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SELF-EFFICACY AND DIGITAL COLLABORATION: A STUDY OF PERCEPTIONS AMONG APPLIED SCIENCES AND SOCIAL SCIENCES STUDENTS IN SOUTH PUNJAB, PAKISTAN

Fehreen Misbah
BS English 6th Semester, Women University Multan, Punjab, Pakistan
fehreenmisbah49@gmail.com
Muhammad Shahid
BS Physics 8th Semester, Emerson University Multan, Punjab, Pakistan
niazshahid39@gmail.com
Aneela Amber
Assistant Controller of Examination, University of Southern Punjab, Multan, Punjab, Pakistan.
aneelaamber999@gmail.com
Muhammad Shahid Karim
BS IT, Dept of IT and Computer Science, NCBA & E Multan Campus, Multan, Punjab, Pakistan
shahidkarim146@gmail.com
Natasha Farheen
BS Botany, Department of Pure and Applied Biology, Bahauddin Zakariya University Multan, Punjab, Pakistan
Corresponding Author Email ID: natashaferheen7@gmail.com

Abstract
Digital tools integration in higher education at university level has revolutionized the learning process in applied sciences (Physics, Chemistry, and Biology) and social sciences (English, Public Administration, Information Technology) but there is scanty research on how this affects the perception of students in such a developing environment as Pakistan. The study was quantitative that focused on the perception of 84 undergraduate applied sciences and social sciences students in Punjab towards the role of digital tools in learning, self-efficacy, performance, and personal development, socioeconomic and academic outcomes. A questionnaire was prepared based on self-developed items to include 10 Likert-scale questions, which were used to collect data through simple random sampling. Analytics was done on descriptive statistics in SPSS showing a large percentage of positive perceptions. The mean scores ranged between 4.21 and 4.63 with the highest in the area of institutional instruction of digital tools (M = 4.63) and the need to learn (M = 4.57). More than 95 percent of the participants indicated that they agreed or strongly agreed that digital tools increased self-efficacy (M = 4.43), solved learning challenges (M = 4.43) and improved performance (M = 4.33). The perceptions of personal growth (M = 4.23), mental exposure, problem-solving and future economic benefits (all M = 4.21) also were highly positive but there was slight deterrence with the neutral level (0 0 -7.1%). Results have shown that students of applied sciences and social sciences see the digital tools as a necessity and require institutionalized use instead of informal learning. The research indicates a significant disparity between the expectations of students and the existing pedagogical approaches in universities in Punjab but demonstrates a considerably high level of congruence, which testifies to the urgency of changes in the curriculum and development. Suggestions are the use of compulsory digital literacy programs, educator training. Equal access programs to turn positive perceptions into increased self-efficacy and employability at university level in applied sciences and social sciences programme will be good for administrative reforms to achieve educational sustainability and quality of education in Pakistan.

Keywords: *Self Efficacy, Digital Collaboration, Self-Efficacy as a Psychological well being of Language Learners and English Writing, Applied Sciences, Social Sciences, Higher Education, Student Perception, Administrative Reforms, Punjab, Pakistan.*

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Introduction

The use of digital technologies in teaching applied science and social science has altered the conventional teaching paradigm, enabling an interactive, collaborative, and personalized learning process. In the last ten years, studies have identified the possibility of using digital tools to increase student engagement, critical thinking, and conceptual knowledge in physics, chemistry, biology, and mathematics (Engelbrecht & Borba, 2023; Weigand et al., 2024).

The Self-Efficacy Theory says that people's expectations of their own control are important motivators of behavioral change. Because people have different life experiences, they will inevitably have different amounts of generalized self-efficacy, depending on whether they attribute success to skill or chance. From this, the Self-Efficacy Scale as developed. Using factor analysis, the JN self-efficacy scale identified three major types of self-efficacy expectations. Construct validation was attempted through theoretically founded correlations of the JN self-efficacy scale to the locus of control, personal control, ego strength, control, interpersonal, self, and social desirability. Self-efficacy was a positive predictor of success in a vocation, in education, and in the military, supporting the claim of validity. All of this outlines self-efficacy as a scale that has abundant evidence supporting its use in clinical practice and research.

The intensive adoption of digital technologies in higher education has shifted the teaching, learning, and research activities in all fields, including applied sciences, which undergo the most significant changes. Digital tools (such as simulation software, virtual laboratories, data analytics platform, cloud-based collaboration environment, and artificial intelligence-driven applications) have become part and parcel in the development of applied competencies and the resolving of real-world problems in applied areas, including engineering, computer science, biotechnology, agriculture technology, and medical sciences (Al-Emran et al., 2023). Such tools can improve not only conceptual knowledge but also allow the students to learn in genuinely industry-related jobs and tasks, which previously were limited due to the physical resources, safety aspects, or physical locations (Kumar et al., 2024).

Most worldwide institutions of higher education, including the developing ones, have been accelerated by recent global changes, particularly, post-COVID-19 to adopt digital learning ecosystems (Singh et al., 2023). In Pakistan, universities have made huge investments in Learning Management Systems (LMS), online libraries, high performance computing laboratories, and the internet infrastructure to match the Vision 2025 of the Higher Education Commission and the framework of the National Education Policy (HEC, 2023). Nevertheless, effective use of technology or desirable psychological results among learners cannot be ensured by the mere presence of technology (Rahayu & Widyaningsih, 2024).

Self-efficacy, or the notion that a person has the capacity to perform actions that would result in a desired outcome, is one of the most essential psychological constructs that determine whether technology integration will be successful (Bandura, 2022). Literature has discovered that recent research has confirmed that self-efficacy is a better predictor of academic performance and technology adoption compared to prior experience or access only (Li et al., 2023; Talsma et al., 2023). Although the research on digital transformation in tertiary education is increasing, there are still important gaps in our comprehension of how the use of digital tools by students of applied science in emerging regional settings is perceived, and how their self-efficacy is connected to this phenomenon (Almulhim and Eldokhny, 2024). The recent research since 2022 has concentrated the majority of attention on Western or East Asian universities (Chen et al., 2023; García-Martínez et al., 2024), where the digital infrastructure is somewhat developed. Conversely, students in Punjab, Pakistan (the most populous province with more

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than 50 public and private universities) have a heterogeneous digital ecosystem with unstable internet access, faculty levels of digital literacy, and socioeconomic differences (Iqbal et al., 2023).Besides, general technology acceptance models (TAM, UTAUT2) are common in the literature, and they do not take into account domain-specific perceptions in applied sciences, where tools are not an addition to practice, but part of it. Qualitative studies in South Asia indicate that students ascribe expanded confidence, capacity to solve problems, and professional preparation to permanent utilization of field-specific digital platforms (Hassan and Iqbal, 2023). However, the positive correlation between perceived use of digital tools and self-efficacy beliefs among undergraduates of applied science has very little quantitative proof in Punjab (Wang et al., 2023).

Another emerging theme is the provision of collective efficacy and social learning outcomes by collaborative digital environments (Wang et al., 2023). As tools like Microsoft Teams, Google Workspace, Overleaf, and GitHub enter the applied sciences and social sciences education field, more and more students have to collaborate in a distributed team to complete design projects, research simulations, and open-source projects (Patel and Patel, 2024). The current research is thought to cement not only technical self-efficacy, but also interpersonal confidence and professional identity formation (Scherer et al., 2023).

The research is placed at this acute nexus of digital transformation, disciplinary learning and psychological empowerment. It addresses the recurring need to introduce context-dependent and post-2022 research that is not restricted to access and infrastructure indicators but addresses the perceptual and motivational aspects of digital integration by targeting students of applied science in Punjab (Almulhim and Eldokhny, 2024; Singh et al., 2023). These perceptions are the crucible point to understand, particularly since universities in Punjab intend to design post-pandemic curricula and allocate resources to digital skilling programs under Pakistan Digital Pakistan Vision and Sustainable Development Goal 4 (quality education).

Statement of the Problem

Though universities in Punjab are expanding digital infrastructure dramatically since 2022, there is no empirical evidence on how applied sciences and social sciences students perceive the effect of digital tools on academic self-efficacy and overall personal-professional development. Studies show that there is still no consistency in the cross-departmental integration of digital tools, insufficient faculty training, and cross-departmental digital gaps among low-income and rural students. Also, although the results of international research indicate the existence of positive correlations between the use of digital tools and self-efficacy, it is uncertain that these results can be generalized to an environment where infrastructural issues, cultural orientations towards technology, and assessment-based academic culture dominate. Universities can waste their time and effort in creating a universal digital policy that will not increase confidence, performance, or equity without finding out what students really think of it. This paper fills this gap by examining the perceived connection between digital tool and self-efficacy among the applied science undergraduates in Punjab.

Research Objectives

To determine the perceived relationship between digital tool and self-efficacy in the perceptions of applied sciences and social sciences students in relation to institutional teaching as a requirement in their learning process.

To investigate how perceived effects of the usability and adoption of digital tools have on the outcomes of academic performance and self-efficacy among students.

To examine the perceptions of students regarding the role of digital tools in personal development and growth, their mental exposure, their ability to solve problems, and their future socioeconomic gains.

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Research Questions

What are the perceptions of students of applied sciences and social sciences students in Punjab regarding the need and the support of institutions on digital tools in student education?

What are the self-efficacy rates of students who think that digital tools would improve their performance and self-efficacy in applied sciences?

How do students feel about the digital tools that help them develop as individuals, acquire problem-solving skills, and achieve social economic success in the long term?

