



Exploring Pre-service Teachers' Perspectives on TPACK: Technology, Pedagogical, and Content Knowledge

Rashmi Nautiyal^{1*} • Prashant Dabral²

Department of Education, HNB Garhwal University Srinagar Garhwal Uttarakhand

Department of Education, B.G.R. Campus Pauri, HNB Garhwal University Uttarakhand

*Corresponding Author Email id: rashminautiyal9@gmail.com

Received: 31.05.2023; Revised: 29.12.2023; Accepted: 30.12.2023

©Society for Himalayan Action Research and Development

Abstract: In the context of educational transformation, the integration of innovations into teacher education programs is essential for enhancing the effectiveness of the teaching-learning process. Teachers must possess comprehensive content knowledge to incorporate suitable pedagogical practices and create technologically enriched educational environments. Teaching is a dynamic endeavor demanding a diverse range of knowledge and skills from educators, encompassing personal qualities, vocational expertise, and instructional abilities. This research focuses on investigating pre-service teachers' perceptions of Technology, Pedagogical, and Content Knowledge (TPACK). Conducted on 200 pre-service teachers from HNB Garhwal University, the study utilized a TPACK questionnaire with seven components. Employing descriptive quantitative research methodology, the analysis revealed that pre-service teachers generally held an average and positive perception of TPACK. Gender and subject stream influenced the Technological Pedagogical Content Knowledge (TPCK) domain, while no significant differences were found in other components. Furthermore, locality and educational qualifications showed no significant impact on TPACK perception. Overall, the findings underscore the importance of understanding pre-service teachers' perspectives on TPACK to inform and improve teacher education programs.

Keywords: TPACK • Pre-service teachers • Perception

Introduction

In the twenty-first century, the rapid development of information and communication technology has provided wide access to all aspects of education. However, to successfully use digital technology tools in an educational context, pre-service teachers must be able to integrate their technological knowledge and apply it to a particular educational situation (Irmak and Tuzun, 2018). Its objective is to assist pre-service teachers in successfully integrating technology into their future jobs. It should be mentioned that improving TPACK requires pre-service teachers to concentrate not only on how to use technology abilities but also on how to incorporate digital technologies into

their educational setting. The benefits associated with incorporating TPACK in instructional techniques have been extensively established in past research, such as how using technology may boost pre-service teachers' confidence (Adamy and Boulmetis 2006; Özçakır and Aydın 2019). The competencies teachers should possess include academic competence (classroom management skills, content knowledge, student motivation, presentation skills, communication skills, and assessment competencies), professional competence, personality competence, and social competence. Out of all these competencies, academic competency serves at the highest level for a teacher. So that he can make his teaching



and learning environment effective and interactive.

Technical knowledge (TK) refers to the knowledge and skills of an individual, including technical awareness, it promotes teachers' knowledge of technical tools, various technologies, and related educational resources, and their ability to problem-solve using them. Content knowledge (CK) describes the teacher's knowledge related to the content, which includes the principles, concepts, facts, theories, and ideas of the content. Pedagogical knowledge (PK) is a collection of knowledge about teaching and learning, in this case closely related to teaching methods, classroom management, curriculum design, student assessment, etc. It includes knowledge related to teaching and learning, understanding of methods, classroom management skills, lesson planning, feedback, and evaluation. Pedagogical competency cannot be separated from content as one is interrelated with the other, thus creating the concept of PCK (Pedagogical Content Knowledge). A teacher should not only have mastery over the subject matter but also have the skill to convey the subject matter to the student so that the knowledge of the subject can be easily passed on to the students through various teaching approaches. Also, present-day teachers need to integrate technology with teaching to make the learning process effective. Along with this, it is also observed that many teachers are not able to keep pace with technology as teachers face problems in the use and implementation of technology in education. There are many such abstract topics in the curriculum. Which will not be easy to explain only by class lecture and such topics become a challenge for the teacher. For this, the teacher needs to adopt something new in his teaching, it may be necessary for the teacher to use technology and other educational resources in teaching to teach such material. In which audio-video resources, animation images,

teaching aids, etc. these tools of educational technology can help in making the teacher effective which creates innovation in the teaching-learning process. The development and dissemination of knowledge require the teacher to know and understand the knowledge and use of TPC (Technology, Pedagogy, and Content). Also, there should be understanding and ability to integrate them so that teaching can be made more effective.

