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Research Article

Techno-Pedagogical Skills, Attitude Towards Use Of Technology And Teaching Performance Among Student-Teachers

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ABSTRACT

The present study investigates the relationship between techno-pedagogical skills, attitude towards use of technology, and teaching performance of student-teachers in the colleges of education. A survey method is used to select a sample of 867 student-teachers using random sampling technique. The research tools used are Techno-Pedagogical Skills, Attitude towards use of Technology, and Teaching Performance Scale developed by the investigators. The results of the statistical analyses show a significant correlation between techno-pedagogical skills, attitude towards use of technology and teaching performance of student-teachers in the colleges of education. However, significant difference was observed among student-teachers in the colleges of education pertaining to techno-pedagogical skills, attitude towards use of technology and teaching performance of student-teachers.

Keywords: Techno- Pedagogical Skills, Attitude towards use of technology, Teaching Performance, Student-teachers

1. Introduction

In the Gurukul system, students were taught a plethora of subjects for overall development without excluding any concept from the point of 'individual brilliance.' However, after standardization of curriculum and the choice of subjects to be taught, there was a shift towards learning processes and teaching effectiveness was seen in the deliberation of Content and 'Pedagogical Skills.' And, with the advent of technology, it became mandatory that teachers should have mastery on technology to capitalize on the new age skills. However, technology itself has witnessed rapid advancements and changes. During the Audio-Visual Aids Era, prior to 1980s, Radio, Television, Filmstrips and Overhead Projectors were used by teachers for delivery of content and with the dawn of the Digital Age, Computer Assisted Instruction and Multimedia came into existence. The advent of multimedia PCs facilitated teachers to make use of it for student engagement and the focus was shifted from student learning to teacher's skill in integrating these resources to create richer learning experiences for students.

The notion of techno-pedagogical abilities is substantiated by research highlighting the significance of educators' proficiency in seamlessly incorporating technology into their instruction. Voogt et al. (2013) emphasized the necessity for educators to cultivate particular technology pedagogical expertise to improve student learning outcomes. This competency encompasses both technical abilities and the capacity to utilize technology to facilitate certain learning objectives and pedagogical approaches. Similarly, the Technology Acceptance Model (TAM) (Davis, 1989) posits that a teacher's attitude towards technology significantly influences their actual utilization of technology in the classroom, hence impacting their teaching efficacy.

2. Need for the current research

The teaching community needs to be tech-savvy and should be able to collect, collate, edit, add subtitles, create online assessments, send and receive online feedback, share screens, employ screen readers for visually impaired students, design interactive lessons, grade the work of students and engage them through social platform. The teachers need to be 'digitally literate' and should learn the nitty-gritties of online security measures, storage techniques and control the access to different forms of learning material at different periods of time. Today's teacher also needs to be vigilant as to the social media platform norms and discipline

students who cross the line purposefully or unknowingly. The teacher should also need to learn to protect his/ her own online and digital privacy to guard himself or herself from the cyber threats. Because a teacher needs to download the works of students and all the hyperlinks and educational sites may not be secured and the teachers can become a soft target of virus threats and cyber-attacks.

Looking at the current set of student-teachers who are going to be the future teachers through the prism of 'techno pedagogical skills', it becomes imperative that the student-teachers need to learn to source the study material, network with other professionals, engage in globally accepted norms, develop assessment techniques based on the insights gained through global standards of teaching community, inspire students towards collaborative projects and assignments, engage in the established loops of feedback mechanism etc.

Similarly, it is a paramount exercise to gauge the 'attitude of student-teachers towards adaptation of technology' to understand their areas of resistance. Attitude towards technology in education is shaped by a journey of gradual integration and evolving understanding, which stemmed from a sense of comfort with traditional pedagogical methods, such as lectures and textbooks, which are familiar and reliable. Therefore, a need is felt to investigate the techno-pedagogical skills and attitude towards use of technology and teaching performance of student-teachers who would be moulding the young potent generation of our country.

3. Review of Related Literature

Studies reviewed pertaining to the present study have been compiled and presented below under appropriate headings.

3.1 Studies Related to Teaching Performance

Enoc (2019) investigated the development of a Student-Teachers Teaching Demonstration Performance Evaluation Tool. This study seeks to create a tool for evaluating the teaching demonstration efficacy of student instructors by identifying essential constructs that affect their performance. By conducting semi-structured interviews with ten student teachers and five cooperating teachers, 18 thematic indicators were discerned and amalgamated with 55 indicators from literature reviews, culminating in a total of 73 indicators. Following content and expert validation, 32 indicators were modified and utilized in a 5-point Likert scale questionnaire distributed to 265 cooperating teachers. The components consisting of classroom management, teaching approach, lesson planning, professional conduct, communication correctness and fluency, and voice modulation constitute the foundation for the weights in the proposed instrument to assess student instructors' teaching demonstration efficacy.