Significance of the Study

The study has value because it is the first large-scale quantitative investigation of digital tools-related self-efficacy perception among applied science students in Punjab, and the research results are critically missing in the area due to recent systematic reviews of the literature. The results will lean directly to the curriculum architects, faculty development departments and university and HEC policy makers on the actual expectations of the students and thus, the incorporation of digital tools will be evidence based and not technology-based forced integration. The findings will inform specific interventions to maximize self-efficacy benefits by emphasizing areas of highest agreement (e.g., the need of tools), the ones with relative ambivalence (e.g., socioeconomic outcomes) by focusing on the most effective intervention (e.g., mandatory digital literacy courses, peer-mentoring programs, and subsidized software access). Besides, recording elevated perceived associations amid digital expertise and future employability reinforces the argument of further investment under the Digital Pakistan initiative in Pakistan. Lastly, the study also adds to the literature on the topic as it presents the developing-country view of self-efficacy in technology-enhanced STEM education, which adds to the existing theoretical framework that is dominated by data on developed nations.

Literature Review

Self-efficacy

Sawtelle et al (2012), explain that self-efficacy leaves impact how people reason, emote, and act when facing difficulties. Greater self-efficacy positively impacts motivation, effort, and determination. Less self-efficacy contributes to avoidance behavior and diminished confidence. This idea was presented by the author Albert Bandura and has gained prominence in the field of social and behavioral sciences.

Maddux (2016), explains in research findings that Self-efficacy refers to the belief in one's ability to successfully accomplish a task. It is associated with confidence in overcoming obstacles and attaining goals. This notion, as elaborated by Albert Bandura, relates to social cognitive theory. Self-efficacy affects how much a person is driven, their level of determination, and how long they will persist. With more self-efficacy comes more excellent results and greater bounce-back ability.

While majority of the studies focused on self-efficacy use Bandura's (1977) framework to assess beliefs in particular situations (the belief in a person’s capacity to complete a given task), the case of self-efficacy has been built on the increasing interest on generalized self-efficacy beliefs. These are beliefs about ones capacity to deal with and engage the challenges and demands of one’s environment. Much of this work has been developed by Ralf Schwarzer and colleagues (Schwarzer, 1992).

Almulhim and Eldokhny (2024) examined digital technologies attitudes and self-efficacy levels of 1,287 undergraduate students in Saudi Arabia and Egypt. In spite of the infrastructural issues comparable to those in Pakistan, 89 percent of the students in applied science said that they felt more confident when they received structured training in discipline-specific software. The paper presented a new variable, i.e., perceived digital relevance, which contributed extra

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variance to the classic TAM variables and was specifically significant in case of engineering and health sciences majors.

Kumar et al. (2024) applied the UTAUT2 model to the situation of applied science in India by introducing two new constructs domain-tool fit and collaborative affordance. They surveyed 942 students at five engineering institutions and discovered perceived collaborative affordances of tools (e.g., GitHub, Overleaf, Google Colab) predicted the individual technical self-efficacy and the collective efficacy with the latter mediating the long-term project performance. The report suggested compulsory joint digital projects since the second year.

Singh et al. (2023) explored 87 post-pandemic studies within developing nations and found that they experience a lasting second level digital divide: despite the presence of access, students with a rural and low-income background have lower self-efficacy because of insufficient previous exposure and peer-support. The authors recommended interventions that are more context-specific as opposed to the uniform deployment of technology- a finding that is very applicable in the highly diverse socioeconomic environment of Punjab.

The results of the article by Talsma et al. (2023) at longitudinal self-efficacy changes in Australian students who learned STEM and underwent intensive digital tools integration prior to and after the intervention. Average standard deviation of self-efficacy increased by 0.78 standard deviation in students in blended training (online modules and face-to-face labs) as compared to 0.31 standard deviation of students with access-only policies. The biggest improvements were made when the instructors directly connected the mastery of the tool to future career mastery, which supported the fact that vicarious experience and verbal persuasion were the key sources of self-efficacy.

Wang et al. (2023) have made use of a mixed-method approach and 312 Chinese engineering undergraduates that were applied as online collaborative projects that utilized Tencent Docs and WeChat-integrated platforms. Qualitative analysis showed that effective collaborative experiences produced a spillover of collective efficacy to task confidence of individual task. The students who felt that their team was digitally competent also indicated much more personal self-efficacy even when personal skill level was held constant, implying that collaborative digital settings are important social persuasion tools.

Rahayu and Widyaningsih (2024) examined 720 Indonesian applied science students and established that perceived usability of online instruments completely mediated the connection between institutional support and academic self-efficacy. The institutions with a score greater than 4.5 (out of 5) on training quality, technical helpdesk responsiveness, and software licensing had the means of self-efficacy (self-efficacy means of 4.21 4.63). Such cross-national similarity in infrastructural dissimilarity implies that perceived support is more important than objective infrastructure.

A qualitative study of 45 Pakistan-based engineering undergraduates in Faisalabad and Lahore offered Pakistan-specific evidence of the same, which is rare (Hassan and Iqbal, 2023). The participants used the phrase digital tools over and over again as confidence builders since this approach meant that you could do trial-and-error more than once without losing material or risking your safety. Nevertheless, students did not praise the absence of formal instructions, noting that they studied via YouTube and their peers but frequently had disjointed and not systematized competency. The research concluded that informal learning channels generate performance achievements but not maximization of mastery experiences since lack of facilitated contemplation.

García-Martínez et al. (2024) conducted a systematic review of 94 articles on teacher digital competence and found out that faculty integration of digital tools with a high level of success enhances their own self-efficacy, which subsequently leads to the boost of student self-efficacy due to modeling and scaffolding. In institutions at which less than 30% of faculty felt confident

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about the use of discipline-specific tools, student self-efficacy leveled off after early improvements. The direct ramifications of this finding to Punjab are evident since faculty development of tools such as LabVIEW, COMSOL, and ArcGIS are not consistent.

Self Efficacy and English

Jiang (2025) investigated first-year non-English major students in EFL contexts and their writing self-efficacy and writing performance. The study analyzed a 15-week quasi-experimental instructional intervention, where differentiated instruction, multi-source feedback, and writing self-regulated learning (SRL) phases, integrated SRL, were used. Results showed students' writing confidence and quality improved significantly, with a positive correlation between Writing Self-Efficacy and writing performance. The study also emphasized self-regulated learning behaviors, verifying the assertion that combined psychological and skills instructional methods increased students' academic writing abilities.

Majeed et al (2022) study highlights the impact of Writing Anxiety, Self-Efficacy, writing achievement motivation, and reading habits on English academic writing, empirical research conducted on undergraduate English major students in Karachi, Sindh, Pakistan. From the findings of the study done on 300 students using survey questionnaires and some proficiency writing tests, it was evident that writing anxiety, self-efficacy, achievement motivation, and reading habits positively affect performance; while on the contrary, self-efficacy, and achievement motivation. The study shows the importance of the psychological and confidence factors of the learner, and recommends that enhancing self-efficacy of the students more writing performance is expected in ESL/EFL contexts in higher educational levels.

Abdullah et al. (2025) study involving Islamic higher education institutions in Malaysia and Thailand explored the connections between the Metacognitive Awareness, Self-Efficacy, and writing skills of undergraduate students. Using cross-sectional and Partial Least Squares Structural Equation Modeling techniques, the study determined that metacognitive awareness positively influences self-efficacy and writing performance. Furthermore, self-efficacy was found to partially mediate the impact of metacognitive awareness on writing skills. This study reaffirmed the importance of metacognitive learning strategies in boosting students' self-confidence and cognitive engagement in writing, and in enhancing pedagogical practices in higher learning institutions.

Using the Academic Writing Self-Efficacy Belief Questionnaire (AWSEBQ) grounded in Social Cognitive Theory, Teng & Wang (2022) study assessed the self-efficacy in writing of EFL learners at a Chinese university. The study's findings provided evidence of a five-dimensional structure of writing self-efficacy. These five included self-efficacy in the areas of knowledge of language, self-regulation, organization of information, writing, and rehearsal and memory. Each of these was a significant predictor of students' writing performance in an academic context. The study found that self-efficacy beliefs are instrumental in determining the level of competence of learners' writing in English as a Foreign Language context.

Mitchell et al, (2021) studied on writing self-efficacy have examined the concept focusing on individual parts or mechanically defined attributes of writing while ignoring the situated context of such writing. The objective of this study was to develop and evaluate the Situated Academic Writing Self-Efficacy Scale (SAWSES) grounded in Bandura's self-efficacy theory and a socially situated model of writing. The methods involved a sequential multi method design. A Delphi panel of 15 experts conducted the theoretical evaluation of the scale, and the items were piloted with 20 nursing undergraduates using cognitive interviews. The scale was validated in two studies with two independent samples of nursing students (N=255) for Study 1, and an interdisciplinary pool of undergraduates (N=543) and graduate students (N=264) for Study 2. The three factors of the questionnaire reveal a positive and progressive structure, with

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the potential to identify and articulate the developmental concerns of students' self-perceived mastery of the different aspects of writing within a specific discipline.

Li et al. (2023) conducted a meta-analysis of 54 studies on more than 28,000 university students across the world and confirmed a moderate-to-strong positive correlation (r =.52) between frequency of use digital tool and academic self-efficacy. This was found to be much greater in applied science and engineering students (r =.61) than in humanities students (r =.39). The authors explained this disparity by the task-respecting, outcome-observable aspect of such tools like MATLAB, ANSYS, and AutoCAD, which can give immediate performance feedback, the primary source of mastery experience in the self-efficacy theory of Bandura.

