International Journal of Education Humanities and Social Science

ISSN: 2582-0745
Vol. 7, No. 04; 2024

TECHNOLOGY-BASED INSTRUCTION AND POSITIVE LEARNING ATMOSPHERE AS PERCEIVED BY GRADE 4 LEARNERS: BASES FOR A SUSTAINED INSTRUCTIONAL PROGRAM

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https://doi.org/10.54922/IJEHSS.2024.0756

ABSTRACT

This study determined the technology-based instruction (TBI) and positive learning atmosphere (PLA) as perceived by 213 Grade 4 learners in Masinloc District, Schools Division of Zambales during the School Year 2023-2024. Employing quantitative methods and a validated questionnaire, the research revealed that most learners were 10-year-old females with limited family income. They spent significant daily time with technology and achieved satisfactory to very satisfactory grades for the first and second quarter. Notably, learners demonstrated proficiency in digital literacy, multimedia tool integration, online engagement, and real-world application. A PLA was found to significantly contribute to conducive learning, particularly in fostering positive peer interactions, strong teacher-learner rapport, active participation, and enthusiasm for learning. Interestingly, age, income, and academic performance affected perceptions of TBI across all dimensions such as digital literacy, multimedia, online engagement, real-world application. There was a positive, very high and significant correlation was identified between TBI across all dimensions such as proficiency in digital literacy, integration of multimedia tools, engagement in online activities, and incorporation of real-world applications and the PLA of the respondents such as positive peer instruction, teacher-learner rapport, willingness to participate in class activities, and enthusiasm and curiosity in learning. This highlights the need for tailored instructional strategies to ensure equitable learning experiences for all. The study's program recommends personalized approaches based on individual learner characteristics. This aims to leverage technology effectively while fostering a PLA that reinforces the link between digital skills, multimedia use, online participation, real-world application, and an overall positive learning experience.

Keywords: Technology-Based Instruction (TBI), Positive Learning Atmosphere (PLA), Grade 4 Learners, Instructional Program.

1. INTRODUCTION

The integration of technology in education has been a significant focus in recent research, with studies highlighting the necessity for digital proficiency among educators. Kalogeratos and Pierrakeas (2023) reveal that Greek teachers have adapted well to digital tools post-COVID-19, reflecting a broader trend toward embracing technology to enhance learning outcomes. This aligns with Grainger et al. (2023) and Triola & Burk-Rafael (2023), who emphasize the need for technology to facilitate meaningful educational transformations and personalized interventions.

Augmented Reality (AR) and gamification have emerged as effective tools for engaging young learners. Olim and Nisi (2021) demonstrate that AR can enhance understanding of abstract

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concepts in chemistry for children aged 8 to 11. Similarly, Mandalika et al. (2023) highlight the benefits of interactive digital platforms in making learning more engaging, and McGlynn-Stewart et al. (2020) show how tablet applications can foster creativity in young learners through outdoor play.

Online and blended learning approaches have been shown to improve learner experiences and teacher-learner communication. Simonova et al. (2023) report positive perceptions of online distance instruction (ODI) among learners, reinforcing the value of integrating online components into traditional classroom settings. This is supported by Dao et al. (2023), who explore how sociocultural approaches and digital tools enhance English teaching, demonstrating the effectiveness of blended learning methods.

However, several gaps in the current research need addressing. There is a lack of longitudinal studies tracking the long-term impact of technology integration on learners' academic and personal development. Additionally, while specific digital tools are explored, comprehensive strategies for integrating these tools across curricula are limited (Kalogeratos & Pierrakeas, 2023). Equity and access issues also require more attention to ensure that underserved communities benefit from technology in education (Milicic et al., 2021).

Furthermore, research on teacher preparedness and support for technology integration remains insufficient. Although innovative training methods, such as digital escape rooms, are discussed (Li & Zhang, 2023), more detailed research is needed to identify effective professional development programs. Emotional and social dynamics in technology-enhanced learning environments also require further exploration to foster positive interactions and well-being (Zhou & Fredrickson, 2023). Addressing these gaps will contribute to a more holistic understanding of technology's role in modernizing education.

2. STATEMENT OF THE PROBLEM

This study determined the TBI and PLA as perceived by Grade 4 learners in Masinloc District, Schools Division of Zambales during the School Year 2023-2024.

Specifically, the study aimed to address these questions:

1. How may the profile of respondents be described in terms of:
    - 1.1. age;
    - 1.2. sex;
    - 1.3. monthly family income;
    - 1.4. number of hours spent using technology per day; and
    - 1.5. average grade for the quarter?
2. How may the perceived TBI by respondents be described in terms of:
    - 2.1. proficiency in digital literacy;
    - 2.2. integration of multimedia tools;
    - 2.3. engagement in online activities; and
    - 2.4. incorporation of real-world applications?
3. How may the PLA as perceived by respondents be described in terms of:
    - 3.1. positive peer interactions;
    - 3.2. teacher-learner rapport;
    - 3.3. willingness to participate in class activities; and
    - 3.4. enthusiasm and curiosity in learning?

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4. Is there a significant difference between perceived TBI and the profile of respondents when grouped accordingly?

5. Is there a significant correlation between perceived TBI and the PLA of respondents?

6. What instructional plan can be proposed to enhance TBI and create a PLA for Grade 4 learners?

3. METHODS AND MATERIALS

This study determined the TBI and PLA as perceived by Grade 4 learners in Masinloc District, Schools Division of Zambales during the School Year 2023-2024. Utilizing a quantitative-descriptive method, data were collected, classified, summarized, and presented using percentages and means. The respondents comprised 213 learners, selected via simple random sampling method to ensure unbiased representation and validity. A researcher-designed questionnaire served as the primary data collection instrument, consisting of three distinct sections: the profile of respondents, the respondents' perceptions of TBI, and the PLA as perceived by respondents. Internal consistency was confirmed through Cronbach's Alpha scores, indicating excellent reliability across dimensions. Non-parametric testing, specifically the Kruskal-Wallis Test and Spearman's Rho Correlation Coefficient, were employed due to the non-normal distribution of data, revealing significant findings across various dimensions.

4. RESULTS AND DISCUSSIONS

4.1. Profile of Respondents

Table 1 presents the distribution of age profiles among respondents, providing both frequency and percentage. The table indicates that 90 learners (42.25%) were 10 years old, 81 learners (38.03%) were 9 years old, 26 learners (12.21%) were 11 years old, 9 learners (4.23%) were 12 years old, 5 learners (2.35%) were 13 years old, and 2 learners (0.94%) were 14 years old and above. The mean age of the learners was 9.93 or 10 years old.

Table 1. Frequency and Percentage Distribution of the Profile of Respondents in terms of Age

Age	Frequency	Percentage
14 years old and above	2	0.94
13 years old	5	2.35
12 years old	9	4.23
11 years old	26	12.21
10 years old	90	42.25
9 years old	81	38.03
Total	**213**	**100.00**
Mean	**9.93 or 10 years old**	

The research studies conducted by Quevedo (2021), Bermas (2022), and Elemento (2022) in Zambales exhibited parallel characteristics to the present study. One notable similarity lies in the common age of learners, which is 10 years old. This implies a consistent age demographic among the participants in both studies, suggesting that the research findings and observations are applicable to learners within the same age group.

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Regarding sex, Table 2 displays the frequency and percentage distribution of respondents' profiles. It is observable that a majority of the learners (50.70%) were female, and 105 learners (49.30%) were male.

Table 2. Frequency and Percentage Distribution of the Profile of Respondents in terms of Sex

Sex	Frequency	Percentage
Male	105	49.30
Female	108	50.70
Total	**213**	**100.00**

The research studies conducted by Ebba (2023), Reyes (2022), and Herrera (2022) in Zambales exhibited parallel characteristics to the present study. One notable similarity lies in the common gender of the learners, which is female. This implies a deliberate focus on understanding and addressing specific challenges or dynamics that may be unique to female learners within the Zambales context.

