Student Perceptions of Digital Tools in General Education Courses: An Exploratory Factor Analysis in a Philippine Private University

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ABSTRACT

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| **Aims:** This study investigates students’ perceptions of digital tool utilization in General Education courses and compares their experiences in onsite and online learning environments. It aimed to identify the key dimensions of these perceptions and determine whether significant differences exist between delivery modalities.**Study Design:** Quantitative, cross-sectional, and comparative research employing exploratory factor analysis and inferential statistics.**Place and Duration of Study:** Conducted at a private higher education institution in the Philippines during the second semester of the 2024–2025 academic year.**Methodology:** A structured 40-item questionnaire was distributed to 302 college students. Exploratory Factor Analysis (EFA) using Principal Axis Factoring with Varimax rotation was employed to extract underlying dimensions. Cronbach’s alpha was used to assess internal consistency. Descriptive statistics summarized student responses, and paired samples t-tests were used to compare perceptions across onsite and online learning contexts.**Results:** Three valid and reliable dimensions were identified: Digital Learning Support (α = 0.909), Engagement and Motivation (α = 0.928), and Access and Confidence (α = 0.834). Students expressed generally positive perceptions, with Digital Learning Support rated highest in onsite settings. Significant differences were found in Digital Learning Support (t = 19.74, p = 0.001) and Engagement and Motivation (t = -2.23, p = 0.027), while Access and Confidence showed no significant difference (t = -1.01, p = 0.312).**Conclusion:** Students held favorable perceptions of digital tool use across both modalities. Onsite settings were associated with stronger digital support, while online environments slightly enhanced engagement. The findings support the adoption of blended learning models that combine the strengths of both delivery modes. |

*Keywords: Student Perceptions, Digital Tools, General Education, Engagement, Academic Impact, Paired t-test, Exploratory Factor Analysis, Accessibility*

1. INTRODUCTION

Digital technology integration in education has grown to be a major worldwide trend that is changing how teachers present material and how students acquire knowledge. Globally, educational systems have adopted online platforms, interactive technologies, and digital resources to enhance instructional efficacy, learning outcomes, and student engagement. This shift is supported by emerging research emphasizing that digital pedagogies, when implemented with institutional support, promote personalized learning, collaborative engagement, and knowledge retention (Bond et al., 2021). The COVID-19 epidemic expedited this transition, necessitating institutions to implement adaptable, technology-based methods to maintain education amid disruptions (Dhawan, 2020). Thus, the utilization of digital resources has transitioned from an ancillary approach to a fundamental component of contemporary education, especially in higher learning.

In the Philippines, the Commission on Higher Education (CHED) has promoted flexible learning and the integration of educational technology via CHED Memorandum Orders and programs responding to the pandemic. This has prompted colleges and universities, including private institutions, to include learning management systems (LMS), video-based instruction, online examinations, and digital reading materials into many courses, particularly in General Education (GE) disciplines. The General Education subjects—such as Readings in Philippine History, The Contemporary World, and Mathematics in the Modern World—constitute essential academic experiences, and their delivery can profoundly affect student learning, retention, and motivation. Aboagye et al. (2021) assert that General Education courses furnish the intellectual framework necessary for students to critically engage with academic and real-world issues, thereby necessitating the optimization of its delivery methods for accessibility and effectiveness. Similarly, Aguilera-Hermida (2020) emphasized that effective delivery of general education content through digital formats can significantly influence learners’ cognitive and emotional engagement.

Digital tools are thought to enhance student engagement by rendering learning more dynamic, accessible, and individualized (Almarzooq et al., 2020). They can augment comprehension with multimedia information, promote engagement through gamified quizzes and forums, and facilitate autonomous learning using asynchronous resources. Furthermore, research has identified a favorable correlation between the utilization of educational technology and students' academic achievement and satisfaction (Händel et al., 2020; Kintu et al., 2017). Martin and Bolliger (2018) underscored that digital engagement tactics, including video lectures, discussion boards, and online feedback mechanisms, directly enhance student satisfaction in blended contexts. More recent studies by Czerkawski and Lyman (2016) and Pelikan et al. (2021) highlight that student engagement with digital tools also depends on usability, instructor feedback mechanisms, and system reliability. The efficacy of these technologies predominantly hinges on students' perceptions and interactions with them. If students experience disengagement, confusion, or overwhelm using digital platforms, the technologies may not achieve their intended advantages.

