

Teachers' Techno-pedagogical Competence on Students' Academic Achievement: Perspectives of Senior Secondary Schools

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ABSTRACT

The study analyses the levels of postgraduate teachers' Techno-Pedagogical Competence (TPC) and students' academic achievement in the Bodoland Territorial Region (BTR) of Assam. The sample of the study consisted of 200 PGT teachers and 400 students' academic achievements from the 20 senior secondary schools. The Teacher's Techno-Pedagogical Competency scale (TPCS) was used to collect data; the scale was developed by S. Rajasekhar and K. Sathiyaraj. The statistical techniques, like mean, standard deviation, Z-score, and t-test, are used to analyze data. The results of the study revealed that the majority (39 percent) of teachers' techno-pedagogical competence levels are average, 19.5 percent are below average, and 3.5 percent are at an extremely low level. While 16 percent are above average, 9.5 percent are high, and 2.5 percent lie in extremely high. The study revealed that the highest portion (51 percent) of students' results lie in grades C₁ and C₂, remarks (fair and average) percentage ranges (1563-1573). Otherwise, 21.75 percent are in grade B₂, remarking (good) percentage ranges (1563-1573), and 8.75 percent are grade B₁, the remark (very good) percentage ranges (1563-1573). A little percent (3) lies in the grade A₂ and remark excellent percentage ranges (1563-1573). There was a negligible correlation ' r ' = 0.045, between teachers' techno-pedagogical competence and students' academic achievement. There was no statistical mean difference between urban and rural postgraduate teachers on techno-pedagogical competence. The above results indicated the average teachers' techno-pedagogical competence and average academic results in this region need technological improvement and continuous teacher training.

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1. Introduction

Education is a complex and multifaceted process that includes the acquisition of knowledge, skills, attitude, belief and habits. It promotes one's own growth and develops the capacity to contribute to society progress via creativity, training and research. So, today, it is not enough to study only theories but also to learn practical skills and create a positive mindset to adjust to the present world. As a result, educational institutions are changing from traditional teaching techniques to modern digital ones in order to prepare students for the needs of the modern workforce. Techno-pedagogy are the three dimensions of knowledge that are technological, pedagogical and content knowledge integrated into the educational theory and practices (Patil & Bharati, 2025). It also includes the skill of leveraging technology in the planning of teaching and learning experiences to improve the learning outcomes (Kumar, 2021). Techno-pedagogy can provide higher educational connectivity and relevant low-cost material to all teaching and learning groups. This approach requires educators' technological knowledge with pedagogical expertise based on sound teaching principles and learning objectives. Techno-pedagogy changed the teaching-learning paradigm from transmission of knowledge to construction of knowledge (Jeena, 2024). Basically, Techno-Pedagogical Competency helps the teacher to teach with proper methodology, principles and strategy for making teaching more meaningful and effective (Sobha, 2021). Ali and Chetia (2026) demonstrated that the today's education is more creative, engaging, collaborative and personalized for these developments and expansions. So, the teachers must use technology in their classrooms to assist students in achieving their future endeavours and to prepare them to face the problems of the twenty-first century.

- **Theoretical Framework**

- **Techno-Pedagogical Competence**

Techno-pedagogy is the meaningful integration of technology within pedagogy or educational theory and practice. Patil & Bharati (2025) stated that technology, pedagogy and content

knowledge are the makeup of techno-pedagogy. Techno-pedagogical competence is technological knowledge with pedagogical expertise based on sound teaching principles and learning objectives. It involves the art of incorporating technology into the design of teaching and learning experiences to enhance student learning outcomes, such as utilizing the Internet for exploration and accessing relevant information to the teaching-learning process (Kumar, 2021). It is also providing educational connectivity and relevant low-cost material to all teaching and learning groups. It focuses on how technology may successfully improve teaching strategies and learning outcomes, going beyond just employing digital tools.

- **Academic Achievement**

Academic achievement is the learning achievement in the final exam. Academic achievement is a scale to determine student's academic success in schools or colleges (Gill, 2020). It is also used in diagnosing the students' strengths and weakness and as a basis of awarding degrees, prizes or scholarships. In the present study, academic achievement is defined as H.S. 2nd year final exam result held in 2024.