Zakareya et al. (2019) studied the Inverted Teaching for Improving the Teaching Performance of EFL Student Teachers at Jubail College of Education. The research assessed the influence of inverted teaching on the instructional efficacy of 54 EFL student instructors participating in the Lesson Planning course at Jubail College of Education, Imam Abdulrahman Bin Faisal University. A pre-test and post-test methodology was utilized, with statistical analysis indicating a significant enhancement in teaching performance ($t=7.6611$, $p<0.05$) following the intervention. The results indicate that inverted teaching is an efficacious approach for improving the instructional efficacy of EFL student teachers.

Evaluation

The research carried by Weshah (2012), Poulou (2017), Dhana Raju and Vijaya Vardhani (2020), primarily focuses on individual factors—such as locus of control, self-efficacy, or organizational support—in isolation. And it is understood that there is limited research that comprehensively examines how these variables interact within techno-pedagogical environments or within rapidly evolving digital classrooms. These gaps indicate the need for more integrative, context-sensitive, and technologically inclusive research models in teacher education

3.2 Studies Related to Techno-Pedagogical Skills and Teaching Performance

In the contemporary digital era, the incorporation of technology in education has revolutionized conventional teaching methodologies, underscoring the significance of techno-pedagogical competencies. These competencies embody the convergence of technology, pedagogy, and topic expertise, empowering educators to adeptly utilize technological resources to improve teaching and learning.

As educational settings evolve to incorporate more technology, the integration of digital technologies into teaching methodologies has become crucial for effective instruction. Techno-pedagogical abilities include not only technological proficiency but also the capacity to choose suitable tools that correspond with pedagogical aims and educational objectives. Studies demonstrate that educators with robust techno-pedagogical competencies can facilitate more engaging, interactive, and tailored learning experiences for their students.

Ngemunang et al. (2021) assessed the relationship between Techno-Pedagogical Skills and teacher performance in Kumba's HTTTC. A multiphase sampling method had been applied and 42 teachers were chosen from among the fourteen departments of HTTTC in Kumba to make up the study's sample. The sample was chosen using a straightforward random sampling procedure. Data was gathered via a questionnaire. Correlation and frequency percentage analyses were performed on the data. The study's conclusions demonstrated a substantial positive correlation between teachers' performance at HTTTC Kumba

and their techno-pedagogical ability. It was determined that the usage of techno-pedagogical abilities by instructors was positively impacted by their performance as teachers.

Rajalakshmi (2022) studied the techno-pedagogical Skills of Future Teacher Educators in order to investigate the techno-pedagogical competencies of aspiring teacher educators. The investigator used a method known as purposive random sampling to choose the sample. The study's sample consisted of aspiring teacher educators of M. Ed. Programme, Tamil Nadu Teachers Education University and the percentage analysis indicated that future teacher educators have an average level of techno-pedagogical skills. The results of the "t" test indicated that female educator candidates perform somewhat better than male educator candidates. There was no discernible difference in the techno-pedagogical abilities of male and female prospective teacher educators. It was also found that there were no discernible disparities in the techno-pedagogical competencies of graduate and undergraduate student teacher educators. It was further concluded that undergraduate prospective teacher educators possess slightly better techno-pedagogical skills than postgraduate prospective teacher educators. Therefore, it was imperative that educators have the abilities needed to effectively use ICT in the classroom. With the use of digital technology, a teacher can improve as a lifelong learner, mentor, facilitator, and creator of useful technical pedagogical topic knowledge.

Liza et al. (2023) investigated on Pedagogical Competence Towards Technology-driven Instruction in Basic Education**.** The study found that elementary school teachers had a positive attitude towards educational technology, and most reported having high levels of competence in its use. However, the level of pedagogical competence toward educational technology varied significantly among teachers. Hence, the study emphasized the need for programs and interventions to improve teachers' pedagogical competence in integrating educational technology into their teaching practices. The investigators suggested that teachers must identify appropriate technological tools and resources to effectively incorporate educational technology to support their teaching objectives and thereby engage students in meaningful learning experiences. Teachers must also assess students' technical skills and design activities appropriate for their technological competency level. The study also recommended that elementary school teachers should undergo training to improve their pedagogical competence for using educational technology.