Notwithstanding these global and national advancements, there exists a paucity of empirical research within Philippine private schools that investigates students' opinions regarding the utilization of digital tools, specifically in the realm of General Education. The emphasis has predominantly been on online delivery logistics rather than on student experience and feedback. Furthermore, perceptions of involvement, accessibility, and academic advantage may differ based on the subject matter, student demographics, and the institution's digital infrastructure. Similar findings were reported by Minga and Ghosh (2024), who explored how student perceptions shape the effectiveness of ICT integration in Tanzanian secondary schools, highlighting the importance of local context in digital learning initiatives. Perception-based studies are significant as they provide insights into student satisfaction and the environmental aspects influencing the learning process (Rapanta et al., 2020). Recent literature emphasizes that learner perceptions are crucial for refining pedagogical frameworks and understanding emotional and cognitive barriers in both online and hybrid settings (Zhao et al., 2021; Muthuprasad et al., 2021).

A particular private higher education school in the Philippines has implemented diverse digital technologies for instructing General Education subjects at the local level. In accordance with its BlendFlex learning model, the university has established a system facilitating both onsite and online education, wherein digital tools are not just adaptable but indispensable. This adaptable learning framework underscores the need of comprehending how students engage with and react to educational technologies in various learning contexts. Nonetheless, no official research has been conducted to assess students' perceptions of these tools on their engagement, usability, and academic influence. Comprehending student opinions is crucial as it offers insights into effective practices, ineffective ones, and the optimization of digital tools for instructional enhancement.

This study aims to address that deficiency by distributing a structured 40-item questionnaire to students participating in Readings in Philippine History, The Contemporary World, and Mathematics in the Modern World. The study employs Exploratory Factor Analysis (EFA) to discern the fundamental elements influencing students' evaluations across four dimensions: Engagement, Technology Acceptance, Academic Impact, and Accessibility. Descriptive statistics will be employed to assess the degree of student perception for each element. Furthermore, as all students engage in both onsite and online formats via a predetermined rotation, the study will employ paired samples t-tests to analyze student impressions across the two delivery modalities. The results are anticipated to inform faculty development, technological integration, and curriculum design initiatives inside the school.

2. methodology

2.1 Research Design

This research utilized a quantitative, exploratory, and comparative methodology to investigate student perspectives regarding the utilization of digital tools in General Education (GE) courses, specifically Readings in Philippine History, The Contemporary World, and Mathematics in the Modern World. The main objective was to discern the fundamental characteristics of these views through Exploratory Factor Analysis (EFA) and evaluate whether students' experiences vary between onsite and online learning modalities. A 40-item Likert-scale questionnaire, devised by a researcher, was employed to assess four principal dimensions: Engagement, Technology Acceptance, Academic Impact, and Accessibility. The questionnaire was administered once and featured concurrent evaluations for both onsite and online environments. Following the exploratory factor analysis (EFA), descriptive statistics were employed to encapsulate student responses for each factor, and paired samples t-tests were performed to contrast student perceptions across the two modalities. The statistical analyses were conducted using JAMOVI, a free and open-source software for quantitative research.

**2.2 Research Respondents**

The study focused on students who had completed the three designated General Education subjects, ensuring all participants had direct experience with the integration of digital tools in both in-person and online settings. Participants were selected through **convenience sampling**, primarily composed of students currently enrolled in or who had recently completed these courses at a private higher education institution in Misamis Occidental.

Given that the questionnaire included 40 items, and considering EFA best practices which recommend a minimum of 5 to 10 respondents per item (Osborne & Costello, 2004), the ideal sample size ranged from 200 to 400 students. This range ensures statistical sufficiency for dependable factor extraction and instrument validation. A final sample of 302 respondents was deemed adequate and representative of the institution’s BlendFlex learning environment. Participation was voluntary, with ethical protocols followed, including informed consent and response anonymity.

**2.3 Instrument of the Study**

This study employed a researcher-created questionnaire to investigate student attitudes regarding the utilization of digital tools in General Education courses. The instrument originally consisted of 40 items, developed according to four conceptual areas identified in the literature: Engagement, Technology Acceptance, Academic Impact, and Accessibility, with 10 items allocated to each domain. All items were evaluated using a 5-point Likert scale, where 1 denoted Strongly Disagree and 5 denoted Strongly Agree.

In line with the institution’s BlendFlex delivery strategy, each item was administered twice to capture student experiences in both onsite and online learning modalities, allowing for a matched comparison across contexts.

