Journal of Humanities, Social and Management Sciences (JHSMS)
eISSN: 2788-4791 (online)
https://ideapublishers.org/index.php/jhsms
Vol. 4, No. 1 (January-June), 2023, pp. 199-224
https://doi.org/10.47264/idea.jhsms/4.1.14 Research Article

Analysis of B.Ed. program in the context of TPACK framework: a case study of Allama Iqbal Open University, Islamabad

Mussarat Iqbal* | Nadia Rehman | Li Yangpin

School of Education, Shaanxi Normal University, Xian, Shaanxi, China.

*Corresponding Author Email: nadiarehman05@outlook.com

Received: 26-Feb-2023 | Revised: 22-Jun-2023 | Accepted: 23-Jun-2023 | Published: 30-Jun-2023

Abstract:

The essence of educational excellence often hinges on the calibre of its educators. An educator's prowess is best reflected through their continuous learning journey, initial educational experiences and ongoing professional training. In this manuscript, we have focused on the incorporation of the Technological Pedagogical Content Knowledge (TPACK) framework within the Bachelor of Education (B.Ed.) curriculum (1.5 years degree) at the Allama Iqbal Open University (AIOU), Islamabad, Pakistan. By meticulously analysing these pertinent program documents, we seek to uncover the depth of TPACK's integration and its role in nurturing the growth of budding educators. The analysis focused on course outlines, learning materials, and assessments, among other things, to identify TPACK concepts and strategies. The findings of the study indicate that the B.Ed. program (1.5 years) consists of sixteen courses over three semesters; however, none are related to integrating technology into teaching and learning. Four courses are related to integrating technology in the teaching and learning process in the last category but are optional. A potential avenue for future research is comparing the B.Ed. program (1.5 years) at AIOU with similar programs at other universities, both within the country and internationally.

Keywords: education, educators, distance learning, distance education, professional education, teacher education, pedagogy, curriculum, content analysis.

How to Cite:
Iqbal, M., Rehman, N., & Yangpin, L. (2023). Analysis of B.Ed. program in the context of TPACK framework: a case study of Allama Iqbal Open University, Islamabad. *Journal of Humanities, Social and Management Sciences (JHSMS), 4*(1), 199-224. https://doi.org/10.47264/idea.jhsms/4.1.14

1. Introduction

The Allama Iqbal Open University was established in 1974 due to a parliamentary act. The main campus of the institution is situated in Islamabad's Sector H-8. It was a revolutionary institution that was first in Asia and second globally. AIOU aimed to give students who couldn't complete their Education in a typical classroom environment chance for distance learning. Allama Iqbal Open University graduates can access various in-service training opportunities (AIOU). Despite the myth that preservice Education is adequate for teachers, everyone needs to update their skills and knowledge to stay relevant, useful, and accepted by society (Jumani et al., 2011).

The University (AIOU) is a semester-based institution that accepts students in the autumn and spring semesters. Graduate applications are only accepted once yearly, although undergraduate applications are accepted twice yearly. Students enrolled at the university have access to course materials developed solely for self-study. Reprints of foreign novels, supplemental resources, and university-prepared study aids serve postgraduate students. The institution has established study centres throughout the country where tutors can assist diverse groups of distance education students. AIOU offers graduate degrees after four years. At educational and literary seminars, workshops, and conferences, the AIOU and its regional centres welcome not only distinguished dignitaries and academics from all over the world but also university students, professors, and staff from such institutions. At a recently constructed scientific complex, scientists and students can conduct experiments and study using the latest cutting-edge equipment (Iqbal & Ahmad, 2010). The student dorms and the Central Library have computers set up so that students can access the most recent information accessible through open-source databases. In response to increasing demands from the international market, the Directorate of Foreign Collaboration and Exchange (IC & E) began admitting international and international students into their B.Ed. programs in the Autumn 2021 session. The research questions of the study are: (a) What are the content standards of the B.Ed. The curriculum of AIOU targets the development and enhancement of the preservice teachers?' (b) What is technological knowledge, pedagogical Knowledge, and content knowledge

1.1. Departments of the faculty

The faculty of Education consists of the six departments listed below:

a) Distance, Non-formal, and Continuing Education.
b) Educational planning, policy studies, and leadership.
c) Early childhood education and Elementary teacher education.
d) Secondary teacher education.
e) Science education.
f) Special Education Distance, Non-formal and Continuing Education (DNFCE).

In the year 2003, the Department of Elementary Teacher Education was created. The Early Childhood Education and Elementary Teacher Education Department was renamed the Elementary Teacher Education Department in April 2008. At Matric, Intermediate, and Graduate levels, "Education" is an option in the Early Childhood Education and Elementary Teacher Education Department's (ADE), PGD in ECE, B.Ed., MEd, MPhil, and Ph.D.

programs. This university has a significant Early Childhood and Elementary Teacher Education Department, which has the most students enrolled and courses provided.

The Department of Teacher Education was founded in 1985 and was divided in July 2003 into Secondary and Elementary Teacher Education Departments. Its programs are designed to provide in-service and preservice teachers and scholars with academic and professional information and training.

In 1988, the Department of Science Education was founded. The department's programs and courses are primarily concerned with the instruction and preparation of science teachers. The department provides specialized science courses at the B.Ed., MA, MEd, MPhil, and PhD levels. Courses in specialization offer a conceptual framework and in-depth knowledge of teaching science successfully.

Founded in 1985, the department has been around ever since. Teachers of children with special needs receive Education and training in four areas: visual impairment, hearing impairment, physical impairment, and mental retardation, focusing on making mainstreaming easier for these children's families. These programs accept special-needs children's parents as well. Postgraduate Diplomas, MA, MPhil, and Ph.D. (MS/MPhil-based) in Special Education are among this department's current programs/courses.

The Faculty of Education predates the establishment of the institution. The Federal Ministry of Education created the National Institute of Education in 1973. In June 1975, it was incorporated into the university as the Institute of Education within the Faculty of Social Sciences. The Institute's gradually expanding activities necessitated institutional restructuring, and it was granted the title of Faculty of Education in 1984.

Personnel with solid professional and academic backgrounds in the field of teacher education are required due to the rising needs and lack of human development resources and greater levels of leadership in the field of Education at the national level (Iqbal et al., 2022). Such academic possibilities are given to instructors through this Program. It was designed to give teachers, administrators, and master's degree holders nationwide access to education and training facilities.

1.2. The rationale of the study

According to Kausar and Akhtar (2013), various reports, such as the Higher Education Commission's report and the National Education Policy (2016), the current teacher preparation programs fall short of meeting course objectives, content standards, effective teaching strategies, and program evaluation. According to the National Curriculum Revision Committee, educator preparation programs require quality improvement. According to that, having a well-defined curriculum in teacher education programs is so important. However, for the programs to be successful, the curriculum's course objectives must align with the National Professional Standards for Teachers. Most students choose AIOU for their professional degree after completing their undergraduate and graduate degrees because of its affordable costs, excellent distance learning, and online academic programs (AIOU, 2020). The current study aimed to -assess the TPACK training curriculum for primary preservice teachers.

2. Literature review

There can be no quality education without a quality teacher, and teachers' professional development, which includes preservice Education and training, goes a long way toward ensuring a quality teacher in the primary grades. By focusing on preservice education and teacher training, Pakistan has to improve its educational quality to improve students' academic outcomes (Darling-Hammond et al., 2005).