Evaluation

The reviewed studies provide valuable insights into the status of techno-pedagogical skills among various groups of teacher education students and practicing teachers, Sathiyaraj and Singaravelu (2013) present findings that most higher secondary school teachers perceive their techno-pedagogical skills as mediocre, with no significant differences based on demographic variables such as gender or location while Sathya and Venkateswaran (2017) have investigated the techno-pedagogical skills of B.Ed. students and found notable variations across subject areas but no significant differences linked to attendance in computer courses. This contrasts with Sibichen (2018), which indicated that other factors beyond formal computer education may influence techno-pedagogical competency. However, the study did not delve into the specific subject-related factors affecting these skills or on how such skills impact pedagogical effectiveness. Across these studies, a recurring limitation was the heavy reliance on self-reported data and cross-sectional designs, which did not capture changes over time or provide a complete picture of how techno-pedagogical skills were enacted in classrooms. Moreover, there is limited research on the long-term impact of these skills on student learning outcomes, as well as on effective professional development models that can build and sustain such skills. Therefore, there is a pressing need for mixed-method studies that assess both perceived and demonstrated techno-pedagogical skills, explore contextual and institutional influences, and examine the practical impact of these skills on teaching and learning processes.

Thus, it becomes imperative to further investigate the impact of techno-pedagogical skills in assessing the teaching performance of student-teachers.

3.3 Studies related to attitude towards use of technology and teaching performance

The integration of Information and Communication Technology (ICT) in education has transformed the teaching and learning landscape, making it essential to examine educators' and students' attitudes towards its use. Attitude towards use of technology encompasses the beliefs, perceptions, and feelings that individuals hold regarding technology, which can significantly influence their willingness to engage with digital tools in educational settings. This review of literature aims to explore the various dimensions of attitudes towards ICT, their determinants, and their impact on effective technology integration in learning environments.

Research has shown that positive attitudes towards ICT are closely linked to higher levels of technology adoption and utilization in classrooms. Conversely, negative attitudes can hinder the effective implementation of ICT, limiting both teaching effectiveness and student engagement. Factors influencing attitudes include prior experiences with technology, perceived ease of use, support from institutions, and professional development opportunities.

Ashong, et al. (2020) examined Pre-Service Teachers' Attitude towards ICT-Integration in Teaching and Learning of Geometrical Constructions. The questionnaire was administered to the pre-service teachers before and after ICT-based intervention and the data was analyzed using correlation, regression, and paired samples t-test, based on which the research questions were answered. The results showed that all the

dimensions have a strong influence on pre-service teachers' attitudes before and after the ICT-based intervention in teaching and learning of geometrical constructions. In addition, the study found significant differences in pre-service teachers' attitudes before and after the ICT-based intervention in teaching and learning of geometrical constructions. This study as well suggested that to influence pre-service teachers' attitudes positively, the affective (feelings) domain should be given more attention when designing ICT-integration lessons in the teaching and learning of geometrical constructions. It was therefore recommended that mathematics tutors in the colleges of education should identify such ICT-based interventions and use them in teaching and learning of mathematics to develop pre-service teachers' attitudes positively towards the subject

Sagufta (2020) studied students' attitudes towards use of ICT in English language as a second language instruction at the undergraduate level. In addition to ICT skills, content knowledge, methods, and approaches, teaching English language also requires infrastructure, such as language labs, teaching aids, teaching-learning materials, teacher resource books, audio-visual aids, etc. The classroom environment is crucial to the teaching and learning of English language. However, it is quite unfortunate to report that the majority of kids in West Bengal Board schools struggle with studying English. The upper secondary level is a career turning point and English is a prerequisite for all subjects taken after high school in order to succeed academically and professionally. Therefore, the researcher attempts to ascertain undergraduate students' attitudes towards ICT-based English as a second language learning. Using standardized scales, the data was gathered from the samples and subjected to statistical analysis (mean, standard deviation, and t-test) using Microsoft Office Excel 2010. The survey discovered that there are differences in the average attitudes of urban and rural students. It indicated that there are differences in perceptions between rural and urban students about the challenges of learning English and learning English as a second language with the use of ICT, but that there were no gender-based disparities in this regard

Kumar and Madhu (2021) studied the Prospective Teachers' Attitudes towards ICT Awareness and E-Learning. The primary objective of this study was to ascertain the perceptions of teacher-educators at teacher training institutions on the utilization of ICT, together with their proficiency and frequency of ICT tool and device usage. The results indicated that teacher-educators have a favourable attitude towards the use of ICT and its tools and gadgets in the teacher education process to some level. The current finding revealed that teacher-educators are under-trained and also that they lack technological support. The present survey also showed that teachers and educators are apprehensive about adopting ICT tools and gadgets in the classroom. Similarly, teacher-educators lack motivation and excitement for using ICT tools and gadgets in the teacher-education process. It was discovered that if teacher-educators are familiar with ICT-training, technical assistance, ICT resources, motivation, management support and the benefits of ICT in the education process, they would be able to successfully include ICT in the teacher education process.

