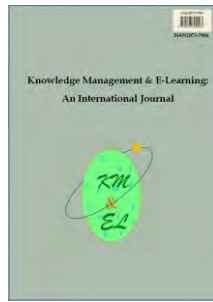# Higher education in 21st century: An analysis of ICT integration for teaching and learning in Pakistan

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# Higher education in 21st century: An analysis of ICT integration for teaching and learning in Pakistan

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**Abstract:** Information Communication Technology (ICT) is ubiquitous in the 21st century, hence both educators and learners need to integrate relevant ICT resources in their teaching and learning practices, to meet stakeholder's expectations and keep abreast with the race of technological advancement. The current research focuses on the analysis of ICT integration elements i-e availability, accessibility, usability and usefulness for teaching and learning in higher education institutions (HEIs) in the Hazara region of Khyber Pakhtunkhwa, Pakistan, characterized as an underdeveloped and mountainous region with limited access to ICT tools in the education system. A mixed method approach was used in this study, with the latest version of SPSS software (version 27) to analyze the data. The findings of the study indicate that there is no significant difference between the respondents in ICT integration for learning as Mann-Whitney U = 6079 and $p < 0.001$ in higher education institutions (HEIs). However, a significant difference was observed between the respondents for teaching as Mann-Whitney U = 9463 and $p > 0.374$. Subsequent findings revealed more significant $p$-values and higher means for learning than teaching. This indicates that the use of ICT tools has a positive and significant impact on learning.

**Keywords:** ICT integration; HEIs in 21st century; Teaching and learning; Educational technology

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## 1. Introduction

Information and communication technology (ICT) in the recent past has rapidly transformed all facets of life. In the current milieu, the term "*ICT*" is a significant concern in various domains including education (Asad et al., 2020). Today, ICT integration has undergone significant innovations, resulting in transformative effects on human life and profound impacts on societies. It has completely reshaped people's working patterns, thinking and way of life (Ghavifekr et al., 2012). In terms of development, technology has been instrumental in bridging the global gap, facilitating people to explore the world and establish connections that were nearly impossible in the past. This revolution has transformed the way information is accessed, preserved and retrieved across all areas by transitioning to a digital system (Al Rawashdeh et al., 2021). Besides, learning and sharing knowledge have become increasingly dependent on the utilization of digital devices and the internet (Ghavifekr et al., 2012).

### 1.1. History of ICT integration in education

The evolution and integration of ICT tools for education began in the 20th century, with the introduction of educational films and mechanical teaching machines. In the 1960s, the University of Illinois pioneered a linked computer terminals system, enabling students to access course information and recorded lectures. Notably, psychology professors experimented with using computers to teach math in California in the 1960s (Morrison et al., 2010). Subsequently, from1970s to the 1980s, computer-based learning initiatives emerged globally, supported by institutions like the New Jersey Institute of Technology and the University of Guelph. The mid-1980s marked the onset of online and distance learning with computer-based training.

The boom in ICT usage began in 1990 with the World Wide Web, leading to the creation of course websites and virtual systems. Online high schools, videoconferencing,

and the first online community were the nests to follow, that have transformed education. The integration of web communication technology into Blackboard by the Britain Open University and the University of British Columbia marked a revolutionary shift towards internet usage for teaching, learning, and online discussions (Woolley, 2016). This era also witnessed the integration of multimedia and webcams for live lectures and recording which has further enhanced educational communication.

According to Toffler (1991), "*the illiterate of the 21st century will not be the one who cannot read and write, but one who cannot learn, unlearn, and relearn*" (Adesote & Fatoki, 2013). Higher education in the 21st century has greatly been transformed by technology and according to Bariu and Chun (2022), the globe is currently in the age of ICT; thus, information is no longer limited by space, time or medium. ICT can be defined as "*the set of accumulated and available knowledge, experiences and skills, as well as the physical, organizational and administrative tools and means that a person uses to obtain verbal and visual information*" (Saeed et al., 2021). Currently, both developed and developing countries use various applications in higher education to facilitate their work like e-learning tools, learning management systems (LMS), ICT-enabled classrooms etc. (Ogbodoakum et al., 2022).

ICT integration for teaching and learning got more importance, especially after the Covid-19 pandemic. ICT was integrated using different tools and methods. For instance, interactive boards allow teachers to display multimedia content, videos, images and presentations, enabling more engaging and interactive lessons (Jibia & Ahmad, 2021). LMS platforms like Google Classroom, Zoom, Microsoft Teams and Moodle facilitate online learning by providing a central hub for assignments, course materials, discussion and assessment. Educational apps and software are used for interactive learning, simulation and practice exercises (Wordu & Anim, 2021). Similarly, digital collaboration tools such as Google Docs and Microsoft Office 365 facilitate students for group projects and peer feedback. Likewise, mobile devices such as smartphones and tablets, particularly social media platforms like Twitter, Facebook, WhatsApp, and YouTube used for discussion, sharing resources, accessing educational apps and collaborating with peers and teachers.

ICT integration in education hinges on several elements that collectively enhance teaching and learning experiences in HEIs. Availability refers to the presence of ICT resources and tools within educational settings. Institutions need to ensure that students and teachers have access to the necessary hardware, software, and digital content. A lack of availability can hinder the adoption and effectiveness of ICT-based teaching and learning (Ahmad & Sheikh, 2022). Accessibility stresses the inclusivity of ICT tools. It is vital that these tools are accessible to all students, regardless of their physical or cognitive abilities. Usability relates to the ease of use of ICT tools. User-friendly interfaces, intuitive design and clear navigation are crucial for students and teachers to engage with technology effectively. When ICT tools are easy to use, educators can focus more on content delivery rather than troubleshooting technical issues. Lastly, usefulness determines the impact of ICT integration on learning outcomes. Technology facilitates and enhances teaching methods, making learning more engaging, interactive, and personalized (Hoque & Alam, 2021).

In the 21st century, the global demand for higher education has experienced a rapid acceleration due to developments in technology (Shaikh & Khoja, 2011). Higher education serves as a platform for spreading knowledge and promotes the cultivation and development of student's cognitive abilities. Extensive literature supports the notion that higher education plays a crucial role in converting information into socially beneficial

knowledge and skills, leading to better living standards and the production of skilled human capital (Egorov et al., 2018; Marozau et al., 2021; Shaikh & Khoja, 2011; Wang et al., 2018). The integration of digital technology as an educational tool has a profound impact on teaching and learning. Various ICT resources have been extensively integrated, particularly in HEIs worldwide, to facilitate teaching and learning (Jibia & Ahmad, 2021). These ICT resources include virtual classes, web portals, e-books and e-mails, employed in HEIs for teaching and learning purposes (Wordu & Anim, 2021).

The transition from conventional methods of teaching, research and innovation to the new digital system requires comprehensive knowledge and effective utilization of ICT resources in HEIs (Shrivastava & Shrivastava, 2022). The increasing demand from markets and societies forces HEIs to restructure the present system and establish a digital collaborative environment among administration, faculty and students (Al Rawashdeh et al., 2021). Developed countries have been actively working towards the transformation of their HES from traditional to digital systems (Cabaleiro-Cerviño & Vera, 2020). Moreover, ICT has also contributed to the improvement of education quality by empowering faculty through computer-assisted learning, and smart classrooms have emerged as a new paradigm in education.

