



## A Study of Digital Competence and Technological Pedagogical and Content Knowledge of Prospective Teachers undergoing Bachelor of Education (B.ED.)

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### Abstract

The purpose of this study is to examine the Digital Competence and Technological Pedagogical and Content Knowledge (TPACK) of prospective teachers undergoing B.Ed. in Nagaland with reference to academic semester, pedagogy and age. A total of 150 teachers participated in the study. The sampling method of the study was simple Random Sampling Method.

The study revealed that B.Ed. third semester prospective teachers have higher digital competence than the first semester. The study also revealed no significant difference among the prospective teachers undergoing B.Ed. on their Digital Competence with respect to age and pedagogy as well as in their TPACK with respect to academic level, pedagogy and age. The study also found weak positive relationship between Digital Competence and TTPACK of the prospective teachers undergoing B.Ed.

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### 1. Introduction

Technology has penetrated every aspects of our society and there is rapid expansion in the use of technology in all walks of life. The educational system of our country emphasizes on the use and integration of technology to support education as evident in the National Policy on Information and Communication technology (2012) and NEP (2020) for the purpose of improving teaching-learning and evaluation processes, teacher preparation and professional development, enhancing educational access, and streamlining educational planning, management and administration. Technology has become a requirement in educational environments, and the effective and purposeful use of technology by teachers will facilitate raising technologically literate individuals (Schmidt *et al.*, 2009)<sup>[12]</sup>. Both teachers and students need to develop knowledge and skills of integrating technology in this 21st century as a lifelong skill, and therefore, it is important to study the TPACK and Digital Competence level of teachers who will be using technology to teach and to equip learners with the required knowledge and skills of the 21<sup>st</sup> century digitalized and technologized world.

Technological Pedagogical and Content Knowledge (TPACK) built upon Shulman's construct of Pedagogical Content Knowledge (PCK), is characterized as the multiple intersections of teachers' knowledge of curriculum content, general pedagogies, technologies, and contextual influences upon learning (Harris & Hofer, 2011; Schmidt *et al.* 2009)<sup>[5, 12]</sup>.

### The field of Technological Pedagogical Content Knowledge (TPACK) encompasses three main areas:

1. Content knowledge (CK) is knowledge about the subject matter that is to be learned or taught- knowledge of concepts, theories, ideas, organizational frameworks, methods of evidence and proof, as well as established practices and approaches toward developing such knowledge in a particular discipline.
2. Pedagogical knowledge (PK) refers to the processes and practices of teaching and learning, encompassing educational purposes, goals, values, methods, techniques, strategies, learners' needs and preferences and more.
3. Technological knowledge (TK) refers to knowledge about the use of various technologies- internet, digital video, interactive whiteboards, software programs, digital devices (Harris & Hofer, 2011; Harris *et al.*, 2009, Schmidt *et al.*, 2009) <sup>[5, 6, 12]</sup>.

### The interactions between these three areas result in:

1. **Pedagogical content knowledge (PCK):** Content knowledge that deals with the teaching process- how to teach specific content-based material
2. **Technological content knowledge (TCK):** How to select technologies for creating new representations that best embody and support particular content-based precepts.
3. **Technological pedagogical knowledge (TPK):** How to use particular technologies in teaching and understanding that technology may change the way teachers teach (Harris & Hofer, 2011; Harris *et al.*, 2009, Schmidt *et al.*, 2009) <sup>[5, 6, 12]</sup>.

The integration of the three concepts result in the framework of Technological Pedagogical Content knowledge (TPCK/TPACK) i.e. knowledge required for integrating technology to teach specific content-based material, using technologies that best embody and support it, in ways that are appropriately matched to students' needs and preferences (Harris & Hofer, 2011; Harris *et al.*, 2009, Schmidt *et al.*, 2009) <sup>[5, 6, 12]</sup>.