The Model of Technological Pedagogical Content Knowledge (TPACK) describes the successful integration of technology into teaching by the teacher. It suggests that teachers need to learn about the interrelationships of technology, pedagogy, and content So that these three can increase the expansion of knowledge by contacting each other. The TPACK framework can be useful in the design, development, and evaluation of the quality of technology integration (Bowers and Stephens 2011; Chai Koh et al 2013; Harris et al 2010). Technological Pedagogy Content information (TPACK) is the theory created to clarify the gathering of information that instructors require for teaching their students successfully and using technology (McGraw-Hill, 2019)

Based on the above research, the present study aims to determine the statistically significant relationship between pre-service teachers' level of perception towards TPACK and their gender, stream, locality or place of residence, and education qualification. However, the following hypothesis has been formulated.

- (1) There is no statistically significant difference between pre-service teachers' TPACK perception based on gender.
- (2) There is no statistically significant difference between pre-service teachers' TPACK perception based on the subject stream.
- (3) There is no statistically significant difference between pre-service teachers' TPACK perception by locality.



(4) There is no statistically significant difference exists between pre-service teachers' TPACK perception based on education qualification.

Research Methods

The descriptive survey method was used in the present study. In this quantitative design, a survey approach was used to collect information about the gender, subject category, and educational qualification of pre-service teachers based on their locality. The sample for this study was collected through visiting purposive sampling methods from 200 student teachers from three campuses of HNBGU University. The data was collected from the students in all the semesters of the 2021-2023 academic years. Data were collected online using Google Forms with a TPACK questionnaire created by the researcher herself. This questionnaire was distributed to the respondents through WhatsApp groups. The TPACK questionnaire was used to assess teachers' perception of technology, pedagogical, and content knowledge. The questionnaire contained 39 statements covering all seven TPACK sub-domains. Description Item delivery details, including 7 PK items, 6 TK items, 6 CK items, 4 TPK items, 4 TCK items, 5 PCK items, and 7 TPCK items. The questionnaire consisted of five

Likert scales: strongly disagree, disagree, neutral, agree, and strongly agree. The TPACK Perception Questionnaire statements have been tested for validity and reliability. Pearson product-moment correlation was used for validity testing with all valid results, while the reliability was tested using Cronbach's alpha with a result of 0.958. T-test and ANOVA tests were used in Microsoft Excel to analyze the data.

Analysis and Results

The demographic characteristics of the pre-service teachers participating presented in Table 1 which shows that out of a total of 200 pre-service teachers, 97 are male and 103 are female with 48.5 and 51.5 percent respectively. Out of a total of 200 pre-service teachers, 91 were arts stream and 109 science stream pre-service teachers, whose percentage was 45.5 and 54.5 respectively, 93 were urban and 107 rural pre-service teachers whose percentage was 46.5 and 53.5 respectively. Out of 200 pre-service teachers, 117 students of 2nd-semester B.Ed, 56 students of 4th semester B.Ed, and 27 students of Master of Education (M.Ed) participated, whose percentage was 58.5%, 28%, and 13.5% respectively.

Table1. Demographic Profile of Respondents

Variable		Frequency (N)	Percentage (%)
Gender	Male	97	48.5%
	Female	103	51.5%
Stream	Arts	91	45.5%
	Science	109	54.5%
Locality	Urban	93	46.5%
	Rural	107	53.5%
Educational Qualification	2nd-semester B.Ed	117	58.5%
	4th-semester B.Ed	56	28%
	Master of Education (M.Ed)	27	13.5%



The TPACK Perception Scale (Table 2) has the highest number of "agree" options across all domains. Pre-service teachers have high and positive levels of technical educational content knowledge (TPAC) perceptions. It is also observed that pre-service teachers have a high level of perception in PK, TK, CK, TPCK, and all the domains 28.31, 23.14, 23.20, 27.74, which means that pre-service teachers have good

knowledge about content, pedagogy, and technology. Have good knowledge and understanding of how to learn, methods of learning, planning, process, and assessment of learning in the classroom and also Pre Service Teachers mean PCK, TPK, TCK, 19.76, 16.03, and 15.73 In which the level of those perceptions was found to be low.

