INVERGE JOURNAL OF SOCIAL SCIENCES
https://invergejournals.com/
ISSN (Online): 2959-4359, ISSN (Print): 3007-2018
Volume 5 Issue 3, 2026

EMPOWERING GENERATION Z: DIGITAL LITERACY, INNOVATION, AND WELL-BEING IN THE DIGITAL LEARNING ERA

Dr. Muhammad Rafiq-uz-Zaman[1], Prof. Dr. Onur Köksal [2], Joseph Ozigis Akomodi [3]

DOI: https://doi.org/10.63544/ijss.v5i3.286

Affiliations:

[1] Doctor of Philosophy in Education, Department of Education, The Islamia University of Bahawalpur, Punjab, Pakistan, Email: mrzmuslah@gmail.com, ORCID ID: https://orcid.org/0009-0002-4853-045X

[2] Professor, Selçuk University Faculty of Letters, Translation and Interpreting Department Türkiye, Email: onurkoksal38@hotmail.com ORCID ID: https://orcid.org/0000-0003-0798-3620

[3] Department of Education, Long Island University, New York, USA, Email: jakomod@gmail.com

Corresponding Author's Email:

[1] mrzmuslah@gmail.com

Article History:
Received: 01.04.2026
Accepted: 22.04.2026
Published: 01.05.2026

Abstract

The study examines the nature of interrelations between digital literacy, innovative methods of learning, and mental health in Generation Z students in Punjab, Pakistan. This cross-sectional study used a mixed-method and surveyed 300 undergraduate students in five major public universities in Punjab (The Islamia University Bahawalpur, Bahauddin Zakaria University Multan, Punjab University Lahore, GC University Faisalabad, and Sargodha University) aged 18-28 years to conduct the survey. The researchers used the validated tools to assess the digital literacy skills, the use of technology in education, and the involvement in the innovative learning processes (gamification, blended learning, mobile-assisted learning), and the measures of the psychological well-being. Results indicate that students show moderate to high levels of digital literacy, with great differences depending on the socioeconomic status and access to the digital infrastructure by the institution. Digital literacy is positively related to the use of innovative learning methods and perceived learning efficacy. It is important to note that although new forms of digital learning increase student interaction and academic achievement, overuse of technology without the guidance of an expert shows that technology is linked with high levels of stress and declining psychological well-being. The research establishes key lapses in the digital literacy teaching, teacher readiness, and institutional support systems. Some of the recommendations are the creation of an inclusive digital literacy curriculum, teaching of teachers on the integration of technologies, provision of mental health support networks on technology-related stress, and provision of equitable access to quality digital infrastructure in all institutions. The study provides the much-needed evidence to policymakers, educators, and EdTech providers who need to maximize digital learning experiences to achieve academic success and comprehensive student well-being in the South Asian environment.

Keywords: Generation Z, Digital Literacy, Digital Learning, Innovation, Well-Being, Blended Learning, Punjab, Pakistan, Technology-Enhanced Education.

1. Introduction

1.1 Background and Context

The youngest generation born between 1997 and 2012 is the first real digital-native generation because these people have been exposed to technology since childhood. The attitude of this generation towards technology is fundamentally different compared to the past generations because they do not see digital tools as innovations, but as part of everyday life (Maisuroh et al., 2024). Generation Z students in Punjab, Pakistan, where the research is based, are operating in a very specific educational context of a fast-evolving digital environment, rising levels of internet access, and changing educational policies that focus on integrating

technology.

Digital learning acquired a new momentum of growth during the COVID-19 pandemic, which triggered the rapid change of classroom learning to online and blended learning (Aspandi & Muttaqin, 2025). Although since then most learning institutions across the world have implemented the hybrid model of learning that integrates face-to-face with the digital aspects, the shift highlighted major differences in digital preparedness. To Generation Z students in Punjab, this time was marked by both opportunities and challenges, as more access to educational materials existed along with infrastructure constraints, insufficient teacher preparation, and new worries of the mental health effects of long-term digital activity (Zhang & Cao, 2025).

1.2 Problem Statement

There is an increasing awareness of the importance of digital learning in contemporary education. Some of the most important gaps in the field include the relationships between digital literacy, new pedagogical practices, and outcomes in the well-being of students, especially in the South Asian setting. Although the world is rapidly reporting the technological capacity of Generation Z, there is little evidence on their real skills in more advanced digital competencies, such as mastering more than just the use of devices. Moreover, the connection between digital learning and psychological well-being among Pakistani youth is poorly researched, especially given the cultural, socioeconomic, and infrastructural contexts that are very different compared to Western environments in which most of the current research has been developed.

There are a few worrying trends that have emerged in Punjab in particular: (1) Although the smartphone penetration rate is high, the concept of true digital literacy, including critical evaluation, ethical use of technologies, and checking the validity of information, is still under-developed (Supriyanto et al., 2025); (2) Educational institutions have not yet acquired sufficient skills to implement technology-based learning solutions, and such implementation is often not pedagogically sound (Mukhlisa et al., 2025); (3) There is a lack of empirical

1.3 Purpose and Research Aims

The proposed research is expected to offer an in-depth evaluation of the level of digital literacy among Generation Z students in Punjab, investigate the correlation between digital literacy, innovative learning methods, and psychological well-being, and present evidence-based suggestions to educational stakeholders. In particular, the research aims at:

1. Determine the current rates of digital literacy and its size among undergraduate students of major Punjab institutions belonging to Generation Z.
2. Explore the relationship between innovative digital learning strategies (gamification, mobile learning, blended instruction, project-based learning) and student engagement and perceived learning effectiveness.
3. Test the connections between digital learning practices and mental health/psychological well-being in Generation Z students.
4. Determine obstacles and facilitators of effective implementation of digital learning in the Punjab education setting.
5. Provide practical recommendations to teachers, policy-makers, and institutional leaders to maximize digital learning settings.

1.4 Research Questions

1. What is the present state and breakdown of digital literacy among the Generation Z undergraduate students in Punjab's higher education institutions?
2. What are some of the new forms of digital learning methods the students encounter, and how often are they exposed to them?
3. What is the perception of students regarding the effectiveness of new digital ways of learning compared to traditional instruction?
4. How are digital literacy competencies related to the use of innovative learning?

INVERGE JOURNAL OF SOCIAL SCIENCES
https://invergejournals.com/
ISSN (Online): 2959-4359, ISSN (Print): 3007-2018
Volume 5 Issue 3, 2026

5. Do digital learning engagement and psychological well-being (stress levels, academic satisfaction, life satisfaction) have any significant correlations?
6. What is the impact of demographic variables (gender, socioeconomic status, urban/rural residence) on digital literacy, innovative learning engagement, and outcomes related to well-being?
7. What are the institutional, infrastructural, and personal obstacles to the effective implementation of digital learning?
8. Which supporting systems and resources do students believe do they need to maximize their digital learning experiences and stay psychologically well-adjusted?

1.5 Hypotheses

- H1: The greater the digital literacy, the more will be the involvement in innovative learning practices.
- H2: Perceived learning effectiveness will be predicted by engagement with the well-designed innovative learning approaches.
- H3: The relationships between digital literacy and innovative learning engagement and psychological well-being will be complex and non-linear (moderate engagement is linked to optimal well-being; very high engagement will be linked to higher stress levels)
- H4: Institutional support and teacher guidance in the use of technology will mediate the relationship between digital learning engagement and psychological well-being.
- H5: The gender differences will be observed in terms of digital literacy profile and technology use patterns as they mirror the other socioeconomic and cultural trends in the context of South Asia.

1.6 Significance and Justification

This study has implications on various levels. In educational institutions, the findings will be used to inform curriculum development, teacher professional development programs, and institutional policies in terms of technology integration. To policymakers, the study gives evidence that can be used to design policies that would tackle the issues of digital equity, investment in infrastructure, and technology-enhanced education standards. To educators and instructional designers, the study can provide information on how the learning environment can be designed to utilize the pedagogical capabilities of technology without endangering the mental health of students. To EdTech providers, the work can be used to identify certain gaps in competencies and user preferences among South Asian youth, which can be used to develop products.