- **Bodoland Territorial Region (BTR) of Assam, India**

Bodoland Territorial Region (BTR) is an autonomous region of Assam in India which consisted four districts. BTR was established on 10th February 2003 under the 6th schedule of Indian constitution. According to the census of 2011, 31% of Schedule Tribe (ST) and 69% of non-Schedule Tribe (non-ST) and 10% of Assam's population live there.

- **Significance**

Techno-pedagogy is trending in the 21st century's digital world. In the digital world ICT dramatically changed the scenario of the teaching-learning process. It is making the classroom more effective, collaborative and personalized. Techno-pedagogy can help both teachers and students achieve more with less time. The senior secondary stage of education is the second foundation of education which

determines the vocational direction of life of students. This stage of education is the bridge between primary and higher education in India. It is crucial to include techno-pedagogy at the secondary stage for making education more accessible and inclusive. Therefore, this study tries to find out the importance of techno-pedagogical competency of the Postgraduate teachers and students' academic achievement. So, the findings of the study will benefit policymakers and educational stakeholders in implementing educational policies suited to the unique requirements of the Bodoland Territorial Region (BTR) of Assam, and promoting equality in education.

- Statement of the Problem

"Teachers' Techno-pedagogical Competence on Students' Academic Achievement: Perspectives of Senior Secondary Schools"

- Objectives

I. To study the techno-pedagogical competence of Postgraduate Teachers (PGT) in the Bodoland Territorial Region (BTR) of Assam.

II. To study the academic achievement of senior secondary school students in the Bodoland Territorial Region (BTR) of Assam.

III. To find out the relationship between Postgraduate Teachers (PGT) techno-pedagogical competence and students' academic achievement in the Bodoland Territorial Region (BTR) of Assam.

IV. To compare the techno-pedagogical competence of Postgraduate Teachers (PGT) in the Bodoland Territorial Region (BTR) of Assam with respect to Location (Rural/Urban).

- Hypotheses

H0₁: There is no significant relationship between Postgraduate Teachers (PGT) techno-pedagogical competence and students' academic achievement in the Bodoland Territorial Region (BTR) of Assam.

H0₂: There is no significant difference in techno-pedagogical competency between rural and urban

Postgraduate Teachers (PGT) in the Bodoland Territorial Region (BTR) of Assam.

- Review of related literature

Palit & Bharati (2025) conducted an empirical study to assess the impact of techno-pedagogy on students' academic achievement in social science at secondary school level. The study selected survey method and 100 samples (teachers and students). Result of the study indicated that there was significant relation between techno-pedagogy and students' academic achievement at secondary level.

Regueras, et al. (2025) conducted a quantitative study on techno-pedagogical approaches and academic achievement based on LMS log data. Result of the study indicated that innovative approaches like multimedia resources did not consistently improve academic achievement. Each discipline had varying degrees of success in science, engineering and health.

Sijali & Poudel (2025) conducted a systemic literature review to investigate the techno-pedagogical approach on educational practices. Results indicated that the techno-pedagogical approach is suitable to create the conducive teaching-learning environment in order to improve students' academic achievement as well as cultural awareness.

Mondal, P.K. (2024) examined the influence of techno-pedagogical competence on the effectiveness on teachers and students' academic achievement in a wide range of educational setting. Results of the study revealed that techno-pedagogical competence had positive correlation with students' academic achievement. The urban teachers showed better techno-pedagogical competence than rural teachers at the secondary school level.

Guru & Beura (2019) presented a survey-type study to find out the techno-pedagogical competency of PGT teachers in relation to students' academic success in science. The findings indicated that most teachers had moderate-level techno-pedagogical competency, while teachers in urban areas exhibited higher levels of competency compared to those in rural

areas due to differences in facilities available at urban and rural schools. So, there was a correlation between teachers' techno-pedagogical competency and students' academic success.

Afzal & Thomas (2019) conducted an experimental study to find out the effect of techno-drive learning on students' academic achievement of public secondary school in Karachi. Results of the study revealed that there was significant difference between techno-drive and traditional learning classroom students' academic achievement.