Since its inception, Pakistan has been striving to bring reforms to the educational sector, but such efforts have not yet been fully matured. The National Education Policy of Pakistan 1998-2008 is a concerted attempt to incorporate ICT into the teaching and learning process. Unfortunately, this initiative could not be materialized due to the paucity of funds and commitment to the cause (Ministry of Federal Education and Professional Training, Government of Pakistan, 1998). Likewise, the National Education Policy of Pakistan from 2017-2025 also placed significant emphasis on ICT integration. This policy aims to reshape education management services, teaching and learning by utilizing ICT for individual fulfilment and sustainable development of the knowledge economy (Ministry of Federal Education and Professional Training, Government of Pakistan, 2017). According to Khan and Shah (2004), ICT is a lifeline for the educational development of 21st-century skills in Pakistan.

In this regard, Pakistan's Higher Education Commission (HEC) plays a significant role in facilitating the development of HES in the country. HEC actively promotes ICT-based applications in HEIs for teaching & learning and this approach was particularly encouraged during the Covid-19 pandemic in Pakistan. The adaptation of ICT for higher education is crucial to meet the requirements of digital transformation and sustainable development goals. Most HEIs in Pakistan lack ICT tools for teaching and learning, particularly in underdeveloped regions (Ahmad & Sheikh 2022).

According to the Education Development Index (EDI) of 2021, Pakistan ranked 113th out of 120 countries, indicating a relatively low literacy rate of 57%. The situation is more alarming in rural areas, where the literacy rate is even lower than 50% (UNESCO, 2021). Hazara is one of the underdeveloped regions of the Khyber Pakhtunkhwa (KP) province and is a gateway to the northern regions of Pakistan and faces numerous challenges in the education sector. HEIs in this region are neglected due to the lack of focus from the government and other institutions on infrastructure development for the integration of ICT equipment in academics. This situation has put this region behind the ICT race (Wasif et al., 2011). In the process of globalization, the role of ICT cannot be denied; however, HEIs in Pakistan, particularly in this region, are deficient in ICT infrastructure and tool availability. Internet connectivity and other tools for accessing

online materials and the active use of ICT for teaching and learning are serious issues in the region that have lagged behind the region in development (Humbhi & Tareen, 2021). This permits ICT integration for teaching and learning in this region.

## 2.    Literature review

### 2.1. ICT integration for teaching and learning

ICT integration in education, as highlighted by Umar and Abu Hassan (2015), creates a dynamic and participatory learning environment, pestering the development of digital literacy and other 21st-century skills. ICT integration in teaching and learning, has significantly impacted higher education, steering it away from traditional teaching methods to more interactive methods (Shrivastava & Shrivastava, 2022). Such integration offers students more flexible and personalized learning with access to diverse resources, facilitating self-paced learning. It also enhances communication between teachers and students, making it easier for them to collaborate and share information (Humbhi & Tareen, 2021). Furthermore, ICT integration provides teachers with new tools and techniques to make their teaching more effective and efficient, such as interactive whiteboards, multimedia presentations and online assessments. Generally, the integration of ICT in higher education has revolutionized the teaching and learning process, making it more engaging, interactive, and accessible (Al Rawashdeh et al., 2021). The subsequent section provides a detailed exploration of ICT integration elements encompassing Availability, Accessibility, Usability and Usefulness in the literature.

### 2.2. Availability

The availability of modern ICT infrastructure is a crucial factor in enhancing the quality of education and facilitating learning in the 21st century. A study conducted by Ahmad and Sheikh (2022) revealed that institutions with better ICT infrastructure were more successful in implementing ICT in the classroom. In another study, Khan et al. (2019) found that the accessibility of ICT resources, including computers, internet connectivity, and software applications influences the overall quality of teaching and learning in HEIs. A review by Kumar and Kumar (2003), highlighted the importance of both ICT availability and teacher training. The authors noted that teachers who have received training in utilizing available ICT resources exhibit greater confidence in integrating technology into their classroom practices.

Moreover, the presence of ICT tools in rural areas has a positive impact on the quality of education. A study conducted by Hoque and Alam (2021) revealed that the availability of ICT resources in rural areas significantly contributes to the promotion of digital literacy and ICT-based teaching and learning. The study found that rural schools with better ICT infrastructure and resources were able to provide quality education to students.

However, insufficient availability and integration of ICT tools, particularly the lack of computers in classrooms, impede effective teaching and learning (Chohan & Hu, 2022). A similar result found by Ahmed et al. (2020), proved that inadequate ICT tools in the department pose a challenge for teachers to be adaptive to ICT in teaching.

## 2.3. Accessibility

ICT accessibility means that all students, regardless of their abilities, have equal access to technology and digital resources for knowledge acquisition (Ndibalema, 2021). In the studies of Chang et al. (2021), Conole et al. (2008) and Jaiswal (2020), students' experiences with using ICT were examined and the results of their studies showed that students having facilities to access modern technologies using it for learning purposes. It was found that ICT enhances the access to essential data and information on different concepts which supports students' learning.

ICT in the field of education has eased students' access the learning materials such as access to e-books, past papers, research information and content-related materials (Sharma, 2011). Similarly, ICT provides great flexibility in education to ensure that learners are able to access knowledge regardless of space and time (Akele, 2014). Since technology is changing constantly, individuals should have to keep pace with the recent developments in order to access information through ICT (Plomp et al., 2007). ICTs also make it easy through the development of electronic resources such as digital libraries where the students, teachers and experts are able to access research-related information and study materials (Ahmad et al., 2023).

## 2.4. Usability

The use of ICT brings about a powerful learning environment and transforms the learning and teaching process into an active, self-directed and constructive approach (Volman & van Eck, 2001). In research in Bangalore, Padashetty and Kishore (2013), found that perceived ease of use is the highest-ranked factor driving the adoption of technology. Similarly, Wilson et al. (2014), also studied the usage of ICT by the students in Winneba University, results of the study showed a high level of competency among the respondents in using ICT for their learning and other academic activities.

The use of ICT resources is directly linked to ICT knowledge, implying that a higher level of ICT proficiency enhances the effectiveness of technology in teaching and learning. Tezci (2011), posits that a high level of ICT knowledge among teachers leads to increased utilization of ICT in their teaching practices. Similar results were also found in the study of Oye et al. (2014), who expressed that the usage of ICT has brought improvement in human knowledge. The authors further argued that the adoption of ICT in educational institutions has built an information bridge between students and teachers.

Furthermore, according to the studies of Asad et al. (2020), the integration of ICT in university education should be the responsibility of the policymakers and the teachers to implement, aiming to enhance the effectiveness and efficiency of the learning experience of the students. Moreover, Jahanian (2015) conducted a survey to identify the relationship between ICT usage and students' learning levels, aiming to inquire about the impact of ICT on students. The results showed a positive correlation between ICT and the academic achievements of elementary school students.

In many studies, researchers (Chang et al., 2021; Chen & Dahalman, 2005; Teo, 2009) argue that ICT usage has made world economies more competitive and interdependent, thereby making the knowledge creation and utilization central to long-term development strategies. They also suggest that ICT improves the standard of living,

modernizes societies, promotes equity in education and enhances the quality of teaching and learning.

