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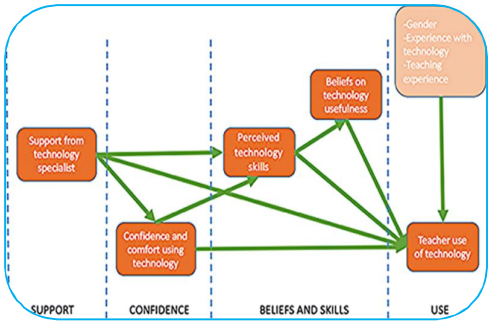
"ADAPTABILITY TOWARDS TECHNO-PEDAGOGICAL SKILLS BY TEACHER EDUCATORS FOR THE HOLISTIC LEARNING ENVIRONMENT"

Dr. Ketki Satpute
I/C Principal
Sree Narayana Guru College of Education(B.Ed.), Mumbai.
Affiliated to University of Mumbai.

ABSTRACT



The education landscape in India is changing fast. To keep abreast with it, NEP–2020 envisioned to "create a model of education aiming not just, on the cognitive development, but also building character, and creating holistic and well-rounded individuals equipped with the key 21st century skills." The role of the teacher educators is pivotal in this respect. They must be proficient in the use of various technologies and technological tools in their teaching-learning process. Integration of new pedagogical approaches along with technological skills facilitates a collaborative and holistic learning environment. Techno-pedagogical skills is the ability of teachers to integrate technology effectively in the teaching-learning process.

Thus, the need for teacher educators to adapt their techno-pedagogical skills is essential to train student teachers to face the challenges of the 21 st century and survive and thrive in Industry 5.0. In education, Industry 5.0 refers to the cooperation between advanced technologies, educators and students to enhance the efficiency and effectiveness of teaching and learning. The matrix of interaction between the teacher, the learner and the environment should be an interactive, creative and fun-filled experience to be treasured and cherished forever. It will lead to active participation and involvement of student-teachers in the process of life-long learning. The researcher aims to study adaptability towards techno-pedagogical skills by teacher educators and the challenges faced by them while adapting to these skills. It also aims to find out whether there is a significant difference with respect to the type of college, geographical area and gender of teacher educators in adaptability towards techno-pedagogical skills. The researcher used a descriptive survey method. The sample included 53 teacher educators from Mumbai and Thane region of Maharashtra state. A purposive sampling technique was used to select the samples. The tool used was a self-constructed questionnaire. Data was analysed through descriptive and inferential statistical techniques such as percentage, mean, standard deviation, graphical representation and 't' test. The key findings reveal above-average techno-pedagogical skills among teacher educators. The study found no significant differences based on institutional type or location, but identified a notable gender disparity, with male educators showing better adaptability to technological skills. The findings highlighted the challenges faced by teacher educators such as inadequate technological resources, internet connectivity issues, difficulty in coping with newer technology and time management, digital divides among student-teachers, and insufficient institutional support and training.

KEYWORDS: *Techno-pedagogical skills, Teacher Educators, Holistic Learning Environment .*

1. INTRODUCTION

The education landscape in India is changing fast. To keep abreast with it, NEP–2020 envisioned to "create a model of education aiming not just, on the cognitive development, but also building character, and creating holistic and well-rounded individuals equipped with the key 21st century skills." Society as well as the Industry expects our students should think critically, be creative, innovative, and able to communicate and collaborate. Our student-teachers should be equipped with necessary 21st-century skills ready to enter into the 5.0 industry workforce. As they are the would-be teachers who will work in various educational institutions to shape the young minds in the schools. Hence, the onus comes on teacher educators to equip them well with 21st century skills such as technological skills and life skills i.e. critical thinking, problem-solving, positive thinking, decision making, effective communication etc. and prepare them to face the challenges of the modern technology-driven world of education. The role of teacher educator is pivotal in this respect.

1.1 *Background*

In education, Industry 5.0 refers to the cooperation between advanced technologies, educators and students to enhance the efficiency and effectiveness of teaching and learning.

Technology, if used properly, has the ability to enhance relationships between teachers and students. Teacher Educators must be proficient in the use of various technologies and technological tools in the teaching-learning process. Content mastery and expertise in pedagogy allow them to explore innovative techniques, strategies and methods of teaching in the classroom. The use of technology along with it enhances the quality of teaching and makes it more enjoyable.