In the literature, experts claim that the quality of the instruction defines the education grade; according to a study, the teacher's credentials determine instructional excellence (Rehman et al., 2021). The quality of a teacher's professional growth and Education, as well as their degree of Education and teaching experience, are significant factors in determining a teacher's qualifications (Turney and Wright, 1990). "Activities that increase instructors' talents, knowledge, expertise, and other teacher qualities" are what professional development for teachers is characterized as (OECD, 2009, p. 49). According to Guskey (2000), professional development is a deliberate, ongoing, and systematic process that seeks to improve an individual's professional knowledge and skills to improve student's learning outcomes. In addition, Bubb (2004) asserted that professional development comprises many activities that increase an individual's knowledge, skills, and comprehension to improve organizational effectiveness. Technology has become an essential part of many professional development programs. Many strategies are being used to include technology in teacher training to develop and increase teachers' technical skills and capacities to use technology in teaching practice. Developing technical skills independent from pedagogy and content is at the heart of a holistic, technology-centered approach (Baran et al., 2011). Interaction encompasses TPACK, which includes all three forms of knowledge: pedagogical, content, and technical (Dilworth et al., 2012; Koehler et al., 2013). The TPACK framework has seven parts: technological knowledge, content knowledge, pedagogical knowledge, pedagogical content knowledge, technical content knowledge, technological pedagogical knowledge, and technological pedagogical content knowledge. The researcher thinks that putting TPACK models into professional development programs for teachers in Punjab would help deal with problems and challenges in teacher education (Guskey, 1986).

Through several measures, the Pakistani government has promised to raise the standard of Education (Mujahid, 2020). Teacher education is one of these crucial methods. It is considered one of the foundational elements of all educational policies. The Millennium Development Goals, statements made by international organizations, and national government programs emphasize the importance of enhancing Education in underdeveloped nations. Without teachers' commitment to raising educational standards and turning aspirations into reality, all educational plans and programs will amount to nothing more than a pile of paper (Fazal et al., 2014).

2. Theoretical framework

The TPACK model (for technological pedagogical content knowledge) was developed by Koehler et al. (2009). Pedagogy, content, and technology all work together in this framework to create a dynamic learning environment. There are three main components to the TPACK model: content, pedagogy, and technology, all of which overlap when it comes to preparing for the classroom setting.

In order to properly manage the challenging classroom environment, teachers must possess specialized expertise in their respective subject areas (Ainley & Luntley, 2007). First, Shulman (1986) acknowledged that teaching necessitated the acquisition of CK and PCK. Shulman defines teacher content knowledge (CK) as the quantity and organization of subject matter information in the teacher's mind. In contrast, pedagogical content knowledge (PCK) represents a distinct combination of content and pedagogical knowledge that shows how the subject is presented and developed so that others can understand it (Shulman, 1986). TPCK is concerned with the organization, presentation, and adaptation of various themes, obstacles, and issues to students' various interests and skills throughout the educational process. Shulman's PCK paradigm has been challenged and altered by many educators who have proposed more sophisticated representations. Teaching-related ideas, student comprehension knowledge, curricular information, and instructional practices are all components of the TPCK paradigm (Grossman, 1990). Magnusson et al., (2002) altered Grossman's components and introduced five elements.

- Education in the field of science
- Knowledge and beliefs about the curriculum
- Knowledge and beliefs about students' understanding of specific topics
- Knowledge and beliefs about instructional strategies for teaching
- Knowledge and beliefs about assessment

These five PCK components have been used in various contexts to assess teachers' PCK. (Cohen & Yarden, 2009; Friedrichsen et al., 2009; Friedrichsen, Van Driel, & Abell, 2011; Henze et al., 2007; Lee & Luft, 2008; Park & Oliver, 2011). According to Magnusson et al. (2002), each instructor adds a unique quantity of knowledge to each PCK component, which causes each component to have a different impact on its subsequent development. There are numerous ways or avenues by which PCK development can be reached. Magnusson et al. (2002) made several recommendations, including examining teachers' current knowledge and beliefs, addressing the relationship between subject matter expertise and PCK, placing learning opportunities in relevant contexts, and using PCK components to enhance teachers' PCK development. Learning about learners and instructional sequences are two components that develop simultaneously, and Brown et al., (2012) discovered a substantial correlation between teaching orientation and both components. In other words, greater comprehension of a particular component might not be sufficient to encourage PCK development. It is important to note how PCK's connections and complexity have increased overall (Park et al., 2011).

The TPACK model was developed by Koehler & Mishra in 2006. Teaching, material, and technology are all intertwined in this open-ended framework. The TPACK paradigm consists of three primary components: content, pedagogy, and technology, all of which are intertwined. Perspective from the TPACK While teaching teachers how to use new technologies, we relied heavily on Mishra and Koehler's TPACK approach. A framework called TPACK, or technical, pedagogical, and subject expertise, helps people comprehend how instructors' technological expertise, topic expertise, and teaching expertise are related. Similar to Shulman's emphasis on the overlap between content and pedagogy, TPACK places a strong emphasis on the overlap between content, pedagogy, and technology (Harris et al., 2011; Mishra and Koehler, 2008; Koehler et al., 2013) and it acknowledges that effective technology-assisted teaching can only take place in these areas of overlap that have been well integrated.

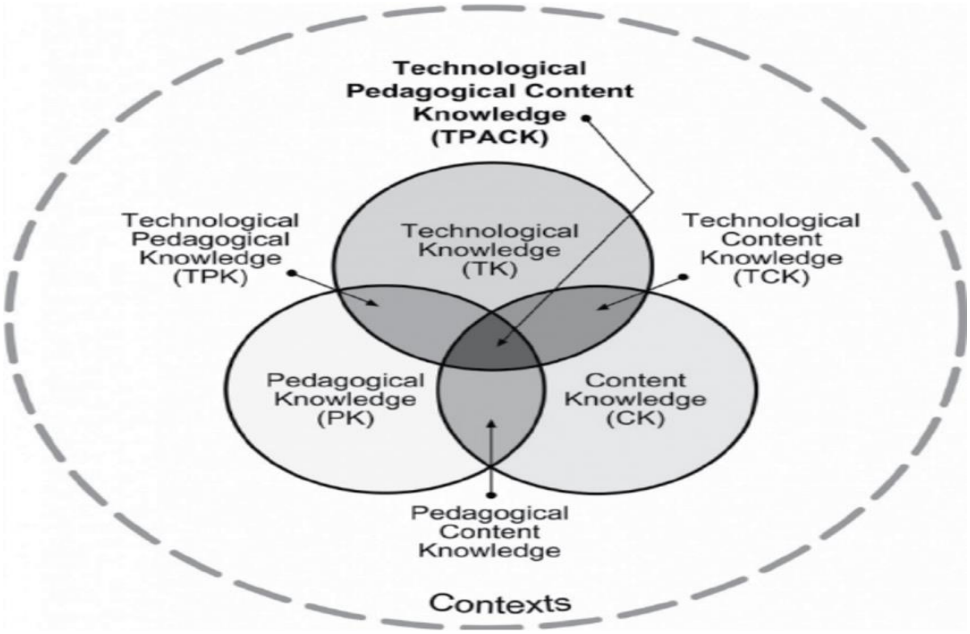

Figure 1: The components of the TPACK framework (graphic from TPCK - Technological Pedagogical Content Knowledge, 2010).

2.1. Content Knowledge (CK)

The teacher's knowledge of the subject matter they will teach is alluded to in the content. It alludes to the comprehension of a specific subject, such as the contrast between English content knowledge and social studies or Urdu content knowledge. According to Shulman (1986), information on concepts, theories, ideas, organizational frameworks, evidence, proof, and established methods and approaches to developing such knowledge is referred to as content knowledge (Koehler & Mishra, 2009).

2.2. Pedagogical Knowledge (PK)

Pedagogical knowledge delves into a teacher's insight into the art and science of teaching and learning. This encompasses a vast spectrum of educational philosophies, values, and goals. Integral to this is the grasp of learning theories, the art of crafting lessons, effective classroom orchestration, and the nuanced art of student assessment (Koehler & Mishra, 2009).