Lack of infrastructure and insufficient ICT tools in HEIs is one of the major demotivating factors for the teachers to fully implement ICT policies. Different researchers (Isman & Isbulan, 2010; Ojo et al., 2007) support this statement and claim that the lack of ICT facilities and infrastructure in the workplace is a significant barrier to ICT use. They conclude that a robust ICT infrastructure in higher education is a critical enabler and prerequisite for knowledge-driven development. Similarly, the study of Alyahya et al. (2022) examined the availability, usability, and accessibility of ICT resources in Nigerian universities. It was found that the usability of ICT resources was limited due to poor infrastructure, inadequate technical support and training of the users.

## 2.5. Usefulness

Perceived usefulness refers to the extent of the prospective adopter's recognition of the relative advantage of adopting the innovation. The perceived utility plays a crucial role in the adoption of new technology; therefore, the more significant the relative advantage of technology is perceived, the faster its adoption rate will be (Rogers, 2003). Increasing numbers of studies have started to evaluate the usefulness of various types of advanced technologies and equipment, including smart classrooms and smart mobile devices such as tablets introduced in HEIs for instruction (Sevindik, 2010).

In developing countries, however, the ICT infrastructure of universities is poorly developed with only basic ICT technologies such as the Internet and computers (Wilson et al., 2014). Teachers' perceived usefulness of technology seems to have a direct effect on their intention to use it (Oye et al., 2014). According to Asad et al. (2020), teacher competence refers primarily to one's ability to integrate ICT into pedagogical practice. Lack of knowledge or competence is regarded as a significant factor that discourages teachers from integrating ICT into their teaching.

## 3. Method

### 3.1. Theoretical framework

This research focuses on examining the integration of ICT for teaching and learning in HEIs. The existing literature provides various theories/frameworks/models that are relevant to this study. However, the Technological, Pedagogical and Content Knowledge (TPACK) framework offered by Mishra and Koehler in 2006 was adopted for this study. This framework highlights that the integration of technological knowledge (TK) with content and pedagogical knowledge makes teaching and learning more effective. The adaption of the TPACK framework solves the content understanding related issues of teaching and helps in transforming conventional teaching methodology to contemporary teaching methods. Thus, the TPACK framework was considered more appropriate. Fig. 1 illustrates the three knowledge domains involved in effectively integrating ICT into teaching and learning: Technological Knowledge (TK) Content Knowledge (CK) and Pedagogical (PK).
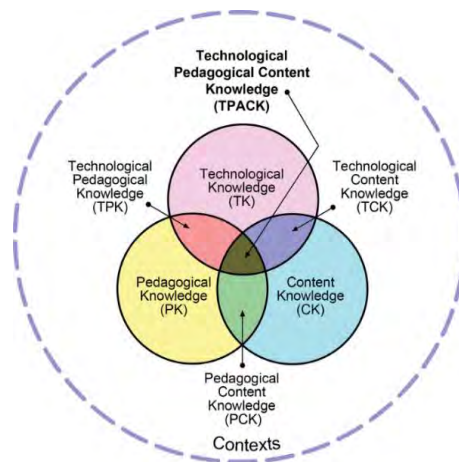
**Fig. 1.** TPACK framework, Adapted from Mishra and Koehler (2006)

CK pertains to the understanding of the actual subject matter that is being taught or learned. It encompasses the knowledge and expertise related to the subject area. PK knowledge refers to the knowledge about instructional methods and learning strategies. It includes skills such as classroom management, lesson planning and assessment techniques that actually facilitate effective teaching and learning. Technological Knowledge (TK) focuses on the understanding and utilization of different technologies in the context of education. It comprises knowledge about different technologies such as the internet, smart boards, graphics, audio-video tools, digital libraries etc. It also includes the ability to operate and leverage these technologies for effective teaching and learning.

In 2006 Mishra and Kohler claimed that the development of TPACK is indispensable for effective teaching and learning in educational institutions. According to this framework, teachers who possess a strong foundation in subject knowledge (CK) and effective instructional methods (PK) are able to integrate technology into the classroom more successfully, leading to improved results. By combining Technological Knowledge (TK) with CK and PK, faculty can harness the potential of ICT tools to attain optimal results in various learning setups.

Traditional teaching methods in the 21st century need to be transformed into contemporary methods as employed in developed countries in order to keep up with the rapid pace of education. Today, technology has become an integral part of the learning experience, benefiting both teachers and students in obtaining the latest knowledge on the subject matter. Fig. 1 highlights the importance of TPACK, which represents the development of technological knowledge for faculty that enables them to create dynamic, attractive and informative content. This framework emphasizes the integration of subject-related activities with the utilization of emerging ICT tools to facilitate effective teaching and learning. Through the effective use of technology, educators can enrich the learning experience by making it more meaningful and impactful for the students.

To analyze the impact of ICT integration on teaching and learning, authors developed the proposed model based on the theoretical framework, highlighting the impact of ICT on teaching and learning in HEIs, as illustrated in Fig. 2.
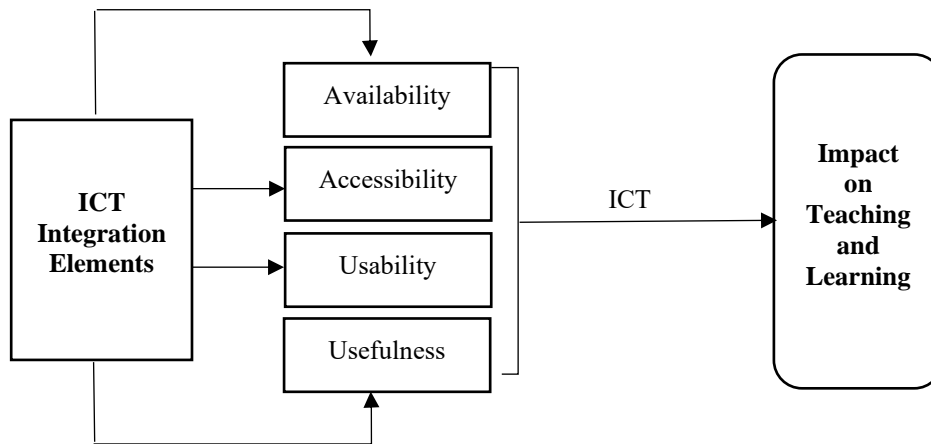
**Fig. 2.** Proposed model of the study

## 3.2. Material and methods

A mixed-method approach was used in this empirical study to get answers to the research questions. The mixed method is the most popular and significant in social science research (Morgan, 2007). It provides a platform to use both quantitative and qualitative methods of data collection in one or a set of related studies (Antwi & Hamza, 2015). Moreover, the mixed method technique provides a complete understanding of the research problem rather than using a single type of method (Creswell, 2014). Employing both qualitative and quantitative methodologies holds importance as they offer complementary strengths and facilitate triangulation, ensuring a thorough understanding of ICT integration.