Techno-pedagogy is the art of incorporating technology in designing teaching-learning experiences so as to enrich learning outcomes. Techno-pedagogical skill is the ability of the teacher to make use of technology effectively, in the teaching-learning process. Teachers should be proficient in using the apt technology to make students more interactive, create something of their own, collaborate and learn with each other, construct their own knowledge, and make their own decisions leading to their all-round holistic development. A Holistic Learning Environment is learning to be with oneself, others and the environment. It is all about interconnectedness and life experiences. It is outcome-based learning infused with experiential learning. Only technology upgradation in institutions will not create a holistic learning environment and improve the performance of student-teachers. Unless the teacher educator has a positive attitude towards the adaptation, use and application of technology in the teaching-learning process. 'Empowering educators with the skills to effectively integrate technology and facilitate learner-centric approaches is critical.'(Trivedi, 2023)

The matrix of interaction between the teacher, the learner and the environment should be an interactive, creative and fun-filled experience to be treasured and cherished forever. It will lead to active participation and involvement of student-teachers in the process of lifelong learning. Integration of new pedagogical approaches along with technological skills facilitates a collaborative and holistic learning environment. Thus, the need to adapt to techno-pedagogical skills by teacher educators to train student teachers to face the challenges of the 21st century to survive and thrive in Industry 5.0., is essential.

1.2 *Research Problem and Objectives*

With this background, the researcher has the following questions in her mind. Are Teacher Educators well-equipped or trained for integrating technology in the teaching-learning process? Are they adapting and using techno-pedagogical skills for a holistic learning environment efficiently? Do the levels of techno-pedagogical skills differ in terms of various variables such as gender, type of college, and geographical area? Are they facing any challenges while adapting advanced technologies in their teaching? With these questions in mind, the researcher aims to find out the level of adaptability and challenges faced while adapting towards techno-pedagogical skills and whether there is a significant difference with respect to the type of college, geographical area and gender of teacher educators. The researcher has thus framed the following objectives;

OBJECTIVES OF THE RESEARCH:

- To study the level of adaptability towards Techno-pedagogical skills among teacher educators of Mumbai and the Thane region of Maharashtra State.
- To study the significant difference in the adaptability towards techno-pedagogical skills among teacher educators with respect to;
- Type of college b) Geographical area c) Gender
- To study the challenges faced by teacher educators in adapting techno-pedagogical skills for the holistic learning environment.

HYPOTHESES OF THE STUDY:

1. There is no significant difference in the adaptability towards techno-pedagogical skills among teacher educators with respect to the type of college.
2. There is no significant difference in the adaptability towards techno-pedagogical skills among teacher educators with respect to geographical area.
3. There is no significant difference in the adaptability towards techno-pedagogical skills among teacher educators with respect to Gender.

2. LITERATURE REVIEW

2.1 Overview.

Shipra Baregama & Rita Arora (2021) conducted a review of studies on Techno-Pedagogical and Content Competencies and concluded that the first study in this respect was taken by Koehler & Mishra in 2005. Koehler and Mishra (2005) found in their study that better teaching was not simply adding technology rather the introduction of technology causes the representation of new concepts and needs developing sensitivity of the dynamic, pedagogy, content and knowledge. Koehler, and Mishra (2009) stated that technology amalgamation incorporation in the education alongside with the content knowledge of the faculty is crucial to create an equilibrium or fairness among all the components. Sathiyaraj and Rajeshkar (2013) found in their study that the techno-pedagogical expertise needs to be improved to equip teachers to face the students of the digital era and the challenges in modern classrooms. Ozdemir (2016) studied an examination of the techno-pedagogical education competencies (TPACK) of pre-service elementary school and pre-school teachers. The study concluded with the statement that the pre-service education had positive effects on TPACK. Along with the education, pre-service elementary school and pre-service teachers should be provided with opportunities to use technology. Hadiya Habib (2018) in his study on impact of Techno-pedagogical Competency on Teacher Effectiveness of Senior Secondary School Teachers found that teachers' performance increases with the increase in their techno-pedagogical competency. He further states that Techno-pedagogical skills are the ways to make accessible and affordable quality education to all. Thus, the teachers should adapt the techno-pedagogical competencies /skills and incorporate a number of supporting pedagogical features into instruction for better learning outcomes. Beri, & Sharma (2019) stated that there are large differences or substantial differences in the techno-pedagogical content competencies of teacher educators with respect to gender, locality, stream, efficacy and type of colleges. S. Sai Sandhiya & P. SivaKumar (2019) stated that the ability of teachers to apply and adopt technology effectively in teaching and learning process is known as Techno-pedagogical competency. It is indispensable to measure the Techno-pedagogical competency among the teachers in order to ensure the competency level. Ozturk, G., Karamete, A., & Çetin, G. (2020) stated in their study that the use of technology in the teaching environment has inevitably increased. This emphasizes that the teacher, the most important element of the teaching environment (Orhaner & Tunç, 2003), should possess the characteristics of techno-pedagogical education competency to integrate technology into teaching and cognitive flexibility to adapt to change. Tan and Zainal (2020) found male lecturers were more likely to use Learning Management System (LMS) for content creation and communication, while female lecturers reported greater challenges adapting to the system. Beri N. (2021) in her study on the development of TPACK for Teacher Educators stated that TPACK helps teachers to update their knowledge and skills which leads