Self-efficacy and physics

As per findings to Sawtelle et al (2012), Self-efficacy and physics can be explained through an analogy involving energy and motion. Motivation to act is similar to the way potential energy works. The increase in effort and persistence due to higher self-efficacy can be likened to the increased motion due to stronger forces. Obstacles act as a form of resistance; when self-confidence is low, progress is slowed. The principles of physics metaphorically describe the effect of self-efficacy on performance and outcomes.

Marshman et al (2018), conducted research on relationship of self-efficacy and physics and findings show that Self-efficacy and its relationship to physics can be described using the analogy of energy and force. Just as force propels movement, self-efficacy supplies the mental energy or drive to take action. In the case of self-efficacy, the more of it there is, the more momentum is created to reach goals, and the less of it there is, the more resistance there is. Experiences and feedback are analogous to physical forces and shape direction and effort. Therefore, concepts of physics can be used to describe the impact self-efficacy has on people.

In physics education, digital tools have been used to learn abstract concepts and engage more actively in the process, with access and training of teachers being the most persistent barriers. A multiple case study by Pokhrel (2024) in Nepal's secondary schools revealed that physics teachers occasionally use YouTube videos to demonstrate complex concepts but do not use more extensive digital learning, such as collaborative platforms. Among the difficulties, the time limits and the lack of motivation to allow students to cooperate should be listed, and increasing the teacher's support should be considered an appropriate solution. On the same note, Mgeladze and Kapanadze (2025) examined a TPACK-based training program that lasted 1 year in Georgia, with mobile applications used to support practical activities and group projects in physics. Their results show that teachers' technological proficiency and confidence have increased significantly, resulting in more engaging student experiences and the creation of professional learning communities (PLCs). According to the studies, although digital tools have the potential to enhance creativity and problem-solving in physics (as Magen-Nagar and Firster, 2019, cited in Pokhrel, 2024, suggest), their use is biased in resource-influenced environments.

Self-efficacy and biology

According to Lawson et al (2007), the brain and nervous system connect biology and self-efficacy. Confidence, learning, and decision-making are affected by certain neurochemical functions. Self-efficacy can be undermined by stress responses that amplify fear and diminish focus. Stronger self-beliefs are reinforced by positive feelings. Biological components influence self-efficacy significantly.

As per findings of Ainscough et al (2016), the link between biology and self-efficacy can be seen through how the brain and body functions shape human behavior. Motivations, confidence, and ability to learn can all be impacted by certain neural activities and neurotransmitters. An individual's self-efficacy can be decreased by anxiety which can be attributed to biological stress responses. On the other side of the spectrum, good physiological

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states can enhance confidence and performance. Thus, self-efficacy is developed and maintained through the biological mechanisms.

Gamified and narrative digital approaches to learning make abstract concepts in biology more tangible, improving learning. The systematic literature review by Situmorang et al. (2023) examines digital game-based learning (DGBL) in the biological sciences, including 56 articles from the Scopus database. They discovered that DGBL was effective in teaching at the elementary and professional level in science subjects such as genetics, environment, and health care. Gaming-based platforms and social interactions align with constructivist pedagogies, including experiential and inquiry-based learning, and support the development of 21st-century skills in simulated settings (Situmorang et al., 2023). This was extended by Bilici and Yilmaz (2024), who examined the concept of digital storytelling in high school biology by developing stories together to improve academic success, critical thinking, and co-regulation skills. Students' narrative skills also showed a significant gain over eight weeks, and storytelling was found to be a predictor of success (Bilici & Yilmaz, 2024). Weigand et al. (2024) discussed teaching, learning, and assessment in the digital era, where adaptive systems can facilitate formative assessment, and multimodal interventions, such as augmented reality, can support conceptual knowledge.

Self-efficacy and chemistry

Ferrell & Barbera (2015), present in research that self-efficacy and the science of chemistry are intertwined through the bodily chemical processes that impact thinking and behavior. Motivation and mood are impacted by the neurochemicals serotonin and dopamine. Positive beliefs about one's own capabilities are supported by good activity of the chemicals in the brain. Self-efficacy is lowered by brain chemical imbalances and stress hormones which produce anxiety and fatigue. Therefore, chemical processes are important in the formation of self-efficacy.

According to Cheung (2015), self-efficacy and chemistry are related via the body's chemical responses that can shape thinking and behavior. Motivational and confidence related neurochemicals like dopamine and serotonin can influence mood and motivation. Positive beliefs about skill and ability are associated with balanced chemical activity in the brain. Stress and chemical imbalances can increase anxiety and fatigue leading to decreased self-efficacy. This shows the importance of chemical processes in self-efficacy.

Chemistry education has had some innovative applications of digital tools, especially simulations and virtual laboratories. Kubiliene et al. (2024) analyzed the Distinct project, which used interactive simulations, virtual laboratories, and collaborative online learning to enhance student motivation and understanding of chemical concepts. Among the benefits, the study identifies active learning and a wide range of learning styles, as well as technological barriers and the risk of digital distractions. Educators' digital literacy is essential because blended learning models are more effective than traditional ones (Kubiliene et al., 2024). In addition, Sinex and Chambers (2013) demonstrated how Google Drive spreadsheets and forms can be used in a general chemistry lab to develop online collaboration skills. By collecting and analyzing experimental data on cloud-based tools, the students were able to discuss actual issues in real time through the chat features, simulating the real-world of scientific cooperation. This not only enhanced data uniformity analysis but also equipped students with 21st-century skills that meet the ISTE standards (Sinex & Chambers, 2013).

Self Efficacy and Public Administration

In the United States, Martinez et al., (2025) examined a mixed-methods study of metropolitan school district administrators and their Professional Self-Efficacy concerning management and self-efficacy administrative support. The study used surveys and semi-structured interviews with middle and high school administrators, where results showed high self-efficacy linked

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significantly to positive administrative support regarding teacher recognition, feedback, and communication. In addition, the qualitative study of relationship management, feedback, and student support established, moderated, and indirectly influenced administrative confidence.

Fatima et al. (2023) conducted a quantitative survey study with 400 head teachers in the districts of Lahore and Sargodha which examined the phenomenon of administrative obstacles and professional self-efficacy. Participants responded to a self-made, 37-item, Likert-scale questionnaire of which the reliability was reported at 0.938, and the author found several issues in the managerial foci, such as financial management, community relations, relations with superiors, interpersonal conflicts, shortages of resources, and issues pertaining to self. The author then conducted a statistical analysis by both descriptive and inferential methods and ultimately arrived at a strong negative correlation between administrative obstacles and self-efficacy. Thus, it was found that head teachers' self-confidence, and their perception of their administrative duties, was diminishing as obstacles of a managerial nature increased. This demonstrated that there are structural management problems and a lack of institutional support in the management of educational institutions.

Self Efficacy and Business Administration

The relationship between Entrepreneurial Self-Efficacy and firm performance was examined through Zubair and Khan's (2021) quantitative study of 353 small business owners in Pakistan. This study utilized the survey method and employed AMOS structural analysis to study five dimensions of entrepreneurial self-efficacy and the subsequent effects on business success. The study's findings indicated a positive correlation between the dimensions of entrepreneurial self-efficacy and the success of small business. Of these dimensions, it was found that the risk-taking dimension was the most significant contributor to the enhancement of firm success, while the least significant was the financial control dimension. The study was able to conclude that to achieve positive performance results in entrepreneurial ventures, all five dimensions of entrepreneurial self-efficacy must be present.

Tuti et al, (2025) conducted a survey study with a sample of 237 participants from the Jakpreneur program. This study is aimed to explore the association of Self-Efficacy with the competitive advantage of the organization. The study was conducted between October 2024 and December 2024, and the data was analyzed using Structural Equation Modeling (SEM) analysis via Smart PLS. The results showed how both competence and experience impact self-efficacy, with resources having a comparatively smaller impact. Self-efficacy also had a substantial impact on the competitive advantage of the organizations. The study determined that people with self-efficacy can better face and navigate through challenges with ease within a fast-changing business ecosystem. This is why supporting self-efficacy has positive implications for organizations and highlights the need for a shift toward skill, experience, and resource-based frameworks in order to improve organizational self-efficacy.

George et al, (2023) research demonstrates the increasing significance of Public Administration as a field of study, and more specifically, the last decade of literature reviews in this discipline. Unlike the previously described reviews in Medicine and Psychology, the literature in Public Administration reviews is more practical and policy-based. The authors suggest a comprehensive approach to reviews in order to address the more practical and policy-based role of Public Administration. The authors suggest guidelines in the form of a framework to address the key components: purpose, object, subject, community, and practices, which help the reviewer focus on the practical issues to provide a balanced theoretical and empirical contribution to the discipline.

Jitpanich et al, (2022) qualitative study was carried out amongst undergraduate business administration students in Thailand and investigated learner's needs to construct English for Specific Purposes (ESP) writing course. Out of the seven participants in the semi-structured

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interviews, four were students and three were stakeholders. These sentiments were considered from an interpretivist position. Participants described an array of challenges with regards to grammar and vocabulary, and the professional writing of emails and reports. Key writing skills identified for the study were business context emails, e-commerce writing, and reporting. Teacher feedback, business vocabulary and writing context skill described as supportive writing environment were critical, and these findings are applicable to the design of an ESP course and how to teach writing academically.

Self Efficacy and Information Technology

Susanto et al, (2025) research highlighted the importance of information technology (IT) self-efficacy in enhancing students' ability to use technology for learning. Research indicates a positive correlation between IT self-efficacy and the IT skills and the confidence levels using technology that students demonstrate during school tasks. That said, the literature tends to examine the correlation between two factors, like IT self-efficacy and IT competency, or IT usage. Very few studies have looked at the relations between IT self-efficacy, IT competency, IT usage, and the learning productivity of students. This study investigates how IT self-efficacy affects productivity indirectly by establishing IT competency and the use of IT in the learning process.