Participants:

The participants in the study consisted of 20 Senior Secondary Schools, 200 PGT teachers, and 400 students. The subjects in the study were selected by the using disproportionate stratified random technique from the four districts in the Bodoland Territorial Region (BTR) of Assam. The random sampling is a bias-free and equal

2. Methodology

Research Design:

The study undertaken to investigate the Postgraduate Teachers' (PGT) techno-pedagogical competence and students' academic achievement. So, the investigator adopted a descriptive survey research design, involving a sample of 200 teachers and 400 students. Data collection was performed using a standardized techno-pedagogical competency scale. Statistical measures including Z-scores and t-tests were employed to conclude the findings.

chance of selected as a sample (Creswell, 2023). Teachers, students' results, and schools are selected from the public and provincialized arts and science schools in both urban and rural areas in the BTR of Assam. The distributed sample are described below figure 1

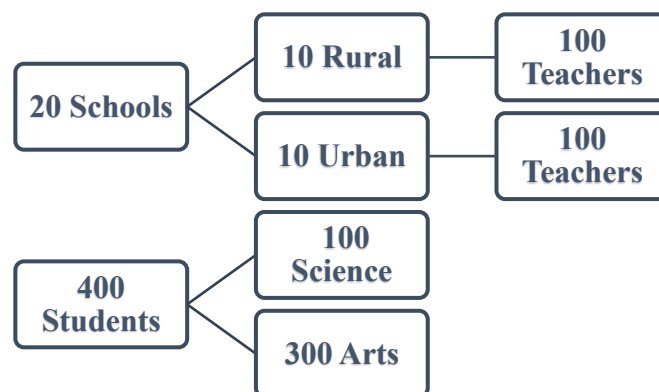


Figure 1. Sampling flowchart of Schools, Students and Teachers.

Instrument:

Teacher's Techno-pedagogical Competence Scale (TTPCS) was used to collect data from teachers at the senior secondary level. The scale was developed and standardized by S. Rajasekhar & K. Sathiyaraj in 2013. The scale consisted of 40 items and four dimensions with highest marks 200, validity and reliability being 0.91 and 0.82.

Procedure:

The study was administered during the last academic session, i.e. 1563-1573 only. Before

administering the questionnaires, the investigator visited the institution to discuss the main purpose of the study with the authorities and sought permission for data collection. The investigator developed a good rapport with the school teachers and was taken into confidence by saying that the information given by them would be strictly kept private and confidential as well as exclusively used for research purposes only.

Data Analysis:

Descriptive statistics (Mean, SD and Z score) are used to find out the level of PGT teachers techno-pedagogical competence and students' academic achievement and inferential statistics (Pearson correlation and t-test) are applied to find out the significance co-relation and differences

among PGT teachers techno-pedagogical competence (independence variable) and students' academic achievement (dependence variable). Both parametric tests are verified before the used.

Table 1: Showing the norms for interpretation of teachers' techno-pedagogical competence

SL No.	Range of Z-scores	Grade	Level of competence
1	+ 2.01 and above	A	Extremely High
2	+1.26 to + 2.00	B	High
3	+0.51 to +1.25	C	Above Average
4	-0.50 to +0.50	D	Average
5	-0.51 to - 1.25	E	Below Average
6	-1.25 to -2.00	F	Low
7	-2.01 and below	G	Extremely Low

Descriptive Statistics

Objective-1: To study the level of techno-pedagogical competence of Postgraduate Teachers (PGT) in the Bodoland Territorial Region (BTR) of Assam.

To study the level of techno-pedagogical competence of PGT teachers, the z-scores were

calculated and arranged from -2.01 and below to +2.01 and above among the 200 teachers' scores. On the basis of z-scores, 200 PGT teachers' scores were categorized from extremely high levels of competence to extremely low. This aspect of data is shown in table 2.

Table 2: Showing percentage wise distribution of (N=200) samples on different levels of TPC.