to enriching their professional progress. Mostafa, & Mohammed A. (2022) mentioned that one of the main challenges of Industry 5.0 in education is the need to adapt teaching and learning methods to accommodate Industry 5.0 technologies. This may require the development of new pedagogical approaches, as well as the integration of technology into the classroom. It may also require the adoption of new assessment methods to evaluate students' knowledge and skills in this rapidly evolving field.

2.2 Theoretical Framework

According to NEP 2020, the thrust of technological intervention will be for the purpose of improving the teaching-learning and evaluation process, supporting teacher preparation and professional development, enhancing educational access, and streamlining educational planning, management and administration. Teachers are the pioneers in bringing change in educational institutions. They are the practitioners who can integrate technology into their teaching-learning process. Teachers can use their pedagogical knowledge, skills and perceptions related to the profession, accept the role of technology in education and use this technology in education. With the use of technology in teaching by in-service teachers, the concept of techno-pedagogical content knowledge has developed. According to Lee Shulman(1986), teachers need to master the interaction between pedagogy and content to implement strategies that help students understand the content fully. Mishra and Koehler(2005,2009) added technology as one more dimension to Shulman's Pedagogical Content Knowledge (PCK). They proposed that addressing Content Knowledge(CK), Pedagogical Knowledge(PK) and Technological Knowledge (TK)concurrently, provides a framework for technological integration in the curriculum.

Content Knowledge represents the subject competency of the teacher. Pedagogy is the art & science of teaching. Pedagogical Knowledge is the teachers' deeper knowledge about the methods, techniques, approaches and practices of teaching-learning. It also includes effective classroom management activities and assessment of learning. Technological knowledge includes understanding how to use technologies and technological tools in an educational context. It is understanding Information Technology, applying it effectively at work and being able to adapt to changes in Information Technology. Due to the technology-driven modern society, the education field too has become tech-savvy, compelling teachers to integrate technology into their pedagogy. Thus emerges techno-pedagogical skills; the ability of the teachers to integrate technology effectively in the teaching-learning process. It is an understanding of how teaching-learning can change when technologies are used in a particular way. It is knowing how to use such technological tools for appropriate pedagogical designs and strategies. Thus, Techno-pedagogical knowledge makes it possible to understand what technology can do for certain pedagogical goals and accordingly select the most appropriate tool based on a specific pedagogical approach. For example, Google Docs can be used for collaborative writing instead of face-to-face meetings. LMS, MOOCs, MOODLE etc. are examples of integrating technological knowledge into pedagogical strategies. According to Lee and Tsai (2010), "Techno-pedagogical competency is the art of integrating sound pedagogic principles of teaching/learning with the use of technology. It refers to weaving the techniques of the craft of teaching into the learning environment itself".

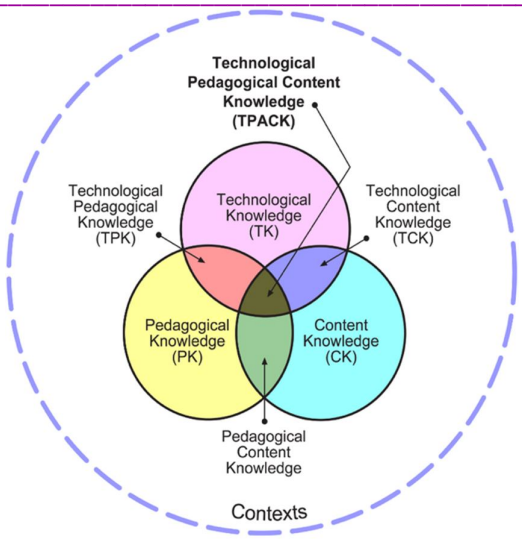


Fig.1

Source:https://educationaltechnology.net/technological-pedagogical-content-knowledge-tpack-framework/

