

4.5. Correlation between the Teachers' Technology-Based Instruction as Perceived by Senior High School Learners and Their Learning Engagement as Perceived by Their Teachers

Table 21

Correlation Between the Teachers' Technology-Based Instruction as Perceived by Senior High School Learners and Their Learning Engagement as Perceived by Their Teachers

Dependent Variables	r	p	Interpretation	Decision
Behavioral Engagement	-.03	.720	Negative Moderate Correlation	Accept H_{02} (Not Significant)
Emotional Engagement	-.05	.584	Negative Moderate Correlation	Accept H_{02} (Not Significant)
Cognitive Engagement	-.03	.740	Negative Moderate Correlation	Accept H_{02} (Not Significant)

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Social Engagement	-.01	.912	Negative Weak Correlation	Accept H_{02} (Not Significant)
Overall	**-.02**	**.804**	**Negative Weak Correlation**	**Accept H_{02} (Not Significant)**

Table 21 shows the correlation between the teachers' technology-based instruction, as perceived by senior high school learners, and their learning engagement, as perceived by their teachers. The values of r for all dependent variables were negative and weak, with p-values above 0.05, leading to the acceptance of the null hypothesis (H_{02}), indicating a non-significant correlation.

The negative weak non-significant correlation suggested that there was little to no meaningful relationship between the technology-based instruction perceived by learners and their engagement levels as perceived by teachers. This indicated that the teachers' use of technology in instruction might not have strongly influenced learners' engagement across the behavioral, emotional, cognitive, and social domains.

The implications of these findings suggested that factors other than technology-based instruction could have been influencing the learners' engagement levels. Future interventions might have needed to consider additional strategies to enhance engagement beyond just technology use.

These findings aligned with the previous study by Bains et al. (2022), which also reported weak or non-significant correlations between technology integration and learner engagement. This supported the notion that technology alone might not have been sufficient to enhance engagement without other supportive measures.

4.6. An Education 5.0-Inspired Instructional Program to Enhance the Teachers' Technology-Based Instruction and Learning Engagement of Senior High School Learners

The program aims to enhance learner engagement, promote inclusivity, and address barriers to education from February 2025 to March 2028. It focuses on age-specific engagement strategies, gender sensitivity, economic constraints, and technology integration to create an equitable learning environment. Key activities include teacher training, resource allocation, and support systems for learners balancing responsibilities, ensuring improved participation and academic performance. Collaboration among teachers, school heads, parents, and community stakeholders strengthens the implementation of support structures and innovative teaching methods. Continuous monitoring, professional development, and feedback mechanisms ensure that instructional strategies remain effective and aligned with learners' evolving needs.

5. CONCLUSIONS

1. The senior high school learners were predominantly 17 years old, male, had two siblings, came from families with a monthly income of P20,000 to P39,999, were guided by college graduate learning facilitators, and spent 2.0 to 2.9 hours studying at home.
2. The senior high school learners moderately perceived their teachers' technology-based i6struction in terms of teaching competence, resources, activities, and approaches.
3. The senior high school learners were perceived by their teachers as moderately engaged in terms of behavioral, emotional, cognitive, and social engagement.
4. A significant difference was observed in the teachers' technology-based instruction as perceived by senior high school learners when compared to their profile variables, including age, sex, number

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of siblings, monthly family income, highest educational attainment of learning facilitators, and daily hours spent studying at home.
5. A weak negative and non-significant correlation was found between the teachers' technology-based instruction as perceived by senior high school learners and their learning engagement as perceived by their teachers, with p-values exceeding the significance threshold.
6. An Education 5.0-inspired instructional program was developed to enhance teachers' technology-based instruction and the learning engagement of senior high school learners.

6. RECOMMENDATIONS

1. Teachers should design personalized learning strategies that consider learners' demographic and socioeconomic profiles to address their unique needs and challenges.
2. Teachers should enhance their competence, diversify their instructional activities, and maximize available resources to improve learners' perceptions of technology-based instruction.
3. Teachers should implement innovative strategies to foster higher levels of behavioral, emotional, cognitive, and social engagement among learners.
4. Schools should tailor technology-based instructional practices to address the diverse profile variables of learners to ensure inclusivity and equity.
5. Teachers should explore complementary approaches beyond technology integration to enhance learners' engagement levels effectively.
6. Schools should implement and periodically evaluate the Education 5.0-inspired instructional program to ensure its effectiveness in achieving the desired educational outcomes.
7. A study on the long-term effectiveness and adaptability of the Education 5.0-inspired instructional program in improving technology-based instruction and learner engagement should be conducted to ensure its sustainability and relevance.

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