2.3. Technology Knowledge (TK)

This refers to the aptitude for integrating a diverse array of technological tools and innovations. It's more than just knowing how to use technology; it's about harnessing it to achieve educational milestones while staying abreast of the ever-evolving digital frontier (Koehler & Mishra, 2009).

2.4. Pedagogical Content Knowledge (PCK)

Rooted in Shulman's pioneering notion of PCK, this expertise is about blending content knowledge with pedagogy. It calls for deep subject mastery, the finesse to communicate that

knowledge through varied methods, and the flair to customize instructional content in sync with students' unique backgrounds and understanding. This holistic approach seamlessly fuses curriculum design, instructional strategy, and evaluative measures (Koehler & Mishra, 2009).

2.5. Technological Content Knowledge (TCK)

Along with having a thorough understanding of the discipline's subject matter, the teacher needs to be knowledgeable about the various innovations that can be used to improve learning. A teacher should also study the interactions and collaborations between content and technology. Teachers need to understand how content affects or suggests technology advances and which technologies are most appropriate for managing subject-matter learning in their area (Koehler & Mishra, 2009).

2.6. Technological Pedagogical Knowledge (TPK)

The use of various technical instruments and an understanding of different educational strategies are both parts of technology pedagogical expertise. It also requires understanding how using particular technological tools in the classroom alters teaching and learning (Koehler & Mishra, 2009).

2.7. Technological Pedagogical Content Knowledge (TPACK)

Technical content knowledge refers to pedagogical practices that include technology to facilitate the teaching-learning process. It is an attempt to simplify the subjects for students to help students build on their past knowledge and simplify complex subjects.

3. Methodology

Utilizing the TPACK framework as a foundational guide, the researcher embarked on a qualitative investigation of the B.Ed. Program's curriculum at AIOU. The methodological approach selected was an in-depth, single-embedded case study. Adhering to Stake's (1995) emphasis, the research cantered on specific nuances and details by focusing on one comprehensive case: the 1.5-year B.ED. Program at AIOU. Drawing upon Creswell's (2003) methodologies, this approach allowed the researcher to deeply probe into the subject matter, gleaning insights from a multitude of sources. According to Zhang and Wildemuth (2009), Content analysis in qualitative research is a method where raw data is distilled into themes or categories through thoughtful interpretation. This approach primarily leans on inductive reasoning, where patterns arise organically from the data due to the researcher's meticulous review. However, this doesn't mean we can't apply deductive reasoning. Using ideas from existing theories or prior studies can be beneficial, especially when starting the data analysis journey. This analysis involves several steps that include preparing raw data, defining the unit of analysis, developing categories or schemes, testing the coding scheme, coding the text, and inferring a conclusion.

4. Analysis of B.Ed. (1.5 years) program

Allama Iqbal Open University's 1.5 B.Ed. Programs were examined under the three topics of technology, pedagogical, and content knowledge to address the first study question. Personnel

with solid professional and academic backgrounds in the field of teacher education are required due to the growing needs and shortage of resources for human development, along with greater levels of leadership in the field of Education at the national level. These academic possibilities are provided to instructors through this Program. It intends to provide teachers, administrators, and master's degree holders in the nation with educational and training facilities.

This Program has 54 credits and uses bilingual instruction (Urdu and English). The university provides tutors and study centres so students can receive appropriate guidance. To properly complete the relevant Educational Program, a student must receive passing grades on their final exams and assignments.

To receive their final degree, students must receive a minimum of 50% on all their semester exams. This Program can last up to three years. This Program was created in response to the growing demands for employees with solid professional and academic backgrounds in the field of teacher education, as well as the shortage of human development resources and higher levels of leadership in the field of Education at the national level. These academic possibilities are provided to instructors through this Programme. It strives to provide training and educational resources for administrators, teachers, and master's degree holders. The core of civilization has always been Education and learning. Without literate human resources, society cannot reach new economic heights.

To achieve the goals of the "education for all" motto, the Pakistani government is pouring a lot of money into the growth and revitalization of the educational system. Promotion of Higher Education is required and must be made in line with business needs. The courses that connect to the fundamental pedagogical paradigm of Education have received the majority of attention from teacher educators. Only a few courses focus on future educational difficulties and demands in particular. The current course is intended to help aspiring teachers become aware of potential issues and better equip themselves to fulfil the demands of a rapidly changing society. Below is a list of the course's goals.

- To acquaint prospective teachers with the latest teaching techniques and methodologies.
- To enable teachers to use instructional technology in the classroom.
- To enable prospective teachers to manage the classroom environment.
- To meet the country's increasing demand for trained personnel

4.1. Eligibility/selection criterion

Students must have at least 16 years of Education in fields other than Education, such as a BA (4-year)/BS (4-year) with at least a second division or the equivalent. The maximum time it will take to earn a degree is three years. Sixteen years of Education (other than Education) MA/MSc/BA (4-year)/ BS (4-year) with at least a second division or equivalent is required for eligibility.

At the AIOU, Islamabad where pre-service teachers can earn their Bachelor of Education degree in three semesters and 1.5 years, we conducted the research. General teaching and assessment methods, curriculum creation, and research methods in Education and educational leadership and management are among the six courses students must study during their first semester.

Table 1: Coursework in the B.Ed. Program

Semester-1	Semester-2	Semester-3
General Methods of Teaching (Professional)-8601	Area of Specialization (Course-I)	Teaching Practice II (Professional)-8608
Educational Assessment and Evaluation (Professional)-8602	Area of Specialization (Course-II)	Philosophy of Education (Foundation)-8609
Curriculum Development (Foundation)-8603	Area of Specialization (Course-III)	Human Development and Learning (Foundation)-8610
Research Methods in Education (Professional)-8604	Area of Specialization (Course-IV)	Professionalism in Teaching (Professional)-8612
Educational Leadership and Management (Professional)-8605	Teaching Practice I (Professional)-8607	Research Project (Content Embedded) (Professional)-8613
Citizenship Education and Community Engagement-86062.	Critical Thinking and Reflective Practices (Professional)-8611	Educational Statistics (Professional)-8614

4.2. Semester-I

4.2.1. General methods of teaching (professional)

Introduction to Teaching, Lesson Planning, Student Motivation, and Activity Methods are the nine sections of this course. Other sections include Discussion Methods and Cooperative Learning. The unit concepts are broken down into specific subtopics. The students require concepts, actions, and exercises for self-evaluation and direction. If they have any questions, they can speak with the course instructors. Assessment questions are supplied at the end of each unit to evaluate students' understanding of the entire unit's concepts. It is a requirement of the course for students to complete assignments. There are two assignments for every three-credit hour course. Students must complete and submit their assignments on time to meet the deadlines. The tutors review the tasks and provide comments to each student individually over time. Because the tasks are part of the course's continuous assessment, students must exercise caution when attempting them. Workshops are a required component. AIOU regional offices host workshops for each course. In the workshop, experts demonstrate how to apply what they've learned. During the discussion sessions, preservice teachers may be able to learn and exchange ideas with others. Attendance at the workshop is mandatory. When a student misses a scheduled workshop for a certain course, they will be listed as "reappearing in the workshop" on the test results card. The objectives and aims of this course can be summarized as follows:

- To teach the fundamentals of teaching.
- To highlight the fundamental qualities of a successful instructor.
- To explain the significance and different sorts of teacher planning.
- To put new teaching approaches to the test in a classroom setting.
- To organize and show its proper use in the classroom.
- To get pupils excited, preservice teachers can use a variety of methods.
- In crafting a supportive and engaging learning environment, educators must be discerning in their choice of audio-visual materials that resonate with their students' unique needs.

Delving deeper into these strategies, we identify the nuanced ways educators can pinpoint learning obstacles their students face. Equally crucial is the curation and application of the right

educational tools to bolster the learning process. This section delves into the intrinsic qualities and professional acumen that set exemplary teachers apart. It provides a detailed exploration of diverse teaching techniques, strategies, and frameworks.