SL. No.	Level of Techno-Pedagogical Competence	N	Percentage
1	Extremely High	5	2.5
2	High	19	9.5
3	Above Average	32	16
4	Average	79	39.5
5	Below Average	39	19.5
6	Low	19	9.5
7	Extremely Low	7	3.5
Total		200	100

Table 2. presents the percentage-wise distributions of 200 samples across different levels of techno-pedagogical competence. The scores categorize teachers into seven levels, ranging from “*extremely high*” to “*extremely low*.” The above table demonstrates that a tiny least of teachers 2.5% have “*extremely high*” techno-pedagogical competence, while 9.5% have “*high*”

and 16% are “*above average*.” The majority of teachers 39.5% fall into the “*average*,” indicating a balanced competence between modern and traditional. Meanwhile, 19.5% of teachers are “*below average*,” 9.5% are “*low*,” and 3.5% have “*extremely low*.”

Objective-2: To study the academic achievement of Senior Secondary School students in the Bodoland Territorial Region (BTR) of Assam.

To study the academic achievement of Senior Secondary School students in BTR, Assam. The

400 students' results were arranged from grade A₁ to O, according to the Assam School Education Board (ASSEB-II). The detailed description of data is shown in the table 3.

Table 3: Showing the grades and remarks of student (Sample 400)

Marks Range (in %)	Grade	Remarks	N	Percentage
1563-1573	A ₁	Exceptional	0	0
1563-1573	A ₂	Excellent	12	3
1563-1573	B ₁	Very good	35	8.75
1563-1573	B ₂	Good	87	21.75
1563-1573	C ₁	Fair	103	25.75
1563-1573	C ₂	Average	101	25.25
1563-1573	O	Marginal	62	15.5
Total		400	100	

Table 3 represents the distribution of 400 students' results into different ranges of marks and grades. The grades are categories from "A₁" to "O" and ranges mark are 1563-1573 to 1563-1573. The above table demonstrated that there are no A₁ or exceptional students among the sample in this region of study. A tiny least of students' results: 0.3% have grade A₂ (Excellent), while 8.75% have grade B₁ (Very Good) and 21.75% have grade B₂ (Good). The majority of students' results lie between grades C₁ and C₂ ((Fair & Average) (51%). Meanwhile, 15.5% of

students received the grade "O" (Marginal), indicating a percentage range from 33 to 40.

Correlation

To test the null hypothesis that there is a significant difference between PGT teachers' techno-pedagogical competence and students' academic achievement. The scores were obtained and subjected to a Pearson correlation '*r*' test, and the results obtained are detailed descriptions shown in the table 4.

Table 4: Showing the significant relation between PGT teachers' TPC and students' academic achievement.

Categories	N	Mean	SD	Df	'r'	Remark
AA	400	53.39	54.57	598	.045	Significance at 0.01 level
TPC	200	115.34	23.44			

Note. AA = Academic Achievement, TPC = Techno-pedagogical Competence, N= Number, SD = Standard Deviation, Df = Degree of freedom, '*r*'= Co-relation.

Table 4. represents the co-relation between Senior Secondary School students' academic achievement and PGT Teachers' Techno-Pedagogical Competence. The null hypothesis

tested and concluded that there is a statistically not significant relationship between students' academic achievement and PGT teachers' TPC. The analysis revealed that df=598 and correlation '*r*' = 0.045 is less than the table value (0.080) at the 0.01 significance level. Therefore, there is a negligible relationship between students' academic achievement and Techno-Pedagogical Competence within the study sample.

t-test

To test the null hypothesis that there is no significant relation between rural and urban PGT

Table 5: Showing the comparison of TPC among rural and urban PGT teachers

Location	N	Mean	SD	Df	<i>t'</i>	SE _D	Remarks
Rural	100	113.05	26.16	198	-1.38	3.31	NS*
Urban	100	117.63	20.24				

Note. NS* = non-significant at both level (0.01&0.05) TPC = Techno-pedagogical Competence, PGT = Postgraduate Teacher, N= Number, SD = Standard Deviation, df = Degree of freedom, *t'* = t- value, SE_D = Standard Error of Deviation.