Table 3 outlines the monthly family income profiles of respondents, illustrating the frequency and percentage distribution. The data on the table shows that 63 learners (29.58%) belonged to families with monthly income of P19,999 and below, 54 learners (25.35%) belonged to families with monthly income of P20,000 to P39,999, 29 learners (13.62%) belonged to families with monthly income of P40,000 to P59,999, 23 learners (10.80%) belonged to families with monthly income of P60,000 to P79,999, 18 learners (8.45%) belonged to families with monthly income of P80,000 to P99,999, 14 learners (6.57%) belonged to families with monthly income of P100,000 to P119,999, and 12 learners (5.63%) belonged to families with monthly income of P120,000 and above. The mean monthly family income was P47,088.70, falling within the bracket of P40,000 to P59,999.

Table 3. Frequency and Percentage Distribution of the Profile of Respondents in terms of Monthly Family Income

Monthly Family Income	Frequency	Percentage
P120,000 and above	12	5.63
P100,000 to P119,999	14	6.57
P80,000 to P99,999	18	8.45
P60,000 to P79,999	23	10.80
P40,000 to P59,999	29	13.62
P20,000 to P39,999	54	25.35
P19,999 and below	63	29.58
Total	**213**	**100.00**
Mean	**47,088.70**	

The research studies conducted by Balanon (2023), Tabun (2023), and Cabling (2024) in Zambales exhibit parallel characteristics to the present study. One notable similarity lies in the shared focus on families with a monthly income of P19,999 and below. This specific income threshold emerges as a consistent characteristic across all the investigations, implying a deliberate emphasis on a particular socioeconomic group.

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Table 4 breaks down respondents' number of hours spent using technology per day, illustrating the distribution through frequency and percentage. The table reveals that 70 learners (32.86%) spent 5.0 hours and above in using technology per day, 55 learners (25.82%) spent 4.0 to 4.9 hours in using technology per day, 33 learners (15.49%) spent 3.0 to 3.9 hours in using technology per day, 24 learners (11.27%) spent 2.0 to 2.9 hours in using technology per day, 18 learners (8.45%) spent 1.0 to 1.9 hours in using technology per day, and 13 learners (6.10%) spent less than 1.0 hour in using technology per day. The mean number of hours spent using technology per day was 3.90 hours, falling within the bracket of 3.0 to 3.9 hours.

Table 4. Frequency and Percentage Distribution of the Profile of Respondents in terms of Number of Hours Spent Using Technology per Day

Number of Hours Spent Using Technology per Day	Frequency	Percentage
5.0 hours and above	70	32.86
4.0 to 4.9 hours	55	25.82
3.0 to 3.9 hours	33	15.49
2.0 to 2.9 hours	24	11.27
1.0 to 1.9 hours	18	8.45
less than 1.0 hour	13	6.10
Total	**213**	**100.00**
Mean	**3.90 hours**	

The research studies conducted by Ogata et al. (2023), Gao and Li (2024), and Sangwan et al. (2024) exhibited parallel characteristics to the present study. One notable similarity lies in the number of hours spent using technology per day, which is more or less than 5.0 hours per day. This implies a consistent trend across multiple studies regarding the significant role of technology in educational settings. The convergence of these studies suggests a broader shift towards leveraging technology, advanced frameworks, and self-regulated learning approaches to enhance educational experiences and address challenges in various domains. This collective research provides valuable insights into the evolving landscape of education in the digital age.

Concerning the average grade for the first quarter, Table 5 showcases the frequency and percentage distribution of respondents' profile. It is noticeable that 91 learners (42.72%) attained the average grade of 80 to 84 for the first quarter, 45 learners (21.13%) attained the average grade of 75 to 79 for the first quarter, 42 learners (19.72%) attained the average grade of 85 to 89 for the first quarter, and 35 learners (16.43) attained the average grade of 90 and above for the first quarter. The mean average grade for the first quarter was 83.57 or 84, interpreted as satisfactory.

Table 5. Frequency and Percentage Distribution of the Profile of Respondents in terms of Average Grade for the First Quarter

Average Grade for the First Quarter	Frequency	Percentage
90 and above	35	16.43
85 to 89	42	19.72
80 to 84	91	42.72
75 to 79	45	21.13
Total	**213**	**100.00**

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Mean	**83.57 or 84**
Interpretation	**Satisfactory**

The findings of these studies (Deliquiña, 2023; Soriano, 2022; Villarin, 2022) conducted in Zambales are parallel to the present study in terms of obtaining satisfactory grades for the quarter, indicating that these learners have consistently met or exceeded the academic expectations set for the respective research contexts. This suggests a shared trend or pattern of academic achievement among learners in Zambales, emphasizing the importance of understanding factors contributing to satisfactory grades, such as effective teaching methodologies, learner engagement, or support systems.

Table 6 details the distribution of respondents' average grade for the second quarter, including both frequency and percentage. According to the table, 82 learners (38.50%) attained the average grade of 85 to 89 for the second quarter, 57 learners (26.76%) attained the average grade of 80 to 84 for the second quarter, 45 learners (21.13%) attained the average grade of 90 and above for the second quarter, and 29 learners (13.42%) attained the average grade of 75 to 79 for the second quarter. The mean average grade for the second quarter was 85.36 or 85, interpreted as very satisfactory.

Table 6. Frequency and Percentage Distribution of the Profile of Respondents in terms of Average Grade for the Second Quarter

Average Grade for the Second Quarter	Frequency	Percentage
90 and above	45	21.13
85 to 89	82	38.50
80 to 84	57	26.76
75 to 79	29	13.62
Total	**213**	**100.00**
Mean	**85.36 or 85**	
Interpretation	**Very Satisfactory**	

The findings of the studies (Tampos, 2023, Rabanzo, 2021; Quiddam, 2021) conducted in Zambales are parallel to the present study in terms of obtaining very satisfactory grades for the quarter, indicating that these learners have consistently demonstrated high levels of academic performance. This commonality underscores the prevalence of learners achieving excellent grades in the academic setting of Zambales.

4.2. Perceived TBI by Respondents

Table 7 outlines the mean rating and interpretations concerning respondents' perceived TBI in terms of proficiency in digital literacy. The table highlights that TBI was observed when their teachers demonstrated how to use the computer for engaging activities such as learning fun things ($\mu = 3.21$), guiding them to click on the right buttons when learning on the screen ($\mu = 3.23$), instructing them on drawing and writing using the magic pen on the tablet ($\mu = 3.18$), facilitating video play for learning ($\mu = 3.20$), narrating stories using pictures and words on the smart board ($\mu = 3.20$), allowing playing learning games on the tablet for reading practice ($\mu = 3.21$), demonstrating online communication to the class ($\mu = 3.21$), teaching mouse usage for computer interaction ($\mu = 3.20$), aiding in finding and opening digital tools for reading time ($\mu = 3.21$), and making computer-based learning easy and enjoyable, akin to a game ($\mu = 3.20$). The general mean rating for proficiency in digital literacy was 3.21, interpreted as observed.