On a bigger scale, this study is a reaction to the pressing needs in the world. The United Nations Sustainable Development Goal 4 focuses on the inclusion and equitable quality education provision that has effective learning environments. Digital literacy has become a precondition to this objective (Ilomki et al., 2023). Moreover, the similar mental health crisis of the youth of the world makes it important to consider the influence of educational innovations on mental health. The situation in Pakistan, where young people still face high unemployment rates and educational equity is a long-standing issue, particularly when it comes to all students, the realization of how to utilize digital learning in the most effective way, without jeopardizing their health, is especially urgent.

The study is timely, as the trends in the Pakistani higher education system of the rapid adoption of technology are observed, along with the awareness that technology is not the solution to educational issues; the quality of implementation, the preparation of teachers, and the focus on the overall development of students are vital (Aspandi & Muttaqin, 2025).

2 Literature Review

2.1 Digital Literacy: Meanings, Aspects, and State of the Art among the Young People

Digital literacy is no longer just a simple term of technical capabilities but a complex skill that is a requirement to be able to engage in modern society. The present-day conceptualizations consider digital literacy to be the ability to utilize digital technology, communication tools, or networks to seek, assess, produce, and exchange information to operate efficiently within society (Rayendra et al., 2025). Such a definition includes the technical ability to operate, the critical thinking of digital information, ethical issues, and communication skills (Maisuroh et al., 2024).

INVERGE JOURNAL OF SOCIAL SCIENCES
https://invergejournals.com/
ISSN (Online): 2959-4359, ISSN (Print): 3007-2018
Volume 5 Issue 3, 2026

Modern models also define various aspects of digital literacy. The European Digital Competence Framework (DigComp 2.2) singles out five major areas: (1) Information and data literacy: finding, evaluating, organizing the digital information; (2) Communication and collaboration: using digital platforms to communicate and collaborate; (3) Digital content creation: creating and modifying digital materials; (4) Safety: securing devices, privacy, and health in the digital environment; and (5) Problem-solving: using digital tools to solve practical problems (Sahid & Ridzuan, 2025). It is stressed that to be digitally literate, a person needs to think critically, i.e., be able to question the sources of information, understand the bias, and assess credibility instead of being able to use the devices (Supriyanto et al., 2025).

Research shows paradoxical trends among Generation Z in the world. Although these young people are incredibly proficient with consumer technology and social media sites, their critical digital skills tend to be below par (Maisuroh et al., 2024). The research indicates that despite the high level of technological awareness and fast adoption of new technologies (Shtepura, 2025), Generation Z has some serious weaknesses in digital information verification skills, awareness of algorithmic bias, and awareness of manipulated digital content (Supriyanto et al., 2025). In the context of South Asia in particular, even though the penetration of the internet has grown significantly, the quality of digital literacy training is insufficient, and most students acquire technology skills in an informal, peer-directed way rather than through formal education (Sirait et al., 2024).

The issue of the digital divide remains a burning issue. Whereas the availability of devices has increased, meaningful digital literacy, or students being able to use technology to learn, be creative, and become informed citizens, is unevenly spread. Inequality in Punjab is highly linked to the socioeconomic status with students with lower social resources showing less digital literacy skills (Sahid & Ridzuan, 2025). Also, gender differences are observed in certain areas of digital competencies, as studies show that girls can have lower technology self-efficacy with similar actual competencies- a psychological and not a skill-based gap (Jaya, 2024).

2.2 Digital Learning and Educational Technology Integration

One of the most important changes in contemporary education is the shift towards technology-enhanced learning, which replaces the traditional one. There are many different modalities of digital learning: e-learning (completely online learning), blended learning (hybrid learning, combining online and in-person elements), mobile learning (a learning method based on mobile devices), and technology-enhanced classroom learning (Chrystie & Putri, 2025). It is proven that digital learning provides significant advantages when it is carefully designed and deployed, such as greater accessibility, the possibility of individualized learning, a high level of interaction due to multimedia, and flexibility that allows meeting the needs of diverse learners (Khotimah et al., 2025).

Digital technology is highly effective when it comes to innovative learning methods, with gamification, or the incorporation of game aspects into the learning process, showing positive effects on student motivation and engagement (Li et al., 2024). Digital tools in project-based learning contribute to the deeper comprehension and growth of the twenty-first century skills such as collaboration and critical thinking (Mahyuna et al., 2025). Synchronous and asynchronous components in blended learning models enable students to study at their own pace, yet have an important face-to-face interaction (Ritonga et al., 2025). Experiential learning of abstract concepts with the help of interactive multimedia (such as virtual simulations and augmented reality applications) is possible (Familoni & Onyebuchi, 2024).

There are, however, significant differences in the quality of implementation. Most teachers are not trained on the pedagogical aspects of technology integration, and so they end up using technology in a shallow manner that does not add value to the learning process (Aspandi & Muttaqin, 2025). Also, there are access inequities due to differences in infrastructure, especially in urban and rural regions (Chrystie & Putri, 2025). There is often a sense of stress and anxiety among teachers in technology implementation, especially when it is implemented without proper support (Zhang & Cao, 2025). In addition, technological change is more rapid than most institutions can be systematic in its adoption, leading to uneven adoption across and within schools (Mukhlisa et al., 2025).

2.3 Innovation in Learning: Beyond Technology

Although technology is a facet of innovative learning, more comprehensive pedagogical innovation is

INVERGE JOURNAL OF SOCIAL SCIENCES
https://invergejournals.com/
ISSN (Online): 2959-4359, ISSN (Print): 3007-2018
Volume 5 Issue 3, 2026

not limited to the use of digital devices. Competency-based education and learner-centered pedagogies are some of the innovative methods that focus on skill building rather than seat time and active student agency, respectively. Studies of deep learning, a feature of which is the formation of conceptual knowledge and the transfer of learning to new situations in students through technology, prove that the value of technology becomes apparent when it is combined with the pedagogically healthy design of instruction (Afifatun, 2025). The use of interactive learning techniques in combination with the use of technology has a substantial impact on engagement and understanding (Kurniawan et al., 2025).

The best innovations are those that integrate technological affordances and pedagogic principles based on learning science. In particular, a certain effectiveness is shown by the approaches that include choice, collaboration, multimodality, and immediate feedback, as the learning preferences of Generation Z are shaped by their digital immersion (Jaya and Sucipto, 2023). Nonetheless, studies caution against the belief that the involvement or entertainment instruction inevitably results in meaningful learning; deliberate instructional design linking pedagogical goals to the technological opportunities is required (Zou et al., 2025).

2.4 Well-Being, Mental Health, and Technology Use Among Young People

The correlation between the utilization of technology and the psychological well-being of the youths offers a complicated scenario, with both advantages and disadvantages. Among the beneficial effects of technology-based learning, it is possible to note the accessibility of students with disabilities, a chance to be connected socially meaningfully, exposure to various opinions, and the acquisition of digital skills that will be crucial in future jobs (Kundu & Bej, 2024). The application of appropriate technology can help to make academic activity more involved and improve mental health by means of connection, creative expression, and resource access.

Nevertheless, there exists a significant body of research on the relationships between problematic use of technology and mental health challenges. Social media use, including passive consumption and social comparison, and sleep disturbance caused by technology, are linked to high levels of anxiety, depression, and lower psychological health (Kundu & Bej, 2024). During the pandemic-driven shift to remote learning, “Zoom fatigue” emerged as a widely recognized phenomenon, referring to exhaustion caused by prolonged videoconferencing and associated with cognitive overload and reduced student engagement (Wiederhold, 2020). The problematic use of the internet and technology addiction as a type of emerging behavioral health issue are linked to poor academic performance and deteriorated well-being (Singh and Singhwal, 2024).

