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Analyzing the Interplay Between Techno-Pedagogical Competence and Cognitive Flexibility Among Pre-Service Teachers

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Abstract:- The most essential 21st-century skill for today's teachers is the ability to judiciously blend technology, pedagogy, and content, all while being attuned to contextual factors. This integration is crucial for fostering effective learning among students. The prime objective of the present research paper is to find the association of techno-pedagogical competence with cognitive flexibility among pre-service teachers. Descriptive survey research was used to meet the objectives of the paper. The stratified random sampling was employed to collect the data from 348 sampled pre-service teachers of Punjab. Techno-pedagogical competence scale by Rajasekar & Sathiyaraj (2013) was used to measure techno-pedagogical competence of the pre- service teachers. For measuring cognitive flexibility among pre-service teachers, the cognitive flexibility Inventory by Denis and Vander (2010) was used. Pearson Product moment correlation analysis disclosed that cognitive flexibility has positive and significant association with techno-pedagogical competence among pre-service teachers. Practical recommendations will be suggested on the basis of the findings to alter the academic and non-academic aspects of teacher training institutions to develop and enrich the techno-pedagogical competence among pre-service teachers.

Keywords*:* Techno-pedagogical competence; cognitive flexibility; descriptive survey; stratified random sampling; correlation analysis.

1. Introduction

Twenty-first century classrooms are evolving to meet the dynamic needs of today's learners and to prepare them for a rapidly changing world. These classrooms integrate advanced technology, innovative teaching methods, and a focus on critical skills to craft a more engaging and effective learning environment. Digitalization of classrooms in the present century has replaced chalkboards with smartboards, requiring teachers to be proficient in the use of technological tools and pedagogical strategies to produce a productive learning environment for students. Kohler & Mishra (2009) recognizes that effective teaching in the digital age requires a unique blend of technological, pedagogical, and content knowledge which lead to coin Technological Pedagogical Content Knowledge and the acronym (TPACK). TPACK emphasizes the intersection of three primary forms of knowledge i.e. content, pedagogy and technology that teachers need for integration of technology into their teaching. This ability of teachers to effectively integrate IT tools into their instructional methods while maintaining a solid understanding of pedagogical principles and contextual factors is termed as a techno-pedagogical competence. It embodies the art of blending sound teaching and learning principles with technology (Lee and Tsai, 2010). It is true that to make learning more interactive, exciting, and motivating, a teacher must be adept at effectively integrating technology, pedagogy, and content in a technologically oriented classroom (Prakash, 2014).

In today's dynamic educational landscape, the capacity to adapt is crucial for survival and growth. Adaptability is fueled by cognitive flexibility, the ability to think creatively, switch gears, and adjust strategies. Cools in 2005 defined cognitive flexibility as the mind's ability to switch between tasks and responses effortlessly, adapting to new and sudden changes in life. This mental agility enables individuals and systems to thrive in dynamic environments by effectively responding to change and exploring innovative solutions. Thus, flexibility enables

individuals to fluidly transition between different thought processes, strategies, and problem-solving approaches. This mental dexterity is required for thriving in complex and ever-changing environments. Literature showcased that task-switching, attentional set-shifting, and reversal learning can be classified as flexible behavior (Brown et al., 2015).

2. Literature Review

Kumar (2017) examined the relation of Technological Pedagogical Content Knowledge (TPACK) and technology anxiety among a stratified sample of 620 student teachers from Calicut university. The results of the data analysis revealed that TPACK is positively related with technology anxiety among female student teachers whereas such relationship does not hold significance among male student teachers.

Baluni and Nasa (2020) explored the relation of TPACK and self-efficacy among 200 pre-service teachers from private institutions. The findings showed that male and female participants from urban areas differs in technology usage with male having higher levels of technology usage.

Chauhan (2004) investigated the relation of techno-pedagogical competence with attitude towards teaching among 190 teachers. Results demonstrated that techno-pedagogical competence is positively and significantly related with attitude towards teaching. Gender and locale have no significant effect on techno-pedagogical competence of teachers.

Bing (2011) uncovered the relationship between cognitive flexibility and school adaptation among 597 college students. Results disclosed that cognitive flexibility has positive and significant relation with school adaptation among college going students.

Sheerha (2020) examined the relationship of cognitive flexibility and mindfulness with flow disposition among 100 college going students. Results showed that students with high cognitive flexibility exhibit high level of mindfulness.

Researches in the past disclosed that there is a dearth of studies exploring relationship between techno-pedagogical competence and cognitive flexibility among pre-service teachers. Therefore, the researcher aims to analyze the interplay between techno-pedagogical competence and cognitive flexibility among pre-service teachers.

Objectives

1. To explore the relationship of techno-pedagogical competence with cognitive flexibility among pre-service teachers.
2. To assess the relationship of techno-pedagogical competence with cognitive flexibility among pre-service teachers across gender.

Hypotheses

1. There is no significant relationship of techno-pedagogical competence with cognitive flexibility among pre-service teachers.
2. There is no significant relationship of techno-pedagogical competence with cognitive flexibility among pre-service teachers across gender.

3. Research Methodology

A descriptive method with correlational approach was used in the current study. The undergraduate students pursuing two-year Bachelor of Education (B.Ed.) degree in Indian teacher

training institutions constitute the universe of the study.

Sample

Stratified sampling was utilized to gather data from 348 pre-service teachers in their final year of the Bachelor of Education (B.Ed.) degree program at government and government-aided colleges of Education situated in the

Majha, Malwa, and Doaba regions of Punjab. Participants were informed about the objectives of the study and assured of the confidentiality of their data, which would be used solely for research purposes. Consent was obtained from each participant before their involvement in the study. Research instruments were distributed to the participants with clear and precise instructions. Demographic characteristics of the sample is provided in the Table 1.