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Table 7. Mean Rating and Interpretations of the Perceived TBI by Respondents in terms of Proficiency in Digital Literacy

Item	Descriptor	Mean Rating	Interpretation
1	My teacher shows me how to use the computer to learn fun things.	3.21	Observed
2	My teacher helps me click on the right buttons when I learn on the screen.	3.23	Observed
3	My teacher teaches me how to draw and write using the magic pen on the tablet.	3.18	Observed
4	My teacher knows how to make videos so I can watch and learn.	3.20	Observed
5	My teacher tells me stories using pictures and words on the smart board.	3.20	Observed
6	My teacher lets me play learning games on the tablet to practice reading.	3.21	Observed
7	My teacher shows me how to talk to the class online and listen to classmates.	3.21	Observed
8	My teacher teaches me to use the mouse to move things on the computer.	3.20	Observed
9	My teacher helps me find and open the digital books for reading time.	3.21	Observed
10	My teacher makes learning on the computer easy and fun, like a game.	3.20	Observed
General Mean Rating		**3.21**	**Observed**

The previous studies of Radovanovic et al. (2020), Spurava & Kotilainen (2023), and Chan (2024) were parallel with the present study in terms of providing comprehensive insights into the multifaceted nature of digital literacy and its intersection with various socio-economic factors. These studies collectively enrich the understanding of digital literacy by addressing challenges in implementation, emphasizing critical skills in professional contexts, and uncovering the interplay between digital literacy, education, and online social capital. The present study aligns with these findings, contributing to the broader discourse on digital literacy and its diverse implications for individuals and societies.

The mean rating and interpretations of perceived TBI, particularly in terms of the integration of multimedia tools, are presented in Table 8. The table reveals observed TBI when teachers showed videos with engaging pictures and sounds to aid understanding ($\mu = 3.18$), utilized the big screen to present colorful slides explaining concepts ($\mu = 3.20$), incorporated listening to

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stories with voices and music on the computer (μ = 3.19), facilitated learning from pop-up pictures on the smart board (μ = 3.21), utilized the computer to make lessons resemble a fun movie (μ = 3.18), encouraged drawing and writing on the tablet during class (μ = 3.20), made learning exciting with moving pictures on the screen (μ = 3.23), taught new concepts using voices and pictures on the laptop (μ = 3.19), facilitated learning through animations and cartoons on the screen (μ = 3.20), and demonstrated the use of the microphone for online communication and idea sharing (μ = 3.19). The general mean rating for the integration of multimedia was 3.20, interpreted as observed.

Table 8. Mean Rating and Interpretations of the Perceived TBI by Respondents in terms of Integration of Multimedia Tools

Item	Descriptor	Mean Rating	Interpretation
1	My teacher shows me videos with cool pictures and sounds to help me understand.	3.18	Observed
2	My teacher uses the big screen to show me colorful slides that explain things.	3.20	Observed
3	My teacher lets me listen to stories with voices and music on the computer.	3.19	Observed
4	My teacher helps me see and learn from pictures that pop-up on the smart board.	3.21	Observed
5	My teacher uses the computer to make my lessons like a fun movie.	3.18	Observed
6	My teacher lets me draw and write on the tablet while I learn in the class.	3.20	Observed
7	My teacher makes learning exciting by showing me pictures that move on the screen.	3.23	Observed
8	My teacher teaches me new things using voices and pictures on the laptop.	3.19	Observed
9	My teacher helps me watch and learn from animations and cartoons on the screen.	3.20	Observed
10	My teacher shows me how to use the microphone to talk and share my ideas online.	3.19	Observed
General Mean Rating		**3.20**	**Observed**

The previous studies of Liu and Zhang (2023), Rogti (2024), and Gamel et al. (2023) resonate with the present study on the integration of multimedia tools, collectively offering insights into the transformative effects of multimedia across diverse domains. These studies collectively emphasize the transformative power of multimedia tools across e-commerce, education, and

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transportation domains. The integration of multimedia not only enhances consumer experiences in online shopping but also plays a pivotal role in shaping learning environments and predicting real-world impacts. The findings contribute to the understanding of how multimedia tools can be strategically employed for diverse purposes, providing valuable insights for developers, educators, and policymakers alike.

The mean rating and interpretations of respondents' perceived TBI in terms of engagement in online activities are displayed in Table 9. The data suggest observed TBI when teachers made online learning enjoyable by playing games on the computer (μ = 3.19), showed engaging videos to facilitate learning (μ = 3.22), facilitated classmate communication using the computer (μ = 3.16), assisted in clicking buttons for collaborative activities on the screen (μ = 3.19), made learning exciting with moving pictures on the screen (μ = 3.18), taught new concepts by allowing drawing and writing on the tablet (μ = 3.22), encouraged sharing ideas and drawings with the class online (μ = 3.21), demonstrated microphone usage for effective communication (μ = 3.20), facilitated reading digital books on the computer during reading time (μ = 3.19), and used the big screen to make lessons feel like fun stories and games (μ = 3.17). The general mean rating for engagement in online activities was 3.19, interpreted as observed.

Table 9. Mean Rating and Interpretations of the Perceived TBI by Respondents in terms of Engagement in Online Activities

Item	Descriptor	Mean Rating	Interpretation
1	My teacher makes online learning fun by playing games with me on the computer.	3.19	Observed
2	My teacher shows me cool videos that help me learn interesting things.	3.22	Observed
3	My teacher lets me talk to my classmates in the class using the computer.	3.16	Observed
4	My teacher helps me click on buttons to do activities together on the screen.	3.19	Observed
5	My teacher makes learning exciting by showing me pictures that move on the screen.	3.18	Observed
6	My teacher teaches me new things by letting me draw and write on the tablet.	3.22	Observed
7	My teacher lets me share my ideas and drawings with the class on the internet.	3.21	Observed
8	My teacher shows me how to use the microphone to talk and listen to each other.	3.20	Observed

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9	My teacher helps me read digital books on the computer during reading time.	3.19	Observed
10	My teacher uses the big screen to make lessons feel like fun stories and games.	3.17	Observed
General Mean Rating		**3.19**	**Observed**

The previous studies of Zoghbi-Manrique-De Lara (2023), Hew et al. (2022), and Yang & Jang (2022) offer valuable insights into different dimensions of online activities, ranging from cyberloafing to online learning engagement and the impact of internet use on the well-being of older adults. These studies collectively contribute to the understanding of engagement in online activities from diverse perspectives. Zoghbi-Manrique-De Lara (2023) broadens the conceptualization of cyberloafing, while Hew et al. (2022) showcase the potential of chatbots in enhancing online learning engagement. Yang & Jang's (2022) study, on the other hand, emphasizes the importance of digital skills and motives in shaping the online experiences of older adults. Integrating these findings with the present study on the integration of multimedia tools can offer a holistic understanding of the dynamic and multifaceted nature of online engagement across various contexts.

In Table 10, the mean rating and interpretations of respondents' perceived TBI in terms of the incorporation of real-world applications are provided. The table indicates that respondents observed TBI when teachers demonstrated how to use computers for real-world applications (μ = 3.20), aided in math problems using the computer for counting and problem-solving (μ = 3.19), taught about animals and nature through pictures and videos (μ = 3.20), facilitated learning about arts on the screen similar to toys (μ = 3.20), used the computer to teach about things seen outside, like trees and cars (μ = 3.21), assisted in writing stories and letters on the tablet similar to paper and crayons (μ = 3.19), showed maps on the screen to enhance understanding of different places (μ = 3.22), taught how to measure things using the computer, like toys and books (μ = 3.18), encouraged exploration of art and music on the computer for self-expression (μ = 3.20), and demonstrated scientific concepts through experiments on the screen (μ = 3.23). The general mean rating for real-world applications was 3.20, interpreted as observed.