Previous studies stressed on the importance of understanding the framework of TPACK for teachers as it helps them to integrate technology, instruction, and content knowledge to support the complex and interconnected nature of teaching and learning (Karaduman & Akman, 2024); and build 'connections among technologies, curriculum content, and specific pedagogical approaches within contextual knowledge' for 'effective discipline-based teaching with educational technologies' (Harris *et al.*, 2009) <sup>[6]</sup>. It can impact the training and professional development of both pre-service and in-service teachers (Schmidt *et al.*, 2009) <sup>[12]</sup> as teachers need to keep up and adapt with the rapid advancements in technology in this diverse society (Lee *et al.*, 2022).

The integration of technology in teaching requires one to have the knowledge and skills of using ICT and digital competence. Digital competence implies the creative, critical, and safe use of information and communication technologies, to achieve objectives related to work, employability, learning, use of free time, inclusion, and participation in society (Hernandez *et al.*, 2020). Teachers need to have the ability, along with a strong theoretical foundation,

investigation and experimentation to apply the knowledge, attitudes and skills necessary to plan, implement, evaluate and continually review ICT-supported teaching and learning processes (Zhao *et al.*, 2021) <sup>[14]</sup>. Digital competence is integrated into the pedagogical and administrative work that encompasses, planning and carrying out teaching in a digital environment, assessing pupils with the aid of digital tools, communication and cooperation with parents and colleagues online, and so on (Kelentrić *et al.*, 2017). The use of digital technology has become an urgent demand in this changing world (Citriadin *et al.*, 2021); and digital competence is considered as one of the life skills- a life-long learning skill (Zhao *et al.*, 2021) <sup>[14]</sup>. This study will also help to understand teacher's ability to use digital tools and information and communication technology based on pedagogical principles by realising all its implications in educational methodology (Zhao *et al.*, 2021) <sup>[14]</sup>.

ICT in education is one of the courses in the two-year B.Ed. programme incorporated as per the National Curriculum Framework for Teacher Education (NCFTE, 2009) to enhance the professional capacities of the prospective teachers where student-teachers are to reflect critically and act responsibly to prevent use of ICTs to support centralisation of larger knowledge structures; and in adapting ICTs to support decentralized structures and processes; as well as build the 'digital public' to make education a participatory and emancipatory process (NCERT, 2009). By understanding the framework and implications of TPACK and digital competence in teaching learning processes, this study aimed to investigate the level of prospective teachers' level of TPACK and digital competence; and whether TPACK has relationship with their digital competence which is an inseparable part of the teachers' professional practice. Though various studies have been conducted on TPACK and Digital Competence separately, not many studies have been conducted on both this area together especially in the context of Nagaland, and therefore, this study was undertaken to give suggestions to the stakeholders in equipping the teachers with the required knowledge and skills in integrating technology in education and to help them meet the challenges of their academic life and future professional work.

## 2. Review of Literature

Anjali Shokeen *et al.*, (2022) <sup>[13]</sup> found that the attitude and belief of pre-service teachers in integrating technology can be changed by giving proper practice and training such as providing practical experience; mentor guidance; interaction with technology experts and updating knowledge of student teachers at all the levels of teacher training programmes. Jiménez-Hernández *et al.*, (2020) <sup>[7]</sup> investigated the Digital Competence of Future Secondary School Teachers. The study revealed teachers from engineering and architecture science had greater digital competence in comparison to teachers from the sciences, social and legal sciences and arts and humanities. Women were found to have lower level of digital competence in comparison to men. Individuals born from 1990 (Z-Generation) scored higher in all digital competence areas. Zhao *et al.*, (2021) <sup>[14]</sup> conducted a survey study on Digital Competence in Higher Education: Students' Perception and Personal Factors. The findings showed positive students' perceptions of digital competencies in terms of information and data literacy, communication and