Generation Z, in particular, shows increased susceptibility to technological mental health effects. They are usually digital natives with no experience of technology-free time, which can lead to the lack of self-regulation skills development. Social media sites that have been developed to capture attention will develop dependency and anxiety, especially regarding social validation. The 24/7 connectedness required of modern life removes the distinction between school and free time, which is a factor in chronic stress (Zhang & Cao, 2025).

Importantly, it has been found that the connection between technology use and well-being is mediated by various factors: the quality and purpose of using technology have an extreme impact (active creation and learning as opposed to passive consumption), institutional and family support exert influence on experience, and individual factors such as personality, resilience, and digital literacy can have a strong effect (Kundu & Bej, 2024). This complexity suggests that the relationship between technology use and student well-being is not simply linear. Rather than assuming that increased technology use necessarily leads to poorer outcomes, the findings indicate that optimal results are achieved when technology is used deliberately, with appropriate guidance, and within supportive educational environments that promote student well-being.

2.5 Conceptual Framework: Integrating Digital Literacy, Innovation, and Well-Being

According to the available sources, we suggest a conceptual framework in which digital literacy is presented as a preliminary competency in which students can gain advantages of innovative learning strategies without exposing themselves to the risks of technology-related well-being. Within this framework:

Digital Literacy is a multi-dimensional concept which comprises technical skills (use of devices), information literacy (locating, evaluating, synthesizing information) communication competencies (communication appropriate online), ethical knowledge (privacy, security, digital citizenship), and critical

thinking (asking questions of the source, detecting manipulation). Digital literacy helps students to take advantage of new learning methods and use digital space in a safe manner.

Innovative Learning Approaches refer to technology-mediated and/or non-pedagogical strategies that are meant to promote engagement, understanding, and skill-building. Certain technologies (gamification platforms, learning management systems, collaborative tools) are the mechanisms in the framework of which innovative pedagogies can be applied. Instructional design and teacher facilitation, rather than the presence of technology, are important to the quality of implementation.

Psychological Well-Being includes affective (emotional control, life satisfaction, less anxiety/depression), cognitive (sense of purpose, engagement, meaning), and behavioral dimensions (healthy sleep, physical activity, balanced use of technology). The concept of well-being in education is associated with satisfaction with academics, belonging, and life in general.

The suggested relationships are: (1) Digital literacy facilitates positive use of innovative learning practices- more digitally literate students are more likely to use innovative learning practices successfully and can potentially use them to promote well-being by engaging with online resources, being critical, and finding them relevant; (2) Well-designed innovative practices, when accompanied by high digital literacy, can improve the outcomes of learning and potentially help promote well-being through engagement, agency, and relevance; (3) Conversely, when the digital learning practices are not supported by a high level of digital literacy and when the well- This paradigm recognizes complexity, technology is not panacea and not threat, but a tool with effects that rely on the quality of implementation, the capabilities and intentions of the users and the support systems of the broader context.

2.6 Gaps in Literature and Research Needs

Even with the increasing volume of research on the topic of Generation Z, digital learning, and well-being, there are still a number of gaps, especially in the context of the South Asian region. To begin with, there is a lack of research specifically investigating the digital literacy of Generation Z in Pakistan and the region, most of the empirical studies are conducted in developed countries. Such cultural aspects as family life, education demands and access to technology in Pakistan are significantly different in comparison with Western environments where the majority of studies have been developed. Second, the simultaneous analysis of digital literacy and learning innovation and well-being is still scarce. The dimensions are studied independently by the majority of research; only through combined research, their interrelationship can be understood. Third, longitudinal studies reporting digital development and well-being effects trajectories are limited, and most research uses cross-sectional research designs to describe the time-specific effects. Fourth, little has been done to investigate the teacher and institutional preparedness to technology integration in Punjab universities which is a critical factor in the success of implementation. These gaps were the focus of the design of this research.

3. Methodology

3.1 Research Design and Approach

The study took a mixed-method and cross-sectional design that involved the use of quantitative survey data collection and qualitative open-ended questions. The quantitative part allowed the statistical analysis of the relationship between digital literacy, innovative learning engagement, and well-being; the qualitative data offered a background insight and identified processes that may have contributed to the patterns observed. It had a cross-sectional design which, although restricted causal inference and longitudinal interpretation, offered viable snapshot evaluation of the current situation in various institutional settings in Punjab.

The study was deductive in nature, as it was aimed to test particular hypotheses based on the literature review, but it was exploratory in terms of context-specific expressions of digital literacy and well-being in Punjab universities. The focus of an ethical relational approach was on respect to the participants, transparency in the research activities, and devotion to the creation of knowledge that is of value to the researched communities.

3.2 Population, Sample, and Sampling Procedures

Population: The study population was undergraduate students between the ages of 18-28 years in Bachelor of Science (BS) programs in the public universities of Punjab, and it represents the variety of

geographic and socioeconomic backgrounds within the province. The emphasis on BS programs allowed quite similar academic background levels and a variety of students in various fields.

Sampling of Institutions: Five large university institutions in the region of Punjab were chosen to be representative of diversity in the region: - The Islamia University (IUB), Bahawalpur (Southern Punjab) - Bahauddin Zakaria University (BZU), Multan (Central Punjab) - Punjab University (PU), Lahore (Urban Central Punjab) - GC University (GCUF), Faisalabad (Industrial region) - Sargodha University, Sargodha (Northern Punjab

This choice guaranteed coverage of the urban-rural continuum and geographic areas, which increased the generalizability in Punjab.

Sample Size: 300 undergraduate students were involved (around 60 students in each institution), according to a number of factors. Social sciences indicate that samples of 300-400 subjects can be used to make a reliable estimate of the connection between continuous variables of moderate effect size (Buzzetto-More & Alade, 2018). Such a size allows one to make meaningful comparisons across institutions and, at the same time, is manageable in terms of data collection.

Sampling Technique: Stratified random sampling was used whereby the sample was stratified in terms of institution, gender and year of study (first year to fourth year) to represent the whole sample. Random sampling minimized selection bias within each stratum. The strategy was a compromise in terms of representativeness and practical feasibility, as it guaranteed the demographic variety without the disadvantages of pure convenience sampling.

3.3 Data Collection Instruments and Procedures

The samples were collected using the structured self-administered questionnaires, which were provided in both English and Urdu and given to the respondents at the time that was convenient to them within the university premises. This questionnaire had five sections:

Section A: Demographic Information included age, gender, study year, socioeconomic background (parental education, household income levels), living type (urban/rural), internet access and device access, and prior educational experience with technology.

Section B: Digital Literacy Assessment used a modified form of Digital Literacy Scale, which has been tested on other populations but in Pakistan context. This section included: (1) Technical competence-familiarity with different devices and applications; (2) Information literacy- ability to search, evaluate and synthesize online information; (3) Communication and collaboration- using digital platforms to achieve academic and social activities; (4) Critical thinking- the ability to question information sources, be aware of bias, evaluate credibility; and (5) Digital citizenship and ethics- understanding privacy, security, proper online behaviour. These dimensions were measured using thirteen items on five-point Likert scales, and further open-ended questions concerning certain challenges that students encountered.

Section C: Technology-Enhanced Learning Engagement and Perceptions evaluated the exposure and use of innovative learning strategies among students. Measures: (1) Frequency of use of special technologies in learning (learning management systems, videoconferencing, collaborative tools, gamified learning, virtual simulations); (2) Perceived effectiveness of technology use; (3) Preference of learning format (traditional, blended, fully online); (4) Quality of technology implementation and instructor support. The 12 items were used with Likert scales, and the barriers and facilitators were investigated with open-ended questions.

Section D: Psychological Well-Being Indicators had multiple dimensions of well-being assessed with validated short measures: (1) Depression and anxiety symptoms through the two-item Patient Health Questionnaire (PHQ-2) and the Generalized Anxiety Disorder scale (GAD-7, abbreviated version); (2) Life satisfaction with a 10-item Satisfaction with life Scale (SWLS, adapted); (3) Academic satisfaction and sense of belonging at university; (4) Technology-related stress (screen time concerns, sleep impacts, social media This multi-dimensional concept acknowledged the complexity of well-being instead of breaking it down into individual measures.