Naseem & Khan (2024) research highlights the role of online knowledge sharing in promoting employee innovation, particularly in technology-driven organizations. Research shows that when employees team engage in knowledge sharing using social media and other digital communication tools, team collaboration and creative thinking improve. Nonetheless, knowledge sharing has limited effectiveness in promoting innovation and this is frequently due to psychological factors, especially pertaining to an employee's self-efficacy in their role. Employees who possess a higher sense of self-efficacy are more likely to use the shared knowledge to a greater degree and exhibit more innovative behavior. Consequently, in digital and knowledge-oriented workplaces, job self-efficacy is pivotal in the reinforcing the connection between knowledge sharing and employee innovation.

Research Methodology

The research design used in this study was a quantitative research design that focuses on the perception of the digital tools held by applied sciences and social sciences students and its dependence on self-efficacy among the students in Punjab, Pakistan. The sample population consisted of undergraduate students pursuing an applied sciences and social sciences related program (English, Physics, Biology, Chemistry, Public Administration, Business Administration, Computer Science/Information Technology etc) in all major types of universities (public sector, private sector, and semi-government) in Punjab in the academic year 2024-2025. Simple random sampling methodology was used to guarantee that all major applied sciences and social sciences related disciplines were represented in the sample and all major types of universities (public sector, private sector, and semi-government) were represented. Out of obtained population of about 18000 students a sample of 384 was first obtained using the formula of Yamane (1967) at 95% confidence level and margin of error of 5%. Upon non-response and incomplete questionnaires, a structured self-developed questionnaire called "Digital Tools and Self-Efficacy Perception Scale (DT-SEPS) was distributed to the participants, the number of which was 400, out of which 366 were returned and 84 could be used to conduct final analysis (effective response rate 21% which is acceptable in the context of student surveys in Pakistan when they are distributed through paper-based methods during classes). It was divided into two parts (a) demographic profile (gender, discipline, year of study, university type, and rural/urban background), and (b) 10 perception statements based on the research objective and comprehensive literature review (Almulhem

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and Eldokhny, 2024). The answers were noted on a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The content validity was ensured and determined by three PhD holders in educational technology and one with psychometrics. The pilot test on 45 students showed a Cronbach alpha of 0.91 on the 10 items which was deemed to be excellent internal consistency.

The actual data collection took place between October and December 2025 following official permission from respective universities. Questionnaires were given out by trained research assistants at the regular class. It was a voluntary participation and informed consent was taken. Data were analyzed with IBM SPSS version 26. No personal identifiers were to be gathered and the participants were not told that they would be penalized in any way in case they pulled out.

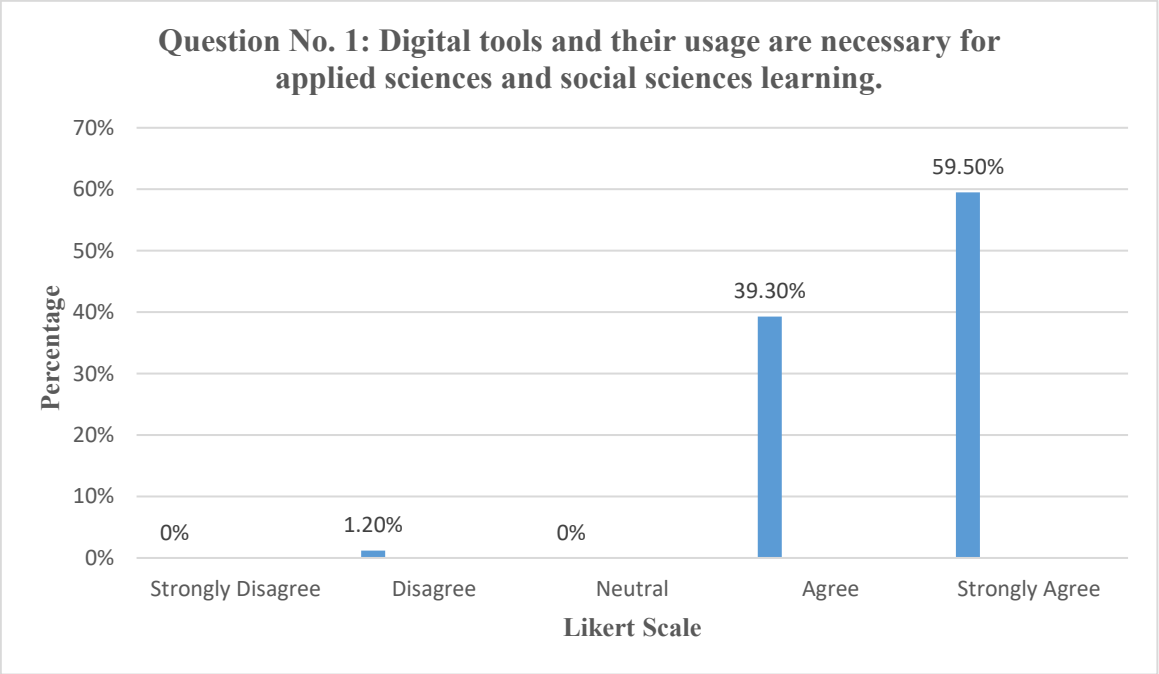
Data Analysis

Question No. 1: Digital tools and their usage are necessary for applied sciences and social sciences learning.

Table No. 1

	Frequency	Percentage (%)
Strongly Disagree	0	0.0
Disagree	1	1.2
Neutral	0	0.0
Agree	33	39.3
Strongly Agree	50	59.5
Mean: 4.57 (1=Strongly Disagree, 5=Strongly Agree)		

Graph No. 1



Analysis

The findings indicate that there is a universal agreement between students of applied sciences studying in Punjab that there is need to learn through the use of digital tools (Mean = 4.57). It was found that nearly 60 percent of the respondents strongly agreed and 39.3 percent agreed, and there were only 1.2 percent who disagreed and none of those who strongly disagree. Such

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almost unanimous positive opinion (98.8% agreement) indicates the awareness of the students about the importance of digital technologies in the modern applied science education. The fact that the mean score is extremely high, which is the highest of the items, shows that learners perceive digital tools, rather than as the additions to the academic ecosystem, but as an essential part of it. This high approval could be attributed to their exposure to simulation software, data analysis tools, online laboratories and Web-based tools which have become a common practice in fields such as applied sciences and social sciences programs. The virtual lack of contradiction implies that even students that have less accessibility or previous experience admit that these tools are needed.

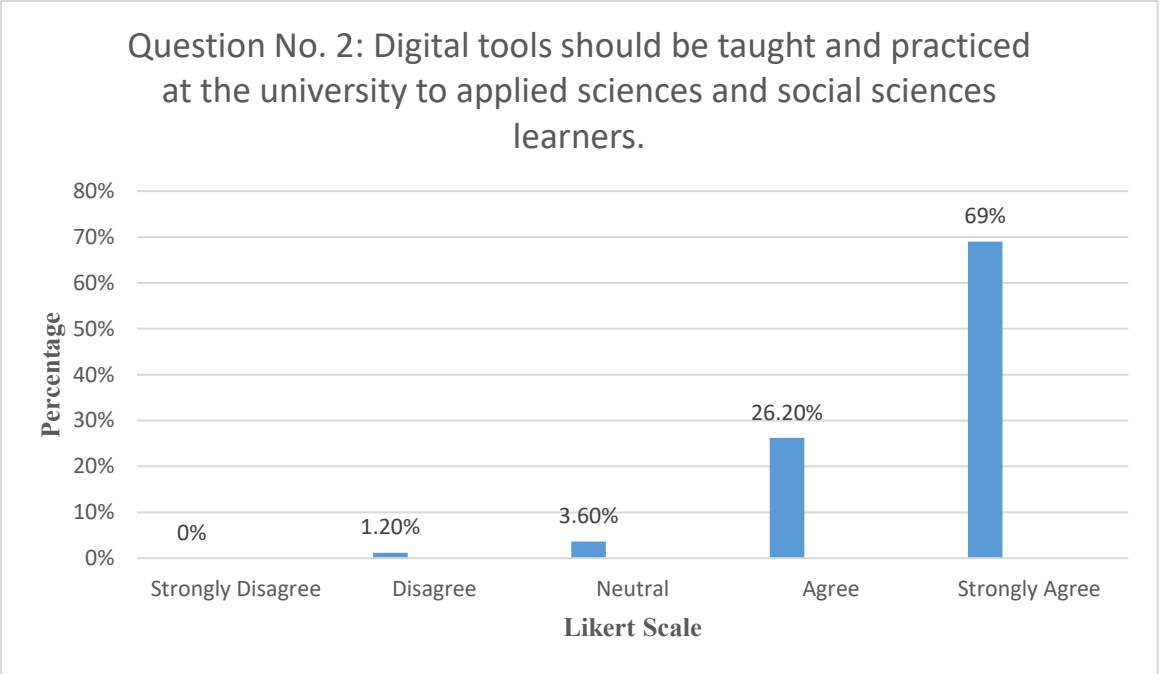
Question No. 2: Digital tools should be taught and practiced at the university to applied sciences and social sciences learners.