Prior to full deployment, the questionnaire underwent **expert review** by two faculty members with specialization in educational technology and instructional assessment. This step was taken to ensure content validity, refine item clarity, and align with the intended conceptual framework.

The instrument was then subjected to Exploratory Factor Analysis (EFA) using Principal Axis Factoring with Varimax rotation via JAMOVI version 2.6.23 to examine the underlying structure of student perceptions. Prior to extraction, the Kaiser-Meyer-Olkin (KMO) test and Bartlett’s Test of Sphericity were conducted to assess data suitability for factor analysis. Factors were retained using the eigenvalue-greater-than-one rule, supported by scree plot inspection. Items with loadings below 0.40 or high cross-loadings were removed from the final structure.

Following factor extraction, Cronbach’s Alpha was computed to assess internal consistency, with values above 0.70 indicating acceptable reliability. The final factor structure served as the basis for subsequent descriptive and inferential analysis.

**2.4 Data gathering procedure**

The researchers created a Google Form version of the questionnaire and distributed it through digital media. Participants were recruited using convenience sampling, primarily focusing on students who had completed the General Education courses: Readings in Philippine History, The Contemporary World, and Mathematics in the Modern World. The survey link was disseminated directly to students and coordinated through faculty members responsible for these courses.

According to best practices for Structural Equation Modeling (SEM), a minimum of 200 responders is deemed adequate. To improve the reliability and generalizability of the findings, the researchers sought to gather data from a minimum of 300 pupils.

**2.5 Statistical Treatment of Data**

The gathered data were processed and analyzed utilizing JAMOVI version 2.6.23. The subsequent statistical methods were employed:

* Exploratory Factor Analysis (EFA): Principal Axis Factoring with Varimax rotation was employed to discern the underlying dimensions of the 40-item instrument. Before extraction, the Kaiser-Meyer-Olkin (KMO) test and Bartlett’s Test of Sphericity were performed to evaluate the appropriateness of the data for factor analysis. Factors with eigenvalues exceeding 1.0 and corroborated by the scree plot were preserved. Items exhibiting factor loadings below 0.40 or possessing substantial cross-loadings were omitted.
* Reliability Analysis: The internal consistency of the resultant factors was assessed using Cronbach’s Alpha, with a threshold of 0.70 or above signifying adequate reliability.
* Descriptive Statistics: Means and standard deviations were calculated to encapsulate students' impressions across the specified dimensions.
* Paired Samples t-test: Paired t-tests were performed to compare students' responses between onsite and online learning modes for each factor.

The analyses were conducted to verify the instrument, delineate broad trends, and evaluate perceptual differences across various instructional modalities.

3. results and discussion

This section explores the outcomes of the statistical studies conducted to investigate student perceptions on the utilization of digital tools in General Education topics. The results encompass the conclusions of the Exploratory Factor Analysis (EFA), the reliability of the identified factors, descriptive statistics, and the paired samples t-test comparison of onsite and online learning experiences.

Descriptive statistics were computed for the elements inside each dimension. The results demonstrated a predominantly high degree of consensus regarding all aspects, indicating that students perceived digital technologies as advantageous for learning. Elements Pertaining to Digital Learning Assistance, Engagement, and Motivation Onsite garnered notably elevated mean ratings, indicating favorable impressions regarding the use of digital technologies and their contribution to sustaining focus and engagement during onsite sessions. The standard deviations were comparatively low, signifying uniform responses among subjects.

**3.1 Exploratory Factor Analysis (EFA)**

Exploratory Factor Analysis (EFA) was conducted using Principal Axis Factoring with Varimax rotation via JAMOVI (v2.6.23) to examine the underlying structure of student perceptions. The instrument initially consisted of 40 elements. Before extraction, the dataset was assessed with the Kaiser-Meyer-Olkin (KMO) metric, resulting in a value of 0.955, signifying exceptional sample adequacy. Bartlett’s Test of Sphericity was significant (χ² = 6900, df = 630, p < .001), indicating that the inter-item correlations were adequate for factor analysis (Hair et al., 2020; Williams et al., 2010).

Three components were extracted according to the eigenvalue-greater-than-one criterion, and this conclusion was additionally corroborated by an examination of the scree plot. Items 1, 2, 17, and 27 were eliminated due to factor loadings falling below 0.40 or exhibiting substantial cross-loadings across many factors. Zhao et al. (2021) and Costello and Osborne (2005) assert that loadings under 0.40 generally lack significant contribution to factor interpretation, whereas cross-loading items diminish the clarity and discriminant validity of constructs.