4.2.2. Educational Assessment and Evaluation (Professional)-8602

The essence of this course revolves around grasping the foundational and applied aspects of classroom evaluations. It intertwines the art of goal articulation with the science of assessment and measurement. The course nurtures the skill of interpreting learning outcomes and critically assessing test findings. Moreover, it acquaints learners with contemporary methodologies and evolving trends in educational evaluation.

4.2.3. Curriculum Development (Foundation)-8603

At the heart of this course is a comprehensive exploration of what defines a curriculum and its integral traits. It casts a wide net, encompassing the myriad facets of curricular design — from its elemental components to its breadth, design principles, and inherent qualities. A significant portion of the course sheds light on the essence of curriculum development and its meticulous planning phases. To facilitate a holistic understanding, the course is punctuated with self-assessment queries for the learners.

4.2.4. Research Methods in Education (Professional)-8604

This course will teach students the fundamentals of research methodology in Education, including the necessity and importance of forms of research, sampling, and various instruments and procedures for collecting data. This course will prepare students to construct research proposals and write research reports. This course consists of a total of nine modules. Each topic is broken down into subtopics in order to cover as much ground as possible. This course aims to teach students how to collect, analyze, and present quantitative data to other scientists. Ethics in quantitative research and the significance of taking the time to develop and think through any research attempt are emphasized in this article whether students will be able to: as a result of this course. Comprehend different concepts related to educational research:

- Apply the scientific method to the solution of research problems.
- Follow the ethics of research.
- Employ different sampling techniques.
- Develop a variety of distinct research tools.
- Produce a high-quality report on preservice teachers' findings.

4.2.5. Educational Leadership and Management (Professional)-8605

The development and enhancement of knowledge, comprehension, and competence in leadership, administration management, and supervision are the main goals of educational leadership, management, and supervision. The key components of educational management and supervision are the main focus. This course has attempted to emphasize all significant aspects of educational management and supervision. Unit 1 emphasizes the importance, principles, and methodologies of educational administration, as well as the Islamic administrative model, whereas Unit 2 discusses the concept of school management. Unit 3

focuses on the concept, types, purposes, and practices of supervision, as well as the traits and role of the supervisor.

The planning for schooling is covered in Unit 4. The principles of purpose and elements in school discipline are highlighted in Unit 5. Similar to how student classification criteria and psychological considerations are included in this course, units 6 and 7 explain management resources and school records, respectively. The Pakistani administrative and judicial systems are highlighted in Unit 8. The idea, significance, and usefulness of evaluation in enhancing the management system are discussed in Unit 9. The evaluation process and standards are also covered.

4.2.6. Citizenship Education and Community Engagement-8606

The emphasis of the training was on how to engage in social interaction with the community and mobilize that community to support the growth of the school. Students will learn about issues such as race and ethnicity, gender, and special needs and foster a sense of community and camaraderie in the classroom and the surrounding community. The socialization and social development process will be introduced in this course. It also focuses on social variables that could have an impact on schooling. This course includes theoretical and practical components, such as community service, strengthening social interaction, and promoting a healthy environment. There are nine units in this course. The nature, traits, and purposes of society, culture, and cultural diversity are covered in Unit 1. The nature, function, and dynamics of groups are highlighted in Unit 2. Unit 3 explains the idea, objectives, contributing factors, and responsible agencies of socialization. The subject of Unit 4 is social institutions. The idea, procedures, and function of schools and teachers in social control are covered in Unit 5. The connection between school, society, and teachers is highlighted in Unit 6. The successful job of a teacher is covered in Unit 7. The technological change and its effects on society are highlighted in Unit 8. Additionally, Unit 9 discusses community development theory, goals for collaboration, plans for collaboration, parental involvement, and effective communication techniques while describing collaboration between schools and the community.

4.3. Semester-II

A subject-based teaching techniques course that involves a practicum and content reading and writing is required of all students in the B.Ed. degree program's second semester (including English, foreign language, mathematics, Science, and social studies). In preparation for their student teaching placements, each student completes a practicum in a classroom during this semester.

a) Area of Specialization (Course-I)
b) Area of Specialization (Course-II)
c) Area of Specialization (Course-III)
d) Area of Specialization (Course-IV)
e) Teaching Practice-I (Professional)-8607

This training provides supervised classroom experience dealing with children. Emphasis will be placed on observing and evaluating classroom experiences, learning environment, and classroom management to strengthen prospective teachers' observational skills. The mentor

teacher will evaluate the potential teachers in the classroom and at the school. This course requires 42 hours of practicum/school time. The department must approve the practicum site and mentor the teacher at least four weeks before the beginning of the practical Programme. Course Learning Results Teachers-in-training will be able to:

- Observe and assess classroom experiences after completing the course.
- Observe school activities/classrooms.
- Write an anecdotal record.
- Create an observation checklist.
- Compile field notes.
- Draft observation report

4.3.1. Teaching practice

The practice of teaching in a school is mandatory in the B.Ed. program after which there is a practical work also.

4.3.2. Workshop (Three Days)

Part of teaching practice I is a three-day workshop that is required. Before the field observation, a workshop will be held in the classroom or school.

4.3.3. School Visits/Internship

Each beginning teacher is required to complete a two-week internship (3 hours each day) in a school. This experience is in the field. In connection with their specialist courses, this provides possibilities for aspiring teachers to work in a professional context.

4.3.4. Field notes and Two Observation reports

In the classroom, the trainee teacher will observe the teacher-student interactions and the overall flow of a lesson. There are examples of observations in the appendix. The aspiring teacher will retain a written record of their classroom observations in their professional portfolio.

4.3.5. Critical Thinking and Reflective Practices (Professional)-8611

Participants in the Allama Iqbal Open University's teacher training programs are intended to participate in this course. It is anticipated that the educators of the twenty-first century will not only be able to comprehend and analyze the most recent findings of educational research as well as educational policies and practices, but they will also be able to think critically and reflect on those practices to enhance them. Students will learn about critical theory, develop their ability to reflect on their practice, begin the process of implementing an action research culture in their classrooms, and develop their ability to engage in critical discourse both orally and in writing, all while strengthening the teaching profession's community of practice. The primary goal of this course is to teach students how to think critically and critically about education.

- This course's primary focus is applying critical thinking and critical pedagogy to the classroom setting.
- Perform an in-depth content analysis and develop creative solutions for teaching it in the classroom.
- Analyze and reflect on current methods of instruction to make future improvements.
- Carry out research projects based on student participation in educational environments.
- Participate in the community of educators and students while maintaining a watchful and engaged attitude.

4.4. Semester-III

The third semester's obligatory educational technology course is when technology is discussed with the most intention. Throughout the semester, students investigate various technological support options for curriculum-based teaching and learning. In particular, they investigate and engage with a variety of technology tools and resources, both general and subject-specific, and their educational applications. The Programme includes a course on educational technology as well as obligatory courses in teaching methods that, to varied degrees, also touch on technology. Below are descriptions of each course.

4.4.1. Teaching Practice-II (Professional)-8608

This Program allows trainee teachers to work in a classroom or school setting. During this practicum, student teachers use their newly acquired knowledge and skills in a classroom or school. Students can gain classroom teaching experience and school-based training by taking this course. This experience will aid in the development of classroom management skills in addition to classroom instruction. An in-school teaching practicum and the presentation of final/model lesson plans are included in this course. Trainers will learn about course prerequisites, lesson planning, and presentation in this workshop. There are 144 hours expected of student teachers throughout their six-week teaching practicum. Student and teachers are required to work four to five hours every day at the school throughout their six-week teaching practicum. The Allama Iqbal Open University regional centre in the area where prospective teacher desires to perform their teaching practicum must sign off on the site approval form. The course's major purpose is to develop lesson plans that use appropriate instructional methods and procedures.