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Table 10. Mean Rating and Interpretations of the Perceived TBI by Respondents in terms of Incorporation of Real-World Applications

Item	Descriptor	Mean Rating	Interpretation
1	My teacher shows me how to use computers to learn things I can use in the real world.	3.20	Observed
2	My teacher helps me do math by using the computer to count and solve problems.	3.19	Observed
3	My teacher teaches me about animals and nature by showing pictures and videos.	3.20	Observed
4	My teacher lets me learn about arts on the screen, just like in the toys.	3.20	Observed
5	My teacher uses the computer to teach me about things I see outside, like trees and cars.	3.21	Observed
6	My teacher helps me write stories and letters on the tablet, like I do with paper and crayons.	3.19	Observed
7	My teacher shows me maps on the screen to help me learn about different places.	3.22	Observed
8	My teacher teaches me how to measure things using the computer, like my toys and books.	3.18	Observed
9	My teacher lets me explore art and music on the computer to express myself.	3.20	Observed
10	My teacher shows me how science works by doing experiments and showing them on the screen.	3.23	Observed
General Mean Rating		**3.20**	**Observed**

The previous studies of Mikkulainen et al. (2024), Song et al. (2024), and Dhopeshwarkar et al. (2023) contribute valuable insights into the incorporation of real-world applications in the context of automated optimization, algorithmic enhancement, and healthcare research. These studies collectively underscore the importance of incorporating real-world applications in the development and application of advanced techniques. Miikkulainen et al. (2024) and Song et al. (2024) demonstrate the practical implications of automated optimization algorithms, while Dhopeshwarkar et al. (2023) showcase the relevance of advanced statistical methods in healthcare research. The integration of these findings with the present study on the integration of multimedia

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tools provides a comprehensive perspective on the diverse ways in which advanced methodologies are applied to address real-world challenges.

The summary of respondents' perceived TBI is detailed in Table 11. It can be seen that TBI was observed by respondents in various dimensions, including proficiency in digital literacy, integration of multimedia tools, engagement in online activities, and incorporation of real-world applications (μ = 3.21, 3.20, 3.19, 3.20, respectively). The overall mean rating was 3.20, interpreted as observed.

Table 11. Summary on the Perceived TBI by Respondents

Item	Dimensions	Mean Rating	Interpretation
1	Proficiency in Digital Literacy	3.21	Observed
2	Integration of Multimedia Tools	3.20	Observed
3	Engagement in Online Activities	3.19	Observed
4	Incorporation of Real-World Applications	3.20	Observed
Overall Mean Rating		**3.20**	**Observed**

The previous studies of Mazzotti et al. (2023), Jimeno & Prado (2024), and Zhou et al. (2024) contribute valuable insights into the integration of TBI in different contexts, ranging from self-determination interventions for learners with disabilities to the impact of TBI on teachers' performance and the specific ways technology facilitates vocabulary learning. These studies collectively highlight the diverse applications of TBI, ranging from supporting self-determination in learners with disabilities to enhancing teachers' performance and facilitating vocabulary learning. The findings contribute to the ongoing discourse on the integration of technology in education, emphasizing its potential to address various educational challenges and enhance learning outcomes. Integrating these insights with the present study on the incorporation of real-world applications and multimedia tools can provide a holistic perspective on the multifaceted role of technology in education.

4.3. PLA as Perceived by Respondents

The mean rating and interpretations of respondents' PLA related to positive peer interactions are depicted in Table 12. The table suggests that respondents experienced a conducive learning atmosphere when they liked classmates who smiled and worked together during lessons (μ = 3.18); felt happy when their classmates helped them when they were stuck (μ = 3.23); enjoyed listening to classmates sharing ideas during group activities (μ = 3.19); felt good when teachers praised their works (μ = 3.21); learned better when classmates talked and learned together (μ = 3.19); felt excited when working in teams on projects and problem-solving (μ = 3.22); liked when classmates encouraged them to try new things (μ = 3.20); felt proud when sharing and showing drawings with classmates (μ = 3.19); learned more when taking turns reading stories with classmates (μ = 3.23); and felt great when celebrating each other's successes (μ = 3.22). The general mean rating for positive peer interactions was 3.21, interpreted as conducive to learning.

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Table 12. Mean Rating and Interpretations of the PLA as Perceived by Respondents in terms of Positive Peer Interactions

Item	Descriptor	Mean Rating	Interpretation
1	I like when my classmates smile and work together during lessons.	3.18	Conducive to Learning
2	I feel happy when my classmates help me when I am stuck.	3.23	Conducive to Learning
3	I enjoy listening to my classmates share their ideas during group activities.	3.19	Conducive to Learning
4	I feel good when my teacher says nice things about my work.	3.21	Conducive to Learning
5	I learn better when my classmates and I talk and learn together.	3.19	Conducive to Learning
6	I feel excited when I work in teams to do projects and solve problems.	3.22	Conducive to Learning
7	I like when my classmates encourage me to try new things.	3.20	Conducive to Learning
8	I feel proud when my classmates and I share and show our drawings.	3.19	Conducive to Learning
9	I learn more when my classmates and I take turns reading stories.	3.23	Conducive to Learning
10	I feel great when my classmates and I celebrate each other's successes.	3.22	Conducive to Learning
General Mean Rating		**3.21**	**Conducive to Learning**

The previous studies of Wang and Feng (2024), Lee et al. (2024), and Edwards et al. (2024) contribute insights into the dynamics of positive peer interactions, emphasizing the role of emotional understanding, competitive peer-to-peer interactions, and the impact of religious identities during peer discussions. These studies collectively contribute to the understanding of positive peer interactions in diverse contexts, from preschool settings to medical education and undergraduate biology courses. They underscore the importance of cognitive abilities, the impact of competitive interactions, and the dynamics of religious identities in shaping peer relationships. Integrating these findings with the present study on TBI can provide a comprehensive perspective on the multifaceted factors influencing positive peer interactions in various educational settings.

The PLA of respondents, focusing on teacher-learner rapport, is outlined in Table 13. The table indicates that respondents experienced a PLA conducive to learning when they felt happy when teachers smiled and talked to them kindly ($\mu = 3.16$); liked when teachers listened to their questions and helped them ($\mu = 3.24$); enjoyed learning more when teachers told interesting stories ($\mu = 3.17$); felt safe when teachers were there to help and support them ($\mu = 3.22$); liked when teachers acknowledged their good job and encouraged them ($\mu = 3.21$); learned better when teachers explained things in a friendly way ($\mu = 3.18$); felt excited to come to school when knowing teachers cared about them ($\mu = 3.18$); liked when teachers and them worked together on fun activities ($\mu = 3.22$); felt proud when teachers noticed their hard work and effort ($\mu = 3.19$); and

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enjoyed school when teachers made them feel like they belonged and were important (μ = 3.20). The general mean rating for teacher-learner rapport was 3.20, interpreted as conducive to learning.

Table 13. Mean Rating and Interpretations of the PLA as Perceived by Respondents in terms of Teacher-Learner Rapport

Item	Descriptor	Mean Rating	Interpretation
1	I feel happy when my teacher smiles and talks to me kindly.	3.16	Conducive to Learning
2	I like when my teacher listens to my questions and helps me.	3.24	Conducive to Learning
3	I enjoy learning more when my teacher tells interesting stories.	3.17	Conducive to Learning
4	I feel safe when my teacher is there to help and support me.	3.22	Conducive to Learning
5	I like when my teacher says I am doing a good job and encourages me.	3.21	Conducive to Learning
6	I learn better when my teacher explains things in a friendly way.	3.18	Conducive to Learning
7	I feel excited to come to school when I know my teacher cares about me.	3.18	Conducive to Learning
8	I like when my teacher and I work together on fun activities.	3.22	Conducive to Learning
9	I feel proud when my teacher notices my hard work and effort.	3.19	Conducive to Learning
10	I enjoy school when my teacher makes me feel like I belong and am important.	3.20	Conducive to Learning
General Mean Rating		**3.20**	**Conducive to Learning**

The previous studies of Onyango (2024), Chen and Rafik-Galea (2024), and Atibuni et al. (2022) offer insights into various factors influencing the well-being of learners in higher education institutions and the dynamics of teacher-learner rapport in the context of English language teaching. These studies collectively contribute to the broader understanding of factors influencing learner well-being in higher education institutions and the dynamics of teacher-learner rapport. While Onyango (2024) explores external factors, Chen and Rafik-Galea (2024) delve into the role of instructor behaviors in learner motivation, and Atibuni et al. (2022) discuss the challenges faced by teacher education programs. Integrating these findings with the present study on positive peer interactions can provide a comprehensive perspective on the multifaceted relationships within educational contexts.