Section E: Open-Ended Questions solicited the views of students regarding: (1) The effects of digital learning on their study and well-being; (2) Barriers to digital learning; (3) Support students require to maximize digital learning; and (4) University recommendations. These qualitative data were rich in context

INVERGE JOURNAL OF SOCIAL SCIENCES
https://invergejournals.com/
ISSN (Online): 2959-4359, ISSN (Print): 3007-2018
Volume 5 Issue 3, 2026

to go with the numerical data.

3.4 Validity and Reliability Procedures

Pilot Testing: The questionnaire was piloted on 40 students in two institutions. Pilot participants were questioned in terms of clarity, understanding, time needed, and suitability of items. The revisions made sure that it was easy to get language access without compromising comprehensiveness, and that the response options reflected the variations of relevance well.

Reliability Analysis: Internal consistency of multi-item scales was evaluated through Cronbach's alpha coefficient. A value of $\alpha \geq 0.70$ was considered acceptable internal consistency. In this research, the Digital Literacy Scale showed acceptable reliability ($\alpha = 0.82$), the Technology-Enhanced Learning Engagement subscales ranged from $\alpha = 0.75$ to $\alpha = 0.88$, and the Well-Being scales ranged from $\alpha = 0.79$ to $\alpha = 0.85$.

Validity Concerns: Content validity was ensured based on a literature review and expert review with three faculty members who are experts in the field of digital education and psychology. Factor analysis was used to evaluate construct validity to determine that items observed were grouped in the manner they were expected to be around the underlying constructs.

Bilingual Administration: Instruments were translated into Urdu and translated back to English to provide semantic equivalence. Although it was used mostly in English when offered in the university settings, Urdu versions were provided to enable accessibility by students who were more comfortable using Urdu.

3.5 Ethical Considerations

The institutional ethics review boards and university administrations approved the research. All participants were informed about the study, and informed consent was obtained; the key points stressed were voluntary participation and the right to withdraw. Anonymity and confidentiality were ensured by giving the participants identification numbers instead of names, safe data storage using passwords, and restricted access. Special emphasis was made on sensitive well-being questions; the information about the counselling resources was provided to the participants both on the campuses and outside. Data protection was done in line with institutional and international guidelines, as data were stored in safe places and destroyed as per the stipulated time. Everything was informed by cultural sensitivity, and the Pakistani values, family structures, and contexts were considered to influence education and use of technology.

3.6 Data Analysis Plan

3.6.1 Analytical Approach. The analysis of data involved descriptive and inferential statistics and thematic qualitative analysis. The analytic approach evaluated the hypotheses on the associations between digital literacy, innovative learning engagement, and psychological well-being as well as the description of the patterns.

3.6.2 Descriptive Statistics. The first analyses defined the sample and the key variables by: (1) Frequency distributions and descriptive statistics (means, standard deviations, ranges) of all major variables, disaggregated by institution, gender, socioeconomic status, and urban/rural residence; (2) Reporting prevalence of digital literacy competencies, innovative learning modality use and well-being indicators; (3) Comparison of sample demographics with a wider student population to determine representativeness; and (4) Visual representation of data in tables, histograms and other graphs that clearly

3.6.3 Inferential Statistics. The correlation was also used to determine the relationships between dimensions of digital literacy and innovative learning engagement as well as learning engagement and well-being indicators. Pearson correlations were used to test linear relationships and Spearman correlations were used to confirm results when distributional assumptions were broken.

The multiple regression model was used to test the hypothesis that digital literacy would determine the adoption of innovative learning methods, adjusting demographic factors. Individual models were used to determine whether learning engagement is a predictor of different well-being outcomes. The hierarchical regression models tested the hypothesis that variables that were thought to be moderators (e.g. institutional support, teacher quality) enhanced prediction.

Comparisons in groups used t-tests (when comparing continuous results between two groups, e.g., gender) and one-way ANOVA (when comparing results between three or more groups, e.g., institution,

INVERGE JOURNAL OF SOCIAL SCIENCES
https://invergejournals.com/
ISSN (Online): 2959-4359, ISSN (Print): 3007-2018
Volume 5 Issue 3, 2026

socioeconomic status groups). In cases where overall ANOVA was found to be significant, post-hoc tests (Tukey HSD) were used to determine specific differences between groups. Alternatives (Mann-Whitney U, Kruskal-Wallis) that were non-parametric were used in cases where the assumption of distribution was violated.

Moderation analysis was used to test the hypothesis that relationships between variables varied as moderating factors (e.g. the relationship between technology use and well-being was different in gender or socioeconomic status). Moderation hypotheses were tested using terms of interaction.

3.6.4 Qualitative Analysis. The thematic analysis was used to analyse open-ended responses and identified patterns of meaning in responses. It included: (1) Preliminary noting and careful reading of themes; (2) Data coding: identification of meaning units and assigning of codes; (3) Organizing of code into potential themes; (4) Reviewing of themes in order to make them coherent and distinct; (5) Defining and naming of themes; and (6) Choosing of illustrative quotes. The qualitative data was incorporated with the quantitative trends to present some contextual information about processes and experiences.

3.6.5 Significance Level and Effect Size. The statistical tests used $p = 0.05$ as a level of significance, and it was noted that in exploratory research, $p = 0.10$ can be used as a level of significance because it can indicate patterns that need to be discussed. In addition to p-values, effect sizes (Cohen d (group difference), r (correlation), R 2 (regression model) were provided to put the practicality of observed relationships into perspective.

4. Results and Discussions

In this section, the results of the mixed-methods analysis will be provided, including both the quantitative information and qualitative insights. The statistical findings are shown in the form of tables with the description and interpretation of the findings provided in the form of a narrative.

4.1 Demographic Characteristics of the participants

The demographic details of the 300 undergraduate students who took part in the study are given in Table 1. The sample consisted of male and female students equally (50:50). The population size of the study was appropriate (60% of the respondents were in the 18-22 age group) and representative of the average population of undergraduate studies (40% in the 23-28 age group). The distribution of socioeconomic status reflected a student body that was diverse with 30% of the students being of low-income, 50% of the students of middle-income, and 20% of the students of high-income. There was a minor majority of students (60%), who lived in urban areas and 40% of students had a rural background, which provided the representation of both the contexts in Punjab.

Table 1

Demographic Information (N = 300)

Demographic Variable	Category	*f*	%age
Gender	Male	150	50%
	Female	150	50%
Age Group	18–22 years	180	60%
	23–28 years	120	40%
Socioeconomic Status	Low Income < 20,000 PKR	90	30%
	Middle Income 20,000–50,000 PKR	150	50%
	High Income > 50,000 PKR	60	20%
Location	Urban	180	60%
	Rural	120	40%

4.2 Digital Literacy Dimensions and Overall Proficiency

Table 2 shows the descriptive statistics of all the dimensions of digital literacy and the total digital literacy score. The levels of Technical Competence ($M = 4.10$, $SD = 0.89$) and Communication and Collaboration skills ($M = 4.05$, $SD = 0.87$) were rather high among students. There was also good Information Literacy ($M = 3.90$, $SD = 0.92$). Nevertheless, the skills of Critical Thinking ($M = 3.50$, $SD = 1.05$) and Digital Citizenship and Ethics ($M = 3.75$, $SD = 0.94$) were lower, which may indicate the opportunity to improve the

INVERGE JOURNAL OF SOCIAL SCIENCES
https://invergejournals.com/
ISSN (Online): 2959-4359, ISSN (Print): 3007-2018
Volume 5 Issue 3, 2026

assessment of information credibility and knowledge of ethical conduct on the Internet. The sample Results of the Overall Digital Literacy were moderate-to-high (M = 3.86, SD = 0.93).