Shally (2022) conducted a comparative study of attitude towards the use of ICT among B.Ed. students. The study compared rural and urban students as well as Government and Private Colleges of education. The data was collected from 300 students and descriptive survey method was used. The major findings showed that the urban students have a positive attitude towards use of ICT and Private college students have a favourable attitude towards use of ICT than the Government Colleges of Education.

Evaluation

When technology is used in class, it positively affects student performance, motivation, and efficiency. The classroom environment will be dynamic and interactive. Therefore, integration of technology becomes mandatory for the teaching learning process and digital literacy of the users is one of the aspects that influence the use of technology in education.

While existing studies have explored student-teachers' and teacher-educators' attitudes and competencies toward ICT integration in education, several critical gaps remain unaddressed. Much of the current research, including that of Yusuf (2011) and Kumar & Madhu (2021), indicates a positive attitude toward technology use among educators; however, this is not matched by adequate practical competence or training. There is a clear disconnection between the willingness to adopt technology and the actual preparedness to integrate it effectively into teaching practices. Most studies highlight that teacher education programs fall short in equipping future teachers with the necessary skills and support systems required for meaningful technology integration, particularly in developing countries. The digital divide, lack of institutional support, limited technical resources, and underdeveloped ICT curricula continue to hinder progress in this area.

Furthermore, the diversity in ICT engagement across different fields of study and individual backgrounds, identified by Slechtova (2015), and the unexpected neutrality in computer attitudes across gender and locale, found by Navaneethakrishnan (2014), reveal the inadequacy of one-size-fits-all approaches in ICT training. These findings suggest that current research does not sufficiently account for contextual, motivational, or institutional factors influencing ICT adoption. Most research remains descriptive and cross-sectional, limiting its ability to inform policy or instructional design in a comprehensive way. This dearth of research highlights the urgent need for more in-depth, practice-oriented, and context-sensitive research.

Thus it becomes imperative to further investigate the impact of attitude towards use of technology in assessing the teaching performance of student-teachers

4. Title of the Problem

The review done from the available relevant literature, relating to the present research area, led the investigators to conceptualize the problem in an attempt to fill in the lacunae found.
Thus the problem is stated as here under:

Techno-Pedagogical Skills, Attitude towards use of Technology and Teaching Performance among student-teachers.

5. Objectives of the Study

- To ascertain the extent of influence of techno-pedagogical skills, attitude towards use of technology and teaching performance;
- To fulfill the objectives, to develop appropriate scales and inventories to assess the select variables of the study and
- To compare student-teachers on the select variables of study using classifications of systems of education and gender.

6. Hypotheses

(i) There will be a significant and positive relationship between techno-pedagogical skills, attitude towards use of technology and Teaching Performance of student-teachers in different categories of colleges of education namely, government, government-aided, and self-financing colleges..
(ii) There will be no significant difference in techno-pedagogical skills, attitude towards use of technology and teaching performance among student-teachers in different categories of colleges of education namely, government, government-aided and self-financing colleges.
(iii) There will be no significant difference in techno-pedagogical skills, attitude towards use of technology and teaching performance among student-teachers with respect to gender.

7. Method of Investigation

The study involved multiple variables necessitating multiple permutations and combinations. The investigator took utmost care to establish a sound research methodology, designing the psychometric properties and executing the same to the sample. Normative survey was carried out and the samples were drawn through Random Sampling technique, which was followed by construction of tools.

7.1 Population and Sample Characteristics

The target population for the present study was the student-teachers at colleges of education. From the target population, a sample of 867 student-teachers was chosen from the chosen colleges of education. The sample comprised of 275 student-teachers from Government Colleges of Education, 294 from Government-aided Colleges of Education and 298 from self-financing Colleges of Education. Accordingly, 425 male student-teachers and 442 female student-teachers from different categories of colleges of education were chosen for the study.

7.2 Tools used for the Study

The variables chosen for the present study necessitated construction of tools by the researchers. The tools used for assessment are as follows:

- Techno- Pedagogical Skill Assessment Scale (Developed by the investigators)
- Attitude towards use of technology Scale (Developed by the investigators)
- Teaching Performance Assessment Scale (Developed by the investigators)

The tools developed were found to be suitable, workable, reliable and valid.