In this study, a qualitative approach was employed to collect data on both student's and teachers' perceptions regarding the implementation of ICT for teaching and learning activities. The inclusion of a qualitative approach alongside a quantitative one is driven by the recognition that students and teachers derive various benefits from the integration of ICT in their academic pursuits (Creswell, 2014). The result of the study of Oye et al. (2012), shows the true picture of acceptance and use of ICT in Nigerian public universities through the help of mixed-method research. This study focuses on ICT integration for teaching and learning in HEIs and is best elucidated through a mixed-method approach. Keeping in view the epistemology and ontology of the research matter, the mixed method was adopted for a better understanding of the research problem and its objectives.

The study scope has been restricted to the Hazara region, located in the North-East of KP province, Pakistan. This region is characterized as a mountainous region, having rough terrain and climate, unstable slopes and landslides became grave reasons for poor internet connection and making it difficult to install and maintain infrastructure, such as cellular towers, long distances and fiber-optic cables (Shafique & Khan, 2015). This study specifically focuses on the Universities of the Hazara region that offer diverse disciplines and a wide range of programs. These Universities include Abbottabad University of Science & Technology (AUST), COMSATS University Islamabad, Abbottabad Campus (CIIATD), Hazara University Mansehra (HU) and University of Haripur (UoH). This

diverse selection provides a comprehensive understanding of ICT integration for teaching and learning and valuable insight into the best practices related to ICT integration.

The participants were selected through purposive sampling to ensure convenient access to the designated universities and facilitate data collection for the study. The study specifically targeted permanent faculty members, including Lecturers, Assistant Professors, Associate Professors, and Professors, employed in the selected HEIs of the Hazara region, as well as students enrolled in various study programs such as Ph.D., MS/MPhil, MA/MSc, and BS. Since teachers play a crucial role in policy implementation and curriculum design, their significance in the teaching and learning process is substantial. Similarly, actively engaged students provide valuable feedback on their experiences in the teaching and learning environment. By including both faculty and students, the study aims to provide comprehensive insights and perspectives on the integration of ICT for teaching and learning. This approach enables a holistic understanding of the perceptions, experiences, and challenges related to ICT implementation across various levels of higher education within the target population. A total of 120 teachers and 240 students from the selected universities participated in the study. Questionnaires were randomly distributed to all participants, yielding 323 responses out of 360, including 85 faculty members and 238 students.

## 3.3. Data collection and analysis

Primary data has been gathered using a pre-defined questionnaire that encompassed all vital variables pertaining to ICT integration, including the availability, accessibility, usability, and usefulness for teaching and learning. Data were collected from both faculty and students between August 2022 and November 2022. In accordance with ethical standards, participants were thoroughly briefed on the study's objectives and the intended use of the data. Adherence to the ethical guidelines and governance policies of the university guaranteed the rigorous preservation of anonymity and confidentiality. It is imperative to note that the data collected is used solely for academic pursuits.

Secondary data, including policies concerning ICT, IT-related information, various learning approaches, regional data, and findings from other studies, has been gathered from pertinent government and institutional reports, publications, departmental sources, websites, articles, books, and existing literature. The inclusion of secondary data has enriched the depth and robustness of the analysis, significantly enhancing the impact of the analysis and subsequent discussions of the results.

The commonly used procedure for Cronbach's alpha analysis was used to assess questionnaire reliability. The reliability of the coefficient indexes showed that the faculty questionnaire demonstrated a high level of internal consistency, with a Cronbach's alpha value of 0.9. This advocates that the items within the questionnaire are strongly interrelated with each other. A Cronbach's alpha value of 0.9 exceeds the commonly accepted threshold of 0.7, indicating robust reliability and suggesting that the faculty questionnaire is suitable for measuring the intended construct reliably (Cortina, 1993). On the other hand, the student's questionnaire exhibits a slightly lower level of internal consistency with a Cronbach's alpha value of 0.7. Yet, the value still meets the minimum threshold for acceptability. A Cronbach's alpha of 0.7 suggests moderate internal consistency, indicating that the questionnaire is generally effective in measuring the intended construct.

Data have been analyzed using independent t-test, Mann-Whitney U test, correlation analysis and thematic analysis. A normality test is also performed using the SPSS program to see if the frequency of faculty and students for ICT integration in teaching and learning was not normally distributed or not, with both faculty ($p < 0.001$) and students ($p < 0.001$). Whereas the distribution of ICT tools employed in teaching and learning is normal for both faculty ($p > 0.076$) and students ($p > 0.078$). Consequently, the researcher employed the Mann-Whitney U test and independent t-test to examine the data.

Qualitative data was extracted from questionnaires for thematic analysis through meticulous scrutiny of transcriptions. Later on, codes were generated based on meaningful concepts and ideas such as "*use of a multimedia projector for lecture delivery*", categories were developed, and thematic analysis was employed through an iterative six-phase process (from familiarization of themes to final write-up). Authors used Excel (MS Office 2016) to manage initial codes systematically, leading to the development of sub-categories and themes such as "*Availability of ICT*". Codes were reviewed, similarities identified, and merged while remaining themes and unmatched codes formed new independent themes. During the process, comprehensive and effective data organization was ensured and emphasis was laid on the inclusion and elimination of irrelevant codes and categories.

## 4. Results

**Table 1**
Demographic information of the respondents

|  | Demographic | Frequency | *% age* |
|---|---|---|---|
| Respondents | Faculty | 85 | 26 |
|  | Students | 238 | 74 |
| Gender | Male | 232 | 72 |
|  | Female | 91 | 28 |
| Age | < 20 | 37 | 11 |
|  | 21-25 | 127 | 40 |
|  | 26-30 | 27 | 8 |
|  | > 30 | 132 | 41 |
| Education | B.S | 155 | 48 |
|  | MA/M.Sc | 7 | 2 |
|  | MS/MPhil | 61 | 19 |
|  | PhD | 100 | 31 |
| University | AUST | 74 | 23 |
|  | COMSATS | 105 | 32 |
|  | HAZARA | 77 | 24 |
|  | HARIPUR | 67 | 21 |

Descriptive analysis has been carried out to examine the frequencies and percentages of respondents' gender, age, education, digital gadgets owned, use of ICT tools for teaching and learning and their use in everyday life. The elaboration of the analysis is shown in Table 1, where 232 (72%) of the participants are male while 91(28%) are females. The majority of them, 132 (41%) of the total, are more than 30 years of age. Furthermore, maximum responses of 151 (48%) were received from B.S. students followed by PhD 100 (31%) and minimum responses received from M.A/M.Sc 7 (2%). These respondents have

participated in the study from different universities, where the maximum response rate is observed from COMSATS University Abbottabad Campus 105 (32%) followed by Hazara University 77 (24%) and a low response rate is received from the University of Haripur.