Table 14 outlines the mean rating and interpretations of the PLA for respondents, specifically in relation to the willingness to participate in class activities. As observed from the table, the PLA was conducive to learning when they felt excited to raise their hands and share ideas in class (μ = 3.17); joined activities when classmates and teachers were friendly (μ = 3.20); answered questions when teachers made them feel comfortable (μ = 3.18); felt happy when teachers encouraged them to take part in games (μ = 3.20); liked to participate when classmates

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and teachers cheered them on (μ = 3.20); enjoyed group activities when everyone worked together and had fun (μ = 3.19); felt brave to speak up when teachers created a nice atmosphere (μ = 3.20); wanted to join discussions when teachers listened to what they said (μ = 3.18); felt good about taking turns when everyone was kind and patient (μ = 3.21); and liked sharing in class when teachers respected their thoughts and feelings (μ = 3.20). The general mean rating for willingness to participate in class activities was 3.19, interpreted as conducive to learning.

Table 14. Mean Rating and Interpretations of the PLA as Perceived by Respondents in terms of Willingness to Participate in Class Activities

Item	Descriptor	Mean Rating	Interpretation
1	I feel excited to raise my hand and share my ideas in class.	3.17	Conducive to Learning
2	I like joining activities when my classmates and teacher are friendly.	3.20	Conducive to Learning
3	I enjoy answering questions when my teacher makes me feel comfortable.	3.18	Conducive to Learning
4	I feel happy when my teacher encourages me to take part in games.	3.20	Conducive to Learning
5	I like to participate when my classmates and teacher cheer me on.	3.20	Conducive to Learning
6	I enjoy group activities when everyone works together and has fun.	3.19	Conducive to Learning
7	I feel brave to speak up when my teacher creates a nice atmosphere.	3.20	Conducive to Learning
8	I want to join discussions when my teacher listens to what I say.	3.18	Conducive to Learning
9	I feel good about taking turns when everyone is kind and patient.	3.21	Conducive to Learning
10	I like sharing in class when my teacher respects my thoughts and feelings.	3.20	Conducive to Learning
General Mean Rating		**3.19**	**Conducive to Learning**

The previous studies of Huang and Liu (2024), Sufian (2024), and Robledo et al. (2024) provide insights into various aspects of educational practices, formative assessment, and learner participation, which are relevant to the willingness to participate in class activities. The studies collectively contribute to the understanding of factors influencing learner participation and highlight the significance of formative assessment, interactive learning environments, and hands-on experiences. Incorporating these insights into classroom practices may contribute to fostering learners' willingness to participate in class activities.

In terms of enthusiasm and curiosity in learning, Table 15 summarizes the mean rating and interpretations of respondents' PLA. It can be observed from the table that the PLA was conducive to learning when they got excited to learn new things when teachers made it fun (μ = 3.18); liked exploring and asking questions when classmates were interested too (μ = 3.22); enjoyed learning when teachers told stories that made them curious (μ = 3.19); felt happy to learn when classmates

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and them discovered things together (μ = 3.24); got curious about subjects when teachers showed them interesting things (μ = 3.18); liked to learn more when teachers let them try hands-on activities (μ = 3.22); felt eager to know when classmates shared cool facts (μ = 3.19); enjoyed learning when teachers showed them colorful pictures and videos (μ = 3.21); got interested in books and lessons when teachers made them exciting (μ = 3.22); and felt enthusiastic about learning when teachers encouraged their questions (μ = 3.21). The general mean rating for enthusiasm and curiosity in learning was 3.21, interpreted as conducive to learning.

Table 15. Mean Rating and Interpretations of the PLA as Perceived by Respondents in terms of Enthusiasm and Curiosity in Learning

Item	Descriptor	Mean Rating	Interpretation
1	I get excited to learn new things when my teacher makes it fun.	3.18	Conducive to Learning
2	I like exploring and asking questions when my classmates are interested too.	3.22	Conducive to Learning
3	I enjoy learning when my teacher tells stories that make me curious.	3.19	Conducive to Learning
4	I feel happy to learn when my classmates and I discover things together.	3.24	Conducive to Learning
5	I get curious about subjects when my teacher shows me interesting things.	3.18	Conducive to Learning
6	I like to learn more when my teacher lets me try hands-on activities.	3.22	Conducive to Learning
7	I feel eager to know when my classmates share cool facts.	3.19	Conducive to Learning
8	I enjoy learning when my teacher shows me colorful pictures and videos.	3.21	Conducive to Learning
9	I get interested in books and lessons when my teacher makes them exciting.	3.22	Conducive to Learning
10	I feel enthusiastic about learning when my teacher encourages my questions.	3.21	Conducive to Learning
General Mean Rating		**3.21**	**Conducive to Learning**

The previous studies of Ahrens (2024), Flores et al. (2024), and Agustin et al. (2020) shed light on factors influencing enthusiasm and curiosity in learning, emphasizing the importance of innovative teaching approaches and organizational culture. These studies collectively highlight the significance of relevant, engaging content, innovative teaching approaches, and a supportive organizational culture in fostering enthusiasm and curiosity in learning. Whether it is through integrating agricultural topics, promoting an intrapreneurial university culture, or enhancing

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mathematics education, these approaches contribute to creating an environment that stimulates learners' intrinsic motivation and passion for learning.

The summary of respondents' PLA is detailed in Table 16. It can be seen from the table that the PLA was conducive to learning in various dimensions such as positive peer instructions, teacher-learner support, willingness to participate in class activities, and enthusiasm and curiosity in learning (μ = 3.21, 3.20, 3.19, 3.21, respectively). The overall mean rating was 3.20, interpreted as conducive to learning.

Table 16. Summary on the PLA as Perceived by Respondents

Item	Dimensions	Mean Rating	Interpretation
1	Positive Peer Interactions	3.21	Conducive to Learning
2	Teacher-Learner Rapport	3.20	Conducive to Learning
3	Willingness to Participate in Class Activities	3.19	Conducive to Learning
4	Enthusiasm and Curiosity in Learning	3.21	Conducive to Learning
Overall Mean Rating		**3.20**	**Conducive to Learning**

The previous studies of Oude Ophuis (2023), Rahimah & Koto (2024), and Fleming (2024) contribute valuable insights into the factors influencing a PLA within educational settings. These studies collectively stress the importance of effective communication, trust, engagement, and supportive strategies in creating a PLA. The factors identified, such as transparent communication, shared interests, supportive teaching strategies, and faculty members' proactive efforts, align with the goal of fostering a PLA. These insights provide practical implications for educators and institutions to design effective learning programs and enhance the overall learning atmosphere.

4.4. Difference Between Perceived TBI by Respondents and Their Profile

Table 17 presents the results of a Kruskal-Wallis Test investigating the difference between perceived TBI and respondents' age. The computed asymptotic significant values for dimensions of perceived TBI, such as proficiency in digital literacy, integration of multimedia tools, engagement in online activities, and incorporation of real-world applications (ASig. = 0.000, 0.000, 0.000, 0.000, respectively) all fall below the 0.05 significant threshold. Consequently, the null hypothesis is rejected, signifying a notable difference between respondents' age profiles and the overall perceived TBI, with an overall computed value of ASig. = 0.000.

Table 17. Difference between Perceived TBI by Respondents and their Profile in terms of Age

Perceived TBI	H-value	Df	Asymp. Sig.	Decision
Proficiency in Digital Literacy	25.798	5	.000	Reject H_{01} Significant
Integration of Multimedia Tools	26.529	5	.000	Reject H_{01} Significant
Engagement in Online Activities	24.517	5	.000	Reject H_{01} Significant
Incorporation of Real-World Applications	26.519	5	.000	Reject H_{01} Significant

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Overall	**25.620**	**5**	**.000**	**Reject H_{01} Significant**

The findings of various researchers (Green, 2024; Pratama & Assidik, 2024; Nurjanis et al., 2024) support the findings of the present study on having significant differences, which implies that age plays a crucial role in shaping the perceptions and responses of nursing learners towards TBI. Specifically, the study focused on resistance to change in technology-based learning (TBL) and explored the mediating mechanisms of ease of use and emotional reaction in relation to short-term focus and behavioral intention to participate.