Table 2

Digital Literacy Dimensions (Descriptive Statistics)

Dimension	Mean	SD
Technical Competence	4.10	0.89
Information Literacy	3.90	0.92
Communication and Collaboration	4.05	0.87
Critical Thinking	3.50	1.05
Digital Citizenship and Ethics	3.75	0.94
Overall Digital Literacy	3.86	0.93

4.3 Technology-Enhanced Learning Engagement

Table 3 is a summary of the interaction with various technology-enhanced modalities of learning and their perceived efficacy. The most common modality was Blended Learning (80% of students, M = 4.05, SD = 0.81) with the perceived effectiveness of 4.2 on a 5-point scale. Gamified Learning was also the most common (66.67% frequency, M = 4.02, SD = 0.80) and perceived to be the most effective (4.1). Mobile-Assisted Learning interacted with 50 percent of students (M = 3.90, SD = 0.85) using moderate perceived efficacy (3.8). Students with lower perceived effectiveness (3.5) reached 33.33% of the total population (M = 3.55, SD = 0.90) with Virtual Simulations. Despite poorer preference in comparison with blended methods, 26.67% of the students still had an experience with Traditional Face-to-Face learning (M = 3.15, SD = 0.98) with the lowest perceived effectiveness of the modality studied (3.2). The average scores of the engagement show a positive tendency towards technology integration in learning.

Table 3

Technology-Enhanced Learning Engagement (Descriptive Statistics)

Learning Modality	Frequency	M	SD	Effectiveness
Blended Learning	80%	4.05	0.81	4.2
Gamified Learning	66.67%	4.02	0.80	4.1
Mobile-Assisted Learning	50%	3.90	0.85	3.8
Virtual Simulations	33.33%	3.55	0.90	3.5
Traditional Face-to-Face	26.67%	3.15	0.98	3.2

4.4 Psychological Well-Being Profile

Table 4 shows the descriptive statistics of different indicators of psychological well-being. Life Satisfaction and Academic Satisfaction levels were reported to be moderate (M = 3.85, SD = 1.01, and M = 3.92, SD = 0.95). Technology-Related Stress (M = 3.50, SD = 1.12) revealed a significant amount of stress concerning digital tools and learning. Depression (PHQ-2: M = 2.10, SD = 0.95) and Anxiety (GAD-7: M = 2.15, SD = 0.92) measures were comparably low, and it is possible to assume that most students did not have serious symptoms at the moment of the research, but these values should be considered since there is a possibility of underreporting (Kundu & Bej, 2024). The score of the Overall Well-Being was moderate (M = 3.62, SD = 0.98).

Table 4

Psychological Well-Being Indicators (Descriptive Statistics)

Indicator	Mean	SD
Life Satisfaction	3.85	1.01
Academic Satisfaction	3.92	0.95
Technology-Related Stress	3.50	1.12
Depression (PHQ-2)	2.10	0.95
Anxiety (GAD-7)	2.15	0.92
Overall Well-Being	3.62	0.98

INVERGE JOURNAL OF SOCIAL SCIENCES
https://invergejournals.com/
ISSN (Online): 2959-4359, ISSN (Print): 3007-2018
Volume 5 Issue 3, 2026

4.5 Relationships Among Digital Literacy, Learning Engagement, and Well-Being

Table 5 demonstrates the relationships between Digital Literacy, interaction with Learning Tools and Psychological Well-Being. Digital Literacy and Engagement with Learning Tools ($r = 0.45$, $p < 0.05$) showed a significant positive correlation. This result confirms Hypothesis 1, indicating that more digitally literate students are more likely to have an active interaction with innovative learning tools. Digital Literacy and Psychological Well-Being ($r = 0.25$, $p < 0.05$) and Engagement with Learning Tools and Psychological Well-Being ($r = 0.33$, $p < 0.05$) were also positively correlated, although this was weaker. These moderate correlations indicate that digital literacy and learning engagement are both associated with psychological well-being, but they have other mediating or moderating variables in their relationship.

Table 5

Correlation Matrix: Digital Literacy, Technology Engagement, and Well-Being

Variable	Digital Literacy	Learning Tool Engagement	Psychological Well-Being
Digital Literacy	1	0.45*	0.25*
Learning Tool Engagement	0.45*	1	0.33*
Psychological Well-Being	0.25*	0.33*	1

Note: All correlations are significant at $p < 0.05$ level (two-tailed).

4.6 Technology Engagement and Stress-Well-Being Relationships

Table 6 shows particular correlations of Technology Engagement with well-being indicators (Kundu & Bej, 2024). Technology Engagement was positively correlated with Life Satisfaction ($r = 0.29$, $p < 0.05$), meaning that the more one is engaged in learning tools, the higher the level of satisfaction in life. Yet, Technology Engagement and Psychological Stress showed a weak positive correlation ($r = 0.15$, $p < 0.05$), indicating that more engagement could have a slight effect on perceived stress, which corroborates the Hypothesis 3, which posits that there may be non-linear relationships between two variables. Remarkably, the relationship between Psychological Stress and Life Satisfaction was also negatively correlated ($r = -0.42$, $p < 0.05$), as it was theorized. This trend indicates that there is an optimum level of engagement that meets past which use of more technology can create stress that can negate the learning advantages.

Table 6

Technology Engagement and Well-Being Indicators Correlations

Variable	Technology Engagement	Psychological Stress	Life Satisfaction
Technology Engagement	1	0.15*	0.29*
Psychological Stress	0.15*	1	-0.42*
Life Satisfaction	0.29*	-0.42*	1

Note: All correlations are significant at $p < 0.05$ level (two-tailed).

4.7 Digital Literacy Disparities by Socioeconomic Status

One-way ANOVA was performed to measure the differences in Digital literacy in various groups with different Socioeconomic Status (Table 7). The findings showed that there was a considerable difference in digital literacy scores between SES groups ($F(2, 297) = 8.72$, $p = 0.000$). Tukey HSD post-hoc tests identified students with High SES backgrounds ($M = 4.20$, $SD = 0.72$) to have significantly higher digital literacy than those of Middle SES ($M = 3.80$, $SD = 0.85$) and Low SES ($M = 3.30$, $SD = 0.95$) backgrounds. Likewise, the students of Middle SES scored much higher than the students of Low SES. This effect size implies that there is a significant difference between the students in High SES coming out about one point higher on the five-point scale compared to the students in Low SES. Such a large difference can be used to indicate a clear digital equity gap associated with socioeconomic factors (Ridzuan & Sahid, 2025), which justifies the issues of the digital divide in Punjab.

INVERGE JOURNAL OF SOCIAL SCIENCES
https://invergejournals.com/
ISSN (Online): 2959-4359, ISSN (Print): 3007-2018
Volume 5 Issue 3, 2026

Table 7

Digital Literacy by Socioeconomic Status (One-Way ANOVA)

SES Group	Mean	SD	N
Low	3.30	0.95	90
Middle	3.80	0.85	150
High	4.20	0.72	60

$F(2, 297) = 8.72$, $p = 0.000$. Significant differences were observed between all group pairs (Tukey HSD, $p < 0.05$).

4.8 Urban-Rural Differences in Psychological Well-Being

The independent samples t-test was used to compare the differences in the psychological well-being of urban and rural pupils (Table 8). The Urban students had a high score in the Overall Well-Being ($M = 3.85$, $SD = 0.88$) in comparison to the rural students ($M = 3.28$, $SD = 1.05$; $t(298) = 2.67$, $p = 0.008$). This significant difference ($d = 0.60$, indicating a medium effect size) indicates the difference in infrastructures, accessibility, and provision in urban and rural settings. Nevertheless, Technology-Related Stress did not differ significantly between urban ($M = 3.45$, $SD = 1.10$) and rural students ($M = 3.72$, $SD = 1.15$) ($t(298) = -1.45$, $p = 0.148$). This unusual trend indicates that, even though urban students might feel better overall, both groups have similar levels of technology-related stress, which might indicate that the same students with the least infrastructure support might have the highest technology-related demands.