Fig. 3 shows information regarding the respondents who owned digital gadgets. It shows that a maximum of 54% of respondents possess smartphones, as they are one of the important gadgets used by respondents for educational information, social media, messaging and chatting. Greater use of smartphones facilitates easy and convenient access to information and other data. The data also show that 31% of respondents have their own laptops and consider them to be an important tool for teaching, learning and research. Maximum response for smartphones and laptops reveals the importance and maximum utilization of these digital gadgets for both teaching and learning in HEIs in the Hazara region. The 14% response rate for computers exhibits that due to portability, small size and multi-use of smartphones and laptops have replaced the use of desktop computers. However, only 1% of respondents own a digital pen.
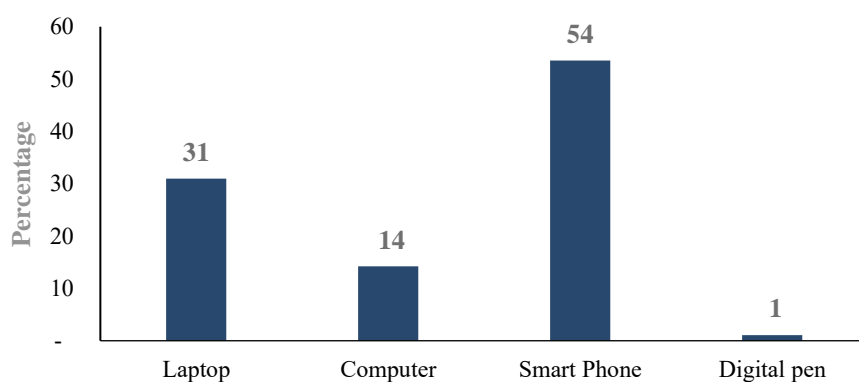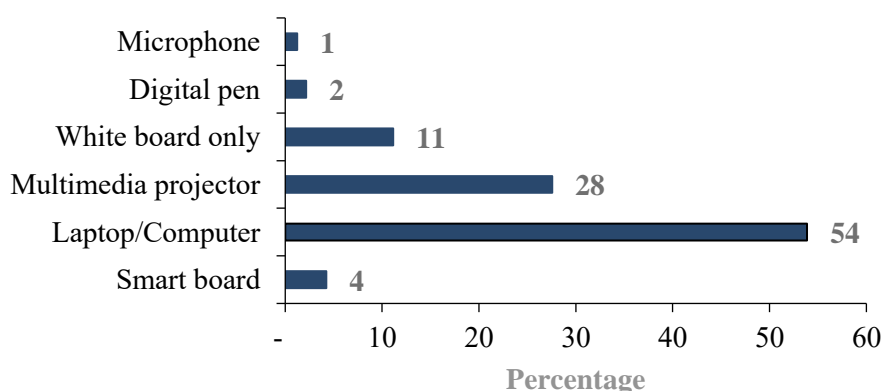


**Fig. 3.** Respondents owned digital gadgets



**Fig. 4.** Usage of ICT tools for teaching in HEIs

Fig. 4 shows the usage of ICT tools for teaching in HEIs. The result shows that a large number of faculty members are cognizant of the benefits and usefulness of ICT tools for teaching. 54% of faculty realize that the use of laptops/computers assists faculty to

enhance teaching while 28% of the faculty are using multimedia projectors for lecture delivery in order to make the lesson more interesting and engaging. Data exhibits that 11% of faculty use whiteboards in association with ICT tools for teaching and learning. However, the data also indicates the lowest use of i-e 4%, 2% and 1% of smart boards, digital pens and microphones respectively by the faculty in the classrooms.

ICT tools usage has also been examined for everyday life. Fig. 5 presents that 42% of respondents use ICT for getting educational information, while 31% of respondents use digital gadgets for social media purposes. Data shows that 13% of the respondents use ICT for messaging & chatting while 10% of respondents use it for watching movies and 4% for listening to music respectively.
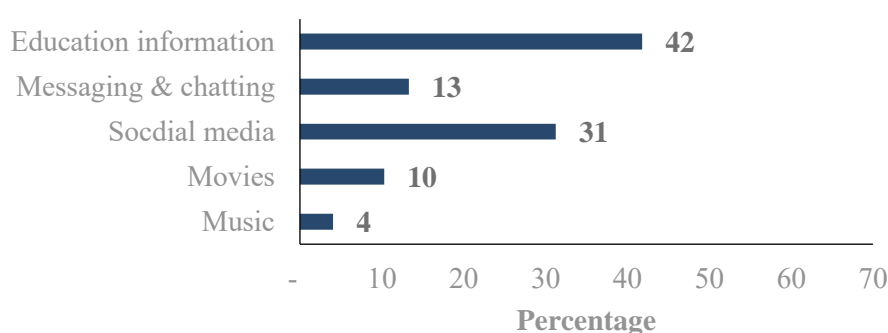


**Fig. 5.** Respondent's use of ICT in daily life

## 4.1. ICT integration in HEIs

Table 2 exhibits the respondent's view on the integration of ICT tools in HEIs for teaching and learning. Analysis of the data illustrates that most respondents agreed on the usefulness and importance of ICT resources and digital infrastructure in HEIs.

According to Table 2, respondents with a (M = 3.45, SD = 1.09) showed a moderate level of ICT integration for teaching and learning and a similar response rate (M = 3.36, SD = 1.09) were also observed when respondents were asked about the availability of ICT tools in the classroom such as (Smartboard, Multimedia projector, computer etc). It shows that classrooms are less equipped with ICT tools for teaching in HEIs of the Hazara region. However, a reasonable number of respondents (M = 3.51, SD = 1.11) indicated that digital libraries and LAN system facilities were available and respondents (M = 3.30, SD = 1.12) highlighted that a sufficient number of computer labs were equipped with sufficient number of computers for the use of students. The availability of local networks and computer labs plays an important role in the provision of centralized storage, access, connectivity and use of applications by the users etc.

Moreover, Table 2 shows that respondents have access to computer labs and digital libraries (M = 3.41, SD = 1.22) in their institution for getting new knowledge and information (M = 3.23, SD = 1.18) through accessing journals, articles and e-books (M = 3.22, SD = 1.18). Moreover, free and easy access to the Internet at different places in the institution (M = 3.41, SD = 1.22) has helped respondents acquire new information, data and other materials for teaching and learning (M = 3.24, SD = 1.26). The use of ICT tools is inquired and the result shows that faculty are not very skilful in the use of ICT for

classroom teaching (M = 3.28, SD = 1.10), ICT makes the teaching and learning process more effective through video clips, and audio sounds and graphical presentations (M = 3.75, SD = 1.09). Respondents further affirmed that they use ICT resources for attendance, assignments, results, lecture notes etc. through the portal/online system of the institution (M = 3.53, SD = 1.39). Furthermore, respondents recognize the significance of ICT and prefer to use it for teaching and learning in the future (M = 3.51, SD = 1.13).