Table 18 displays the results of a Kruskal-Wallis Test examining the difference between perceived TBI by respondents and their sex profiles. The computed asymptotic significant values for dimensions of perceived TBI, including proficiency in digital literacy, integration of multimedia tools, engagement in online activities, and incorporation of real-world applications, all exceeded the significance level of 0.05 (ASig. = 0.602, 0.750, 0.905, 0.826, respectively). As a result, the null hypothesis is accepted, indicating no significance difference between perceived TBI and respondents' sex profiles, with an overall computed value of ASig. = 0.749.

Table 18. Difference between Perceived TBI by Respondents and their Profile in terms of Sex

Perceived TBI	H-value	Df	Asymp. Sig.	Decision
Proficiency in Digital Literacy	.272	1	.602	Accept H_{01} Not Significant
Integration of Multimedia Tools	.102	1	.750	Accept H_{01} Not Significant
Engagement in Online Activities	.014	1	.905	Accept H_{01} Not Significant
Incorporation of Real-World Applications	.048	1	.826	Accept H_{01} Not Significant
Overall	**.103**	**1**	**.749**	**Accept H_{01} Not Significant**

The findings of various researchers (Yuberta & Firmanti, 2024; Sulaiman et al., 2024; Putra et al., 2024) support the findings of the present study on having no significant difference, which implies that there is no clear distinction in the perceived TBI based on the sex of learners. While the previous studies focused on various aspects such as mathematics teachers' ICT use strategies, learners' technology use skills, and the impact of augmented reality (AR) on understanding Solar System material, none of them found a significant difference between male and female learners in their perceptions of TBI.

In Table 19, a Kruskal-Wallis Test is presented to investigate the difference between perceived TBI and respondents' monthly family income. The computed asymptotic significance values for dimensions of perceived TBI, such as proficiency in digital literacy, integration of multimedia tools, engagement in online activities, and incorporation of real-world applications (ASig. = 0.000, 0.000, 0.000, 0.000, respectively), are all below the 0.05 significance level. Hence, the null hypothesis is rejected, suggesting a significant difference between respondents' monthly family income and the overall perceived TBI, with an overall computed value of ASig. = 0.000.

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Table 19. Difference between Perceived TBI by Respondents and their Profile in terms of Monthly Family Income

Perceived TBI	H-value	Df	Asymp. Sig.	Decision
Proficiency in Digital Literacy	41.581	6	.000	Reject H_{01} Significant
Integration of Multimedia Tools	35.606	6	.000	Reject H_{01} Significant
Engagement in Online Activities	34.803	6	.000	Reject H_{01} Significant
Incorporation of Real-World Applications	37.805	6	.000	Reject H_{01} Significant
Overall	**38.448**	**6**	**.000**	**Reject H_{01} Significant**

The findings of various researchers (Geoghegan & Wanger, 2024; Atashinsadaf et al., 2024; Adhikari & Shrestha, 2024) support the findings of the present study on having a significant difference, which implies that there are notable distinctions in the perceived TBI based on the monthly family income of learners. This aspect becomes particularly relevant as it sheds light on the socioeconomic factors that might affect the effectiveness and acceptance of TBL. The significant differences in perceived TBI across income levels underscore the need for targeted interventions and considerations in educational planning. Acknowledging and addressing these distinctions can contribute to the development of inclusive and equitable TBL environments that cater to the diverse economic backgrounds of learners.

Within Table 20, the results of a Kruskal-Wallis Test are displayed, examining the difference between respondents' perceived TBI and their number of hours spent using technology per day. Notably, the computed asymptotic significance values for various dimensions of perceived TBI – proficiency in digital literacy, integration of multimedia tools, engagement in online activities, and incorporation of real-world applications (ASig. = 0.798, 0.812, 0.840, 0.814, respectively) – all exceed the 0.05 significance level. Consequently, the null hypothesis is accepted, suggesting no significant difference between the respondents' number of hours spent using technology per day and the overall perceived TBI, with an overall computed value of ASig. = 0.827.

Table 20. Difference between Perceived TBI by Respondents and their Profile in terms of Number of Hours Spent Using Technology Per Day

Perceived TBI	H-value	Df	Asymp. Sig.	Decision
Proficiency in Digital Literacy	2.355	5	.798	Accept H_{01} Not Significant
Integration of Multimedia Tools	2.259	5	.812	Accept H_{01} Not Significant
Engagement in Online Activities	2.064	5	.840	Accept H_{01} Not Significant
Incorporation of Real-World Applications	2.248	5	.814	Accept H_{01} Not Significant

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Overall	**2.155**	**5**	**.827**	**Accept H_{01} Not Significant**

The findings of various researchers (Peter, 2023; Rizal et al., 2024; Tamara et al., 2024) support the findings of the present study on having no significant difference, which implies that there is no clear distinction in the perceived TBI based on the number of hours spent using technology per day by learners. Despite differences in the focus of the studies, ranging from the effective use of technology in teaching and learning to the enhancement of creative thinking skills through mobile learning and the utilization of information and communication technology (ICT) in the learning process, none found a significant impact of the number of hours spent using technology per day on the learners' perceptions. The absence of a significant difference in these studies suggests that the effectiveness and perceptions of TBI may not be strongly affected by the number of hours learners spend using technology per day. Other factors such as the quality of instructional design, the integration of technology into pedagogical practices, and the specific context of technology use appear to play more critical roles in shaping learners' perceptions of TBI.

In Table 21, the outcomes of a Kruskal-Wallis Test are presented, exploring the difference between perceived TBI and respondents' average grade for the first quarter. The computed asymptotic significant values for dimensions of perceived TBI, such as proficiency in digital literacy, integration of multimedia tools, engagement in online activities, and incorporation of real-world applications (ASig. = 0.000, 0.000, 0.000, 0.000, respectively) all fall below the 0.05 significance threshold. Therefore, the null hypothesis is rejected, suggesting a significant difference between the respondents' average grade for the first quarter and the overall perceived TBI, with an overall computed value of ASig. = 0.000.

Table 21. Difference between Perceived TBI by Respondents and their Profile in terms of Average Grade for the First Quarter

Perceived TBI	H-value	Df	Asymp. Sig.	Decision
Proficiency in Digital Literacy	44.775	3	.000	Reject H_{01} Significant
Integration of Multimedia Tools	49.096	3	.000	Reject H_{01} Significant
Engagement in Online Activities	46.795	3	.000	Reject H_{01} Significant
Incorporation of Real-World Applications	44.466	3	.000	Reject H_{01} Significant
Overall	**45.116**	**3**	**.000**	**Reject H_{01} Significant**

The findings of various researchers (Lin et al., 2024; Weiszhaupt et al., 2024; Karuru et al., 2024) support the findings of the present study on having a significant difference, which implies that there are notable distinctions in the perceived TBI based on the average grade for the first quarter of the learners. The studies collectively shed light on the correlation between academic performance and various aspects of TBL, such as cultural integration, authentic assessment, and the development of critical thinking skills. These studies collectively emphasize the significance

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of TBI in influencing academic performance. The findings suggest that incorporating technology into educational practices, whether through cultural integration strategies, authentic assessment methods, or critical thinking skill development, can positively contribute to learners' academic achievements. Acknowledging these relationships can inform educators and institutions in tailoring technology-based instructional approaches to better meet the diverse needs of learners and enhance their overall academic success.