- Implement lesson plans for effectively teaching the content to students.
- Identify the learning needs of students.
- Collaborate with teachers at the school for professional responsibilities.
- Utilize feedback from teachers at the school in a non-defensive manner.
- Reflect on the teaching practicum in school.
- Establish a learning environment to meet children's cognitive and affective needs.
- Utilize appropriate techniques for assessing students' performance.

4.4.2. Philosophy of Education (Foundation)-8609

In this subject, students learn about Education's ideologies, philosophical underpinnings, and socioeconomic and historical contexts. Students in this course will better understand how

various philosophical theories influence schooling. The course will assist trainee teachers in acquiring the ability to analyze information in its historical, philosophical, ideological, and social context, which will lead to critical viewpoints on Education both in and outside of schools.

4.4.3. Human Development and Learning (Foundation)-8610

The stages of physical, social, mental, and linguistic development that take place from birth until age eight are referred to as "human development." Teachers must be familiar with the requirements and characteristics of preservice teachers' children. Therefore, understanding child development is essential for all early childhood educators and teachers. It enables teachers to use strategies that are suitable for each child's developmental stage. This calls for children's growth and learning in various physical, cognitive, social, emotional, linguistic, and artistic domains. All these topics are covered in the course. The goal was to emphasize every significant facet of human development.

4.4.4. Professionalism in Teaching (Professional)-8612

The course's main goal is to improve students' understanding of professional standards of conduct and their capacity to apply them both within and outside of the classroom. The book covers a wide range of professionalization-related topics. The course explains how teachers' roles are changing in the twenty-first century and how they might integrate technology into their lesson plans. Additionally, it describes the qualities of a professional teacher who ought to be living examples of particular virtues, beliefs, or attitudes ingrained in the socio-cultural environment of the society. The course also looks at teaching ethical dilemmas. The morality of educators and moral problems in educational institutions has been debated. Due to the rapidly expanding phenomena of a multicultural and multiethnic population in the society where children attend the schools, this argument attracted a lot of attention from academic circles.

4.4.5. Research Project (Content Embedded) (Professional)-8613

For teachers, developing a scientific worldview, critical thinking, and reflective abilities is the goal of this course. A student could have taken "Research Methods in Education," "Critical Thinking and Reflective Practices," or "Teaching Practice-I" in prior semesters. Students will be able to complete this research project with the help of the information they've gained in these classes. The research project's main objective is to get student-teachers involved in the action research process. Students-teachers can use action research to kick-start a cycle of inquiry, data collecting, reflection, and decision-making in their classrooms and classrooms. Students learn more about the research process and a particular subject or phenomenon when they work on a research project. They learn how the research process, the evolution of knowledge, and how to contribute to the body of information already in existence are intertwined and interdependent.

4.4.6. Educational Statistics (Professional)-8614

This subject is required of prospective B. Ed. graduates due to its significance. The course's first unit provides an introduction to its features, purposes, importance, limitations, and use in

educational research. This section also includes a basic introduction to the scientific method, descriptive and inferential statistics, variables and types, and notation used in the field. Some fundamental ideas, like variables, data, and population samples, are explained in Unit 2. Unit 3 sophisticated graphical skills or approaches for exploratory data analysis. The basics of measures of dispersion, including range, mean deviation, variance, and standard deviation, as well as form measurements like skewness and kurtosis, are highlighted in Unit 4. Unit 5 describes central tendency measures, including mean, median, and mode. Inferential statistics are covered in Unit 6, along with their logic and significance in educational research. This unit also covers t-tests and its various types, as well as hypothesis testing, its logic, its mistakes, and its faults. Regression and its types, along with the Pearson and Spearman correlation approach, are covered in Unit 7. ANOVA, the reasoning behind employing ANOVA, the F-distribution, one-way ANOVA, and multiple comparison techniques are covered in Unit 8. Unit 9 discusses chi-square (2) distribution, its applications, and its kinds.

4.5. Elective/Major Courses

4.5.1. Leadership and Management (Course-I)

This course aims to introduce and orient students to the field of educational leadership and prepare them for their future roles as leaders. It contains theoretical and conceptual context and the practical ramifications of these ideas and notions. Educational leadership is a large field in which top and intermediate managers and school principals are regarded as the most important actors. Leadership styles and methods differ based on the circumstances. Therefore, an educational planning and administration student must have professional and practical knowledge and abilities to handle the responsibility of leading successfully and efficiently and developing.

4.5.1. Management Strategies in Educational Institutions-

The course's major goal is to help students grasp management theory, practice, and application to their jobs. - To help them understand the significance of resource management and efficient ICT use in educational management.

4.5.2. Administration and supervision

The main focus of school administration is leadership. Leaders are said to be born, not manufactured, according to common thinking, but more crucially, academic research suggests that skills may be learned. Although some leaders will undoubtedly be genetically better than others, the fundamentals of leadership may be learned and developed. The first four of this book's nine units discuss administration, while units five through eight discuss supervision. The ninth unit examines the application of technology to management and supervision. The primary goals are to understand management principles, processes, and practices as they apply to their work. To enable them to appreciate the significance of resource management and effective use of ICT in the context of educational management.

4.5.3. Plan implementation and educational management

The overall overview to the entire course was given in the Introduction to Plan Implementation

and Management. It outlines the course's overall goals, structure, and brief descriptions of each of the course's blocks and modules. The planning cycle and the role of feasibility testing are discussed in detail in the unit titled "Feasibility Testing." Performing a feasibility study is an important step in the planning process, but it should come after estimating the costs and determining realistic goals. This action aims to increase the likelihood of the plan's success. This thoroughly examines all of the plan's built-in assumptions and objectives, which will determine its success or failure.

4.5.4. School Leadership

This course aims to assist learners in becoming effective leaders of the future by introducing and orienting them to educational leadership. It provides background on theoretical and conceptual ideas and the applications of such ideas in the real world. School heads, top and middle managers are considered the most important role actors in educational leadership. Different circumstances call for different leadership philosophies and tactics. Therefore, to be responsible for leading and developing effectively and efficiently, a student of educational planning and management needs to possess both professional and practical knowledge and abilities.

4.5.5. Educational Technology and Evaluation (Course-II)

As aspiring educators, it is crucial to be adept at seamlessly weaving the powers of modern Information and Communication Technologies (ICTs) into our teaching methods. This course will take you on a journey where you'll explore the myriad of tools at your disposal – from the ubiquity of computers and the internet to the dynamic capabilities of mobile phones, audio-visual aids, and a plethora of online tools. The aim is to craft a teaching experience where the learner is at the heart of it all. Together, with the fellow teacher trainees and our dedicated mentors, we will dive into creating lessons that engage, inspire, and resonate and trainees. By the course's end, you will have the confidence and know-how to incorporate ICTs in ways that enhance collaboration, pique students' interests, and bolster both comprehension and assessment.

4.5.6. Educational Technology

Venturing into the realm of education today demands a nuanced understanding of how technology can be harnessed to enrich the classroom environment. This course has been tailored to arm you with the expertise needed to employ ICTs efficiently, amplifying both interaction and understanding among students. Beyond merely knowing, students will discover ways to engage learners, enhance their grasp of subjects, and refine teaching and assessment techniques. It's worth noting that whenever we mention "students" in this context, we are primarily referencing young minds in elementary or junior high school. In order to accomplish this goal, student teachers will collaborate closely with their student learners to plan, develop, and carry out instructional modules that make extensive use of technology. The course will focus on utilizing various forms of technology in the classroom. Even though a teacher's training is fundamentally the same regardless of whether or not they utilize a laptop or a mobile phone, this course's primary focus will be computers and laptops. Consequently, it investigates policy directives, research on the use of technology in Education and learning, standards, and the various ways in which technology can assist in the acquisition of subject matter knowledge,

teaching, evaluation, and cooperation. The course also examines current technological trends and other types of technologies besides computers.