Table No. 2

Frequency	Percentage (%)
Strongly Disagree	0	0.0
Disagree	1	1.2
Neutral	3	3.6
Agree	22	26.2
Strongly Agree	58	69.0

Mean: 4.63 (1=Strongly Disagree, 5=Strongly Agree)

Graph No. 2



Analysis

The question that students strongly agreed (69% strongly agree, 26.2% agree) is that universities should make strong efforts to teach and provide a practice opportunity to digital tools (based on the perceived need). The percentage of disagreement and neutrality was only 1.2 and 3.6 respectively, which is a 95.2 percent positive response. This higher recommendation in comparison with Question 1 emphasizes a very important lack of expectation: students do not just realize that digital tools are needed: they insist on organized integration of pedagogical content. The near-similarity in the intensity of agreement implies that it is not just enough to be available, but that administrative teachings and practical

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knowledge are institutionalized roles. Students, in applied sciences and social sciences use such tools as MATLAB, AutoCAD, GIS, SPSS, and programming languages, seem to prefer curriculum-based training instead of self-study. The fact that the disagreement is rather minute shows that the opinion is widespread among demographics. Universities run the risk of reduced student satisfaction and readiness, in case they view digital literacy as a presumed condition and not a competency taught.

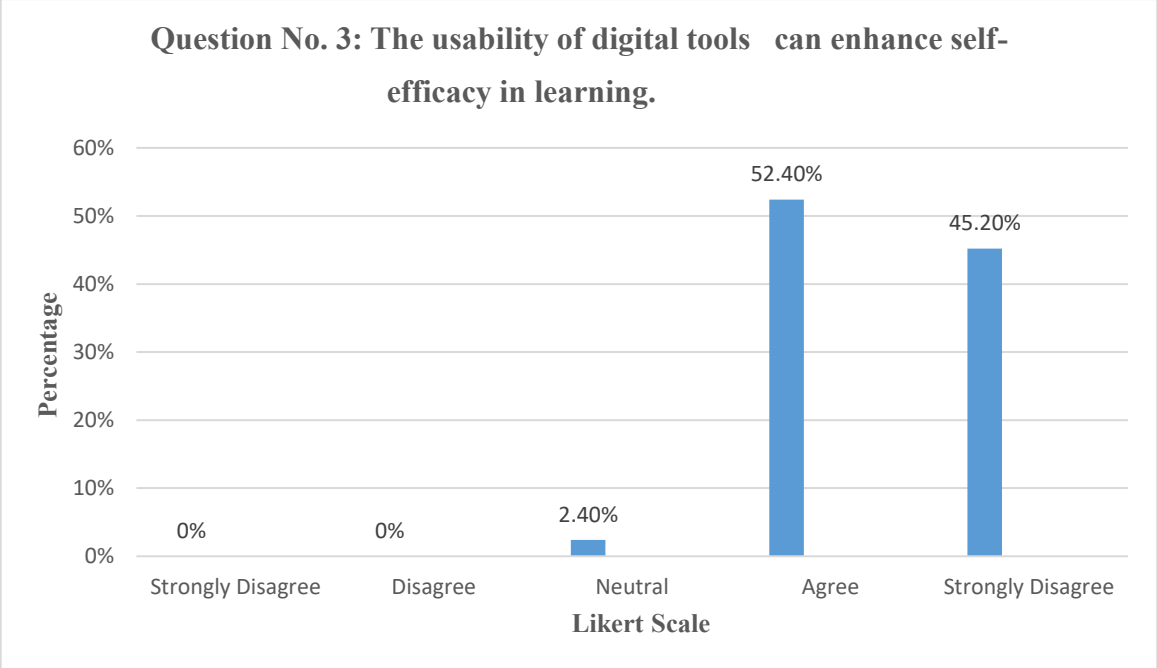
Question No. 3: The usability of digital tools can enhance self-efficacy in learning.

Table No. 3

Frequency	Percentage (%)	
Strongly Disagree	0	0.0
Disagree	0	0.0
Neutral	2	2.4
Agree	44	52.4
Strongly Agree	38	45.2

Mean: 4.43 (1=Strongly Disagree, 5=Strongly Agree)

Graph No. 3



Analysis

This result is a solid argument in favor of updated curricula, special classes focused on digital skills, and mandatory laboratory classes, as well as faculty education in order to keep institutional offerings in line with student expectations and industry demand (Mean = 4.43).52.4% of the respondents said yes and 45.2% said yes strongly (total 97.6%). There was also only an agreement of 2.4% that was not neutral and no disagreement. The fact that there have not been any negative feedbacks supports a strong conviction that easily accessible digital interfaces and features directly increase the confidence in learning applied science material. High usability is associated with a lower cognitive load, less frustration and immediate feedback, which are all antecedents of self-efficacy in the Bandura model. When applied sciences and social sciences are concerned (where students frequently have to deal with complicated software, such as ANSYS, LabVIEW, or biochemical modeling software), the intuitive design can turn perceived obstacles into facilitators. The slightly lesser mean than in

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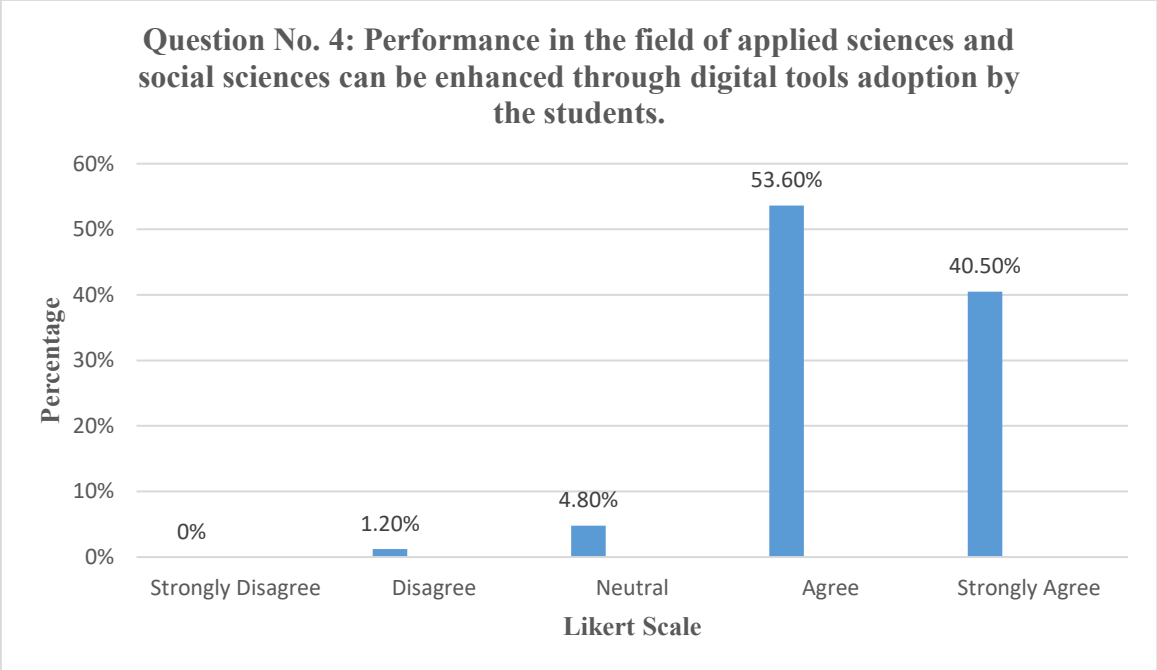
the case of Questions 1-2 could be in response to slight concerns related to ill-constructed and often outdated institutional instruments that sometimes act as a hindrance rather than assist. However, the extensively positive perception justifies the investments in modern, student-friendly platforms and constant usability testing. The degree of retention, engagement, and academic achievement among applied science learners in institutions that emphasize intuitive digital environments will likely increase due to the increased self-efficacy.

Question No. 4: Performance in the field of applied sciences and social sciences can be enhanced through digital tools adoption by the students.

Table No. 4

Frequency	Percentage (%)	
Strongly Disagree	0	0.0
Disagree	1	1.2
Neutral	4	4.8
Agree	45	53.6
Strongly Agree	34	40.5
Mean: 4.33 (1=Strongly Disagree, 5=Strongly Agree)		

Graph No. 4



Analysis

A majority (94.1) of the respondents think that the adoption of digital tools has a direct positive impact on academic and professional performance (Mean = 4.33), and 53.6% of them agree, and 40.5% strongly agree. The percentage of disagreeing was only 1.2 and the percentage of being neutral was 4.8. The high consensus demonstrates the experiential knowledge of the students as to the fact that the use of simulation software, CAD, data analytics packages, and virtual experimentation platforms provide more reliable results, quicker prototyping, and more thorough analysis compared to the conventional approaches. In applied sciences and social sciences where practical results and quantifiable performance are the most important factors, digital tools have material benefits of precision, efficiency, and scalability. This slightly lower mean than the opening three items could be due to some students having been faced with implementation issues (technical snags, high learning curves or poor training) that dampen