Table 22 displays the results of a Kruskal-Wallis Test examining the difference between perceived TBI by respondents and their average grade for the second quarter. The computed asymptotic significant values for perceived TBI, including proficiency in digital literacy, integration of multimedia tools, engagement in online activities, and incorporation of real-world applications, all fall below the significant level of 0.05 (ASig. = 0.000, 0.000, 0.000, 0.000, respectively). As a result, the null hypothesis is rejected, indicating a significant difference between perceived TBI and respondents' average grade for the second quarter, with an overall computed value of ASig. = 0.000.

Table 22. Difference between Perceived TBI by Respondents and their Profile in terms of Average Grade for the Second Quarter

Perceived TBI	H-value	Df	Asymp. Sig.	Decision
Proficiency in Digital Literacy	33.874	3	.000	Reject H_{01} Significant
Integration of Multimedia Tools	36.874	3	.000	Reject H_{01} Significant
Engagement in Online Activities	33.235	3	.000	Reject H_{01} Significant
Incorporation of Real-World Applications	33.161	3	.000	Reject H_{01} Significant
Overall	**34.021**	**3**	**.000**	**Reject H_{01} Significant**

The findings of various researchers (Manshur et al., 2024; Tuan et al., 2024; Calik et al., 2024) support the findings of the present study on having a significant difference, which implies that there are notable distinctions in the perceived TBI based on the average grade for the second quarter of the learners. These studies collectively contribute insights into the effectiveness of TBL media on learner outcomes, ranging from Islamic Religious Education (PAI) subjects to academic performance in the context of chemical bonding interventions. These studies collectively highlight the positive impact of TBI on learner learning outcomes, encompassing various subjects and intervention types. The findings imply that integrating technology into educational practices,

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whether in religious education or scientific subjects like chemistry, can contribute significantly to enhancing learners' academic achievements. This reinforces the importance of considering technology as a valuable tool in educational methodologies for improved learner outcomes.

4.5. Correlation Between Perceived TBI and the PLA of Respondents

Table 23 presents the correlation between perceived TBI and the PLA of respondents regarding positive peer interaction, utilizing Spearman's Rho Correlation Coefficient. The perceived TBI in terms of proficiency in digital literacy (r_s = 0.954), integration of multimedia tools (r_s = 0.958), engagement in online activities (r_s = 0.960), and incorporation of real-world applications (r_s = 0.949) exhibits a positively very high significant correlation with their PLA in positive peer interaction. The corresponding significant values (α = 0.000, 0.000, 0.000, 0.000, respectively) are all significant at the 5% level, leading to the rejection of the null hypothesis. Overall, there exists a positively very high significant correlation (r_s = 0.957, α = 0.000) between perceived TBI and the PLA of respondents in terms of positive peer instruction.

Table 23. Correlation between Perceived TBI and the PLA of Respondents in terms of Positive Peer Interaction

Perceived TBI	Correlation Coefficient	Interpretation	Sig. (2-tailed)	Decision
Proficiency in Digital Literacy	.954	Positive Very High Correlation	.000	Reject Ho_2 Significant
Integration of Multimedia Tools	.958	Positive Very High Correlation	.000	Reject Ho_2 Significant
Engagement in Online Activities	.960	Positive Very High Correlation	.000	Reject Ho_2 Significant
Incorporation of Real-World Applications	.949	Positive Very High Correlation	.000	Reject Ho_2 Significant
Overall	**.957**	**Positive Very High Correlation**	**.000**	**Reject Ho_2 Significant**

The findings of the various researchers (Etemi et al., 2024; Seethamraju & Murthy, 2023; Puspitaloka et al., 2024) significantly coincide with the present study in terms of the correlation of perceived TBI and the PLA, particularly in terms of positive peer instruction. The contemporary educational landscape is undergoing a transformative shift towards innovative instructional approaches, with the flipped learning approach being a prominent example. These collective findings affirm that integrating technology-based instructional methods, such as the flipped

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learning approach and technology-enabled active learning, correlates positively with creating a conducive and engaging learning atmosphere. The emphasis on peer instruction, problem-solving, and self-directed learning aligns with the contemporary goals of advancing innovative teaching methods in higher education, as evidenced by the studies conducted by Etemi et al. (2024), Seethamraju & Murthy (2023), and Puspitaloka et al. (2024).

In Table 24, the correlation between respondents' perceived TBI and their PLA concerning teacher-learner rapport is presented using Spearman's Rho Correlation Coefficient. The perceived TBI, measured in terms of proficiency in digital literacy (r_s = 0.952), integration of multimedia tools (r_s = 0.958), engagement in online activities (r_s = 0.966), and incorporation of real-world applications (r_s = 0.950), exhibits a positively very high significant correlation with their PLA in teacher-learner rapport. The corresponding significant values (α = 0.000, 0.000, 0.000, 0.000, respectively) are all below the 5% significance level, leading to the rejection of the null hypothesis. Overall, a positively very high significant correlation (r_s = 0.960, α = 0.000) exists between perceived TBI by respondents and their PLA in terms of teacher-learner rapport.

Table 24. Correlation between Perceived TBI and the PLA of Respondents in terms of Teacher-Learner Rapport

Perceived TBI	Correlation Coefficient	Interpretation	Sig. (2-tailed)	Decision
Proficiency in Digital Literacy	.952	Positive Very High Correlation	.000	Reject Ho_2 Significant
Integration of Multimedia Tools	.958	Positive Very High Correlation	.000	Reject Ho_2 Significant
Engagement in Online Activities	.966	Positive Very High Correlation	.000	Reject Ho_2 Significant
Incorporation of Real-World Applications	.950	Positive Very High Correlation	.000	Reject Ho_2 Significant
Overall	**.960**	**Positive Very High Correlation**	**.000**	**Reject Ho_2 Significant**

The findings of the various researchers (Li et al., 2024; Pinkerton, 2021; Xiao, 2024) significantly coincide with the present study in terms of the correlation of perceived TBI and the PLA in terms of teacher-learner rapport. The research landscape has seen a growing interest in understanding the dynamics between TBI and the interpersonal relationship between teachers and learners. The convergence of findings from Li et al. (2024), Pinkerton (2021), and Xiao (2024) with the present study underscores the multifaceted relationship between perceived TBI and the PLA, particularly in terms of teacher-learner rapport. As technology continues to shape

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educational practices, understanding and enhancing the interpersonal dynamics between teachers and learners remain crucial for fostering a positive and effective learning environment.

Table 25 outlines the correlation between perceived TBI by respondents and their PLA in terms of willingness to participate in class activities, employing Spearman's Rho Correlation Coefficient. The perceived TBI, specifically in terms of proficiency in digital literacy ($r_s = 0.940$), integration of multimedia tools ($r_s = 0.973$), engagement in online activities ($r_s = 0.943$), and incorporation of real-world applications ($r_s = 0.945$) display a positively very high significant correlation with their PLA in willingness to participate in class activities. The associated significant values ($\alpha = 0.000, 0.000, 0.000, 0.000$, respectively) fall below the 5% significance level, leading to the rejection of the null hypothesis. Overall, a positively very high significant correlation ($r_s = 0.956$, $\alpha = 0.000$) is evident between perceived TBI by respondents and their PLA related to willingness to participate in class activities.

Table 25. Correlation between Perceived TBI and the PLA of Respondents in terms of Willingness to Participate in Class Activities

Perceived TBI	Correlation Coefficient	Interpretation	Sig. (2-tailed)	Decision
Proficiency in Digital Literacy	.940	Positive Very High Correlation	.000	Reject Ho_2 Significant
Integration of Multimedia Tools	.973	Positive Very High Correlation	.000	Reject Ho_2 Significant
Engagement in Online Activities	.943	Positive Very High Correlation	.000	Reject Ho_2 Significant
Incorporation of Real-World Applications	.945	Positive Very High Correlation	.000	Reject Ho_2 Significant
Overall	**.956**	**Positive Very High Correlation**	**.000**	**Reject Ho_2 Significant**

The findings of the various researchers (Pradana et al., 2024; Fidan & Fidan, 2023; Aini et al., 2024) significantly coincide with the present study in terms of the correlation of perceived TBI and the PLA in terms of willingness to participate in class activities. These collective findings emphasize the positive relationship between perceived TBI and the creation of a PLA that enhances learners' willingness to actively participate in class activities. The studies by Pradana et al. (2024), Fidan & Fidan (2023), and Aini et al. (2024) underscore the importance of technological integration in education for fostering engagement, collaboration, and overall positive learning experiences.