4.5.7. Computers in Education-I

The primary goal of this course is to investigate the potential for effectively employing computers in our teaching. In particular, teachers who do not teach science topics should recognize the computer's potential as a tool. Teachers are presumed to be programs rather than trained technologists in this context, but with some practical training, they may utilize computers in their instruction. This course is designed for teachers unfamiliar with computers or meeting them for the first time. A computer is a machine that can accept raw data (input) and transform it into useful information (output). This book has been prepared and organized specifically for teachers' requirements. Unit 1 explains the computer as a machine and gives an overview of the computer. Unit 2 introduces students to the operation of a computer. Unit 3 discusses operating systems, application software, self-developed programs, and programming languages. Computer Assisted Instruction is defined in Unit #4, along with its benefits and drawbacks. The continuation of Unit 4's introduction of the CAI tools and packages is Unit 5. Computer Managed Learning is the topic of Unit 6. Computer education and teacher training are the main topics of Unit 7. In Unit 8, the use of computers in Education has been discussed in relation to various educational modalities. Unit 9 evaluates the use of computers in the classroom and the issues associated with their use.

4.5.8. Broadcast media

This course has been created and designed in a way to showcase the complete distance learning system. The general public, as well as teachers, can benefit from it. The course's primary goals are: a). to define the characteristics of broadcast media. b). Talk about the function of broadcast media. c). Understand how broadcast media are planned and managed. d). Describe the methods used to finance broadcast media. e). Talk about the importance of educational television, notably in Pakistan, Singapore, China, Japan, the United Kingdom, and Thailand. f). Describe the function of radio in Education in nations like Pakistan, Mexico, Japan, and India. g). Describe the TV program production procedure. h). Examine the radio program creation procedure. i). Describe the methods used to evaluate broadcast media. j). Talk about the function of those working in the broadcast media. k). Examine the challenges that come with using broadcast media.

4.5.9. Non-Broadcast media

This course has been designed to a). Describe the characteristics and reach of non-broadcast media. b). Identify the variables influencing media choices. c). Talk about the value of the chalkboard/blackboard, the bulletin board, and the flannel board in the instructional process. d). Describe how record players and tape recorders are used in the classroom. e). Talk about the value of projectors for film strips and slides in the classroom. f). Examine the value of closed-circuit television in the classroom. g). Describe the nature and categories of educational technology. Recognize how computer-assisted learning plays a part in online education. h). Talk about the creation of teaching materials for distance learning. i). Examine the role that video cameras have played in distance learning. j). Describe the administration and planning of non-broadcast media.

4.6. Teacher Education (Course-III)

The plan and actions taken by teacher educators to train and conduct research for teachers at all levels are referred to as teacher education. The term "teacher education" refers to a curriculum that combines Education with hands-on experience and independent study to enhance teaching abilities from the basic grades through higher Education. For teachers to be prepared for the difficulties of today's classrooms and the future, teacher education is viewed as a set of activities. All values, conventions, and characteristics are given to children through teachers, who play a crucial role in forming nations. This course has three sections: Primary, Secondary, and Higher Education. This course covers teacher preparation, effective educational theory, and professional skills.

4.7. Teacher education in Pakistan

Teacher education is viewed as a series of activities intended to help educators improve their abilities to satisfy classroom demands and professional growth. All formal and non-formal actions and experiences that help a person become a member of the educational profession or more effectively carry out his or her duties as an educator are included in teacher education." For this reason, teachers must be well-versed in the latest educational technology and how they might benefit students. Education policies have long focused on pedagogical aspects of instruction, but actually putting those rules into practice has proven difficult. Teachers must have a strong sense of purpose, a positive outlook toward their work in Education, and specialized material knowledge and pedagogical expertise.

4.8. Science Education (Course-IV)

This course's primary goal is to improve the subject matter expertise of future student teachers. It offers an additional chance to deepen the understanding of scientific topic understanding needed to teach general Science in primary school. Physical Science, life science, and earth science fundamentals are all covered in the course. Additionally, it discusses the finest learning and teaching methods that foster scientific conceptual understanding growth. Science II develops linkages between fundamental ideas like matter and energy and comprehensive systems like the Earth's systems or systems within the human body, in contrast to science, which focuses on more straightforward ideas.

4.9. Foundation of Science Education

The students intending to become teachers would benefit from this class because it will provide them with a comprehensive knowledge of various scientific teaching foundations. This class is worth 0.5 credits hours and is broken into nine units. The majority of this class is broken up into four parts as: a) the social, b) economic, c) psychological, and d) Islamic basis of science education.

4.10. Assessment in Science Education

Both preservice and in-service teachers will benefit from taking this course. Several tasks in this course have been created to assess the effect. This course also includes a number of approaches, including projective technique, interview, and observation. Additionally, this

course has discussed ethical concerns with assessment. In order to optimize student scientific learning, course material, teaching practices, and assessment feedback should be modified to suit the learning environment. Additionally, the assessment results should be used to design suitable professional development opportunities for teachers, pinpoint students who require additional assistance and/or learning accommodations, and review and redesign assessment instruments to reflect the learning objectives and instructional context better.

4.11. Laboratory Organization, Management, and Safety Methods

The first unit of this course focuses on laboratory design. The second unit discusses the management of science laboratories, including all types of laboratories. Lab work cannot be performed without specific skills and practices. This section covers laboratory techniques such as dealing with glass, wood, electricity, and chemical reagents. Unit four develops practical Science for low-income nations. The aims and objectives of laboratory activity are described in unit number 5. We are aware that teaching tactics play a crucial role in science education. This article describes lab teaching strategies, controlled exercises, experimental investigations, and research projects. In unit 7, sequencing and sequencing of laboratory activities, emphasis is placed on sequencing principles, sequencing methodologies, sequencing factors, and the organizing of student activities.

4.12. General Science in Schools

This course aims to introduce students to fresh approaches to lesson preparation, instruction, evaluation, and assessment. The course's main objective is to prepare qualified science teachers to instruct science at the primary school level. As a result, "General Science in Schools" was created to support science instructors. This course covers all pertinent topics of teaching and learning science. Students will study the nature of science in the first unit. It goes into great length on all the key ideas related to this theme. There is also a discussion of the implications of the nature of science for scientific teaching and learning. The overview of science education at the primary level is covered in the second unit. The necessity of teaching science at the elementary school level is also emphasized in this subject. The function of a science teacher has been discussed in the third unit. The role of the teacher is evolving along with technology's breakthroughs and the world's changing landscape. Therefore, it also discusses the qualities of a teacher. The fourth unit focuses on science education. In this unit, the many types of learning are also covered. Additionally, misunderstandings about science are discussed, and methods for dispelling them are provided. Science teaching ideas and procedures are covered in the fifth unit. It will be simpler for pupils to comprehend concepts and procedures once they have a basic understanding of the nature of science, the need to teach it at the elementary school level, and the function of the science teacher. Future teachers must have a full understanding of these methods and tactics in order to teach Science.

As a result, the lesson thoroughly examines the tactics and techniques. Science principles are taught in the final unit of this course. Different lesson plans based on various methodologies have been provided for this course. The prospective teacher will find this course to be of great use as it provides insight and knowledge for lesson plans in various scientific disciplines, including teaching biology, chemistry, and physics. This course is fairly extensive, and because of its breadth, it can be a valuable resource for experienced teachers, science coordinators, educators, and aspiring and new instructors.