Table 5 showing the comparison of PGT teachers techno-pedagogical competence base on location (rural/urban).

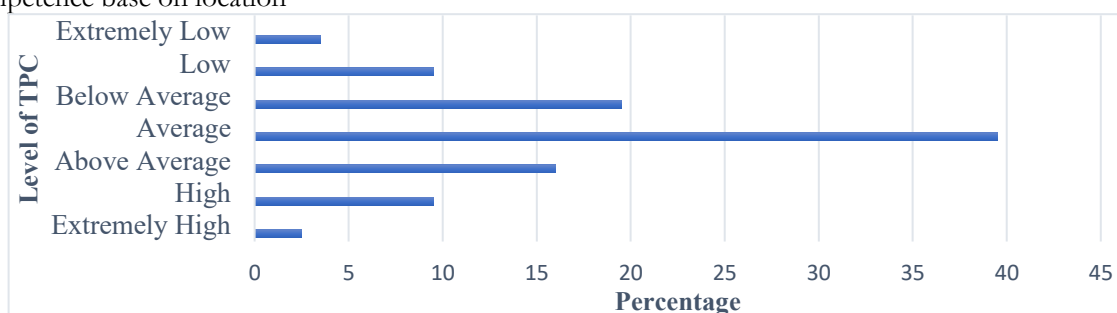
Statistically tested the null hypothesis and concluded that it is not significant at both level. It is indicated that there is no significant difference

in techno-pedagogical competency between rural and urban Postgraduate Teachers (PGT) in the Bodoland Territorial Region (BTR), Assam is accepted. The analysis revealed that (df)=198, *t'* value =-1.38 and SE_D =3.31. The analysis concluded that rural and urban PGT teachers

teachers' techno-pedagogical competence. The scores were obtained and subjected to a '*t*' test and result obtained are shown in the table 5.

3. Results

The study is designed to test the tentative hypotheses and to achieve the corresponding objectives, which are assessed in the light of the findings. The findings and conclusions are



sequenced in order to the objectives and hypotheses of the study;

- i. The majority of PGT teachers in the Bodoland Territorial Region (BTR) of Assam showed average and below-average techno-pedagogical competence as shown in table- 2 and below figure 2. (59 percentage)

Figure 2. Level of Techno-Pedagogical Competence

- ii. More than half of the senior secondary students' results lie between the grades C₁ and C₂ and remarks are fair and average in the Bodoland Territorial Region (BTR) of Assam, as shown in table-3 and figure 3- mark ranges 40 to 60 percentage.

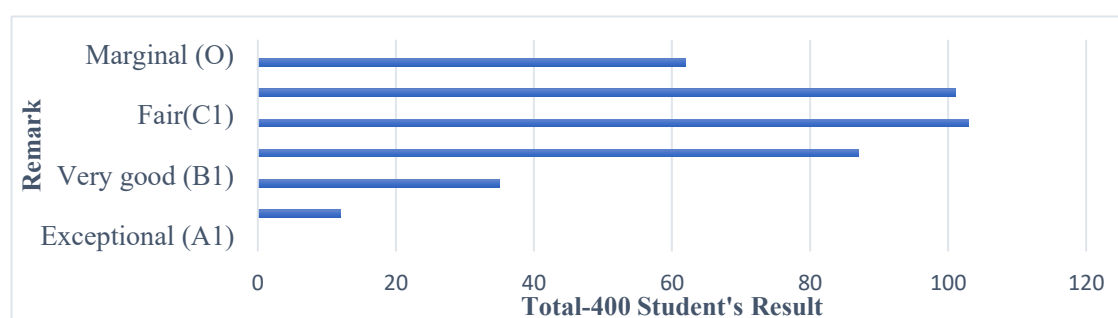


Figure 3. Students Result

iii. There was a negligible relationship between academic achievement of Senior Secondary School students and techno-pedagogical competence of PGT teachers in the Bodoland Territorial Region (BTR) of Assam ($r^2=0.045$) as shown in table 4 and figure 4.