collaboration, and safety. Furthermore, significant differences were found in students' self-perceptions of digital competence related to gender in the areas of information and data literacy, digital content creation and problem solving. With regard to grade level, fourth year students were perceived to have higher digital competence than the first years in terms of their digital competence in the section of information and data literacy; and digital content creation; Students with an urban residence were found to have higher digital competence than students with a rural residence in the section of information and data literacy, communication and collaboration, digital content creation, as well as safety and problem solving; and students with prior relevant training were found to have higher digital competence than those without training. Fanaturiza and Rindaningsih (2024)<sup>[4]</sup> conducted a review study of TPACK AND Teachers' Digital Competence in the era of Industry 4.0. It highlighted the importance of teachers' digital competence to equip themselves and adapt to the changing technological developments, to understand digital ethics and to teach students to be responsible users of technology. The study emphasized on how the TPACK framework can help teachers to understand how to integrate technology with pedagogical and content knowledge for effective and relevant learning experiences. Teachers can thus design technology-based learning activities that enhance students' understanding of the subject matter, leading to increased student engagement, participation, collaboration and personalized learning. Ozdemir (2016) conducted a descriptive study on Techno-Pedagogical Educational Competencies of Pre-service Elementary School and Preschool Teachers. The study revealed found high TPACK level among the third- and fourth-year pre-service teachers. Further, pre-service education had positive effects on their TPACK and recommended the use of technology as one of the criteria of their assessment and to provide opportunities to the teachers for using technology. Dangwal and Srivastava (2016)<sup>[3]</sup> discussed the role of digital pedagogy in the teacher education institutions in India. They suggested on providing appropriate knowledge and develop skills among student-teachers for using and integrating the correct technology in a suitable manner, and ensuring technological integration, pedagogy and subject area content effectively in their classroom teaching.

### 3. Objectives of The Study

- To study the difference in Digital Competence scores among prospective teachers undergoing B.Ed. with respect to academic semester, pedagogy and age.
- To study the difference in TPACK scores among prospective teachers undergoing B.Ed. with respect to academic semester, pedagogy and age
- To study the relationship between Digital Competence and TPACK of prospective teachers undergoing B.Ed.

### 4. Hypotheses of The Study

- **H<sub>01</sub>:** There is no significant difference in the Digital Competence between 1<sup>st</sup> semester and 3<sup>rd</sup> semester prospective teachers undergoing B.Ed.
- **H<sub>02</sub>:** There is no significant difference in Digital

Competence scores among prospective teachers undergoing B.Ed. with reference to their pedagogy.

- **H<sub>03</sub>:** There is no significant difference in Digital Competence scores among prospective teachers undergoing B.Ed. with reference to their age.
- **H<sub>04</sub>:** There is no significant difference in the TPACK between 1<sup>st</sup> semester and 3<sup>rd</sup> semester prospective teachers undergoing B.Ed.
- **H<sub>05</sub>:** There is no significant difference in TPACK scores among prospective teachers undergoing B.Ed. with reference to their pedagogy.
- **H<sub>06</sub>:** There is no significant difference in TPACK scores among prospective teachers undergoing B.Ed. with reference to their age.
- **H<sub>07</sub>:** There is no significant difference in the relationship between Digital Competence and TPACK of prospective teachers undergoing B.Ed.

## 5. Methodology of The Study

### 5.1. Research Design

Descriptive survey method was adopted to study the Technological Pedagogical and Content Knowledge (TPACK) and Digital Competence of Prospective teachers undergoing B.Ed. in Nagaland.

### 5.2. Population and Sample

The population of the study consisted of all the prospective teachers undergoing Bachelor of Education (B.Ed.) in both the government and private Teacher Education Institutions in Nagaland in the academic year 2024-2026 and 2025-2027 in Nagaland. The sample consisted of 150 prospective teachers studying in B.Ed. 1<sup>st</sup> and 3<sup>rd</sup> semesters from the pedagogy of Language, Mathematics, Sciences and Social Sciences and in the age range of 21-25 years, 26-30 years and 31 years above, selected randomly through simple random sampling technique.

### 5.3. Tools and techniques

The tool employed to collect the data was Teachers' Technological Pedagogical and Content Knowledge Scale (TTPACKS) developed by Hemant Lata and Leena Sharma (2017) which consisted of 55 items and Digital Competence Scale for Teachers (DCST) developed by Ramkrishna (2017) which consisted of 50 items. The analysis of the data was done with the help of appropriate statistical technique such as, Mean and Standard Deviation, T-test, ANOVA and correlation.