Fig.1 presents the components of TPACK (Kereluik et al., 2011; Koehler & Mishra, 2005). TPACK model is an approach emphasizing the interaction and cooperation among three different disciplines: pedagogy, technology and content knowledge. This model mainly consists of content knowledge [CK], pedagogical knowledge [PK] and technological knowledge [TK] components. The pedagogical content knowledge [PCK]), the technological content knowledge [TCK] and the technological pedagogical knowledge [TPK] are the binary intersections of these basic components and the technological pedagogical content knowledge [TPCK or TPACK] is expressed as a combination of all components (Kereluik, Mishra, & Koehler, 2011; Koehler & Mishra, 2005, 2008, 2009; Mishra & Koehler, 2006). Technology is inevitable in the teaching-learning environment. Tecno-pedagogical skills are very much needed for teacher-educators because they facilitate the prospective teachers and make them become techno-pedagogues. Hence teacher-educators should be given opportunities to get practical knowledge and enhance pedagogical – skills by using the current technology during their teaching-learning process. (Ozturk et.al 2020). In the 21st-century, the society also demands for such faculty members who can easily, successfully and productively adapt to the changing challenges as per the requirements of the education system (Anand, 2019).

With this theoretical background, the primary purpose of the present study is to assess the adaptability towards techno-pedagogical skills among teacher-educators and the challenges faced by them in adapting these skills.

3.METHODOLOGY

The main aim of the present study was to study the techno-pedagogical skills of teacher educators and the challenges faced by them in adapting these skills. Accordingly, the descriptive methodology was selected by the researcher.

3.1 Research Design

The researcher employed the Descriptive Survey Method to conduct the present study. Descriptive research gathers the data on a particular event and then organizes, tabulates, depicts and describes the data. The Teacher educators teaching in different B.Ed. Colleges of Mumbai and Thane District of Maharashtra, affiliated to University of Mumbai, were selected as samples. The sample size is 53 teacher educators.

3.2 Data Collection

A purposive sampling technique was employed to gather the data from the respondents. The data was collected using Google Forms through online platforms. A total of 53 responses were collected from the Teacher Educators. The researcher used the self-constructed Questionnaire as a tool to collect the data. The tool consisted total of 31 items, out of which 25 items were constructed as per 5 5-point Likert Scale to know the opinion of the participants towards the use of technology in the teaching-learning process, using web resources for pedagogical practices and interactive classrooms, ethical considerations, etc. to know their adaptability towards techno-pedagogical skills. Each of these 25 items consists of five alternatives, viz. always, sometimes, uncertain, rarely, and never with a weightage of 5,4,3,2,1, respectively, for positively worded statements. Only one item was negatively worded, scoring reversely as 1,2,3,4,5 for alternatives given. 2 items consisted of three alternatives, viz., to great extent, to some extent and not at all. 2 items were closed-ended questions, and the remaining 2 items were open-ended questions. Close-ended and open-ended questions pertained to challenges faced in integrating technology into pedagogical practices and efforts taken by teacher educators to use digital tools to make classrooms interactive and enhance their technological skills.

3.3 Data Analysis.

The present research used statistical techniques such as Percentage, Mean, Standard deviation, Graphical presentation, Leven's test and t-test for analysis of the data.

4. RESULTS

An analysis of the results gives us an understanding of the various challenges faced by teacher educators in adapting to techno-pedagogical skills and their level of adaptability towards these skills.

4.1 Findings

The major findings of the study are :

- The level of techno-pedagogical skills of teacher educators working in B.Ed. Colleges of Mumbai and Thane region of Maharashtra are above average.
- No significant difference was found between the teacher educators working in Government Colleges and Private Colleges in adaptability towards techno-pedagogical skills.
- No significant difference was found between the teacher educators working in urban and semi-urban areas in adaptability towards techno-pedagogical skills.
- A significant difference was found between male and female teacher educators in adaptability towards techno-pedagogical skills. Male teacher educators have adapted better than female teacher educators towards techno-pedagogical skills.
- The majority of the teacher educators revealed the following challenges faced by them while adapting to techno-pedagogical skills: a)Inadequate technological resources in the college b) Learning a new thing and integrating it into regular lectures within a limited time available c)Disturbed Network issue, unavailability of Wi-Fi connection d) Digital divide among student-teachers e)Inadequate training and support from the institute.

5. DISCUSSION

5.1 Interpretation of Results

The subtitles that follow pertain to the questions that were asked to participants and it discusses the results in detail. Further, it tests the hypotheses of the study.