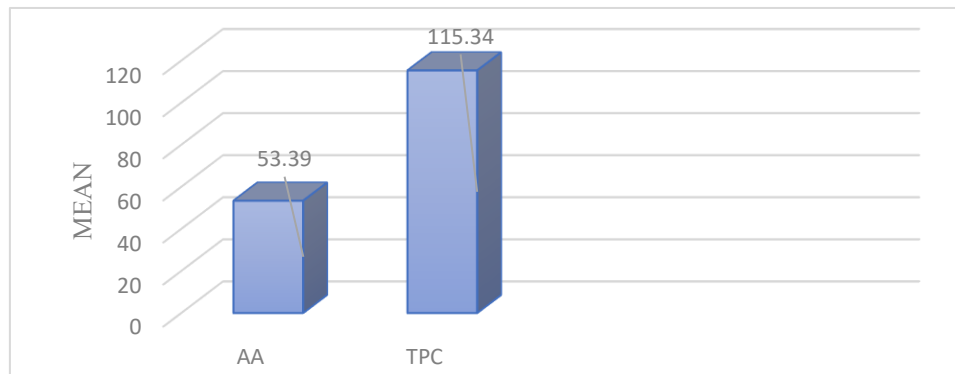


Figure 4.

Significant mean difference

iv. There was no significant difference in the techno-pedagogical competence of rural and urban PGT teachers in the Bodoland Territorial Region (BTR) of Assam is shown in the table 5 and figure 4.

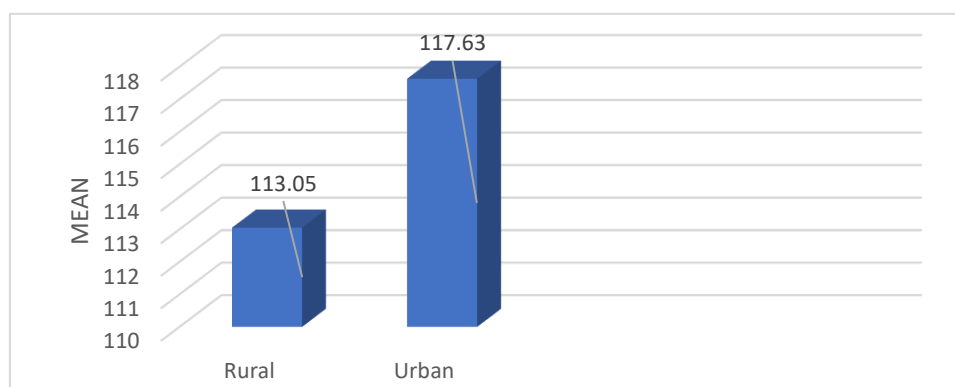


Figure 5.

Significant mean difference

4. Discussion

This study analysis the level of PGT teachers' techno-pedagogical competence and students' academic performance in the Bodoland Territorial Region (BTR) of Assam, India. The study revealed that average to below average PGT teachers' techno-pedagogical competence and students' academic results. Teachers' techno-pedagogical competence slightly associated students' academic achievement. Urban are rural PGT teachers showed same level techno-pedagogical competence. Average to below average (59 percent) techno-pedagogical competence; average to below average confidence to use ICT in the classroom. Least percent of teachers showed very confident of ICT meaningful integration in the teaching-learning

process and least percent showed loose confident to use ICT; they want to teach traditionally.

More than half of the senior secondary students' results lie between the grades C_1 and C_2 and remarks good and fair (1563-1573) percentage. Which is indicated most of the students results fair and average (40 to 60) percentage. Other findings indicated that the students' academic achievements are negligible correlated with teachers' techno-pedagogical competence ($r^2=0.045$). Students and teachers have partial confident on ICT used in their teaching and learning. Teachers are unable to create confidence to used ICT in their learning in this specific region of Assam, India. Further result showed that the urban and rural region's teachers

showed same level of techno-pedagogical competence ($Df=198$, t value $=-1.38$ and $SE_D=3.31$). It indicated there is no regional difference in this region of Assam, India. Malla & Mattoo (2022) concluded that there is no significance different of techno-pedagogical competence based on rural, urban, arts and science.