8. Analyses of Data

The result of the analyses of data collected are compiled and presented in tables below:
Statistical analyses will be based on the hypotheses formulated for the present study. It is envisaged to be multivariate statistical analyses as the study includes multiple variables.

Table - 1a Simple Correlation Matrix between the Selected Independent Variables and Teaching Performance of Male Student-teachers in Government Colleges of Education (N=135)

Variables	Techno-Pedagogical Skills	Attitude towards use of technology	Teaching Performance
Techno-Pedagogical Skills	1	0.67**	0.81**

Attitude towards use of Technology	X	1	0.84**
Teaching Performance	X	X	1

***Significant at 0.01 level**

It is seen in the table above (Table-1a) that all independent variables, techno-pedagogical skills and attitude towards use of technology correlates significantly and positively with the dependent variable, teaching performance of the male student-teachers in the government colleges of education.

Table – 1b Simple Correlation Matrix between the Selected Independent Variables and Teaching Performance of Female Student-teachers in Government Colleges of Education (N=140)

Variables	Techno-Pedagogical Skills	Attitude towards use of Technology	Teaching Performance
Techno-Pedagogical Skills	1	0.50**	0.62**
Attitude towards use of Technology	X	1	0.80**
Teaching Performance	X	X	1

****Significant at 0.01 level**

In the table above (Table-1b), it is seen that similar to the case of male student-teachers, in the case of the female student-teachers in the government colleges of education also, all independent variables, techno-pedagogical skills and attitude towards use of technology correlate significantly and positively with the dependent variable, teaching performance of the female student-teachers in the government colleges of education.

Table – 1c Simple Correlation Matrix between the Selected Independent Variables and Teaching Performance of Male Student-teachers in Government-aided Colleges of Education (N=148)

Variables	Techno-Pedagogical Skills	Attitude towards use of Technology	Teaching Performance
Techno-Pedagogical Skills	1	0.68**	0.82**
Attitude towards use of Technology	X	1	0.84**
Teaching Performance	X	X	1

****Significant at 0.01 level**

It is seen in the table above (Table 1c), similar to the cases of both male and female student-teachers in government colleges of education, all independent variables, and techno-pedagogical skills and attitude towards use of technology correlate significantly and positively with the dependent variable, teaching performance of the male student-teachers in the government-aided colleges of education.

Table – 1d Simple Correlation Matrix between the Selected Independent Variables and Teaching Performance of Female Student-teachers in Government-aided Colleges of Education (N=146)

Variables	Techno-Pedagogical Skills	Attitude towards use of Technology	Teaching Performance
Techno-Pedagogical Skills	1	0.37**	0.70**
Attitude towards use of Technology	X	1	0.61**
Teaching Performance	X	X	1

****Significant at 0.01 level**

In the above table (Table-1d), as in the previous case, all independent variables, techno-pedagogical skills and attitude towards use of technology correlate positively and significantly with the teaching performance of female student-teachers in government-aided colleges of education

Table – 1e Simple Correlation Matrix between the Selected Independent Variables and Teaching Performance of Male Student-teachers in Self-financing Colleges of Education (N=142)

Variables	Techno-Pedagogical Skills	Attitude towards use of Technology	Teaching Performance
Techno-Pedagogical Skills	1	0.51**	0.69**
Attitude towards use of Technology	X	1	0.75**
Teaching Performance	X	X	1

****Significant at 0.01 level**

In the above table (Table-1e), it is seen that all independent variables, techno-pedagogical skills and attitude towards use of technology correlate significantly and positively with the dependent variable, teaching performance of the male student-teachers in the self-financing colleges of education.

Table – 1f Simple Correlation Matrix between the Selected Independent Variables and Teaching Performance of Female Student-teachers in Self-financing Colleges of Education (N=156)

Variables	Techno-Pedagogical Skills	Attitude towards use of Technology	Teaching Performance
Techno-Pedagogical Skills	1	0.45**	0.70**
Attitude towards use of Technology	X	1	0.68**
Teaching Performance	X	X	1

****Significant at 0.01 level**

It is seen in the table above (Table-1f), that similar to the case of female student-teachers in government and government-aided colleges of education, in the case of the female student-teachers in self-financing colleges of education, all independent variables, techno-pedagogical skills and attitude towards use of technology correlate significantly and positively with their teaching performance.

Results of Comparison of Student- teacher based on Gender in the Three Categories of Colleges of Education

The groups compared were students (both male and female student-teachers) belonging to government, government-aided and self-financing colleges of education. The statistical analysis was computed using the technique of analysis of variance. The results have been presented in Table-2a, 2b and 2c.

The table presented below shows the analysis of variance computed with male and female student-teachers of government colleges of education.