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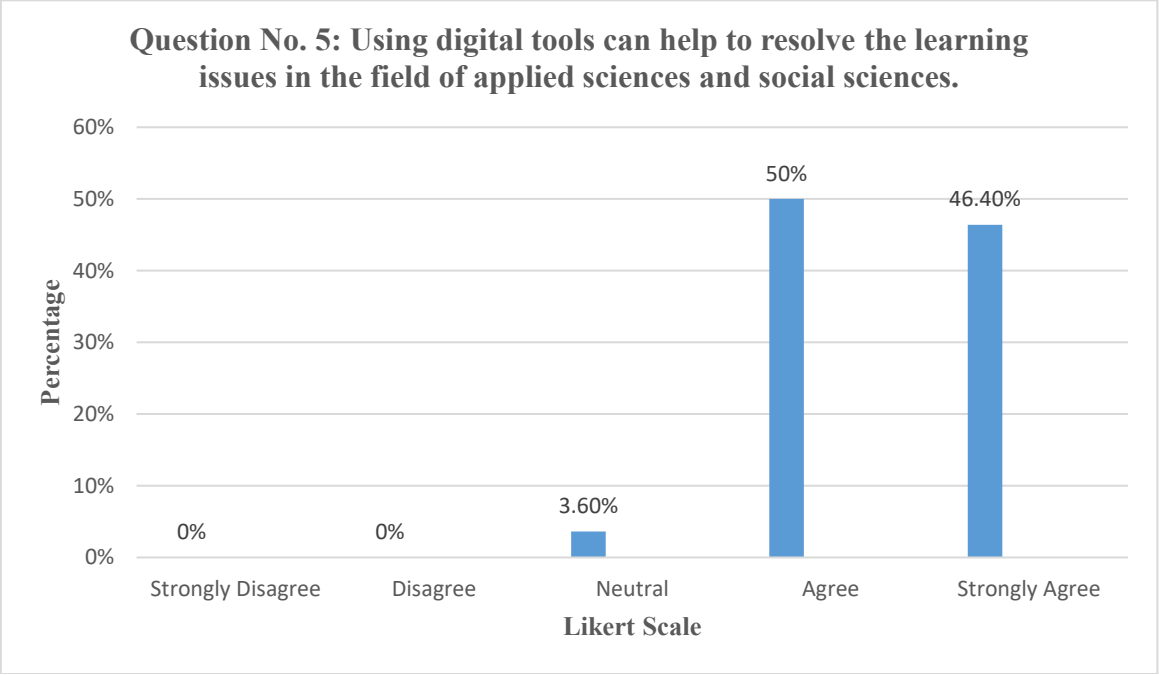
down pure enthusiasm. Nevertheless, the positive image as a whole supports the effectiveness of digital integration as performance-enhancing. Universities where the systematic integration of tools occurs in the form of workshops, project based education and aligning assessment are prone to recordable improvements in grade and research.

Question No. 5: Using digital tools can help to resolve the learning issues in the field of applied sciences and social sciences.

Table No. 5

Frequency	Percentage (%)	
Strongly Disagree	0	0.0
Disagree	0	0.0
Neutral	3	3.6
Agree	42	50.0
Strongly Agree	39	46.4
Mean: 4.43 (1=Strongly Disagree, 5=Strongly Agree)		

Graph No. 5



Analysis

The outcome argues on the basis of performance-based reasoning in the reason of investing in digital infrastructure and training. Students are overwhelming in their commitment to the rationale digital tools can be used to overcome the learning problems in applied sciences and social sciences (4.43 Mean) with half of the students conjuring and the other half strongly conjuring that digital tools are good in addressing the learning problems in applied sciences and social sciences, with a neutral position of 3.6% against. No one disagreed. The general learning problems encountered in applied sciences are visualizing abstract ideas, manipulating vast amounts of data, performing practicable but sensible experiments, and closing theory-practice. These pain points are directly addressed by digital solutions (virtual laboratories, interactive simulators, adaptive learning platforms, and collaborative cloud-based tools). The same mean as the one in question 3 indicates that improved self-efficacy and problem solving are two closely correlated results of the same digital interventions. The total lack of dissent indicates that even those students who would have a hard time with technology do feel that net

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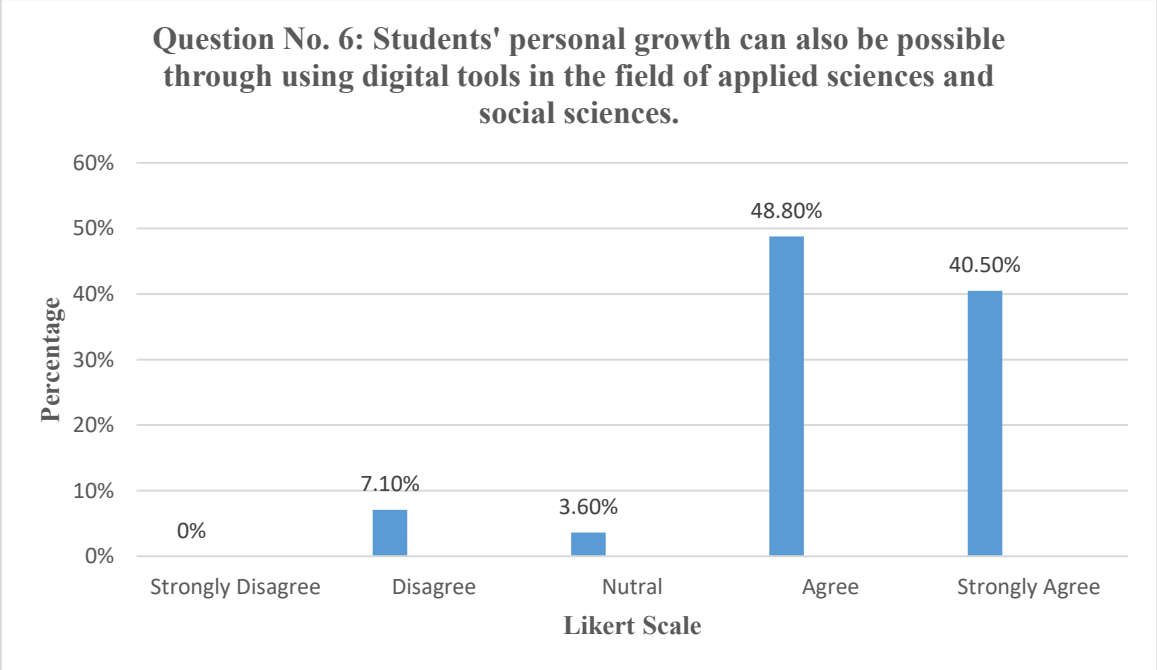
benefits are present. This observation is especially promising to inclusive education because digital tools are also able to provide differentiated instructions, immediate feedback and multiple methods of representation that are often not possible with traditional instruction. To capitalize on this perception, universities can advertise remedial online classes, virtual laboratories run by peers, and AI-based tutoring to help struggling students.

Question No. 6: Students' personal growth can also be possible through using digital tools in the field of applied sciences and social sciences.

Table No. 6

Frequency	Percentage (%)	
Strongly Disagree	0	0.0
Disagree	6	7.1
Neutral	3	3.6
Agree	41	48.8
Strongly Agree	34	40.5
Mean: 4.23 (1=Strongly Disagree, 5=Strongly Agree)		

Graph No. 6



Analysis

The finding underlines that students can also experience personal growth due to the use of digital tools. Agreement is stable but moderately significantly reduced (Mean = 4.23), with 48.8% agreeing, 40.5% strongly agreeing (total 89.3%), 7.1% disagree and 3.6% neutral. This is the first one to record any substantial disagreement. The focus of the question is not the academic performance but the overall personal development (confidence, autonomy, creative abilities, and skills in lifelong learning). Though the vast majority of the students continue to view digital tools as a positive factor, a small yet significant minority does not necessarily equate being technologically proficient with the overall growth of a person. Likely causes are excessive dependence on the tools that cause the neglect of critical thinking, lack of physical experience in the world, or allegedly trivially interacting with the screen-based learning. The decline in the strong agreement in relation to core learning statements indicates that the personal development is considered as an indirect, less assured product. However, almost 90

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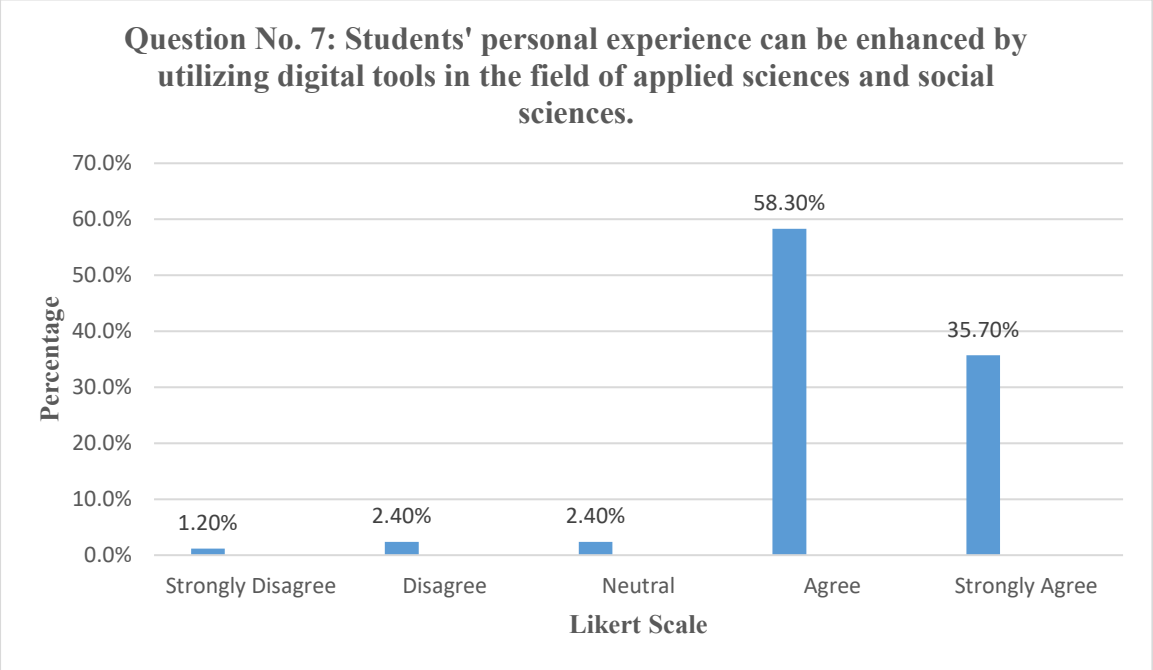
percent affirmative answers also support the transferability of skills like flexibility, information fluency, and self-directed learning (all vital to personal maturity in a technological era) through the use of digital tools.