Table 26 presents the correlation between perceived TBI by respondents and their PLA in terms of enthusiasm and curiosity in learning, using Spearman's Rho Correlation Coefficient. The perceived TBI, specifically in terms of proficiency in digital literacy ($r_s = 0.965$), integration of multimedia tools ($r_s = 0.975$), engagement in online activities ($r_s = 0.947$), and incorporation of real-world applications ($r_s = 0.976$), exhibits a positively very high significant correlation with their PLA in enthusiasm and curiosity in learning. The associated significant values ($\alpha = 0.000, 0.000, 0.000, 0.000$, respectively) all meet the 5% significance criterion, resulting in the rejection of the null hypothesis. Overall, a positively very high significant correlation ($r_s = 0.977$, $\alpha = 0.000$)

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exists between perceived TBI by respondents and their PLA concerning the enthusiasm and curiosity in learning.

Table 26. Correlation between Perceived TBI and the PLA of Respondents in terms of Enthusiasm and Curiosity in Learning

Perceived TBI	Correlation Coefficient	Interpretation	Sig. (2-tailed)	Decision
Proficiency in Digital Literacy	.965	Positive Very High Correlation	.000	Reject Ho_2 Significant
Integration of Multimedia Tools	.975	Positive Very High Correlation	.000	Reject Ho_2 Significant
Engagement in Online Activities	.947	Positive Very High Correlation	.000	Reject Ho_2 Significant
Incorporation of Real-World Applications	.976	Positive Very High Correlation	.000	Reject Ho_2 Significant
Overall	**.977**	**Positive Very High Correlation**	**.000**	**Reject Ho_2 Significant**

The findings of the various researchers (Majdoub & Heilporn, 2024; Amalia et al., 2024; Hossain, 2024) significantly coincide with the present study in terms of the correlation of perceived TBI and the PLA in terms of enthusiasm and curiosity in learning. The collective findings of Majdoub and Heilporn (2024), Amalia et al. (2024), and Hossain (2024) support the idea that perceived TBI correlates positively with the creation of a PLA characterized by increased enthusiasm and curiosity among learners. These studies highlight the role of technology in fostering engaging, enjoyable, and dynamic learning environments that contribute to learners' motivation and active participation in the learning process.

4.6. An Instructional Plan in Enhancing TBI and Creating a PLA for Grade 4 Learners

Implementing technology-enhanced lessons, such as digital learning labs and virtual field trips, will immerse grade 4 learners in interactive and dynamic educational experiences, catering to diverse learning styles and increasing engagement. Integrating educational tools like adaptive learning platforms and multimedia projects will enable personalized instruction, allowing learners to take ownership of their learning journey and deepen their understanding of key concepts. Fostering digital literacy skills, including navigating digital interfaces and critically evaluating online resources, will equip learners with essential competencies for success in the digital age. Creating a supportive and inclusive learning environment through collaborative projects, culturally relevant content, and flexible learning options will develop learners' collaboration skills, confidence, and sense of belonging. Consistent collaboration among school heads, ICT coordinators, teachers, parents, and learning facilitators, along with ongoing professional development, will ensure the effective implementation of the instructional plan, leading to the academic and social-emotional success of grade 4 learners.

5. CONCLUSIONS

1. The majority of learners were 10 years old, primarily female, with a monthly family income of P19,999 and below. They devoted 5.0 hours or more daily to using technology and achieved a

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satisfactory average grade for the first quarter, progressing to a very satisfactory average grade for the second quarter.
2. Learners exhibited proficiency in digital literacy, integration of multimedia tools, engagement in online activities, and incorporation of real-world applications.
3. The PLA among learners significantly contributed to conducive learning environments, particularly in the realms of positive peer interactions, teacher-learner rapport, willingness to participate in class activities, and enthusiasm and curiosity in learning.
4. A noteworthy difference was observed in the perceived TBI among respondents across all dimensions – proficiency in digital literacy, integration of multimedia tools, engagement in online activities, and incorporation of real-world applications – based on age, monthly family income, and average grade for the first and second quarter. The computed asymptotic significant value fell below the 0.05 level of significance, prompting the rejection of the null hypothesis.
5. A positive, very high and significant correlation was identified between perceived TBI across various dimensions – proficiency in digital literacy, integration of multimedia tools, engagement in online activities, and incorporation of real-world applications – and the PLA of respondents. This correlation was notably evident in the context of positive peer instructions, teacher-learner rapport, willingness to participate in class activities, and enthusiasm and curiosity in learning. The computed significant value achieved significance at a 5% level, necessitating the rejection of the null hypothesis.
6. A program has been devised to enhance TBI and foster a PLA for Grade 4 learners.

6. RECOMMENDATIONS

1. The learners must receive targeted support and resources to address potential challenges associated with their age, gender, and socioeconomic background, while also encouraging continued positive engagement with technology and academic success throughout the school year.
2. The teachers must consistently hone and further develop their proficiency in digital literacy, adept use of multimedia tools, active participation in online activities, and practical application of knowledge to real-world scenarios.
3. The learners must actively cultivate and sustain a PLA by fostering positive peer interactions, building strong teacher-learner rapport, actively participating in class activities, and maintaining enthusiasm and curiosity in the learning process.
4. The learners must benefit from tailored instructional strategies, considering the identified differences in TBI based on age, monthly family income, and academic performance, thereby ensuring equitable learning experiences for all.
5. The learners must continue to thrive in an environment that promotes positive TBI, reinforcing the correlation between digital literacy, multimedia integration, online engagement, real-world application, and an overall PLA.
6. The teachers and learners must actively participate in and benefit from the devised program aimed at enhancing TBI and fostering a PLA specifically designed for Grade 4 learners.
7. Further studies must be conducted by other researchers to delve deeper into the specific challenges faced by learners based on their age, gender, and socioeconomic background, aiming to provide more nuanced insights and targeted interventions for academic support.

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8. Other studies must be conducted on the long-term effectiveness of tailored instructional strategies in TBI, exploring sustained benefits and potential areas for improvement, with a focus on continuous professional development for teachers.

7. ACKNOWLEDGMENT

The researcher extends profound gratitude to all who contributed to the completion of this study. First, Edgar B. Geniza, PhD, Editha B. Geniza, PhD, Elisa A. Menor, PhD, Yzagany Ivarra B. Geniza, PECE, MS, and Arturo P. Caseñas Jr., MIT, MHRM, MBA, from Mondriaan Aura College, Subic Bay Freeport Zone, for their crucial remarks and recommendations. Special thanks to Jessie D. Ferrer, CESO V, Schools Division Superintendent, Lani A. Miraflor EdD, Public Schools District Supervisor of Masinloc District, Isagani C. Canonizado, PhD, School Principal IV of Cabangan Elementary School, and Grade 4 learners and their teachers for their active participation and valuable responses. The researcher's family, including Willie Garcia Edpao, Angelina Nazareno Edpao, Winston N. Edpao, Willie N. Edpao Jr., Wilson Angelo N. Edpao, Willen Joy N. Edpao-Edillor, and Alona Jane N. Edpao-Rivera, for their constant assistance and her her loving husband, Marinello Ella Amorante, and children Herminio Miguel Iñigo E. Amorante and Sean Maverick E. Amorante, for their unwavering support. This acknowledgment is a testament to the collective effort and collaboration that contributed to the successful completion of the research project.

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