Table – 2a Summary of Significance of Mean Difference between Male and Female Student-teachers in Government Colleges of Education

Variables	Groups	N	Mean	SD	SEM	SED	CR	Level of Significance
Techno-Pedagogical Skills	Male	135	51.39	6.92	0.60	1.02	11.77	0.001**
	Female	140	63.38	9.76	0.83			
Attitude towards use of Technology	Male	135	50.92	6.53	0.56	0.96	10.51	0.001**
	Female	140	61.06	9.18	0,78			
Teaching Performance	Male	135	63.15	7.29	0.63	1.12	10.39	0.001**
	Female	140	74.79	10.95	0.93			

****Significant at 0.01 level**

It is seen from the above table (Table-2a) that when comparing the male and female student-teachers in government colleges of education, there is a significant difference between male and female student-teachers pertaining to all independent and dependent variables. The female student-teachers are found to be significantly better than the male student-teachers pertaining to all independent variables, techno-pedagogical skills, attitude towards use of technology and the dependent variable, teaching performance.

Table – 2b Summary of Significance of Mean Difference between Male and Female Student-teachers in Government-aided Colleges of Education

Variables	Groups	N	Mean	SD	SEM	SED	CR	Level of Significance
Techno-Pedagogical Skills	Male	148	69.80	6.26	0.51	0.73	9.01	0.001**
	Female	146	76.42	6.33	0.52			
Attitude towards use of Technology	Male	148	69.59	6.31	0.52	0.87	4.50	0.001**
	Female	146	73.51	8.45	0.70			
Teaching Performance	Male	148	86.08	7.48	0.61	0.80	9.41	0.001**
	Female	146	93.63	6.20	0.51			

****Significant at 0.01 level**

A picture similar to the comparison of male and female student-teachers in government colleges of education exists when comparing the male and female student-teachers in the government-aided colleges of education, and the results are presented in Table-2b. The female student-teachers are significantly better than their counterpart, male student-teachers pertaining to techno-pedagogical skills, attitude towards use of technology and teaching performance.

Table – 2c Summary of Significance of Mean Difference between Male and Female Student-teachers in Self-Financing Colleges of Education

Variables	Groups	N	Mean	SD	SEM	SED	CR	Level of Significance
Techno-Pedagogical Skills	Male	142	33.98	6.70	0.56	0.75	12.14	0.001**
	Female	156	43.13	6.31	0.50			
Attitude towards use of Technology	Male	142	33.66	6.70	0,56	0.85	11.8	0.001**
	Female	156	43.74	7.90	0.63			
Teaching Performance	Male	142	40.85	6.30	0.53	0.76	16.07	0.001**
	Female	156	53.04	6.76	0.54			

****Significant at 0.01 level**

In the above table (Table-2c), it is seen that in self-financing colleges of education, when male and female student-teachers are compared, the female student-teachers are found to be significantly better than the male student-teachers pertaining to all variables, techno-pedagogical skills, attitude towards use of technology and teaching performance, similar to their counterparts in other two categories of colleges of education, the government and government-aided colleges of education.

Results of Comparison of Students based on the Three Categories of Colleges

The table presented below has provided a comparison male student-teachers belonging to the three categories of colleges, namely, government, government-aided and self-financing colleges.

Table – 3 One-way Analysis of Variance for the Three Groups of Male Student-teachers belonging to Government, Government-aided and Self-financing Colleges of Education N=135 (Government) + 148 (Government-aided) + 142 (Private) = 425

Variables	Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F value	Level of Significance
Techno-Pedagogical skills	Between Groups	2	93043.84	46521.92	1060.23	0.001**
	Within Groups	422	18517.05	43.88		
	Total	424	111560.88			
Attitude	Between	2	93676.29	46838.14	1105.12	0.001**

Variables	Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F value	Level of Significance
towards use of Technology	Groups					
	Within Groups	422	17885.55	42.38		
	Total	424	111561.84			
Teaching Performance	Between Groups	2	148349.46	74174.73	1493.21	0.001**
	Within Groups	422	20962.66	49.67		
	Total	424	169312.12			

**Significant at 0.01 level

On comparing the male student-teachers in different categories of colleges of education, government, government-aided and self-financing colleges of education, it is evident that there exists a significant difference among the male student-teachers pertaining to all independent variables, techno-pedagogical skills, attitude towards use of technology and the dependent variable, teaching performance.
The tables 3a, 3b and 3c clearly give the nature and direction of difference for explanation of the difference.