**Table 2**
Participant's responses for ICT integration in HEIs

| Statement | Mean | SD |
|---|---|---|
| **Availability** | | |
| Institutions have integrated ICT tools for teaching and learning. | 3.45 | 1.09 |
| The institution has a sufficient number of computer labs & computers. | 3.30 | 1.12 |
| The institution has the availability of a digital library and LAN system. | 3.51 | 1.11 |
| The institution's classrooms are equipped with the latest ICT tools (Smartboard, Multimedia projector, computer etc). | 3.36 | 1.09 |
| The institution has clear guidelines/policies on ICT integration. | 3.85 | 0.92 |
| Overall Availability Mean | 3.49 | 1.07 |
| **Accessibility** | | |
| The institution provides easy access to computer labs and a digital library. | 3.41 | 1.22 |
| ICT provides easy access to journals, articles, e-books and downloads. | 3.22 | 1.18 |
| Your institution does not provide free and easy access to internet connectivity. | 3.24 | 1.26 |
| ICT provides access to new information, | 4.27 | 0.83 |
| ICT helps in accessing and obtaining distance learning | 4.07 | 0.92 |
| Overall Accessibility Mean | 3.64 | 1.08 |
| **Usability** | | |
| Your institution's faculty is skilful in the use of ICT tools. | 3.28 | 1.10 |
| I use computer & internet to learn through video clips, audio sounds & visual presentations | 3.75 | 1.09 |
| Faculty /Students use a portal /online system for attendance, assignments, results, lectures notes, etc. | 3.53 | 1.39 |
| I prefer to use ICT for teaching and learning in the future | 3.51 | 1.13 |
| ICT use is not important for teaching and learning | 3.00 | 1.27 |
| Overall Usability Mean | 3.41 | 1.20 |
| **Usefulness** | | |
| ICT resources are useful for research collaboration with other institutions. | 4.01 | 1.01 |
| ICT-based teaching-learning is more useful than traditional methods of teaching | 4.17 | 0.90 |
| ICT is useful and essential for Research & Development | 4.14 | 0.97 |
| ICT integration is useful for developing the competitiveness and the reputation of the institution | 3.59 | 1.12 |
| ICT knowledge and skills create employment opportunities | 3.98 | 1.27 |
| Overall Usefulness Mean | 3.98 | 1.05 |

*Note.* Likert Scale: 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree

A significant number of respondents were aware of the usefulness of ICT tools for teaching and learning (M = 4.17, SD = 0.9) and considered that ICT-based teaching and learning is more useful than traditional methods of teaching. Moreover, some "agree" and some "strongly agree" on the significance of computers and internet in today's time for research and development (M = 4.14, SD = 0.97) and also feel it is important for research collaboration with other institutions at national and international level (M = 4.01, SD = 1.01).

The statistical findings in Table 3 show that faculty ($N = 85$) have a slightly better mean rank = 169.66 and the sum of ranks = 14421.1 for ICT integration in teaching compared to the students ($N = 238$) response, whose mean rank = 159.26 and the sum of ranks = 37903.88. Similarly, a high mean rank = 209.27 and sum of ranks = 17787.95 for faculty was also found in the process of ICT integration for learning compared to their students' counterparts whose mean rank = 145.12 and sum of ranks = 34538.56.

**Table 3**
Faculty and students mean rank in use of ICT tools for teaching and learning

| Respondents | | *N* | Mean rank | Sum of ranks |
|---|---|---|---|---|
| Teaching | Faculty | 85 | 169.66 | 14421.1 |
| | Students | 238 | 159.26 | 37903.88 |
| Learning | Faculty | 85 | 209.27 | 17787.95 |
| | Students | 238 | 145.12 | 34538.56 |

The Mann-Whitney U test is used to compare the distribution of two variables and to determine their statistical difference. The Mann-Whitney U test result in Table 4 indicates that there is no significant difference in ICT integration for teaching as $p > 0.374$. As the p-value is greater than the significance level ($\alpha = 0.05$). Thus, it shows that teachers' focus is more on the use of traditional methods and tools than ICT for teaching in the region. However, a significant difference was observed in the process of ICT integration for learning as $p < 0.001$. It indicates that ICT has a greater impact on learning, as they use ICT tools for accessing online materials, digital libraries and collaboration with peers.

**Table 4**
Test results between respondents and ICT integration for teaching and learning

| | Mann-Whitney U | Wilcoxon W | *Z* | Asymp. Sig. (2-tailed) |
|---|---|---|---|---|
| Teaching | 9463.50 | 37904.50 | $-.888$ | .374 |
| Learning | 6079.00 | 34538.00 | $-5.473$ | .001 |

Table 5 reveals the ICT tools' effects on teaching and learning in HEIs of the Hazara region. It was found that there is no significant difference between faculty and students' opinions on the use of ICT tools for lecture delivery in the classroom as $t = 1.40$ and $p > 0.16$. However, the means in Table 5 show that faculty employed ICT more in the classroom than students (Faculty Mean = 4.10; Students Mean = 3.81).

A significant difference in frequency was found between faculty and students that ICT usage enhances computer and teaching skills (Faculty Mean = 4.30; Students Mean = 3.92) where $t = 3.56$ and $p > 0.01$. Table 5 shows that there is no significant difference between faculty and students on the use of ICT tools for getting teamwork collaboration as $t = 2.73$ and $p > 0.07$ and getting new information where $t = 1.18$ and $p > 0.23$. However, the means in Table 5 show that faculty employed ICT more than the students for teamwork collaboration (Faculty Mean = 4.38; Students Mean = 4.03) and getting new information (Faculty Mean = 4.32; Students Mean = 4.00) respectively. Similarly, no significant difference was found between faculty and students on the use of ICT for getting feedback and submission of assignments as $t = 0.08$ and $p > 0.93$.

**Table 5**
Opinion of the respondents on ICT effects on teaching and learning

| Item | Respondents | Mean | SD | $t$ | Sig. (2-tailed) |
|---|---|---|---|---|---|
| Effect of ICT on teaching | | | | | |
| ICT use during lectures to students | Faculty | 4.10 | 0.84 | 1.40 | 0.16 |
| | Students | 3.81 | 1.19 | | |
| Enhancing computer and teaching skills | Faculty | 4.30 | 0.86 | 3.56 | 0.01* |
| | Students | 3.92 | 0.92 | | |
| Teamwork collaboration and communication with people | Faculty | 4.38 | 0.80 | 2.73 | 0.07 |
| | Students | 4.03 | 0.90 | | |
| Getting new information on the subject | Faculty | 4.32 | 0.83 | 1.18 | 0.23 |
| | Students | 4.00 | 0.84 | | |
| Getting feedback from the students and submission of assignments | Faculty | 4.20 | 1.07 | 0.08 | 0.93 |
| | Students | 4.21 | 0.94 | | |
| ICT effect on learning | | | | | |
| ICT Tools provides new ways of learning | Faculty | 4.38 | 0.88 | 4.82 | 0.01* |
| | Students | 3.81 | 0.68 | | |
| ICT helps to understand lectures through pictorial and graphical presentation | Faculty | 4.29 | 0.94 | 1.49 | 0.17 |
| | Students | 3.85 | 0.75 | | |
| The use of the internet and computer has improved my learning and performance | Faculty | 4.42 | 0.76 | 2.23 | 0.02* |
| | Students | 3.84 | 0.75 | | |
| ICT helps in academic research, online searches, downloading articles etc | Faculty | 4.41 | 0.79 | 3.16 | 0.00** |
| | Students | 4.53 | 0.97 | | |
| Digital library and computer labs are helping sources of learning | Faculty | 4.43 | 0.74 | 4.90 | 0.00** |
| | Students | 3.48 | 0.99 | | |

*Note.* ** $p < 0.01$; * $p < 0.05$; $N$(Faculty) = 85; $N$(Students) = 238

A significant difference in frequency was found between faculty and students that ICT usage enhances computer and teaching skills (Faculty Mean = 4.30; Students Mean = 3.92) where $t = 3.56$ and $p > 0.01$. Table 5 shows that there is no significant difference between faculty and students on the use of ICT tools for getting teamwork collaboration as $t = 2.73$ and $p > 0.07$ and getting new information where $t = 1.18$ and $p > 0.23$. However, the means in Table 5 show that faculty employed ICT more than the students for teamwork collaboration (Faculty Mean = 4.38; Students Mean = 4.03) and getting new information (Faculty Mean = 4.32; Students Mean = 4.00) respectively. Similarly, no significant difference was found between faculty and students on the use of ICT for getting feedback and submission of assignments as $t = 0.08$ and $p > 0.93$.