- **Preparedness in using basic technology skills**

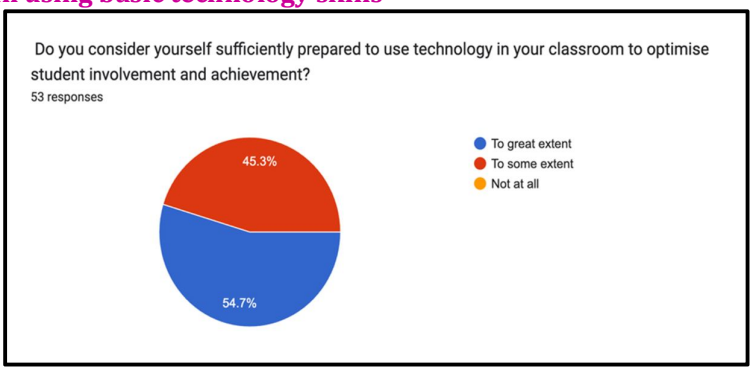


Fig.2

In Fig. 2, though 54.7% of teacher educators consider themselves sufficiently prepared to use technology in their classroom to optimise student involvement and achievement, there are still 45.3% of teacher educators who consider themselves sufficiently prepared to some extent to use technology which is a large number and need an urgent action towards preparing them well so that they can confidently use technology in their classroom. In their study, Ozturk, Karamete, & Cetin (2020), stated, ' use of technology in the teaching environment has inevitably increased. This emphasizes that the teacher, the most important element of teaching environment (Orhaner & Tunç, 2003), should possess the characteristics of techno-pedagogical education competency to integrate technology into teaching and cognitive flexibility to adapt to change (Krueger, Hansen, & Smaldino, 2000).'

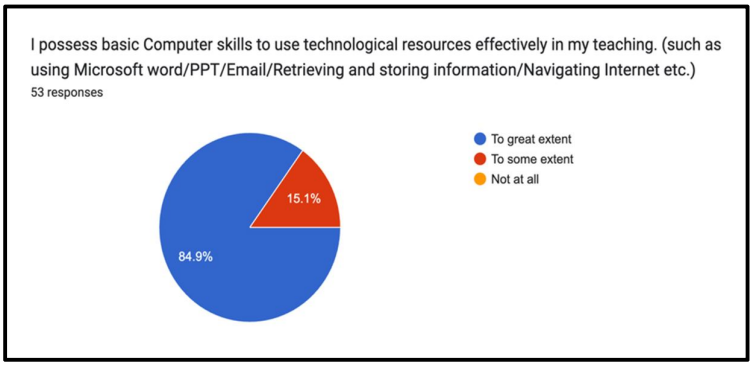


Fig.3

In Fig.3, 84.9% of teacher educators possess basic computer skills to use them effectively in their teaching. But still, 15.1% of teachers possess it to some extent and may not be confident enough to use it effectively in their teaching. That necessitates rigorous training in basic computer skills for such teachers to reduce the digital divide among teacher educators. UNESCO's report 2004, highlights, "Teachers, as well as other educators, must have the knowledge and skills needed to integrate ICT effectively into the learning environment. If not, students will not be exposed to the wealth of information resources available and will be prevented from learning to use ICT effectively themselves." For teachers to become fluent in the usage of educational technology means going beyond mere competence with the latest tools. (Anand, S.2019). Ongoing training programs are essential for teacher educators to strengthen basic computer skills and keep abreast of the latest technological tools and use them in teaching.