Table 2. Descriptive analysis of the TPACK domains

TPACK Domains	Mean	SD	Level of Perception
Pedagogy Knowledge (PK)	28.31	3.24	High perception
Technology Knowledge (TK)	23.15	3.48	High perception
Content Knowledge (CK)	23.22	3.40	High perception
Pedagogical Content Knowledge(PCK)	19.77	2.68	Low perception
Technological Pedagogical Knowledge (TPK)	16.03	2.05	Low perception
Technological Content Knowledge (TCK)	15.74	2.19	Low perception
Technological Pedagogical Content Knowledge(TPCK)	27.74	3.56	High perception

Pre-service Teacher's TPACK perceptions of 7 components by gender were analyzed using a t-test with Microsoft Excel. Table 3 shows the results of the analysis. The results show that there is no significant difference in gender on

the components of PK, TK, CK, PCK, TPK, TCK, and all domains of TPACK. This result also indicates that there is a significant difference in gender on the components of TPCK. Other studies have also stated that there is no significant impact of gender on TPACK.

Table 3. TPACK Perceptions of Pre-service Teachers Concerning Gender

Domain	Gender	N	Mean	SD	Df	t	P(two-tails)
PK	Male	97	28.62	3.43	198	1.287	0.1997
	Female	103	28.03	3.05			
TK	Male	97	23.63	3.46	198	1.901	0.0586
	Female	103	22.7	3.46			
CK	Male	97	23.3	5.29	198	0.318	0.7506
	Female	103	23.15	3.06			
PCK	Male	97	20.14	2.7	198	1.953	0.0522
	Female	103	19.41	2.64			
TPK	Male	97	16.27	2.12	198	1.567	0.1186
	Female	103	15.82	1.96			
TCK	Male	97	15.89	2.15	198	0.919	0.359
	Female	103	15.6	2.21			
TPCK	Male	97	28.26	3.54	198	1.996	0.0473
	Female	103	27.26	3.51			
All domain	Male	97	156.103	17.17	198	1.692	0.0988
	Female	103	151.96	17.43			



Pre-services are based on teachers' perceptions of TPACK by subject category. The results of the analysis using a t-test according to Microsoft Excel to compare pre-service teachers' TPACK perceptions about the 7 components of TPACK can be seen in Table 4. The results showed that

no significant difference was found between Arts and Science subjects on PK, TK, CK, PCK, TPK, TCK, and all domains of TPACK. However, the difference was observed based on the steam-wise TPCK domain.

Table 4. TPACK perceptions of pre-service teachers concerning streams

Domain	Stream	N	Mean	SD	Df	T	P(two-tails)
PK	Arts	91	28.09	2.85	198	0.904	0.3669
	Science	109	28.50	3.54			
TK	Arts	91	22.71	3.29	198	1.625	0.1057
	Science	109	23.51	3.60			
CK	Arts	91	23.21	2.96	198	0.043	0.9661
	Science	109	23.23	3.74			
PCK	Arts	91	19.63	2.43	198	0.666	0.5059
	Science	109	19.88	2.89			
TPK	Arts	91	15.78	1.87	198	1.614	0.1081
	Science	109	16.25	2.13			
TCK	Arts	91	15.60	2.23	198	0.865	0.3879
	Science	109	15.86	2.27			
TPCK	Arts	91	27.15	3.36	198	2.170	0.0311
	Science	109	28.24	3.65			
All domain	Arts	91	152.16	16.24	198	1.344	0.1803
	Science	109	155.48	18.22			

The results of the analysis are shown in Table 5. The results show that there is no significant difference in locality on the components of PK, TK, CK, PCK, TPK, TCK, TPCK, and all

domains of TPACK. The findings of the study show that there is no significant difference in the perception of TPACK between urban and rural pre-service teachers.