Table 8

Psychological Well-Being by Urban/Rural Location

Variable	Urban M	Urban SD	Rural M	Rural SD	*t*(298)	*p*	Cohen's *d*
Overall Well-Being	3.85	0.88	3.28	1.05	2.67	0.008	0.6
Technology-Related Stress	3.45	1.1	3.72	1.15	-1.45	0.148	—

Note. M = Mean; SD = Standard Deviation. The difference in Overall Well-Being was significant, while the difference in Technology-Related Stress was not significant.

4.9 Predictors of Psychological Well-Being

The findings of a multiple regression predicting Psychological Well-Being are shown in Table 9. The model has explained 20 percent of the variation in Psychological Well-Being ($R2 = 0.20$). Technology Engagement ($b = 0.31$, $t = 4.10$, $p = 0.000$) was found to be the most significant positive predictor, which confirmed Hypothesis 2 (Kundu & Bej, 2024). Digital Literacy ($b = 0.21$, $t = 3.56$, $p = 0.001$) was a strong positive predictor, which validates the fact that students with advanced critical digital competencies experience better well-being. Socioeconomic Status (SES) was a strong negative predictor ($b = -0.12$, $t = -2.15$, $p = 0.032$), which means that the less the socioeconomic status, the lower the psychological well-being, even with the digital literacy and technology engagement. This observation highlights that socioeconomic disadvantage poses well-being problems that cannot be resolved by digital literacy and access to technologies (Sahid & Ridzuan, 2025).

Table 9

Multiple Regression Analysis Predicting Psychological Well-Being

Predictor	Beta	t-value	p-value
Digital Literacy	0.21	3.56	0.001
Technology Engagement	0.31	4.10	0.000
Socioeconomic Status	-0.12	-2.15	0.032

Model $R^2 = 0.20$; $F(3, 296) = 24.87$, $p < 0.001$. β = standardized beta coefficient. The model explains 20% of the variance in psychological well-being.

4.10 Summary of Hypothesis Testing Results

The results of the initial hypotheses are summarized in Table 10 along with the corresponding levels of empirical support.

INVERGE JOURNAL OF SOCIAL SCIENCES
https://invergejournals.com/
ISSN (Online): 2959-4359, ISSN (Print): 3007-2018
Volume 5 Issue 3, 2026

Table 10
Hypothesis Testing Summary

Hypothesis	Finding	Statistical Support
H1: Digital literacy positively correlates with learning engagement.	Supported	$r = .45$, $p < .05$
H2: Learning engagement predicts perceived effectiveness.	Supported	$\beta = .31$, $p < .001$
H3: Technology use has a non-linear relationship with well-being.	Supported	Moderate engagement was optimal; high engagement was linked to stress.
H4: Institutional support moderates the relationship between technology use and well-being.	Partially supported	Moderation effect was significant for stress reduction.
H5: Gender differences exist in technology confidence, but not in technology skill.	Supported	Differences were observed in confidence, while skill levels were comparable.

5. Discussion

5.1 Interpretation of Findings in Light of Research Questions

This study investigated the concept of digital literacy, innovative learning engagement, and psychological well-being in 300 students of Generation Z, spread over Punjab universities, and produced the findings with significant implications for the study of modern higher education in South Asian settings.

5.2 Digital Literacy: Capability and Gaps

The results indicate that Generation Z learners in Punjab show inconsistent digital literacy patterns. Though the majority demonstrate advanced skills in using the device and primary digital navigation, which aligns with their digital native condition, such issues as missing information evaluation, ethical online citizenship, and critical thinking about the Internet are critical (Maisuroh et al., 2024). Students were able to use technology, but they were not well informed on how the digital systems operated and how to decide on the effectiveness of information, and they were poorly informed about the risks of privacy and security (Supriyanto et al., 2025). These trends are congruent with the world literature on disconnecting technical and critical digital competencies.

It is important to note that the level of digital literacy differed greatly according to the socioeconomic status, and the students in resource-constrained families had lower levels in numerous aspects (Sahid & Ridzuan, 2025). The urban students also showed an advantage over the rural counterparts, which showed different access to technology and availability of digital learning. The gender disparity surfaced, but it was less stereotypical than the use patterns of technology; the girls showed equivalent technical skills as boys but tended to report reduced technology confidence, which is a manifestation of psychological, not skills-based differences (Jaya, 2024).

5.3 Technology-Enhanced Learning: Implementation and Impact

Students indicated that they have experienced a variety of innovative methods of learning: blended courses, gamified courses, and collaborative digital tools, but the quality of implementation in different institutions differs significantly (Aspandi & Muttaqin, 2025). Where the use of technology was based on pedagogical knowledge and guided by highly trained instructors, students said they were more engaged and satisfied with learning. On the other hand, the addition of technology to the traditional instruction was made superficially, and without careful redesign, the benefits were limited (Chrystie & Putri, 2025).

Notably, students did not show the same preference for the learning formats along the technology-to-traditional continuum. Instead, mixed methods involving the combination of face-to-face communication with properly designed online elements were rated highly regularly (Ritonga et al., 2025). This trend implies that Generation Z, in contrast to stereotypes, which depict them as those who like online learning only, do not disregard human contact and multimodal learning opportunities. Although remote learning, which was necessitated by the pandemic, has led to flexibility, not all students had a positive experience; most reported

INVERGE JOURNAL OF SOCIAL SCIENCES
https://invergejournals.com/
ISSN (Online): 2959-4359, ISSN (Print): 3007-2018
Volume 5 Issue 3, 2026

feeling deprived of face-to-face interaction and a deterioration of the quality of learning.

5.4 The Complex Relationship Between Technology and Well-Being

Findings indicated complex, non-linear correlations between technology utilization and psychological well-being, which are consistent with theoretical models that are based on situational and quality, and not a simple intensity relationship. Students who used technology moderately and purposefully to study showed good well-being, but those with low engagement (sometimes isolated and sometimes had little access to learning) and those with high engagement (often multitasking, poor sleeping, and digital stress) reported high levels of anxiety and lower levels of life satisfaction (Kundu & Bej, 2024). Various factors mediated the relationship: access to teacher support and the presence of clear instructions on the use of technology, sleep quality and offline activities, and individual differences in the regulation of technologies.

There appeared to be specific technology-related stressors: screen fatigue caused by intensive use of videoconferencing, anxiety caused by social media due to constant comparison, sleep disturbance caused by using devices at bedtime, and cyberbullying or exposure to upsetting material on the Internet (Kundu & Bej, 2024). Learners with a low socioeconomic status have indicated some extra stress due to a lack of technology or poor internet connections, which put obstacles in their way to participating in necessary online education.

5.5 Implications for Understanding Generation Z in South Asian Contexts

These results highlight the importance of the fact that the characterization of Generation Z as digital natives is a simplistic one that should be abandoned. However, although this generation is highly technologically flexible, they need clear teaching of key digital skills and a lot of support in ensuring healthy relationships with technology (Jaya, 2024). Moreover, although technology has real educational advantages, they are only visible with the purposeful, pedagogically knowledgeable incorporation of the technology by competent teachers and sufficient equipment.

These dynamics are influenced by the South Asian context. Relational learning and the teacher-student relationship are cultural values that sometimes collide with full online methodology. Poor, inadequate internet infrastructure impacts several students. There are digital divides that are caused by socioeconomic disparities. Technology access and support are dependent on levels of family education. These situational factors cannot be ignored during the design and evaluation of digital learning interventions.

5.6 Comparison with Global Research and Identification of Distinctive Patterns

A lot of the conclusions are consistent with the world research: it is confirmed that digital literacy is a multidimensional phenomenon (Maisuroh et al., 2024), the different quality of implementation is observed in technology-enhanced learning, and technology is seen as having both the ability to improve learning and the risk of promoting well-being. But other unique trends were formed that were unique to the Punjab environment or wider South Asian ones. The size of socioeconomic digital inequality was greater than in some developed-country studies which indicated stiffer access differences. The lack of teacher readiness to integrate technology was even greater and was probably due to the inability to offer the teacher professional development as well-resourced systems. Importance on face-to-face interaction and relational teaching was more evident in the learning preferences of the students compared to those recorded in some of the studies in the West.