Table 2: Semester-Wise Breakup of Scheme of Studies of B.Ed. (1.5) under TPACK Model

TPACK component	Semester-1	Semester-2	Semester -3	Specialized Courses
Technological knowledge	0	0	0	
Pedagogical knowledge	General Methods of Teaching (Professional)-8601	0	Teaching Practice II (Professional)-8608	1. Educational Technology 2. Computers in Education 3. Broadcast Media 4. Non-Broadcast Media
Content knowledge	0	0	0	0
Technological pedagogical knowledge	0	0	0	0
Technological pedagogical content knowledge	0	0	0	0

This table describes the distribution of B.Ed. Courses among three semesters. It is concluded that sixteen courses are offered in three semesters, and none of them is related to integrating technology in the teaching and learning process. Also, four courses are taught in the specialized courses of three categories of "leadership and management" In this category, four courses are offered, all related to school leadership and management.

Four courses are offered in the "educational technology and evaluation" category. These include Educational Technology, Computers in Education, Broadcast Media, and Non-Broadcast Media. These four courses are completely related to technology integration in the teaching and learning process. In the last category, "Teacher Education," four courses are offered; they all are related to the hierarchy of the Pakistani education system, like primary, tertiary, and Secondary Education, after the content analysis of B.Ed. The Program concluded that four courses are offered in this Program, but they are not compulsory to study for preservice teachers; along with that, there is a dare need to upgrade the content material of the courses, which is outdated and theoretical.

5. Discussion

In Pakistan, the preparation of professional education courses for elementary school teachers is structured as a 1.5-year program (54 credits). Acquiring fundamental content and pedagogical knowledge is crucial to the first two semesters of preservice teacher education. In addition to assessing the acquisition of this fundamental knowledge, a final exam is administered at the end of the academic year.

According to the current analysis, the B.Ed. The curriculum is not exhaustive. The first two semesters of the Programme are devoted to general pedagogical and philosophical aspects of Education. The first course is an introductory one that covers the fundamental principles of teaching various subjects. Following that are strategies for assessment, developing curricula, leading, and conducting research. There is not even a single course regarding integrating technology. In this stage of the preservice teacher education curriculum, English and math played a minimal part for students who focus on other topics, such as Urdu. The situation is very different when it comes to how technology is addressed in the B.Ed. Program's curriculum in our study. Since technology is not a subject that must be covered in primary school, it is not covered in the workshop or internship.

In the optional courses, emphasis is placed on using interactive whiteboards and preparing lessons using technological programs such as CAI. Specific themes are featured in some, such as cyberbullying, Internet safety education, and the TPACK structure. Aside from its importance, technology is offered as an elective course in the final semester. Three technology-related courses were enrolled in the previous semester; nevertheless, this Program's objective to integrate technology in subject domains has yet to be fulfilled since subject domain teachers lack the expertise and abilities to incorporate technology in their lessons. According to research, new instructors do not believe they are fully equipped to use ICT in their classes (Sang et al., 2010). While there may be a number of contributing factors, it is well-recognized that preservice exposure to the use of ICT for learning significantly impacts how teachers view and use technology once they are in the classroom (Agyei and Voogt, 2011). In doing so, it has become evident that preservice Education must incorporate ICT experiences with subject matter material (Kay, 2006).

The second semester is content area focused. This Programme included four connected courses in the areas of social studies, English, math, and foreign language. That includes practical training and practice. The majority of courses deal with pedagogical expertise, and first-semester courses generally cover teaching pedagogy in great detail. The students received pedagogical information last semester as well. Two courses are merely related to teaching practice and provide students with practical teaching and learning experiences.

Tondeur et al., (2013) carried out a multiple case study to investigate how teacher education institutions (TEIs) support the development of TPACK. They discovered that TEIs have trouble incorporating TPACK into the curriculum. Although everyone preferred it, connecting TPACK to topic areas led to less emphasis being placed on ICT in the teacher education curricula. ICT should be incorporated into the entire curriculum, according to Tondeur et al. (2013), so that preservice teachers would have the chance to (a) comprehend the pedagogical justifications for utilizing ICT and (b) experience how ICT may help teaching and learning across multiple topic domains. (p. 242).

According to a study, preservice teacher educators should be concerned with integrating technology into the teaching and learning of subject areas. There is a need to promote TPACK development among preservice teachers through extensive coursework and fieldwork. Preservice teachers require academic knowledge, in-depth comprehension, and practical experience. It may be best to emphasize the pedagogical uses of technology in teacher education courses for first and last-semester students, given that this is what preservice teachers prioritized. By starting with technologies already considered vital (electronic storybooks), it may be advantageous to introduce more types of technology one by one in this manner.

5. Conclusion

In conclusion, while the B.Ed. Program at AIOU does lay foundational stones in pedagogy and subject matter, but its glaring exclusion of technology in this digital age needs rectification. The gravity of this lapse is even more pronounced considering the pivotal role of technology in contemporary Education. Embracing the TPACK framework, with due emphasis on technology, could usher in a more holistic and future-ready teaching program. Against modern educational viewpoints, the present study accentuates a glaring void in the B.Ed. Curriculum, particularly in the realm of technological integration. The global shift towards technology-

enhanced Education underscores the urgency to revisit this curriculum and infuse it with tech-savvy modules. While foundational pedagogical aspects are undoubtedly paramount, incorporating modern teaching tools and strategies would substantially augment the novelty and relevance of this research(Rehman et al., 2023). Addressing the gap of technological inclusion in the Program would also position the study at the forefront of contemporary educational discourse.

Declaration of conflict of interest

The author(s) declared no potential conflicts of interest(s) with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship and/or publication of this article.

ORCiD ID

Mussarat Iqbal https://orcid.org/0000-0003-4921-204X

Nadia Rehman https://orcid.org/0000-0002-4172-625X

References

Agyei, D., & Voogt, J. (2011). Exploring the potential of the will, skill, tool model in Ghana: predicting prospective and practicing teachers' use of technology. *Computers & Education*, *56*, 91–100. https://doi.org/10.1016/j.compedu.2010.08.017

Ainley, J., & Luntley, M. (2007). Towards an articulation of expert classroom practice. *Teaching and teacher education*, *23*(7), 1127–1138. https://doi.org/10.1016/j.tate.2006.09.002

Baran, E., Chuang, H.-H., & Thompson, A. (2011). TPACK: An emerging research and development tool for teacher educators. *Turkish Online Journal of Educational Technology*, *10*(4), 370–377.

Brown, P., Friedrichsen, P., & Abell, S. (2012). The development of prospective secondary Biology teachers PCK. *Journal of Science Teacher Education, 24(1) 133-155*. https://doi.org/10.1007/s10972-012-9312-1

Bubb, S. (2004). *The insider's guide to early professional development: Succeed in your first five years as a teacher*. Routledge. https://www.routledge.com/The-Insiders-Guide-to-Early-Professional-Development-Succeed-in-Your-First/Bubb/p/book/9780415334945

Cohen, R., & Yarden, A. (2009). Experienced junior-high-school teachers' PCK in Light of a curriculum change: "The Cell is to be studied longitudinally." *Research in Science Education*, *39*, 131–155. https://doi.org/10.1007/s11165-008-9088-7

Cresswell, J. W. (2003). Research design: qualitative and quantitative and mixed approaches (2nd ed.). Sage.

Darling-Hammond, L., & Bransford, J. (2005). *Preparing teachers for a changing world: what teachers should learn and be able to do*. Jossey-Bass, A Wiley Imprint. https://psugtep.pbworks.com/f/Preparing%20Teachers%20for%20a%20Changing%20World.pdf

Dilworth, P. P., Donaldson, A., George, M., Knezek, D., Searson, M., Starkweather, K., Strutchens, M., Tillotson, J., & Robinson, S. (2012). *Editorial: preparing teachers for tomorrow's technologies*. *12*.