- **Difficulty in coping with newer digital technologies**

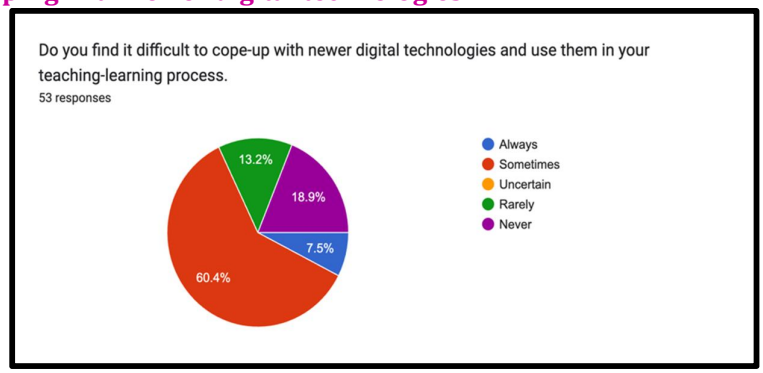


Fig.4

It can be seen from the above Fig.4 that 60.4% of teacher educators find it difficult sometimes to cope-up with newer digital technologies and use them in their teaching-learning process. There are only 18.9% of teacher educators who are well versed with newer technology and never find it difficult to cope with it. It shows that they have adapted themselves well to using new technology through various means. Also, there are 13.2% who rarely find it difficult to cope up with new technology. But there are still 7.5% who always find it difficult to cope with newer technology. Maybe they are not confident and comfortable in using technological devices efficiently. They may not possess basic computer skills or may not be much interested in exploring newer technologies. In UNESCO's report on Experts' Meeting on Teachers/Facilitators Training in Technology-Pedagogy Integration, Bangkok, 2004, it is rightly pointed out that 'For the teacher, all these new technologies pose what may seem like an endless need to continue to learn new technical skills. Just when a teacher becomes familiar with one technology, a new version is introduced with accompanying revised software, and time and energy must be extended to learn the new features. In addition, these skills must be learned while continuing to teach classes filled with demanding students.' One needs motivation, support and appreciation for using the latest technologies in the teaching-learning process. In this respect when the researcher asked the question, only 69.8% of teacher educators opined that they get institutional support, motivation and appreciation for integrating technology into their teaching. Whereas 26.4% get this support only sometimes and the remaining 3.8% rarely get such support from their institute. The role of the institution is paramount here to boost the morale of the teachers to increase the use of newer technology in teaching. One of the important elements identified in UNESCO's report 2004 for building the capacity of teachers is professional development. 'If educators are to acquire the necessary skills, have opportunities to reflect on the changes needed in their classrooms, and move toward a more learning-centred classroom, educational agencies must have professional development plans that provide appropriate training and support on a continuing basis.'

- **Most commonly used digital tools by Teacher Educators**

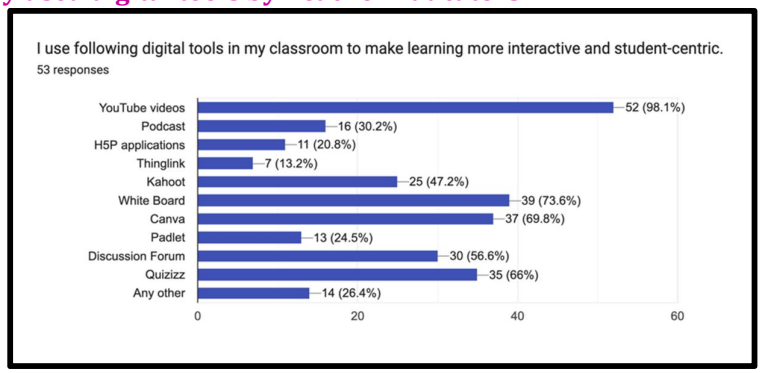


Fig.5

Though teacher educators are integrating technology into their teaching and using various digital tools, the most commonly used digital tools as seen in Fig.5, are YouTube Videos (98.1%), White Board (73.6%), Canva App (69.8%) and Quizizz (66%) to make learning more interactive and student-centric. Discussion Forum (56.6%) and Kahoot (47.2%) are also used by many but H5P applications, Thinglink, Padlet, Podcast and gamification tools are used by very few teacher educators. 'Game-based learning is a crucial requirement for Education 5.0 because it can engage students in a way that traditional classroom teaching may not. Game-based learning can help increase motivation, engagement, and learning outcomes. (Shabir Ahmad et al). Techno-pedagogical expertise needs to be improved in order to equip teacher educators to face the students belonging to the digital era and also to face the challenges in the modern classroom. (Sathiyaraj & Rajasekar, 2013). Thus, updating oneself to newer digital tools is essential for teacher educators.

- **Efforts taken by teacher educators to upgrade their technological skills**

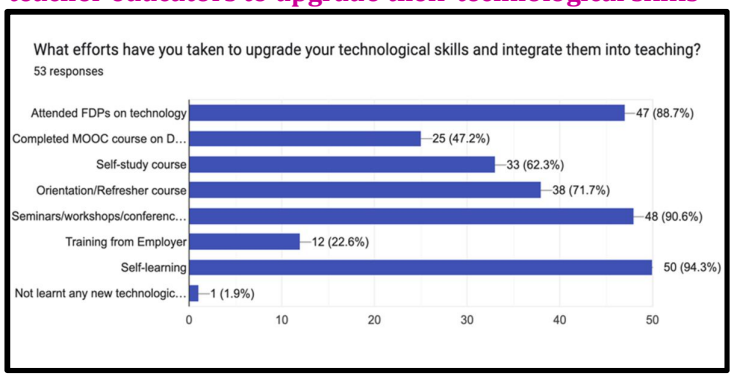


Fig.6

It can be observed from the above fig.6 that through self-learning (94.3%), majority of teacher educators are making efforts to upgrade their technological skills. Many of them have attended faculty development programs, orientation/refresher courses, seminars, workshops, and conferences related to technological aspects. Some of them have attended self-study courses and a few have completed MOOC courses too. In all these efforts, teacher educators get very little support from the employer (only 22.6%) for the training towards technological upgradation. This needs to be improved by more support to the employees from the institution through various means such as hands-on training programs on awareness of newer digital tools and their use in teaching, monetary support for self-study courses, appreciation for professional development etc. Y. Supriya et al.(2024) in their paper also suggested a solution to 'provide comprehensive training programs for educators to enhance their technological

proficiency and integrate tools like collaborative platforms, Augmented Reality, and Virtual Reality into pedagogical practices.'