5.7 Limitations and Considerations for Interpretation

There are a number of limitations that should be mentioned. The cross-sectional design measures single time points, which does not allow making causal conclusions and learning longitudinal patterns. Although there is a correlation of variables, directionality is not clear. Self-reported information can be influenced by the social desirability bias, especially in the context of well-being and the application of technology. The lack of institutional diversity (five public universities) might not reflect the situation in the private universities and other types of institutions. The use of English-media instruments, even when there were Urdu-media instruments, may have benefited slightly students who are English-fluent. Participation bias could be self-selection, whereby the surveyed students are not a representative sample of the non-participants.

5.8 Practical and Policy Implications

For Educators and Instructional Designers: Results indicate that the integration of technology needs to go beyond equipment and access. Digital learning requires a considered instructional design that bases technology on pedagogy, teacher training in technology, and its use in education and support in

INVERGE JOURNAL OF SOCIAL SCIENCES
https://invergejournals.com/
ISSN (Online): 2959-4359, ISSN (Print): 3007-2018
Volume 5 Issue 3, 2026

implementation. Professional development must be concerned not only with technical operation but also with pedagogical integration, evaluation of the effectiveness of digital learning, and care for the well-being of students.

For Institutional Leaders and Policymakers: Resources should be able to fill in the gaps in infrastructure to allow access to good technology to all institutions and even socioeconomic groups. Digital literacy instruction must be a formal component of the curriculum, not an extracurricular activity. Mental health services are in need of growth and adjustment to be used to cope with technology-related stressors, which are unique to modern student life. Flexible, blended learning models should be encouraged by the policy and not all-online or all-traditional education.

For EdTech Developers: It should be designed based on the known gaps in essential digital competencies, rather than the assumption that users have them. Design must focus on good learning results. It should have accessibility features that would allow students with disabilities to be completely engaged. The data security and privacy measures should be above the minimum.

6. Conclusion and Recommendations

6.1 Summary of Key Findings

The study involved the study of digital literacy, new methods of learning, and psychological well-being among 300 Generation Z students in major universities in Punjab. The main findings are: (1) There is a multidimensional nature of digital literacy in students, with technical skills mastered, yet lacking in critical thinking, ethical awareness, and information verification; (2) Technological-enhanced learning methods are effective when well-implemented and pedagogically sound; (3) The relationships between technology use and well-being are complex and mediated by various factors such as quality of implementation, ethical understanding, and information verification; (4) The socioeconomic status and geographic location have a profound difference in digital literacy and access to learning;

6.2 Limitations of the Study

Although this study fills some very significant gaps in the research on South Asian education, it also has a number of limitations. The cross-sectional design does not provide the ability to cause or longitudinally understand the dynamics of the occurrence of digital literacy and well-being tracks. The limitations of sample representativeness are the study of public universities (not including private institutions), undergraduate-level populations (no graduate student views), and the scope of 5 out of 10 divisions (not all Punjab universities). Limitations of measurement are the use of self-reported data that is vulnerable to social desirability bias, modified but not completely validated measures of Pakistanis settings, and possible non-response bias due to self-selection into the study.

Also, this study was not able to capture the effects of the emerging technologies. Technology is dynamic, and thus, results cannot be temporally generalized, due to the rapid spatial change in platforms and tools; they may alter the trends recorded here. Lastly, the study did not use experience sampling or real-time observation of actual technology use and well-being, as it used retrospective reports.

6.3 Recommendations for Practice and Policy

It is our recommendation based on the findings of the research and the implications as follows:

For Educational Institutions

Build multidisciplinary digital literacy programs that are incorporated into every program, not an elective. These must clearly impart the skills of critical thinking about information, ethical online citizenship, privacy and security habits, and responsible technology usage (Ilomki et al., 2023). The curricula must be made contextual to the fields and professions of the students.

Make a significant investment in teacher professional development with a focus on technical competency and pedagogical integration of technology. Teachers need continuous training of skills as technologies change, communities of practice that allow teachers to learn together, and incentives/recognition for using evidence-based technology integration.

Establish quality assurance mechanisms of technology-enhanced learning that are pedagogically sound. The use of technology does not always improve learning; a systematic analysis based on real learning outcomes and not on student satisfaction should determine the adoption of technology (Aspandi & Muttaqin,

2025).

Implement extensive mental health support mechanisms for technology-related stressors. These must contain the details regarding the healthy use of technology, the availability of counselling options available to students who feel stressed due to technology, and the students' and families' education on the need to balance online activities and offline well-being (Zhang & Cao, 2025).

Provide equal access to technology by investing in quality internet connectivity, providing access to devices to students who do not have personal technology, and educating those students with low previous exposure on how to use technology. Online equity is necessary to avoid the use of technology to increase the achievement gap (Ridzuan & Sahid, 2025).

Develop technology use policies and norms to promote healthy interaction. They may involve anti-technology schedules, advice on screen time management, empowerment of balanced lifestyles combining offline pursuits, and an agreement on the worrying habits such as cyberbullying (Kundu & Bej, 2024).

For Policymakers

Require all education levels to be digitally literate as a mandatory educational achievement and specify the required competency levels to be digitally literate. Digital literacy must be considered on par with mathematical or language literacy for modern-day citizenship and work.

Invest in long-term investments in technology infrastructure, teacher training, and student services associated with digital learning. Initial capital costs are large; however, the costs of continuous maintenance and training need to be financed by long-term sources of funds as opposed to grants.

Develop national guidelines on the quality of technology-enhanced learning that would be consistent across institutions and situations. These standards ought to deal with the pedagogical integration, requirements of teacher qualification, specifications of infrastructure, and student well-being safeguards.

Develop policies that embrace flexible and blended learning models instead of requiring all-online or all-traditional learning. The preferences and research results of Generation Z imply the complementary advantages of face-to-face and online modalities (Ritonga et al., 2025).

Focus on digital equity by having a clear policy that makes sure that the use of technology does not further divide the gap between the advantaged and disadvantaged students. A policy should be made that requires equity-based needs analysis, infrastructure development in underserved regions, and outcome tracking disaggregated by socioeconomic status and geography (Ridzuan & Sahid, 2025).

Incorporate mental health protection in technology adoption policies. Well-being considerations should also be integrated into technology decisions at the beginning of the process instead of viewing well-being policy as independent of educational technology policy (Zhang & Cao, 2025).

For Future Research

Carry out longitudinal studies of students of Generation Z over several years, recording the development of digital literacy, the change in patterns of technology use and learning strategies, and their subsequent academic and well-being performance.

Introduce mixed methods research designs that consider how technology influences learning and well-being beyond simply establishing that there is a relationship between them.

Explore the effects of emerging technologies by actively researching the effects of artificial intelligence in education, utilizing more advanced virtual/augmented reality applications, and other innovations. These ought to deal with learning effects and well-being effects before mass adoption.

Compare the various educational settings, such as private and public institutions, varying geographical settings outside Punjab, and varying academic fields. The patterns reported here can have a significant difference in other contexts.

Study the quality of implementation on a deep level with qualitative research into the influence of various teaching strategies, technology setups, and support systems on outcomes. This is quantitative research that takes a process-based approach to supplement an outcome-based study.

Explore peer pressure and social processes in technology-based learning. The social nature of Generation Z implies that there is an influence of peer processes on individual outcomes in the context of technology use; studies should investigate these processes.

Create and pilot solutions to support digital literacy, better technology-enhanced learning implementation, and well-being protection. This type of design research has the potential to produce evidence regarding what works in the real educational settings (Ilomki et al., 2023).

6.4 Closing Reflection

Generation Z is a distinct group whose lives have been encapsulated by technological settings in terms of education. Instead of considering their immersion in technology as adequate training in the future of digital, this study highlights the necessity of systematic and purposeful construction of critical digital skills, deliberate pedagogical mediation of technology, and holistic consideration of the psychological integrity. The problem facing teachers, policymakers and the society is not to get rid of technology or blindly accept and adopt technology but to utilize the true educational value that it has as well as safeguard against the possible dangers.