Fazal, S., Khan, M. I., & Majoka, M. I. (2014). Teacher education in transition: a reform program in initial teacher education in Pakistan. In *Annual Review of Comparative and International Education 2014*. *25*, 357–378. https://doi.org/10.1108/S1479-367920140000025020

Friedrichsen, P. J., Abell, S. K., Pareja, E. M., Brown, P. L., Lankford, D. M., & Volkmann, M. J. (2009). Does teaching experience matter? Examining Biology teachers' prior Knowledge for teaching in an alternative certification program. *Journal of Research in Science Teaching*, *46*(4), 357–383. https://doi.org/10.1002/tea.20283

Friedrichsen, P., Van Driel, J. H., & Abell, S. K. (2011). Taking a closer look at science teaching orientations. *Science Education*, *95*(2), 358–376. https://doi.org/10.1002/sce.20428

Goktas, Y., Yildirim, S., & Yildirim, Z. (2009). Main barriers and possible enablers of ICTs integration into preservice teacher education programs. *Educational Technology & Society*, *12(1)*, 193–204. https://www.jstor.org/stable/jeductechsoci.12.1.193

Grossman, P. L. (1990). *The making of a teacher: Teacher knowledge and teacher education*. Columbia University. https://lccn.loc.gov/90038509

Guskey, T. R. (1986). Staff development and the process of teacher change. *Educational Researcher*, *15*(5), 5–12. https://doi.org/10.3102/0013189X015005005

Guskey, T. R. (2000). *Evaluating Professional Development*. Corwin Press.

Harris, J. B., & Hofer, M. J. (2011). Technological Pedagogical Content Knowledge (TPACK) in Action. *Journal of Research on Technology in Education*, *43*(3), 211–229. https://doi.org/10.1080/15391523.2011.10782570

Hatton, E. (1992). Shaping Australian teacher education: teacher educators' AARE research interests. *The Australian Educational Researcher*, *19*(1), 29–44. https://doi.org/10.1007/BF03219502

Henze, I., van Driel, J. H., & Verloop, N. (2007). Science teachers' knowledge about teaching models and modelling in the context of a new syllabus on public understanding of science. *Research in Science Education*, *37*(2), 99–122. https://doi.org/10.1007/s11165-006-9017-6

Iqbal, M. J., & Ahmad, M. (2010). Enhancing Quality of Education Through E-Learning: the case study of Allama Iqbal Open University. *Turkish Online Journal of Distance Education*, *11*(1). https://dergipark.org.tr/en/download/article-file/156081

Iqbal, M., Yanping, L., Rehman, N., & Khalid, M. S. (2022). Challenges to the pre-service teachers and enabling their TPACK knowledge during B.Ed. Degree program of AIOU, Pakistan. *Liberal Arts and Social Sciences International Journal (LASSIJ)*, *6*(1). https://doi.org/10.47264/idea.lassij/6.1.14

Jumani, N. B., Rahman, F., Chishti, S. H., & Malik, S. (2011). Teachers Training through Distance Mode in Allama Iqbal Open University (AIOU) Pakistan: a case study. *Turkish Online Journal of Distance Education*, *12*(2), 76–90. https://dergipark.org.tr/en/pub/tojde/issue/16904/176253

Kausar, G., & Akhtar, R. N. (2013). Teachers' perception regarding the effect of curriculum and examination system on Pakistani college students. English language performance. *Journal of Education and Practice*, *4*(1), 152. https://core.ac.uk/download/pdf/234633896.pdf

Kay, R. (2006). Evaluating strategies used to incorporate technology into preservice education. *Journal of Research on Technology in Education*, *38*, 383–408. https://doi.org/10.1080/15391523.2006.10782466

Koehler, M. J., Mishra, P., & Cain, W. (2013). What is Technological Pedagogical Content Knowledge (TPACK)? *Journal of Education*, *193*(3), 13–19. https://doi.org/10.1177/002205741319300303

Koehler, M. J., Mishra, P., Akcaoglu, M., & Rosenberg, J. M. (2013). The technological pedagogical content knowledge framework for teachers and teacher educators. *ICT integrated teacher education: A resource book*, 2-7. https://journals.sagepub.com/doi/abs/10.1111/j.1467-9620.2006.00684.x

Koh, J., & Divaharan, S. (2011). Developing Preservice Teachers' Technology Integration Expertise Through the TPACK-Developing Instructional Model. *Journal of Educational Computing Research*, *44*, 35–58. https://doi.org/10.2190/EC.44.1.c

Lee, E., & Luft, J. A. (2008). Experienced Secondary Science Teachers' Representation of Pedagogical Content Knowledge. *International Journal of Science Education*, *30*(10), 1343–1363. https://doi.org/10.1080/09500690802187058

Magnusson, S., Krajcik, J., & Borko, H. (2002). Nature, Sources, and Development of Pedagogical Content Knowledge for Science Teaching. In J. Gess-Newsome & N. G. Lederman (Eds.), *Examining Pedagogical Content Knowledge, 6*, 95–132. Kluwer Academic Publishers. https://doi.org/10.1007/0-306-47217-1_4

Mishra, P., & Koehler, M. J. (2008, March). Introducing technological pedagogical content knowledge. In *annual meeting of the American Educational Research Association*. *1*, 16. http://www.matt-koehler.com/publications/Mishra_Koehler_AERA_2008.pdf

Mujahid, Y. H. (2002). Digital opportunity initiative for Pakistan. *The Electronic Journal of Information Systems in Developing Countries*, *8*(1), 1-14. https://doi.org/10.1002/j.1681-4835.2002.tb00050.x

Ottenbreit-Leftwich, A. T., Glazewski, K. D., Newby, T. J., & Ertmer, P. A. (2010). Teacher value beliefs associated with using technology: addressing professional and student needs. *Computers & Education*, *55*(3), 1321–1335. https://doi.org/10.1016/j.compedu.2010.06.00

Park, S., Jang, J.-Y., Chen, Y.-C., & Jung, J. (2011). Is Pedagogical Content Knowledge (PCK) Necessary for Reformed Science Teaching? Evidence from an Empirical Study. *Research in Science Education*, *41*(2), 245–260. https://doi.org/10.1007/s11165-009-9163-8

Rehman, N., Zhang, W., & Iqbal, M. (2021). The use of technology for online classes during the global pandemic: Challenges encountered by the schoolteachers in Pakistan. *Liberal Arts and Social Sciences International Journal (LASSIJ)*, *5*(2). https://doi.org/10.47264/idea.lassij/5.2.13

Rehman, N., Zhang, W., Mahmood, A., Fareed, M. Z., & Batool, S. (2023). Fostering twenty-first century skills among primary school students through math project-based learning. *Humanities and Social Sciences Communications*, *10*(1). https://doi.org/10.1057/s41599-023-01914-5

Sang, G., Valcke, M., Braak, J. van, & Tondeur, J. (2010). Student teachers' thinking processes and ICT integration: Predictors of prospective teaching behaviors with educational technology. *Computers & Education*, *54*(1), 103–112. https://doi.org/10.1016/j.compedu.2009.07.0

Stake, R. (1995) *Case Researcher Roles, the Art of Case Study Research*. Sage.

Shulman, L. S. (1986). Those Who Understand: Knowledge Growth in Teaching. *Educational Researcher*, *15*(2), 4–14. https://doi.org/10.3102/0013189X015002004

Tondeur, J., Roblin, N. N. P., Braak, J. van, Fisser, P., & Voogt, J. (2013). Technological pedagogical content knowledge in teacher education: in search of a new curriculum. *Educational Studies*, *39*(2), 239–243. https://doi.org/10.1080/03055698.2012.713548

Zhang, Y., & Wildemuth, B. M. (2009). Qualitative analysis of content. In B. M. Wildemuth (Ed.). Applications of social research methods to questions in information and library science, libraries unlimited. 1-12. https://www.ischool.utexas.edu/~yanz/Content_analysis.pdf