On the other hand, ICT integration has also facilitated both respondents in their learning through the provision of different ways and tools. Table 5 shows a significant difference in the frequency of faculty and students in the use of ICT for learning as $t = 4.82$ and $p > 0.01$ with (Faculty Mean = 4.38, Students Mean = 3.81). Similarly, a significant difference was also found in respondent's frequency of ICT integration in their learning however, both the respondents agreed that the internet and computers have improved learning and performance $t = 2.23$ and $p > 0.02$ with (Faculty Mean = 4.42, Students Mean = 3.84). Besides, a significant difference was observed in the availability and access to digital libraries and computer labs as $t = 3.16$ and $p > 0.00$. A similar result was also found

for online searches, articles, e-books and academic research where $t = 4.90$ and $p > 0.00$ and (Faculty Mean = 4.43, Students Mean = 3.48).

## 4.2. Faculty's perception of ICT integration

In addition, ICT integration for teaching has been examined from a faculty point of view. Where, most of the faculty particularly, associate and assistant professors perceived that ICT integration elements; availability, accessibility, usability and usefulness play an important role in its implementation for teaching. It is observed that most of the faculty use multimedia projectors as a tool for lecture delivery. Smartboard is identified as one of the demanding tools and during the study majority of the faculty highlighted the lack of this gadget. A common perception from faculty under the theme "*Availability of ICT*" is received as "*ICT tools are an important source for advanced teaching methodology, but lack of adequate availability and up-to-date ICT tools and software are the main hurdle in its integration for teaching purposes.*"

Similarly, their views on the theme "*Accessibility of ICT*" for teaching is: "*Institutions provide easy access to ICT resources and that has improved their access to the latest information and supportive teaching materials that help in effective lecture delivery.*" Furthermore, a collective perception received under the theme "*Usability of ICT*" from faculty is "*ICT tools are important sources in delivering lectures but lack of proper training to the faculty on use of ICTs is the major concern that has negatively affected the ICTs implementations in the classroom environment at one hand and demotivation of the faculty on the other hand.*"

Moreover, the usefulness of the ICTs cannot be denied particularly, in the field of education. Usefulness is an important factor in the adoption of new technology, thus greater the perceived relative advantage of technology, the more rapid its rate of adoption (Rogers, 2003). A common perception is noted under the theme "*Usefulness of ICT*" during the study that "*ICT is useful for effective lecture delivery if universities authorities ensure adequate availability, provision of uninterrupted internet connectivity and strict compliance on implementation policy.*" A similar result of the perception is found in the study of Khan et al. (2019), who state that the availability of ICT resources such as computers, internet access, and software applications significantly impact the quality of teaching and learning in HEIs. Teachers' perceived usefulness of technology seems to have a direct significant effect on their intention to use it (Oye et al., 2014).

## 4.3. Student's perception of ICT integration

Integration of ICT in education provides students with a more interactive and engaged learning environment and opportunities to develop digital literacy and other 21st-century skills (Umar & Abu Hassan, 2015). The availability of modern ICT infrastructure is a crucial factor in enhancing the quality of education and facilitating student learning in the 21st century. During the survey students of different programs particularly, BS programs took a keen interest in the study. Both male and female students are of the opinion that ICTs bring improvement in their learning and academic performance. A common opinion observed among the students under the theme "*ICT Integration for Learning*" is that "*ICT tools are important sources for obtaining; the latest information on the subject, for submission of assignments, for getting timely feedback from the faculty, for communication with each other's and social engagement*". ICT in the field of education has eased students'

access the learning materials such as access to e-books, past papers, research information and content-related materials (Sharma, 2011). Similarly, ICT provides great flexibility in education to ensure that learners are able to access knowledge regardless of space and time (Akele, 2014).

## 4.4. Correlation analysis

Pearson's coefficient analysis was conducted to evaluate the relationship and interdependency between variables, Results as shown in Table 6 reveals that ICT integration (availability 0.41, accessibility 0.33, usability 0.44 and usefulness 0.43) and faculty teaching were recognized to be significant contributors toward the variance of students learning in HEIs under investigation in this study.

**Table 6**
Correlation analysis of ICT integration and teaching ($N = 85$)

| Variables | Availability | Accessibility | Usability | Usefulness | Teaching |
|---|---|---|---|---|---|
| Availability | 1 | | | | |
| Accessibility | 0.58* | 1 | | | |
| Usability | 0.34 | 0.96** | 1 | | |
| Usefulness | 0.32 | 0.52** | 0.55* | 1 | |
| Teaching | 0.41* | 0.33 | 0.44* | 0.43* | 1 |

*Note.* ** $p < 0.01$, * $p < 0.05$.

These results confirmed that every unit increase in availability, accessibility, usability and usefulness will bring 0.41. 0.33, 0.44, and 0.43 points increase in teaching respectively. Similarly, the relationship and interdependency between variables of ICT integration and learning is also analyzed. Results in Table 7 indicate that ICT integration (availability) 0.22 and ICT (accessibility) 0.26 are identified as positive but weak contributors towards students learning under investigation in the present study. It means that for every unit increase in availability and accessibility, it is expected that there will be 0.22 and 0.26 points increase in students learning respectively. However, the relationship between ICT integration (usability) and learning was identified as positive and significant at 0.61 which means that one unit change in usability will bring a 0.61-point increase in students' learning. A positive correlation is also established between ICT (usefulness) and students' learning with a value of computed correlation 0.38. As a result, we analyzed that the usefulness of ICT tools has a positive impact on learning.

**Table 7**
Correlation between ICT integration and students learning ($N = 238$)

| Variables | Availability | Accessibility | Usability | Usefulness | Teaching |
|---|---|---|---|---|---|
| Availability | 1 | | | | |
| Accessibility | 0.51** | 1 | | | |
| Usability | 0.31 | 0.27 | 1 | | |
| Usefulness | 0.39* | 0.31 | 0.35 | 1 | |
| Teaching | 0.22 | 0.26 | 0.61** | 0.38* | 1 |

*Note.* ** $p < 0.01$; * $p < 0.05$

## 4.5. Respondent's perception of relationships between ICT integration and teaching and learning

During the survey relationship between ICT integration and teaching and learning is examined, where almost all the respondents are of the opinion that ICT integration determinants are important elements for the true implementation of ICT tools in the learning environment. They highlight under the theme "*Perception of ICT Tools for Teaching and Learning*" that "*adequate availability of ICT tools with easy accessibility can improve teaching and learning in the institutions*". It is also pointed out that such a relationship can be further strengthened through the provision of proper training on these tools and involving teachers in the process of policy implementation. Such training will enable both faculty and students to make effective use of these tools, which will ultimately enhance the teaching and learning process. According to the study of Alghizzawi et al. (2019), the utilization of diverse digital devices like smartphones, laptops, personal computers, and tablets has led to heightened interaction between teachers and students through online content sharing, lecture notes, assignments, and feedback. This increased connectivity has effectively enhanced the learning experiences for both teachers and learners.