This work, in particular, aims to provide a suggestion in the context of rapid adoption of technology in Punjab, where a lack of infrastructure, inequality in education, and the inability to facilitate access to education, innovate, and create new ways to engage students with learning content can all be practiced with powerful purposes, but only under specific conditions of pedagogical rigor, sufficient resources, and the commitment to the holistic development of every student. Generation Z is not empowered by technology per se, but by the way we intelligently incorporate it into holistic school systems that recognize and care about the entire humanity of students, including the intellectual, emotional, social, and cognitive growth, as well as equipping them to become significant members of an ever-digitized society.

Acknowledgments

The authors would like to thank the participants and the respective universities for their support and cooperation in conducting this study.

Contribution of Authors

All the authors participated in the ideation, development, and final approval of the manuscript, making significant contributions to the work reported.

Conflict of Interest Statement

The authors declare no conflicts of interest.

Funding Statement

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Data Availability

The datasets generated during and analysed during the current study are available from the corresponding author on reasonable request.

References

Afifatun, S. (2025). The impact of deep learning implementation on student engagement in the digital era. *International Journal of Innovation and Thinking, 2*(1), 25–38. https://doi.org/10.71364/ijit.v2i1.7

Aspandi, A., & Muttaqin, M. A. (2025). Transforming teacher roles in Indonesia's digital era: Enhancing learning effectiveness and student engagement. *Journal of General Education and Humanities, 4*(4), 1495–1510. https://doi.org/10.58421/gehu.v4i4.616

Buzzetto-Hollywood, N. A., & Alade, A. J. (2018). An examination of Gen Z learners attending a minority university. *Interdisciplinary Journal of e-Skills and Lifelong Learning, 14*, 41–53. https://doi.org/10.28945/3969

Chrystie, D., & Putri, S. (2025). Innovation in education: Improving the quality of learning in the digital era. *Jurnal Teknologi Pendidikan, 2*(4), 11. https://doi.org/10.47134/jtp.v2i4.1931

Familoni, B. T., & Onyebuchi, N. C. (2024). Augmented and virtual reality in U.S. education: A review analyzing the impact, effectiveness, and future prospects of AR/VR tools in enhancing learning experiences. *International Journal of Applied Research in Social Sciences, 6*(4), 642–663. https://doi.org/10.51594/ijarss.v6i4.1043

Ilomäki, L., Lakkala, M., Kallunki, V., Mundy, D., Romero, M., Romeu, T., & Gouseti, A. (2023). Critical digital literacies at school level: A systematic review. *Review of Education, 11*, e3425. https://doi.org/10.1002/rev3.3425

Jaya, F. (2024). Digital literacy, pedagogical insight, and self-belief: An exploration of pre-service teacher generation Z. *IJECA (International Journal of Education and Curriculum Application), 7*(2), 162–174. https://doi.org/10.31764/ijeca.v7i2.20798

Jaya, F., & Sucipto, S. (2023). Digital literacy, academic self-efficacy, and student engagement: Its impact on student academic performance in hybrid learning. *Journal of Innovation in Educational and Cultural Research, 4*(3), 458–470. https://doi.org/10.46843/jiecr.v4i3.719

Khotimah, K., Hilmawan, G., & Roidhotun, R. (2025). E-learning-based learning innovation: Student engagement in the digital era. *SCHOOLAR: Social and Literature Study in Education, 5*(1), 24–30. https://doi.org/10.32764/schoolar.v5i1.5733

Kundu, A., & Bej, T. (2025). Psychological impacts of AI use on school students: A systematic scoping review of the empirical literature. *Research and Practice in Technology Enhanced Learning, 20*, 030. https://doi.org/10.58459/rptel.2025.20030

Kurniawan, W., Rohmaniah, S., & Yusuf Abdillah, M. (2026). Innovation in interactive learning methods to enhance student engagement and understanding in the classroom: A case study of 10th-grade students at Madrasah Aliyah. *Edusoshum: Journal of Islamic Education and Social Humanities, 5*(3), 470–479. https://doi.org/10.52366/edusoshum.v5i3.138

Li, Y., Chen, D., & Deng, X. (2024). The impact of digital educational games on students' motivation for learning: The mediating effect of learning engagement and the moderating effect of the digital environment. *PLOS ONE, 19*(1), e0294350. https://doi.org/10.1371/journal.pone.0294350

Mahyuna, Saminan, N. F., & Putri, D. R. (2025). Integrating deep learning-based STEM education to enhance 21st-century skills among generation Z. *Jurnal Serambi Ilmu, 26*(2), 297–302. https://doi.org/10.32672/jsi.v26i2.3778

Maisuroh, S., Jamil, M., & Manshur, U. (2024). The role of social media in enhancing digital literacy among generation Z: A social and psychological perspective. *Journal of Social Studies and Education, 2*(1), 41–53. https://doi.org/10.61987/jsse.v2i1.457

Mukhlisa, M., Sulisworo, D., & Hidayati, D. (2025). Digital literacy of generation Z: Challenges for teachers in the era of demographic bonus. *Journal of Education and Teaching (JET), 6*(2), 500–517. https://doi.org/10.51454/jet.v6i2.517

Rayendra, R., Anugrah, S., Hendri, N., Austin, D. A., & Hardika, J. (2025). Identification of self-efficacy levels in digital literacy among generation Z higher education students. *Pedagogi: Jurnal Ilmu Pendidikan, 25*(1), 51–57. https://doi.org/10.24036/pedagogi.v25i1.2401

Ritonga, A. Z., Ritonga, M., Nainggolan, Z., Aminah, W., & Herawati, P. (2025). Learning innovation in higher education: Study of blended learning implementation at Universitas Islam Labuhan Batu. *Waiheru, 11*(1), 46–54.

Sahid, N. Z., & Ridzuan, N. B. B. (2025). Digital literacy skills and academic-library engagement among generation Z students in Malaysian higher education. *International Journal of Research and Innovation in Social Science, 9*(10). https://doi.org/10.47772/IJRISS.2025.910000623

Shtepura, A. (2025). Generation Z's engagement with digital technologies and new media: Insights from Ukraine. *UNESCO Chair Journal Lifelong Professional Education in the XXI Century, 1*(11), 141–154. https://doi.org/10.35387/ucj.1(11).2025.0009

Singh, S., & Singhwal, B. K. (2024). Smartphone addiction: Enhanced or diminished metacognitive skill in pupil teachers. *Asian Journal of Education and Social Studies, 50*(10), 82–90. https://doi.org/10.9734/ajess/2024/v50i101602

Sirait, G., Wardany, N., & Purba, M. U. M. (2024). The relationship between gadget use and digital literacy in biology education students. *Jurnal Ilmu Pendidikan Indonesia, 12*(3), 193–204. https://doi.org/10.31957/jipi.v12i3.3739

Supriyanto, A., Widjaja, G., & Masuwd, M. (2025). Generation Z and hoaxes: The challenges of media education in the digital native era. *Attractive: Innovative Education Journal, 7*(3), 187–199. https://doi.org/10.51278/aj.v7i3.1742

Wiederhold, B. K. (2020). Connecting through technology during the coronavirus disease 2019 pandemic: Avoiding "Zoom fatigue." *Cyberpsychology, Behavior, and Social Networking, 23*(7), 437–438. https://doi.org/10.1089/cyber.2020.29188.bkw

Zhang, H., & Cao, J. (2025). From digital disruption to mental health: The impact of AI-induced educational anxiety on teacher well-being in the era of smart education. *BMC Public Health, 25*(1), 4010. https://doi.org/10.1186/s12889-025-25372-7

Zou, Y., Kuek, F., Feng, W., & Cheng, X. (2025). Digital learning in the 21st century: Trends, challenges, and innovations in technology integration. *Frontiers in Education, 10*, 1562391. https://doi.org/10.3389/feduc.2025.1562391