Table 5. TPACK perceptions of pre-service teachers concerning the locality

Domain	Locality	N	Mean	SD	df	T	P(two-tails)
PK	Urban	93	28.44	3.34	198	0.511	0.1534
	Rural	107	28.20	3.16			
TK	Urban	93	23.08	3.91	198	0.283	0.7778
	Rural	107	23.21	3.07			
CK	Urban	93	23.29	3.99	198	0.272	0.7856
	Rural	107	23.16	2.80			
PCK	Urban	93	19.91	2.81	198	0.731	0.4657
	Rural	107	19.64	2.57			
TPK	Urban	93	16.25	2.23	198	1.369	0.1723
	Rural	107	15.85	1.86			



TCK	Urban	93	15.78	2.41	198	0.270	0.7872
	Rural	107	15.70	1.98			
TPCK	Urban	93	28.12	3.65	198	1.429	0.1544
	Rural	107	27.41	4.33			
All domain	Urban	93	154.88	19.16	198	0.691	0.4906
	Rural	107	153.18	15.72			

In the context of TPACK, the perceptions of pre-service teachers based on their educational qualifications are investigated. Educational qualifications have been classified into three categories: second-semester B.Ed, fourth-semester B.Ed, and M.Ed semester to assess pre-service teachers' perceptions of seven TPACK

components using Microsoft Excel. Table 6 shows the results of the analysis done with the F-test. The findings indicated that there was not a significant difference in pre-service teachers' perceptions of TPACK based on their educational qualifications (2nd-semester B.Ed, 4th-semester B.Ed, Master of Education (M.Ed).

Table 6. TPACK perception of Pre-services teachers concerning educational qualification

Domain	Educational Qualification	N	Mean	Df	F	P(two-tails)
PK	2nd-semester B.Ed	117	28.50	3.32	0.518	0.4563
	4th-semester B.Ed	56	28.16	3.11		
	Master of Education (M.Ed)	27	27.85	3.21		
TK	2nd-semester B.Ed	117	23.41	3.70	0.788	0.3889
	4th-semester B.Ed	56	22.79	3.38		
	Master of Education (M.Ed)	27	22.78	2.59		
CK	2nd-semester B.Ed	117	23.50	3.29	0.976	0.37882
	4th-semester B.Ed	56	22.91	3.90		
	Master of Education (M.Ed)	27	22.67	2.86		
PCK	2nd-semester B.Ed	117	19.94	2.97	0.632	0.5326
	4th-semester B.Ed	56	19.57	2.37		
	Master of Education (M.Ed)	27	19.41	1.91		
TPK	2nd-semester B.Ed	117	16.15	2.20	1.357	0.2599
	4th-semester B.Ed	56	15.66	1.96		
	Master of Education (M.Ed)	27	16.30	1.41		
TCK	2nd-semester B.Ed	117	15.89	2.32	0.758	0.4701
	4th-semester B.Ed	56	15.61	1.99		
	Master of Education (M.Ed)	27	15.37	2.00		
TPCK	2nd-semester B.Ed	117	27.85	3.94	0.496	0.6095
	4th-semester B.Ed	56	27.82	3.08		
	Master of Education (M.Ed)	27	27.11	2.58		
All domain	2nd-semester B.Ed	117	155.24	18.94	0.782	0.4588
	4th-semester B.Ed	56	152.52	15.80		
	Master of Education (M.Ed)	27	151.48	12.81		



Discussion, Conclusion and Suggestion

The present study studied pre-service teachers' perceptions of Technological Pedagogical and Content Knowledge (TPACK) about gender, stream, locality, and educational qualification. Pre-service teachers studying at HNB Garhwal University have an average level of perception as well as a high level of score on the PK, TK, CK, and TPACK components, which means that pre-service teachers have good knowledge of technology, content, individual differences, learning domain, Good understanding of Ways of Assessment, Feedback Methodology and Classroom Management. Pre-service teachers understand the concept of TPACK and know how to use technology to deliver knowledge throughout the classroom. Students knew more about pedagogy and content than they did about technology. This finding correlates with earlier research (Schmidt et al 2009; Roig-Vila et al 2015). All participants in pre-service teachers pre-service teachers were favorable in TPACK perceptions in this study (Lin et al 2013; Luik et al 2017). The findings of the study showed that there was no meaningful difference between male and female pre-service teachers regarding the overall TPACK except for the TPAC dimension. The score of the male in TPACK was higher than that of female participants only within the entire TPACK scale. Several studies show that the overall TPACK of gender variables and participants has no significant difference (Çoklar 2014; Karaca 2015; Ersoy et al 2016; Karakaya and Yazıcı 2017). There is no significant difference in technological pedagogical content knowledge between students of the Arts stream and students of the Science stream is accepted except the TPAC domain" the study supported by studies Sathya (2017), Pradeep (2018). As a suggestion, instead of providing proper content, variety of technology, and pedagogy competence, there is a need to design curriculum in teacher education