## 5. Discussion

This study revealed that ICT integration has a moderate positive correlation with teaching and learning in higher education. These findings are in line with the results of Ayub (2015). Similarly, it also supports the study results of Thannimalai and Raman (2018), that ICT integration has a positive and significant effect on teaching and learning. This proves the substantial role of ICT for students and faculty in searching, consulting and retrieving different information.

## 5.1. Impact of ICT tools on teaching and learning

Data analysis revealed that significant faculty numbers use various ICT tools for teaching and learning such as computers, laptops, internet, multimedia projectors, smart boards, digital pens, and microphones. This indicates that the teaching and learning processes have become more engaging and interactive. However, the availability of these tools was found to be inadequate in the study, which supports the findings of Alghizzawi et al. (2019) and Kusuma (2023), who stated that the use of various digital gadgets such as Smartphones, Laptops, Personal Computers, and Tablets has resulted in increased interaction between teachers and students through online content sharing, lecture notes, assignments, and feedback. This enhanced connectivity has positively improved the learning experiences of both learners and teachers. Likewise, Wang and Chang (2013), also proved that enhanced connectivity and use of ICT have a positive impact on learning. However, insufficient availability and integration of ICT tools obstruct effective teaching and learning processes, particularly insufficient computers in classrooms, hindering teachers from implementing ICT in their instruction (Chohan & Hu, 2022). A similar result found by Ahmed et al. (2020), proved that inadequate ICT tools in the classrooms are a challenge for teachers to be adaptive to ICT in teaching.

This research has also revealed that the use of multimedia projectors and power points is more compelling and valuable in teaching and attracts students' attention for improved learning. These findings agree with those of Ayub (2015) and Isman and Isbulan

(2010). Similarly, the results of the study also proved that the Internet enhances students' and teachers' levels of motivation, learning, and information. This finding strengthens the study by Dumford and Miller (2018), which states that ICT for e-learning increases learners' thinking ability and helps them become independent learners. Likewise, it also validates the findings of Chang (2016), that students' effective learning occurs with the use of the internet as an ICT tool.

## 5.2. Provision of ICT resources

It was also observed during the study that smart board availability and integration are inadequate in universities. A smart board is recognized as a cutting-edge ICT tool used for teaching learning in the classroom environment. Insufficient availability and integration of ICT tools obstruct effective teaching and learning processes; particularly, the non-availability of smart boards in classrooms stuck teachers from effective teaching and learning environments (Chohan & Hu, 2022). Tikoria and Agariya (2017), also showed that ICT-enabled classroom depends on the provision of ICT infrastructure, resources, and technical staff. A similar result was reported by Ahmed et al. (2020), who showed that inadequate ICT tools in the classrooms are a challenge for teachers to adapt to ICT in teaching. The use of ICT brings about a powerful learning environment and transforms the learning and teaching processes in an active, self-directed and constructive manner (Volman & van Eck, 2001).

## 5.3. ICT Training

Furthermore, the results of the study indicate that the majority of HEI faculties in the Hazara region lack training in the use of various applications and ICT tools. This highlights the need for appropriate training in the use of computers, internet, and other applications. Such training would motivate and enable them to effectively utilize ICT tools to enhance their skills and knowledge (Eager & Brunton, 2023). The result also reinforces the study of Das (2019), who states that ICT training plays an important role, and the lack of such training is an issue in the way of effective teaching and learning. In addition, teachers' inadequate ICT proficiency significantly affects their ability to effectively incorporate these technologies into their educational practices. Consequently, the process of integration and implementation becomes challenging, as teachers with limited exposure to ICT may be hesitant to effectively utilize these tools (Alkahtani, 2017).

## 5.4. Implications of theory

The results of this study support the TPACK framework presented by Mishra and Kohler (2006). According to the framework, effective teaching and learning depend on the association of technology and faculty for effective teaching, which depends on three domains of knowledge. TPACK connects all three types of knowledge (TK, CK, and PK) and the development of such TPACK by the faculty is essential for effective teaching and learning, as shown in Fig. 1. The same has been proven in this research and the high-level mean score of 4.10 and 4.38 given in Table 5, that effective teaching and learning depends on ICT integration. Correlation analysis also indicated a moderate, positive, and significant association between ICT integration and teaching and learning in HEIs of the Hazara region as shown in Table 6 and 7. These findings support those of the study of Dexter et al. (2012).

## 6.  Conclusion and recommendations

ICT has revolutionized the education system and teaching and learning processes to a large extent and will be enhanced further in the near future. Regular advancement of ICTs in education systems will have a positive effect on teaching and learning processes. The results of this study demonstrated the effectiveness of ICT in teaching and learning. The findings of the study indicate a positive and significant relationship between ICT integration and learning; however, this relationship was positive but not significant for teaching in HEIs in the Hazara region, and ICT tool usage is neither prevalent nor optimized. By emphasizing the importance of integrating relevant ICT resources, this study encourages educators and learners to adopt innovative teaching and learning practices that can lead to more engaging and effective educational experiences.

The study also identified a significant gap between ICT resources and faculty training in universities. These tools include smart interactive boards, computers, and multimedia projectors. This poses a serious challenge to effective teaching and learning. To address this problem, educational institutions and the government are required to provide an adequate amount of ICT resources and funding for the procurement and maintenance of equipment. Similarly, it is crucial to provide training on ICT usage and its applications to both faculty and students, as it helps develop skills and competencies to efficiently incorporate technology in their teaching and learning practices. Moreover, sharing different educational practices through ICT can contribute to the dissemination of best practices and improve the overall educational system. It was also found that the availability of the internet facilitates educators in obtaining new knowledge for research, teaching and innovation in the education system. Therefore, free and widespread open Wi-Fi systems with uninterrupted connectivity are essential for all universities. This research adds to the existing knowledge on the effectiveness of ICT in education and provides a foundation for making decisions based on evidence.

In the 21st century, students must have essential skills to be successful, such as communication, technical, collaborative, creative, and problem-solving. Hence, ICT competencies and their integration directly impact effective teaching and learning. Decision-makers and management at educational institutions need to recognize the significance of ICT integration in HEIs and solve ICT-related issues by extending all possible assistance to universities. The provision of new technological knowledge and the use of ICT will not only improve and promote the standard of living and enhance the teaching and learning environment but will also significantly impact the economic development of this region.

In conclusion, there is a dire need for government and university authorities to prioritize the integration of ICT in classrooms and actively involve teachers in the process. Moreover, the provision of training and availability of ICT tools, particularly the smart board, will enable them to meet the demands of 21st-century teaching skills. Such steps will provide students with quality education in the region that will align with the needs of the digital age.

## Author Statement

The authors declare that there is no conflict of interest.

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