• **Objective 1**: To study the level of adaptability towards Techno-pedagogical skills among teacher educators of Mumbai and Thane region of Maharashtra State.

Table 1
Descriptive statistics of techno-pedagogical skills of teacher educators of Mumbai and Thane region of Maharashtra State

	N	Mean	Level
Level of Techno-Pedagogical Skill	53	4830/53= 91.13	Above average

Table 1 shows the mean score of all 53 teacher educators in Mumbai and Thane regions is 91.13, which means the techno-pedagogical skills of teacher educators of Mumbai and Thane region is above average. Beri N. & Sharma (2021) also found in their study technological pedagogical and content knowledge (TPACK) competency among teacher-educators in the region of Punjab is high.

• **Objective 2**: There is no significant difference in the adaptability towards techno-pedagogical skills among teacher educators with respect to;
a) Type of college b) Geographical area c) Gender

Table 2 gives descriptive data analysis of Likert scale items on the adaptability of teacher educators towards techno-pedagogical skills.

Table 2
Relevant statistics of adaptability towards tecno-pedagogical skills by Teacher Educators on the basis of Type of college, Geographical area and Gender

Variables	Gender	N	Mean	SD	Leven's test	t test	P value	Significance (0.05 level)
Type of College	Govt. College	18	91.61	12.94	0.33	0.213	0.41	Not significant
	Private College	35	90.88	11.03				
Geographical Area	Urban	45	91.31	11.92	0.35	0.264	0.39	Not significant
	Semi urban	08	90.12	10.23				
Gender	Male	10	99.90	9.72	0.43	2.827	0.003	Significant
	Female	43	89.09	11.12				

For N=53, df = 51, tabulated t = 2.012 at 0.05 level

From Table 2, it can be seen with respect to the Type of College that the mean score of teacher educators working in government colleges is 91.61 which is slightly higher than the teacher educators working in private colleges i.e. 90.88. Table 1 also shows the significant level of Lavene's Test for Equality of Variance is 0.33, which is not significant at $p<0.05$, hence t-test assuming equal variances was conducted. The obtained 't' value is 0.213 which is smaller than the tabulated 't' value (2.012) and 'p' value is greater than 0.05, hence there is no significant difference between the teacher educators of Government College and Private College in adaptability towards techno-pedagogical skills. Hence hypothesis is accepted. The findings of research conducted by Nimisha B. & Lalit S. (2019) contradict

the findings in the present study, that the TPACK competencies of private colleges' teacher-educators are high in comparison to the teacher educators from Govt./ Govt. Aided colleges.

It can be seen from Table 2, that the mean scores of teacher educators working in urban and semi-urban areas are 91.31 and 90.12, respectively. It means that teacher educators from urban areas have adapted better towards techno-pedagogical skills than semi-urban areas. The Leven's test conducted was not significant at $p<0.05$, showing equal variances in the means of urban and semi-urban teacher educators. The t-test assuming equal variance shows that the obtained 't' value is 0.264 which is less than the tabulated 't' value of 2.012 and p-value is 0.35 which is greater than 0.05, hence the hypothesis is accepted. There is no significant difference between the teacher educators working in urban or semi-urban areas with respect to adaptability towards techno-pedagogical skills. Nimisha & Lalit S. (2019) in their studies found that TPACK competencies of urban teacher-educators are high in comparison to rural teacher-educators, though in present study there are no responses from rural area. With respect to gender, the mean scores of male teacher educators are 99.90 and female teacher educators are 89.90, which shows the techno-pedagogical skills of male teachers are moderately higher than those of female teacher educators. Leven's test shows the equal variance as the p-value is not significant. Hence t test assuming equal variances was conducted. The obtained 't' value is 2.82 with respect to gender, which is greater than the tabulated 't' value (2.012) and 'p' value is less than 0.05, hence it is significant. That means the hypothesis is not accepted. Therefore, there exists a significant difference between the male and female teacher educators in adaptability towards techno-pedagogical skills. Male teacher educators have adapted better than female teacher educators towards techno-pedagogical skills. This result has been supported by Dr. Anuradha S. (2019), Anand S. (2019) wherein techno-pedagogical competency of male group was higher than that of female group.