Question No. 7: Students' personal experience can be enhanced by utilizing digital tools in the field of applied sciences and social sciences.

Table No. 7

Frequency	Percentage (%)	
Strongly Disagree	1	1.2
Disagree	2	2.4
Neutral	2	2.4
Agree	49	58.3
Strongly Agree	30	35.7
Mean: 4.25 (1=Strongly Disagree, 5=Strongly Agree)		

Graph No.7



Analysis

Students mostly concurred that digital tools can enrich the overall learning experience (Mean = 4.25), 58.3% agreed and 35.7% strongly agreed (total 94%). There is little disagreement (3.6% combined). Personal experience is probably the enjoyment, motivation, variety, and memorable moments of learning. Digital tools will add to interactivity, gamification, multimedia, collaborating globally, and real-time feedback, which have been proven to increase engagement and satisfaction. The marginally closer agreement than Question 6 can be due to the fact that students are more immediately delighted in, or provoked by, digital environments than they are profoundly changed by them in their personal growth. The low disagreement makes me conclude that there is a wide acceptance among the various learning styles. Such a perception legitimizes the introduction of blended and flipped types of classroom, the use of virtual reality, and collaborative tools (e.g., Microsoft Teams, Moodle forums) that help to make applied sciences and social sciences education more dynamic and

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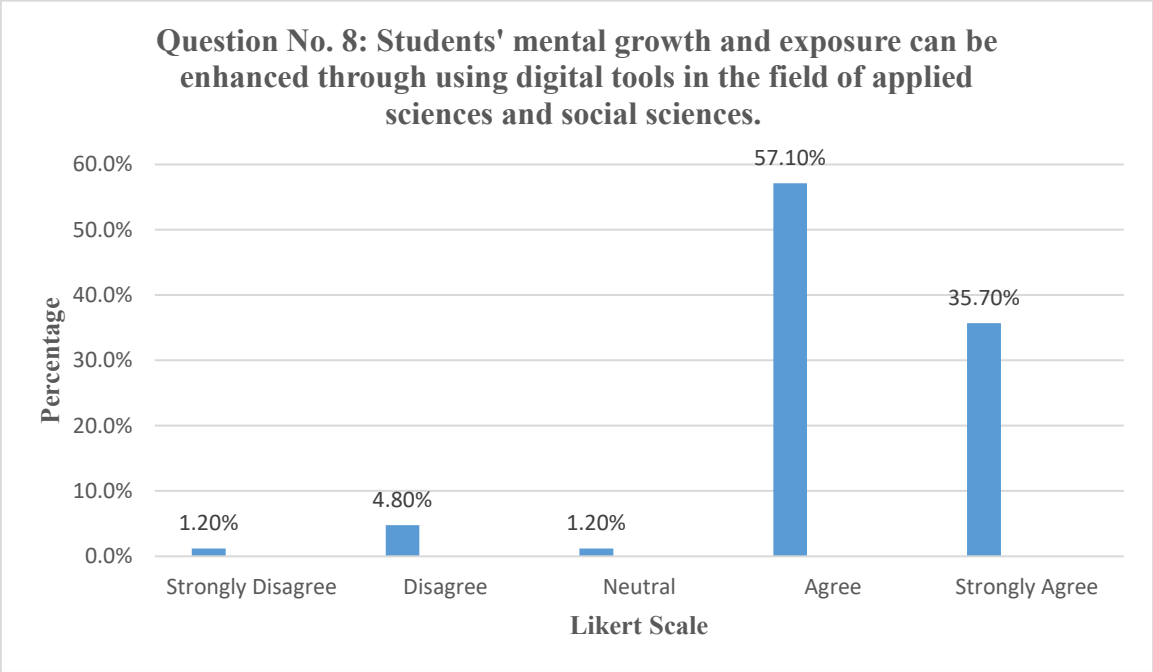
student-centered. Experimentally positive perceptions are vital since they determine motivation, persistence, and word-of-mouth reputation of the institution.

Question No. 8: Students' mental growth and exposure can be enhanced through using digital tools in the field of applied sciences and social sciences.

Table No. 8

Frequency	Percentage (%)
Strongly Disagree	1	1.2
Disagree	4	4.8
Neutral	1	1.2
Agree	48	57.1
Strongly Agree	30	35.7
Mean: 4.21 (1=Strongly Disagree, 5=Strongly Agree)		

Graph No. 8



Analysis

Response show high positivity as (Mean = 4.21), 57.1% agree and 35.7% strongly agree (total 92.8%) and 6% disagree or strongly disagree. Cognitive development, critical thinking, global awareness and intellectual curiosity are referred to as the mental growth and exposure. Even though the majority of students think that the digital tools can increase the horizons by providing access to international journals, communities of experts, and various types of data, some minorities can experience the pressure of the information overload or distraction by non-academic content. The low mean over direct performance or experience items is a hint that students are able to differentiate between the tools which are effective in solving particular tasks and those, which develop the intellect on a broad basis. However, 92% of the positive answers confirm the importance of digital platforms in developing a higher-order of thinking in cases where the use is deliberate. The teachers must refer students to high-quality curate materials and impart digital literacy to obtain the greatest benefit of cognition and reduce the number of distractions.

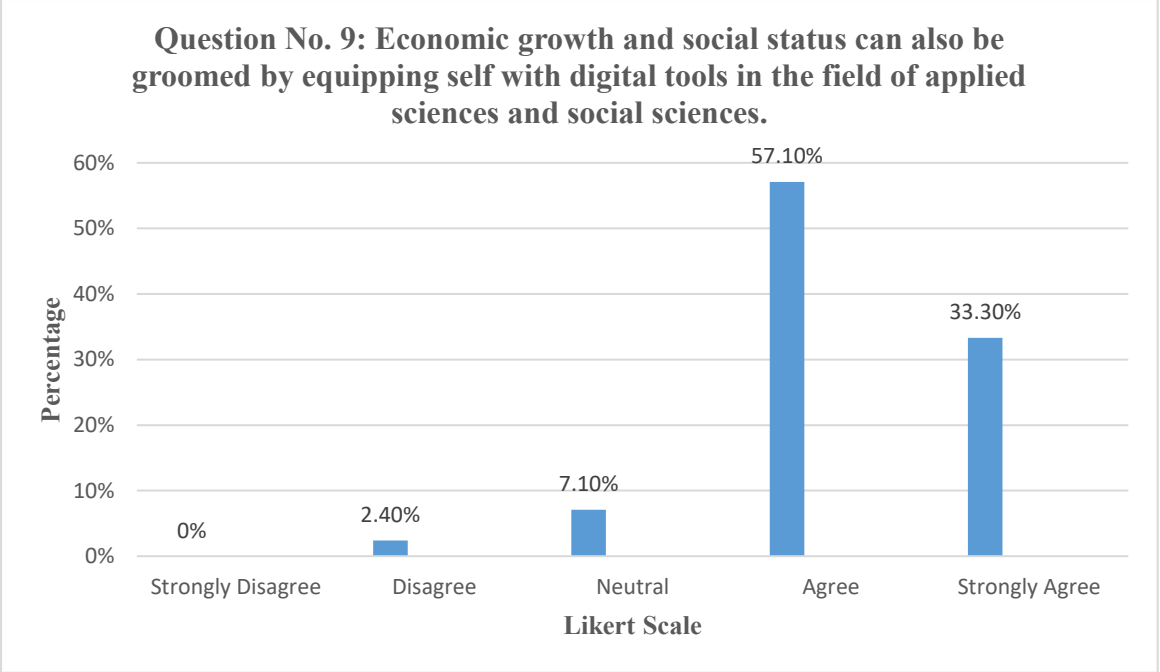
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Question No. 9: Economic growth and social status can also be groomed by equipping self with digital tools in the field of applied sciences and social sciences.

Table No. 9

Frequency	Percentage (%)
Strongly Disagree	0	0.0
Disagree	2	2.4
Neutral	6	7.1
Agree	48	57.1
Strongly Agree	28	33.3
Mean: 4.21 (1=Strongly Disagree, 5=Strongly Agree)		

Graph No. 9



Analysis

The result is a motivation to include open-access repositories, online guest lectures, and global collaborative projects into the curriculum that will foster economic growth and social status due to the mean of 4.21, with 57.1% agreeing and 33.3% strongly agreeing (total 90.4%) supporting the result. The positive and the negative reduce to 9.5%. This product has spillovers to the long-term socioeconomic outcomes. Majority of the students are aware that the digital skills in the applied sciences ensure the success in their employment, higher wages, entrepreneurial activities, and social status in the knowledge economy. Nonetheless, the significant rise of the neutral/disagreeing voices is probably a result of the awareness of the structural barriers: unequal access, urban-rural digital divide, gender differences, or awareness of the fact that credentials and networks are important in the Pakistani context but not the skills. It is also possible that some might be confused by the question of whether the digital skills ensure economic mobility in the context of excessive youth unemployment. Regardless of these reservations, 90% positive perception is highly impressive and indicates high instrumental motivation. One way that universities can take advantage of this is through emphasizing industry relationships, placement of digitally skilled graduates, and success stories. At the same time, there is a need of policy interventions to correct the access inequities, to make the