The optimized approach preserved 36 components, which distinctly clustered into three interpretable factors: Digital Learning Support, Engagement and Motivation, and Access and Confidence. Internal consistency was evaluated by Cronbach’s alpha, revealing strong dependability across all three factors: Digital Learning Support (α = 0.909), Engagement and Motivation (α = 0.928), and Access and Confidence (α = 0.834). These values surpass the well-recognized criterion of 0.70, signifying robust internal consistency (Nunnally & Bernstein, 1994; Taber, 2018).

The findings validate that the instrument consistently measures distinct and comprehensible aspects of students' perceptions of digital tools in General Education, in accordance with recent research highlighting the significance of psychometrically validated instruments for assessing student technology experiences in post-pandemic educational settings (Al-Fraihat et al., 2020; Adnan & Anwar, 2020).

**Table 1: Factor Summary and Reliability Coefficients for the Retained Dimensions**

|  |  |  |  |
| --- | --- | --- | --- |
| Factor | Description | NO. of Items | Cronbach’s alpha |
| Digital Learning Support | Usefulness, efficiency, and reliability of digital tools for learning and task management | 15 | 0.909 |
| Engagement and Motivation  | Interest, attention, and motivation when digital tools are used during onsite classes | 15 | 0.928 |
| Access and Confidence  | Comfort in accessing and navigating digital tools in face-to-face learning. | 6 | 0.834 |

**3.2 Descriptive Statistics**

Descriptive statistics were calculated to encapsulate students' opinions of digital tool utilization across three specified factors: Digital Learning Support, Engagement and Motivation, and Access and Confidence, in both onsite and online educational environments. Per-item scores were derived by dividing total scores by the quantity of items per factor, facilitating a standardized comparison across all dimensions.

Of the three criteria, Digital Learning Support exhibited the greatest mean in the onsite environment (M = 4.231, SD = 2.07), indicating that students placed significant value on the trustworthiness, accessibility, and academic utility of digital technologies inside organized classroom contexts. This corresponds with the findings of Almarzooq et al. (2020), who observed that digital platforms can improve understanding and decrease task completion time when effectively integrated into education. The online counterpart (M = 3.970, SD = 1.97) received favorable evaluations, suggesting that students saw online resources as beneficial, albeit potentially less reliable due to infrastructural or instructional constraints.

The mean scores for Engagement and Motivation were comparably stable in both learning environments (M = 3.793 onsite; M = 3.827 online). This discovery corroborates the assertions of Martin and Bolliger (2018), who highlighted that digital engagement strategies—such as interactive content, films, and discussion forums—can sustain or elevate student motivation in both hybrid and entirely online environments. The analogous ratings indicate that students in this study valued these tools irrespective of medium; nevertheless, their motivational effect may hinge on the extent of active utilization by instructors.

Access and Confidence had comparable means in both online (M = 3.657, SD = 1.74) and onsite (M = 3.643, SD = 1.69) delivery modalities. This indicates student trust in utilizing learning platforms and regularly accessing information across various environments. The findings align with Händel et al. (2020), who determined that digital competency and accessibility greatly affect students' adoption and continued utilization of technology in higher education.

The descriptive statistics indicate that students held predominantly favorable views toward the utilization of digital tools, especially for learning assistance and accessibility. Nonetheless, sustaining elevated engagement levels may necessitate deliberate planning and proactive facilitation by educators.

**Table 2: Descriptive Statistics of Student Perceptions by Factor and Modality**

|  |  |  |
| --- | --- | --- |
| Factor | Mean | Standard Deviation |
|  | Online | Onsite | Online | Onsite |
| Digital Learning Support | 3.970 | 4.231 | 1.97 | 2.07 |
| Engagement and Motivation  | 3.827 | 3.793 | 2.42 | 2.42 |
| Access and Confidence  | 3.657 | 3.643 | 1.74 | 1.69 |

**3.3 Paired Sample T-test**

A paired samples t-test was conducted for each of the three identified factors—Digital Learning Support, Engagement and Motivation, and Access and Confidence—to ascertain significant differences in students’ perceptions of digital tool usage between onsite and online learning modalities. The difference was computed using the formula onsite – online, indicating that a positive t-value reflects a superior onsite impression, whereas a negative t-value implies that students evaluated the online modality more favorably.