programs to enhance pre-service teacher TPACK in an integrated manner. Thus, there is a need to bring innovations in education, in which technology should be integrated with traditional methods of teaching. Students should have more opportunities and facilities to enhance and apply their content knowledge. In which knowledge of pedagogy and technology can help in improving their teaching.

References

- Adamy Peter and Boulmetis John (2006).The impact of modeling technology integration on pre-service teachers' technology confidence. *Journal of Computing in Higher Education*. 17. 100-120. 10.1007/BF03032700.
- Bowers J S and Stephens B (2011). Using technology to explore mathematical relationships: A framework for orienting mathematics courses for prospective teachers. *Journal of Mathematics Teacher Education*, 14, 285-304.
- Chai Ching and Koh Joyce and Tsai Chin-Chung (2013). A Review of Technological Pedagogical Content Knowledge. *Educational Technology & Society*. 16. 31-51.
- Çoklar A N (2014). Primary School pre-service teachers' technological pedagogical content knowledge competency in terms of gender and ICT use phase. *Egitim ve Bilim*, 39 (175), 319-330.
- Ersoy M, Yurdakul I K, and Ceylan B (2016). Investigating pre-service teachers' TPACK competencies through the lenses of ICT skills: An experimental study. *Egitim ve Bilim*, 41(186), 119-135.
- Harris Judith, Grandgenett Neal and Hofer Mark. (2010). Testing a TPACK-Based Technology Integration Assessment Rubric.
- Irmak M, and Yilmaz Tüzün Ö (2018). Investigating pre-service science teachers'



- perceived technological pedagogical content knowledge (TPACK) regarding 19.<https://digitalcommons.unomaha.edu/tefacproc/19>.
- Karaca F (2015). An investigation of pre-service teachers' technological pedagogical content knowledge based on a variety of characteristics. *International Journal of Higher Education*, 4(4), 128-136.
- Karakaya F and Yazici M. (2017). Examination of technological pedagogical content knowledge (TPACK) self-efficacy for pre-service science teachers on material development. *European Journal of Education Studies*, 2(9), 252-270.
- Lin Tzu-Chiang , Tsai Chin-Chung, Chai Ching and Lee Min-Hsien (2013). Identifying Science Teachers' Perceptions of Technological Pedagogical and Content Knowledge (TPACK). *Journal of Science Education and Technology*. 22.
- Luik P, Taimalu M and Suviste R (2017). Perceptions of technological, pedagogical and content knowledge (TPACK) among pre-service teachers in Estonia. *Education and Information Technologies*, 23(2), 741–755.
- McGraw-Hill (2019). what is TPACK theory and how can it be used in the classroom? www.mheducation.ca/blog/what-is-tpack-theory-and-how-can-it-be-used-in-the-classroom.
- Pradeep K S L (2018). A Study of Techno-Pedagogical skills of Secondary school Hindi teachers working in Kerala: *International Journal of Advance Research and Innovative Ideas in Education*, 4 (1).
- Roig-Vila Rosabel, Mengual-Andres, Santiago, Quinto Medrano Patricia (2015). Primary Teachers' Technological, Pedagogical and Content Knowledge. *Comunicar*. 23. 10.3916/C45-2015-16.
- Sathya G (2017). Techno pedagogical skills of B.Ed students: *International research journal of India*, 2 (10).
- Schmidt D A, Baran E, Thompson A D, Mishra P, Koehler M J and Shin T S (2009). Technological pedagogical content knowledge (Track): The development and validation of an assessment instrument for pre-service teachers. *Journal of Research on Technology in Education*, 42(2), 123149.
- Özçakır B and Aydın B (2019). Effects of augmented reality experiences on technology integration self-efficacy of prospective mathematics teachers. *Turkish Journal of Computer and Mathematics Education*, 10(2), 314–335.