- **Objective 3 : To study the challenges faced by Teacher Educators in adapting techno-pedagogical skills**

The majority of teacher educators responded to open-ended questions with respect to challenges or difficulties faced by them while integrating technology into their classroom teaching, and revealed the following as major challenges:

- Inadequate technological resources in the college.
- Learning a new thing and integrating it into regular lectures within a limited time i.e. time management.
- Disturbed Network issue, unavailability of Wi-Fi connection.
- Difficulty in coping with the speed with which the newer technology is developed.
- Digital divide among student-teachers.
- Insufficient training and support from the institute.

Y. Supriya (2024) in her studies discussed various challenges in Industry 5.0 in Smart Education such as internet connectivity and access to devices, recognizing and bridging the skills gap among both educators and students to harness the full potential of Industry 5.0 technologies in education, lack of necessary infrastructure to accommodate the new technology which corroborates with the challenges mentioned in the present study. Addressing these challenges is imperative for the successful implementation of the 5.0 technologies in education.

6. CONCLUSION

6.1 Summary of Findings

This research was conducted with the aim of studying the adaptability towards techno-pedagogical skills of teacher educators and the challenges faced by them in adapting these skills. With this aim, the present study conducted a descriptive survey of teacher educators working in B.Ed. colleges of Mumbai and Thane region of Maharashtra state and studied their general level of techno-pedagogical skills and also techno-pedagogical skills with respect to the type of college, geographical region and gender. The findings of the study revealed that the teacher educators of Mumbai and Thane region have above-average techno-pedagogical skills. The study found no significant differences based on institutional type or location, but identified a notable gender disparity, with male educators showing

better adaptability to technological skills.The study throws light on the fact that male teacher educators have better adaptability towards techno-pedagogical skills than female teacher educators. Hence, the present study highlights the importance of enhancing techno-pedagogical skills of women teacher educators and the need for targeted interventions to boost women's confidence in technological skills. Institutions can establish mentorship programs, pairing female teacher educators with tech-savvy peers for guidance and support.

The findings revealed the major challenges faced by teacher educators while adapting to techno-pedagogical skills, such as inadequate technological resources, disturbed internet connectivity, difficulty in coping with newer technology and time management, digital divide among student-teachers, and insufficient training and support from the institute. The researcher recommends comprehensive training programs for teacher educators that will help them grasp the industry 5.0 technologies and integrate them into teaching. The support of institutions in improving technological infrastructure, providing resources for training programs and appreciation for professional development is the need of the hour. Inclusive policy frameworks should be advocated for promoting equal access to technology and training opportunities for all educators, regardless of gender.

6.2 Implications and Future Work

'The ultimate goal of Education 5.0 is to create a more efficient, effective, and equitable education system that can adapt to the changing needs of society in the fifth industrial revolution. Education 5.0 promotes collaboration and connectedness among students, teachers, and other stakeholders. It represents a new level of technology integration in education.' (Shabir Ahmad et al.). It can be achieved through enhancing the techno-pedagogical skills of teacher educators and providing interactive learning experiences to student-teachers for their holistic development.

The findings of the present study will help teacher training institutes and policymakers to take into consideration the importance of techno-pedagogical skills while course designing, curriculum development, ICT implementation, policy-making, planning various FDPs., orientation and refresher courses etc. Integration of technological tools in the classroom will enhance the learning environment and will also assist students in becoming familiar with using technology in their day-to-day lives. 'Transformation of teachers to techno-pedagogues would not only increase the capability of the teachers but also make the teaching-learning process effective, efficient and they will bring the entire world into the classroom as well as make students competitive in the international arena. (Beri, N. 2020). Hence, Teacher Educators must be trained and well-equipped with the skills to weave technology with pedagogy seamlessly and make the learning environment a place of innovation, creativity, problem-solving, and enjoyment, leading to holistic development. Inclusive policy frameworks should be advocated for promoting equal access to technology and training opportunities for all educators, regardless of gender.

The present study focused on the techno-pedagogical skills of teacher educators in Mumbai and Thane region of Maharashtra state. Several other aspects can be considered for future research. It can be replicated in other districts of Maharashtra and other states of India. TPACK competencies with other sub-variables such as experience, age, subjects etc. can be considered. Perceptions of students and teachers towards Industry 5.0 in education can be studied. The mixed methodology can be used to know more in-depth opinions of teachers towards techno-pedagogical skills through observation, focus interviews etc. The impact of new digital technologies used in the classroom on student achievement can be tested through experimental studies.

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