5. Conclusion

After analyzing the collected data, it can be finalized that the majority of PGT teachers in the Bodoland Territorial Region (BTR) showed average to below-average techno-pedagogical competence. Further, it was found that a large number of Senior Secondary School students' results lie between the great C_1 and C_2 , remarks fair and average (40 to 60 percent). The academic achievement of Senior Secondary School students and PGT teachers' techno-pedagogical competence are least correlated with each other because of their average technological ability and academic achievement. While both rural and urban PGT teachers showed the same level of techno-pedagogical competence in this region of Assam, India. The findings of the study concluded that the average teachers' techno-pedagogical competence and average student academic performance and there is negligible correlation between them, so the stakeholder, administrator and policymaker need to take initiatives for technological improvement in this region of Assam, India.

6. Implications

The results of the current study have several major implications for senior secondary education in the Bodoland Territorial Region of Assam for teachers, students, stakeholders, administrators, and policymakers. The findings showed that techno-pedagogical competence and digital competence are crucial for students' performance both in the classroom and in the workplace in the digital age; these competencies also facilitate the appropriate use of technology in the digital age. It also helps with the suitable integration of ICT in the classroom (Leong et al., 2024). Therefore, the professional development of technological skills for each PGT teacher should go beyond basic training and focus on

more effectively integrating ICT into their pedagogy and teaching content in the specific region of Assam. The government and administrator should remove the electrical, technological, and networking problems among the senior secondary schools in the specific region of Assam. The school authority and administrator should develop the ICT classroom in every school, and at least one class should be compulsory for each teacher in a week.

The findings also have implications for school authorities and administrators: the creation of a supportive environment where teachers can utilize ICT tools in the classroom is effective for learning. The government and educational agency should timely conduct workshops, seminars, symposiums, etc., for techno-pedagogical updating among the PGT teachers in a geographically backward region like BTR, Assam. At the policy level, the results indicated that the authorities preparing a policy consisting of the development of technological infrastructure and regular base assessment of teachers may help educational authorities identify professional development needs areas and context-based training. Such initiatives may help teachers with more technology-supportive teaching and optimum student learning at the senior secondary school in the BTR region of Assam.

Finally, the findings' implication for students' learning experiences is that teachers with stronger techno-pedagogical competence may help to create effective, collaborative, and personalized learning environments in the Bodoland Territorial Region (BTR) of Assam, India.

7. Limitations and Recommendations for Future Research

The study was conducted at the senior secondary schools in the Bodoland Territorial Region (BTR) of Assam, India, with 600 samples only. There are only two variables; techno-pedagogical competence and academic achievement. It is also limited to govt. and provincialized art and science senior secondary schools only. The study used the 12th final results as an academic achievement only.

The findings indicated the recommendations for the teachers, students, administrations,

policy maker and local & state government. The recommendations are -

Postgraduate teachers have to have basic training on educational applications for mobile apps and computers, like MS Word, MS Excel, Google Meet, Google Classroom, etc. Establish a joint (state and local) government agency to help PGT teachers strengthen their techno-pedagogical competence. Established an ICT training center at the district level, where each PGT teacher will be provided training quarterly. The major findings recommend organizing regular need-based ICT and techno-pedagogical training programs for PGT teachers in BTR of Assam. The policymakers and educational stakeholders should upgrade their digital infrastructure and provide opportunities for ongoing professional development to enhance teachers' Techno-Pedagogical Competence (TPC). The government and educational agency should cover

the electricity and broadband connectivity for each Senior Secondary School of BTR, Assam. There are a number of limitations in this study. Firstly, the generalizability of the findings is limited to a small sample size and only two variables, Techno-Pedagogical Competency (TPC) and academic achievement. At last, this study focuses on government PGT teachers within the Bodoland Territorial Region (BTR) of Assam only.

Future research should examine the contextual elements with a larger sample size and the contextual factors, including infrastructure and institutional issues, that affect technology acceptance to improve implementation. Longitudinal and experimental studies can be conducted to find out factors that are hindering the improvement of the techno-pedagogical competence of PGT teachers and will find out the solutions

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Author Declaration

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