## 6. Results and Interpretations

**Objective 1:** To study the difference in Digital Competence scores of prospective teachers undergoing B.Ed. based on academic semester, pedagogy and age.

To find out the significant difference, the data has been analysed and interpreted using descriptive statistics such as mean, and standard deviation. The hypothesis is tested by employing the "t" test and ANOVA.

**H<sub>01</sub>:** There is no significant difference in the Digital Competence between 1<sup>st</sup> semester and 3<sup>rd</sup> semester prospective teachers undergoing B.Ed.

**Table 1:** Result of t-test in respect of Digital Competence between B.Ed. 1<sup>st</sup> Semester and 3<sup>rd</sup> semester prospective teachers undergoing B.Ed.

Academic Semester	N	Mean	Std. Deviation	df	t	S/NS
1 <sup>st</sup> Semester	68	176.94	31.35	148	3.683	S*
3 <sup>rd</sup> Semester	82	195.05	28.77			

\*At 0.05 level of significance

From Table 1, it can be observed that the calculated t value (3.683), for the significance of the difference between the means of 1<sup>st</sup> semester and 3<sup>rd</sup> semester prospective teachers undergoing B.Ed. in Nagaland on Digital Competence is more than the table value (1.96) for df=148 at 0.05 level of significance. Hence, the null hypothesis that there is no significant difference in Digital Competence between means of 1<sup>st</sup> semester and 3<sup>rd</sup> semester prospective teachers

undergoing B.Ed. cannot be accepted. Hence, the null hypothesis is rejected. The mean score (195.05) of the third semester prospective teachers is more than that of the mean score (176.94) of the 1<sup>st</sup> semester prospective teachers.

**H<sub>02</sub>:** There is no significant difference in Digital Competence scores among prospective teachers undergoing B.Ed. with reference to their pedagogy.

**Table 2:** Result of the F-test for the significant difference in the Digital Competence among prospective teachers undergoing B.Ed. with respect to their pedagogy

Source of Variance	Sum of Squares	df	Mean Square	F	S/NS
Between Groups	4386.682	3	1462.227	1.493598	NS*
Within Groups	142933.5	146	978.9964		
Total	147320.2	149			

\*At 0.05 level of significance

Table 2 showed that the calculated value of F (1.4935) for df=3 and 146 is less than the critical F value (2.66) and is therefore, statistically not significant at 0.05 level of significance. Hence we cannot reject the null hypothesis that, there is no significant difference among the means of different groups on the basis of their pedagogy on Digital

Competence. Therefore, null hypothesis is accepted at this degree of confidence.

**H<sub>03</sub>:** There is no significant difference in Digital Competence scores among prospective teachers undergoing B.Ed. with reference to their age.

**Table 3:** Result of the f-test for the significant difference in the Digital Competence among prospective teachers undergoing B.Ed. with respect to age

Source of Variance	Sum of Squares	df	Mean Square	F	S/NS
Between Groups	5301.223	2	2650.612	2.743577	NS*
Within Groups	142018.9	147	966.1152		
Total	147320.2	149			

\*At 0.05 level of significance

From table 3, it can be observed that the calculated value of F (2.743) for df=2 and 147 is less than the critical F value (3.06) and is therefore statistically not significant at 0.05 level of significance. Hence, we cannot reject the null hypothesis that, there is no significant difference among the means of different groups on the basis of their age on Digital Competence. Therefore, null hypothesis is accepted at this degree of confidence.

Teachers undergoing B.Ed. based on academic semester, pedagogy and age

To find out the significant difference, the data has been analysed and interpreted using mean, and standard deviation. The hypothesis is tested by employing the “t” test and ANOVA.

**H<sub>04</sub>:** There is no significant difference in the TPACK scores between 1<sup>st</sup> semester and 3<sup>rd</sup> semester prospective teachers undergoing B.Ed.