Table - 3a Summary of Significance of Mean Difference between Male Student- teachers in Government and Government-aided Colleges of Education

Variables	Groups	N	Mean	SD	SEM	SED	CR	Level of Significance
Techno-Pedagogical skills	Government	135	51.4	6.92	0.60	0.78	23.5	0.001**
	Government-aided	148	69.8	6.26	0.51			
Attitude towards use of Technology	Government	135	50.9	6.53	0.56	0.76	24.5	0.001**
	Government-aided	148	69.6	6.31	0.52			
Teaching Performance	Government	135	63.1	7.30	0.63	0.88	26.1	0.001**
	Government-aided	148	86.1	7.48	0.61			

**Significant at 0.01 level

It is seen from Table-3a, that the male student-teachers in government–aided colleges are significantly better than the male student-teachers in government colleges of education pertaining to all independent variables, techno-pedagogical skills, and attitude towards use of technology, and the dependent variable, teaching performance. A similar comparison was made with the male student-teachers belonging to government and self-financing colleges of education and the results are presented below.

Table - 3b Summary of Significance of Mean Difference between Male Student-teachers in Government and Self-Financing Colleges of Education

Variables	Groups	N	Mean	SD	SEM	SED	CR	Level of Significance
Techno-Pedagogical skills	Government	135	51.39	6.92	0.60	0.82	21.27	0.001**
	Self-financing	142	33.98	6.70	0.56			
Attitude towards use of Technology	Government	135	50.92	6.53	0.56	0.79	21.70	0.001**
	Self-financing	142	33.66	6.70	0.56			
Teaching Performance	Government	135	63.15	7.30	0.63	0.82	27.26	0.001**
	Self-financing	142	40.85	6.30	0.53			

**Significant at 0.01 level

On comparing the male student-teachers in government and self-financing colleges of education, it is seen that the male student-teachers in government colleges are significantly better than the male student-teachers in self-financing colleges of education pertaining to all independent and dependent variables, techno-pedagogical skills, attitude towards use of technology and teaching performance. A third comparison has

been made with the male student-teachers in government-aided and self-financing colleges of education and the results are presented below.

Table - 3c Summary of Significance of Mean Difference between Male Student-teachers in Government-aided and Self-financing Colleges of Education

Variables	Groups	N	Mean	SD	SEM	SED	CR	Level of Significance
Techno-Pedagogical skills	Government-aided	148	69.80	6.26	0.51	0.76	47.05	0.001**
	Self-financing	142	33.98	6.70	0.56			
Attitude towards use of Technology	Government-aided	148	69.59	6.31	0.52	0.76	47.04	0.001**
	Self-financing	142	33.66	6.70	0.56			
Teaching Performance	Government-aided	148	86.08	7.48	0.61	0.81	55.58	0.001**
	Self-financing	142	40.85	6.30	0.53			

****Significant at 0.01 level**

On comparing the male student-teachers in government-aided and self-financing colleges, the male in government-aided are found to be significantly better than the male student-teachers in self-financing colleges of education pertaining to all variables, techno-pedagogical skills, attitude towards use of technology and teaching performance.

The following analysis of variance was computed with a comparison of the three groups of female student-teachers belonging to government, government-aided and self-financing colleges of education.

Table – 4 One-way Analysis of Variance for the Three Groups of Female Student-Teachers belonging to Government, Government-aided and Self-financing Colleges of Education N = 140 (Government) + 146 (Government-aided) + 156 (Private) = 442

Variables	Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F value	Level of Significance
Techno-Pedagogical skills	Between Groups	2	85195.14	42597.57	741.59	0.001**
	Within Groups	439	25216.62	57.44		
	Total	441	110411.77			
Attitude towards use of Technology	Between Groups	2	67626.69	33813.34	467.42	0.001**
	Within Groups	439	31757.78	72.34		
	Total	441	99384.47			
Teaching Performance	Between Groups	2	124654.49	62327.24	932.31	0.001**
	Within Groups	439	29348.28	66.85		
	Total	441	154002.77			

****Significant at 0.01 level**

In the above table (Table-4), the female student-teachers in all categories of colleges of education, government, government-aided and self-financing are compared. It is seen that there exists a significant difference among the female student-teachers pertaining to techno-pedagogical skills, attitude towards use of technology and teaching performance.

The variables, manifesting differences among female student- teachers in the three different categories of colleges of education necessitated further analysis using critical ratio. The results are presented in tables 4a, 4b and 4c.