The findings for Digital Learning Support revealed a statistically significant difference, t(301) = 19.74, p = 0.001, demonstrating that students regarded onsite digital tools as considerably more beneficial than those employed in online environments. This finding indicates that students saw in-person access to learning materials, instructor support, and the incorporation of digital resources in the classroom as more organized and successful. Baber (2021) and Al-Fraihat et al. (2020) assert that physical classroom environments integrating technology facilitate real-time assistance, reduce technical obstacles, and provide immediate feedback, hence enhancing perceptions of digital support.

Conversely, involvement and Motivation produced a significant negative t-value, t(301) = -2.23, p = 0.027, suggesting that students indicated greater involvement and motivation in online environments than in onsite settings. This may indicate the advantages of self-directed learning, adaptable accessibility, or multimedia-enhanced environments offered by online platforms. Adnan and Anwar (2020) and Czerkawski and Lyman (2016) saw analogous findings, indicating that digital learners frequently perceive online learning environments as engaging when educators integrate gamification, asynchronous discussions, and multimedia resources.

No significant difference was seen for Access and Confidence, t(301) = -1.01, p = 0.312. This indicates that students perceived themselves as equally confident and competent in navigating digital platforms, regardless of whether they were onsite or online. This conclusion aligns with Zhao et al. (2021), who highlighted that enhanced digital literacy and ongoing engagement with virtual platforms have enabled students to attain proficiency and adaptability in diverse learning contexts.

The t-test results indicate that students experienced greater digital support in onsite environments, but they reported somewhat higher engagement and motivation in online learning, with no significant differences in confidence or access across the two modalities. These patterns underscore the dynamic nature of student choices and the necessity for hybrid methodologies that optimize both structure and flexibility. This supports earlier findings by Means et al. (2010), whose meta-analysis demonstrated that online learning can be equally or more effective than traditional face-to-face instruction when pedagogically well-designed.

**Table 3: Paired Samples T-Test Results Comparing Onsite and Online Modalities**

|  |  |  |  |
| --- | --- | --- | --- |
|  | t-value | p-value | Verbal Interpretation |
| Digital Learning Support | 19.74 | 0.001 | Significant |
| Engagement and Motivation  | -2.23 | 0.027 | Significant |
| Access and Confidence  | -1.01 | 0.312 | Not Significant |

4. Conclusion

This research investigated student perceptions regarding the utilization of digital tools in General Education courses using Exploratory Factor Analysis (EFA), descriptive statistics, and paired samples t-tests. The EFA results validated the instrument's psychometric integrity, identifying three distinct and dependable factors: Digital Learning Support (α = 0.909), Engagement and Motivation (α = 0.928), and Access and Confidence (α = 0.834). Descriptive data indicated that students predominantly possessed positive impressions of digital resources, with elevated ratings specifically for digital help in onsite environments and uniform levels of access and confidence across both learning modalities. The findings of the paired samples t-test revealed significant differences in Digital Learning Support and Engagement and Motivation, with the former favoring onsite locations and the latter showing a small preference for online settings. No substantial difference was observed in Access and Confidence, indicating that students perceived themselves as equally proficient with digital tools irrespective of the delivery medium. These findings underscore the necessity of including well-organized digital tools in both modalities, while also acknowledging the imperative to improve incentive techniques in physical settings and provide consistent access in online delivery. Educators and academic planners are advised to implement hybrid educational methods that merge the organization and immediacy of onsite digital integration with the adaptability and engagement techniques provided by online platforms. Subsequent research could enhance this study by using qualitative methodologies to further investigate student preferences and digital engagement patterns. Monib, Qazi, and Mahmud (2025) similarly emphasized the role of student perception in evaluating emerging AI-driven educational tools such as ChatGPT, suggesting broader implications for digital engagement in higher education. As Graham (2013) emphasized, emerging research in blended learning highlights the importance of integrating both modalities to create more adaptive, learner-centered environments an approach affirmed by the current study.

In the regional context, Tanhueco-Tumapon (2023) emphasized that Philippine higher education must prioritize digital pedagogy and blended frameworks to sustain quality instruction in the post-pandemic era. The present study supports this call, providing empirical data that can inform CHED-aligned strategies for digital integration, faculty training, and student-centered hybrid learning practices. Future studies may also explore policy-level implications and conduct longitudinal analyses to assess digital engagement trends over time.

**Consent**

As per international standards or university standards, Participants’ written consent has been collected and preserved by the author(s).

**Disclaimer (Artificial intelligence)**

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Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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Details of the AI usage are given below:

1.

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3.

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