**Objective 2:** To study the difference in Technological Pedagogical Content and Knowledge of Prospective

**Table 4:** Result of t-test in respect of TPACK between 1<sup>st</sup> Semester and 3<sup>rd</sup> semester prospective teachers undergoing B.Ed.

Academic Semester	N	Mean	Std. Deviation	df	t	S/NS
1 <sup>st</sup> Semester	68	207.19	33.0	148	0.85702	NS*
3 <sup>rd</sup> Semester	82	211.56	28.6			

\*At 0.05 level of significance

From Table 4, it can be observed that the calculated t value (0.85702), for the significance of the difference between the means of 1<sup>st</sup> semester and 3<sup>rd</sup> semester prospective teachers undergoing B.Ed. in Nagaland on Teachers' Technological Pedagogical and Content Knowledge is less than the table value (1.96) for df=148 at 0.05 level of significance. Hence,

the null hypothesis that there is no significant difference between means of 1<sup>st</sup> semester and 3<sup>rd</sup> semester prospective teachers undergoing B.Ed. on Teachers' Technological Pedagogical and Content Knowledge cannot be rejected. Hence, the null hypothesis is accepted.

**H<sub>05</sub>:** There is no significant difference in TPACK scores among prospective teachers undergoing B.Ed. with reference to their pedagogy.

**Table 5:** Result of the F-test for the significant difference in the TPACK among prospective teachers undergoing B.Ed. with respect to pedagogy

Source of Variance	Sum of Squares	df	Mean Square	F	S/NS
Between Groups	4823.205	3	1607.735	1.7368	NS*
Within Groups	135147.3	146	925.6667		
Total	139970.5	149			

\*At 0.05 level of significance

Table 5 showed that the calculated value of F (1.7368) for df=3 and 146 is less than the critical F value (2.66) and is therefore, statistically not significant at 0.05 level of significance. Hence, we cannot reject the null hypothesis that, there is no significant difference among the means of different groups on the basis of their pedagogy on Technological Pedagogical and Content Knowledge.

Therefore, null hypothesis is accepted at this degree of confidence.

**H<sub>06</sub>:** There is no significant difference in TPACK scores among prospective teachers undergoing B.Ed. with reference to their age.

**Table 6:** Result of the f-test for the significant difference in the TPACK among prospective teachers undergoing B.Ed. with respect to age.

Source of Variance	Sum of Squares	df	Mean Square	F	S/NS
Between Groups	5339.754	2	2669.876838	2.9156	NS*
Within Groups	134630.8	147	915.8556893		
Total	139970.5	149			

\*At 0.05 level of significance

From table 6, it can be observed that the calculated value of F (2.9156) for df=2 and 147 is less than the critical F value (3.06) and is therefore statistically not significant at 0.05 level of significance. Hence, we cannot reject the null hypothesis that, there is no significant difference among the means of different groups on the basis of their age on Technological Pedagogical and Content Knowledge. Therefore, null hypothesis is accepted at this degree of confidence.

**Objective 3:** To study the relationship between Digital Competence and TPACK of prospective teachers undergoing B.Ed.

**H<sub>07</sub>:** There is no significant difference in the relationship between Digital Competence and TPACK of prospective teachers undergoing B.Ed.

**Table 7:**

Correlation between Digital Competence and Tpack of prospective teachers undergoing B.Ed.

Variables	'r' value	S/NS
Digital Competence TTPACK	0.0933	S*

From table 7, the correlation coefficient is 0.0933 and the significant value indicates a weak positive correlation between the Digital Competence and TPACK of prospective teachers undergoing B.Ed. at 0.05 level of significant. Therefore, the null hypothesis is accepted.