Table - 4a Summary of Significance of Mean Difference between Female Student-teachers in Government and Government-aided Colleges of Education

Variables	Groups	N	Mean	SD	SEM	SED	CR	Level of Significance
Techno-Pedagogical skills	Government	140	63.38	9.76	0.82	0.97	13.46	0.001**
	Government - aided	146	76.42	6.33	0.52			
Attitude towards use of Technology	Government	140	61.06	9.18	0.78	1.04	11.94	0.001**
	Government-aided	146	73.51	8.45	0.70			
Teaching Performance	Government	140	74.79	10.96	0.93	1.05	17.99	0.001**
	Government-aided	146	93.63	6.20	0.51			

****Significant at 0.01 level**

In the above table (Table-4a), on comparing the female student-teachers in government and government-aided colleges of education, it is observed that the female student-teachers in the government-aided colleges of education are significantly better than the student-teachers in government colleges of education pertaining to all independent variables, namely, techno-pedagogical skills, attitude towards use of technology and the dependent variable, teaching performance.

Table-4b presents the comparison among female student-teachers of government and self-financing colleges of education.

Table - 4b Summary of Significance of Mean Difference between Female Student-teachers in Government and Self-financing Colleges of Education

Variables	Groups	N	Mean	SD	SEM	SED	CR	Level of Significance
Techno-Pedagogical Skills	Government	140	63.4	9.76	0.82	0.95	21.40	0.001**
	Self-financing	156	43.13	6.31	0.50			
Attitude towards use of Technology	Government	140	61.06	9.18	0.78	0.99	17.43	0.001**
	Self-financing	156	43.74	7.90	0.63			
Teaching Performance	Government	140	74.79	10.96	0.93	1.05	20.77	0.001**
	Self-financing	156	53.04	6.76	0.54			

****Significant at 0.01 level**

As per the above table (Table 4b), on comparing the female student-teachers in government and self-financing colleges, like in the case of the male student-teachers, the female student-teachers in the government colleges of education are significantly better than the female student-teachers in self-financing colleges pertaining to all independent and dependent variables selected for the present study.

Table - 4c Summary of Significance of Mean Difference between Female Student-teachers in Government-aided and Self-financing Colleges of Education

Variables	Groups	N	Mean	SD	SEM	SED	CR	Level of Significance
Techno-Pedagogical Skills	Government-aided	146	76.42	6.33	0.52	0.73	45.75	0.001**
	Self-financing	156	43.13	6.31	0.50			
Attitude towards use of Technology	Government-aided	146	73.51	8.45	0.70	0.94	31.63	0.001**
	Self-financing	156	43.74	7.90	0.63			
Teaching Performance	Government-aided	146	93.63	6.20	0.51	0.75	54.27	0.001**
	Self-financing	156	53.04	6.76	0.54			

****Significant at 0.01 level**

On comparing the female student-teachers in government-aided and self-financing colleges of education, it is seen in the above table (Table-4c) that the female student-teachers in government-aided colleges are significantly better than the female student-teachers in self-financing colleges of education pertaining to all independent and dependent variables.

9. Discussion

Female teachers across all categories of colleges—government, government-aided, and self-financing—demonstrate significantly better techno-pedagogical skills, attitude towards use of technology, and consequently, superior teaching performance compared to their male counterparts. This trend is attributed to several factors: increased societal exposure to digital devices among women, a strong inclination among female student-teachers for collaborative learning (which is enhanced by digital tools), and a high motivation to integrate technology into future teaching for classroom effectiveness, and their proactive engagement with digital literacy programs promoted by educational institutions. (Yusuf, 2021)
Regarding the different types of colleges, government-aided colleges of education show a significant advantage in student-teachers' techno-pedagogical skills, attitude towards technology, and teaching performance for both genders because of continuous support by teacher educators and other mentors. It was found that student-teachers in Aided-Colleges of Education are given more opportunities to use technology for a lot of collaborative activities like formation of web teams, development of e-content for seminar presentations, etc.

10. Conclusion

More than often, the teacher-students are ‘digital immigrants’ as they are not born with the digital technology which we use these days for the educational purposes. They themselves would not have experienced such digital tools while they were mere students in the school or universities. Though the pandemic forged such alliance between the digital mediums and educational systems, the digital tools are here to not only stay permanently but also to expand its reach owing to its ability to democratize learning opportunities and ease of learning, especially outside the formal classroom settings. Teacher-students today recognize that their pupils are ‘digital natives’ and use of digital technology is quite innate and natural phenomenon for them. These teacher-students need to step into the digital world of their pupils to make any meaningful interactions, engagement and induce learning. The positive approach and attitude toward the upcoming technology and the ease of usage of such technologies as much as possible in the curriculum design and delivery becomes pivotal in the modern scape of learning today. Teacher-students necessarily need to welcome technological advancements and embrace them as quickly as possible instead of trivializing them as mere distractions.

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