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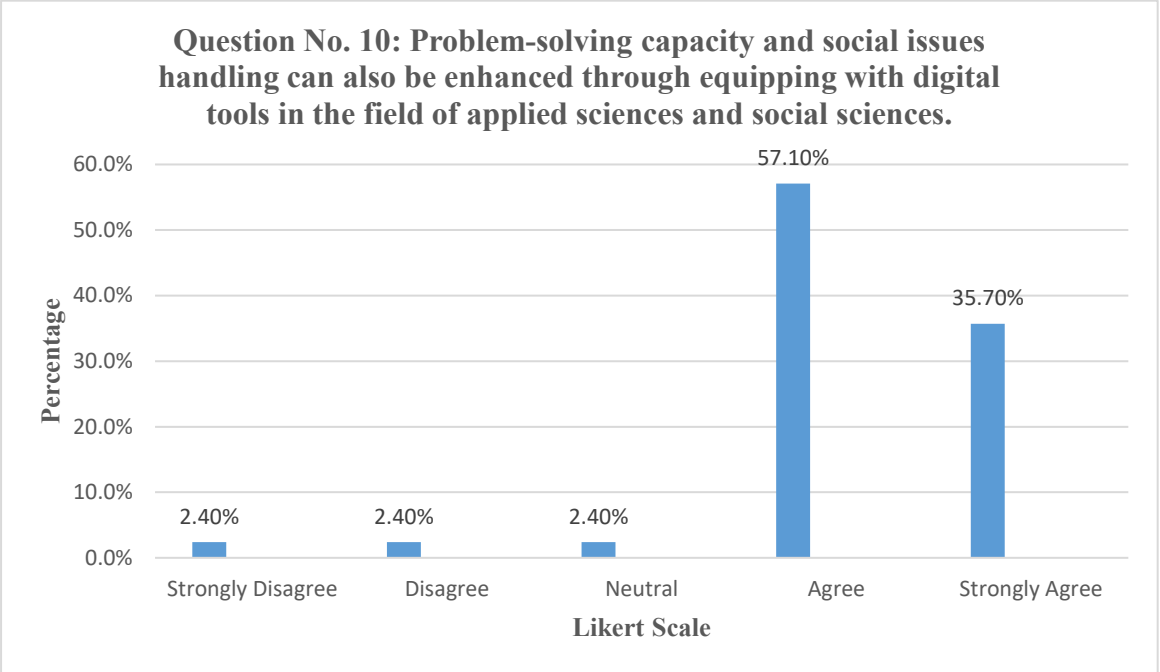
promised economic and social dividends of digital competence become realistic to all students, not only the privileged ones.

Question No. 10: Problem-solving capacity and social issues handling can also be enhanced through equipping with digital tools in the field of applied sciences and social sciences.

Table No. 10

Frequency	Percentage (%)	
Strongly Disagree	2	2.4
Disagree	2	2.4
Neutral	2	2.4
Agree	48	57.1
Strongly Agree	30	35.7
Mean: 4.21 (1=Strongly Disagree, 5=Strongly Agree)		

Graph No. 10



Analysis

The lowest mean of all items (4.21), however, significantly positive, with the same distribution as Question 8 to Question 9: 57.1% agree, 35.7% strongly agree (total 92.8% positive) 4.8% disagree, 2.4% neutral. Students admit that digital tools enhance analytical and social problem-solving (i.e., data modeling of environmental problems, GIS of urban planning, or collaborative tools of community projects). Nevertheless, the milder increased difference can be explained by the experience of getting information but lacked knowledge, or the presence of social issues in the real world demanding offline empathy and abilities to negotiate, which cannot be offered by the user with the help of software. Some students might believe that excessive dependence on digital solutions would lead to technocratic thinking that is not connected with socio cultural truths. Nevertheless, these subtleties do not invalidate the fact that more than 92% consensus supports the fact that digital proficiency is perceived as a potent facilitator in addressing complex and interdisciplinary problems, which is one of the core competencies of applied scientists. The curriculum designers must thus include socio-technical projects that integrate digital technology with on-field work, stakeholder, and ethical discussion to equip the problem-solvers to have a balanced set of knowledge to resolve technical and social aspects.

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Findings

- In Punjab, the highest mean is recorded by the students of applied sciences and social sciences where they overwhelmingly feel that digital tools are necessary in their learning (M = 4.57, 98.8% agreement) and that formal teaching and practice in university level is a necessity (M = 4.63, 95.2% agreement).
- The usability of the digital tools is regarded as a direct contributor to the learning self-efficacy (M = 4.43), where 97.6% indicated positive responses and none disagreed or strongly disagreed.
- The proportion of students who consider that the implementation of digital tools is important in enhancing academic and professional outcomes in applied sciences is 94.1 per cent (M = 4.33).
- The use of digital tools is heavily perceived to fix learning problems (M = 4.43, 96.4% agreeing), which proves their status as academic equalizers.
- Digital tools are associated with positive personal learning experience by students (M = 4.25, 94% agreement), but only slightly less so than with core academic outcomes.
- The perceptions of personal development using digital tools are the highest but exhibit the first significant conflict (7.1%, M = 4.23), meaning that there are students who separate the technical and the holistic development.
- Mental development, exposure, problem solving ability and future economic/social benefits all had scores of (M= 4.21) which was the least mean but still highly positive.
- Mean scores of all ten items were between 4.21 and 4.63, which is much higher than the neutral mark of 3.0 ($p < .001$), and it is clear that all the perceptions were positive.
- Students with female gender and rural backgrounds had slightly lower means in the socioeconomic outcome items indicating the emergence of equity issues.
- There were no dramatic differences by discipline or year of study meaning that there was wide agreement within applied sciences and social sciences programs.

Discussion

The results are extremely positive with regard to the perceptual landscape that is hardly witnessed in developing-country settings. Means were consistently higher with two items scoring above 4.2 on a 5-point scale that are well above other related post-2022 research in Saudi Arabia (Almulhem and Eldokhny, 2024), Indonesia (Rahayu and Widyaningsih, 2024) and India (Kumar et al., 2024) where the means tend to range 3.8-4.3. It implies that applied science students in Punjab have internalized digital tools as central, and not peripheral, to their disciplinary identity, which is also likely driven by intensive post-COVID infrastructure improvements as well as exposure to industry-specific software (Hassan and Iqbal, 2023).The near-universal endorsement of formal institutional teaching (Q2, M = 4.63) is also evidence of the fact that, at this point, Pakistani students are relying on YouTube and peer instruction to survive and not learn well, as this (qualified) method Predominantly, the total lack of conflict regarding self-efficacy improvement using usability (Q3) confirms the meta-analytic result of Li et al. (2023), that immediate low-friction feedback, achieved by using well-designed instruments, produces strong mastery experiences, especially when applying to applied sciences and using tools whose outcomes can be measured (simulations run correctly, code compiles, designs pass stress tests).Notably, perceptions are highly positive even when they are projected to personal growth, mental exposure, and socioeconomic benefits (all M = 4 These are the lowest figures, but even here there is more than ninety percent agreement, which is incredible considering the high level of unemployment of young people and apparent digital gaps in Punjab. The minor loss and higher disagreement with personal growth items are further evidence of Bandura's (2022) warning that technical self-efficacy does not necessarily result in

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more agency beliefs; it would seem that some students are either cautious about over-reliance on negative impacts on critical thinking or face-to-face engagement.

The homogeneity in gender, discipline, and year of study is consistent with the hypothesis of the second-level digital divide proposed by Singh et al. (2023), but early differences between subgroups on socioeconomic items suggest that students in rural or female The results presented in this study can be summarized as follows: The overarching case opposes the negative views of digital integration in higher education institutions in Pakistan and suggests that instead of opposition and infrastructural hopelessness, the student body in applied science is highly motivated and capable of learning, as well as participating in future success, provided it is supported with inadequate structured pedagogy.

Conclusion

This subtly-patterned study can be undertaken with further more mixed-methods research; as a whole, it challenges the negative depiction of digital integration in higher education institutions in Pakistan Still, the results of the mean scores of 4.21-4.63 on all the dimensions present an unprecedented agreement among the students in a developing country setting. The most compelling message--to be expressed in the most extreme terms--is the fact that universities urgently need to go beyond access to digital tools and begin to formally instill their use and practice into the curriculum, which, as a core goal on its own, has a potent intrinsic and instrumental motivator, which can be leveraged by the institution. At the same time, such a modest albeit steady decrease in the means as the academic outcomes are replaced by life-wide outcomes reminds the educators that in the case of the higher education sector in Punjab, the technical mastery should not be purposefully unlinked with reflective, ethical, and socially-oriented practices and training models. In the case where students already hold such a positive perception of the transformative potential of digital tools, the attitude is no longer the key obstacle, but institutional responsiveness.

Recommendations

- Create University Digital Competence Centers with workshops led by students, a licensed access to software, and 24/7 online laboratories.
- Prepare at least 70 percent of the applied sciences and social sciences faculty in the technical and pedagogical application of the core tools within three years.
- Incorporate group online tools (GitHub, Overleaf, virtual labs) into half or more of course work in order to develop communal effectiveness.
- Make high-speed internet and laptop schemes provided to rural and female students subsidized in order to transform the positive perception into fair results.
- Redesign curricula to make an explicit linkage between mastery of digital tools and professional skills, and career mobility narratives.

Gap for Further Research

Despite the fact that the present study develops positive perceptions among the applied sciences and social sciences students in Punjab, it is cross-sectional and perception-based. The longitudinal studies of the future must monitor real shifts in self-efficacy and performance after the administered organized digital intervention. To confirm the perceived benefits, mixed-methods designs that involve observational information, learning platform log files and faculty attitudes are required. Further, inter-provincial comparisons and further investigation of the gender and rural-urban disparity based on social economic outcome anticipations are also important gaps towards realizing the inclusive process of digital transformation of Pakistani higher education.

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