## 7. Discussion

The study found the third semester prospective teachers undergoing B.Ed. to have higher level of Digital Competence than the 1<sup>st</sup> semester prospective teachers. One reason may be because the third semester students had more opportunities to integrate ICT in their learning process through seminar presentations, group projects, assignments, class activities as well as assessment activities in comparison to the 1<sup>st</sup> semester who had recently joined the programme and thus, had lesser opportunities. This finding is consistent with the findings of Zhao *et al.*, (2021) [14] where fourth year students were perceived to have higher digital competence than the first years. The study also found no significant difference among the means of different groups on the basis of their pedagogy on Digital Competence. This finding is contrary to the study of Jiménez-Hernández *et al.*, (2020) [17] which found teachers from engineering and architecture science to have greater

digital competence in comparison to teachers from the sciences, social and legal sciences and arts and humanities; and Kozuh *et al.* (2021) which showed that science and technology teachers apply digital tools more frequently while teaching than other subject teachers. The study also found no significant difference among the means of different groups on the basis of their age on Digital Competence. Reasons for this could be due to similar kinds of ICT exposure activities that are given to the student teachers throughout the B.Ed. programme regardless of their pedagogy or age difference. The study found no significant difference between means of 1<sup>st</sup> semester and 3<sup>rd</sup> semester prospective teachers undergoing B.Ed. on TPACK. This finding is contrary to the findings of Ozdemir (2016) where senior teachers had higher TPACK competencies than junior pre-service teachers. The study found no significant difference among the means of different groups on the basis of their pedagogy on Technological Pedagogical and Content Knowledge which is consistent with the findings of Kalaimani and Stephen (2022) [18]. The study found no significant difference among the means of different groups on the basis of their age on Technological Pedagogical and Content Knowledge. The reasons for these findings may be due to the gap between theory and practice as the

prospective teachers are yet to apply their knowledge and skills of pedagogical practices using technology in their teaching practice during their school internship in the fourth semester.

The study found weak positive relationship between the Digital Competence and TPACK of prospective teachers undergoing B.Ed. This shows that digital Competence have positive effect on TPACK and vice versa; and the weak relationship may indicate that having digital competence may not directly lead to competence in TPACK unless the teachers are given the knowledge, skills and competencies of incorporating technology in their pedagogical practices. It may also be because the prospective teachers are yet to develop their knowledge, skills and competencies in practically integrating technology in the teaching learning process.

## 8. Implications

### Some of the educational implications of this study are:

1. Teacher education institutions should provide sufficient opportunities and practical hands-on classes to the prospective teachers undergoing B.Ed. to integrate technology in their teaching learning process from the very start of their B.Ed. programme.
2. Teachers should be given adequate seminar, training and workshops inviting experts on how to integrate technology in their pedagogical process to enhance their delivery of the subject matter.
3. Sufficient ICT facilities should be provided in the institutions to enable the prospective teachers to acquire knowledge of ICT and practice the skills of using ICTs in developing digital competence and TPACK.
4. Sufficient opportunities should be given to the teachers to develop their digital competence and TPACK before they embark on their internship.
5. Enhancing Professional Capacities (EPC) course on 'ICT in Education' should be an intensive course where the prospective teachers should be made to demonstrate the use of technology in their learning process.
6. Teachers should be motivated and their interest aroused by giving them activities to present seminar papers through PPTs, use smart boards & interactive board, develop E-resources and E-content using ICT. All these will enable them to gradually become more confident and competent in using technology in their teaching learning process as well as a lifelong skill.

## 9. Conclusion

The study found the third semester prospective teachers undergoing B.Ed. to have higher level of Digital Competence than the 1<sup>st</sup> semester prospective teachers. The study also found no significant difference among the means of different groups on the basis of their pedagogy and age on Digital Competence. The study also found no significant difference Teachers' Technological Pedagogical and Content Knowledge based on academic semester, pedagogy and age. The study found weak positive relationship between the Digital Competence and TPACK of prospective secondary school teachers. It can be concluded that the prospective teachers undergoing B.Ed. are yet to develop their knowledge, skills and competencies in practically integrating technology in the teaching learning process; and therefore, TEIs should focus on providing more practical opportunities

through which prospective teachers can develop their digital competence and technological pedagogical and content knowledge for effective teaching learning process.

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