Table 1. Demographics of the sample.

Variables	Options	N	%
Gender	Male	62	17.82
	Female	286	82.18
Place of residence	Urban	221	63.50
	Rural	127	36.49

Table 1 reveals that out of the 348 pre-service teachers, 62 (17.82%) were male pre-service teachers and 286 (82.18%) were female pre-service teachers. Additionally, 63.50% of the respondents belong to urban areas, while 36.49% of the pre-service teachers are from rural locales.

4. Instruments & Procedures

1. Techno-Pedagogical Competence Scale

The Techno-Pedagogical Competence Scale by Rajasekar & Sathiyaraj (2013) was employed to measure the techno-pedagogical competence of pre-service teachers. This scale utilizes a 5-point Likert format, with responses ranging from 1 (Never) to 5 (Always). Scores on the scale can range from 40 to 200, with higher scores is an indication of greater level of techno-pedagogical competence. The Techno-Pedagogical Competence Scale has an intrinsic validity of 0.91 and a split-half reliability of 0.82.

2. Cognitive Flexibility Inventory (CFI):

Cognitive Flexibility Inventory (CFI), formulated by Dennis and Vander Wal (2010) comprising 20 items will be used to measure individuals' ability to react adaptively to difficult life situations. This inventory is a 5-point Likert scale ranging from 1(not suitable) to 5 (completely suitable). The scores on this inventory ranges from 20 to 140. Higher the scores of the individual on the cognitive flexibility inventory, higher will be the cognitive flexibility level of the individual. This inventory contains two sub-scales- alternative (the ability to generate alternative solutions to the situations) and control (ability to perceive difficult situation as controllable).

Statistical treatment of the data

SPSS 25.0 version is used for data analysis. Descriptive analysis and correlation analysis were carried out for the statistical treatment of the data. The results are presented in different sections under data analysis and interpretation.

5. Data Analysis and Interpretation

The analysis of the data is represented in different sections under (i) Descriptive analysis (ii) Correlation Analysis

(I) **Descriptive Analysis of the data:** The mean and standard deviation of the sample is tabulated in Table 2

Table 2: Descriptive Analysis of the data

Variables	Mean	S.D.
Techno-Pedagogical Competence	147.90	26.00
Cognitive Flexibility	103.02	13.79
Cognitive flexibility	Maximum score = 137	Minimum score= 19

Techno-Pedagogical Competence	Maximum score = 197	Minimum score= 44

The mean scores for techno-pedagogical competence and cognitive flexibility were 147.90 and 103.02, respectively. The S.D. for these variables were 26.00 and 13.79, respectively. The range of scores for techno-pedagogical competence among pre-service teachers was 44 to 197.

(II) **Correlation Analysis of the data**

Pearson product moment correlation was used to compute coefficient of correlation between techno-pedagogical competence and cognitive flexibility among pre-service teachers. Table 3 represents the coefficient of correlation values between techno-pedagogical competence and cognitive flexibility among pre-service teachers.

Table 3: Inter Correlation of techno-pedagogical competence of cognitive flexibility among pre-service teachers

Variables	Cognitive Flexibility (N=348)	Cognitive Flexibility (Females, N=286)	Cognitive Flexibility (Males, N=62)
Techno-pedagogical competence	0.233**	0.271**	0.149^{NS}

** significant at 0.01 level of significance, NS= non-significant

Table 3 shows that techno-pedagogical competence has positive and significant correlation with cognitive flexibility among pre-service teachers ($r = 0.233$, $p < 0.01$). This indicates that as cognitive flexibility increases, the level of techno-pedagogical competence among total sample of pre-service teachers also increases. Therefore, the hypothesis, "*There is no significant relationship of techno-pedagogical competence with cognitive flexibility among pre-service teachers*" stands accepted.

It is evident from Table 3, techno-pedagogical competence has significant correlation with cognitive flexibility for female pre-service teachers ($r=0.271$, $p<0.01$). This suggests that as female pre-service teachers become more cognitively flexible, their techno-pedagogical competence also increases. However, the relationship of techno-pedagogical competence with cognitive flexibility is not significant for males ($r = 0.149$, $p > 0.05$). Therefore, the hypothesis, "*There is no significant relationship of techno-pedagogical competence with cognitive flexibility among pre-service teachers across gender*" stands rejected for female pre-service teachers.

6. Results and Discussions

Female pre-service teachers (82.18%) constitute the major proportion of the sample. Results from the correlational analysis revealed that techno-pedagogical competence increases in tandem with cognitive flexibility among total and female pre-service teachers. The relationship of cognitive flexibility and techno-pedagogical competence loses significance among male pre-service teachers. Findings suggested that the increase in techno-pedagogical competence, defined as the capability to integrate technology, pedagogy, and content knowledge, can be linked to the rise in cognitive flexibility among pre-service teachers. Techno-pedagogical competence encompasses both the ability to use technology and the understanding of how to meaningfully integrate it with pedagogical practices, content, and context to enhance student learning effectively. Individuals with high levels of mental flexibility excel at adapting to rapidly changing educational environments, such as the continual emergence of new technological tools like AI, virtual reality, and adaptive learning platforms (Bali et al., 2024; Ozturk et al.,2020 & Mishra et al. 2010). Cognitive flexibility assists in fostering self-assurance, encourage experimentation with new tools, equips individual with confidence to face the challenges and opportunities presented by technology integration. This ultimately leads to increased familiarity and competence to deal with the dynamic scenario of digitalised or 21st century classrooms. Therefore, cognitive flexibility equips pre-service teachers with the mental agility, optimistic attitude, and confidence necessary to embrace and effectively utilize technology in conjunction with sound pedagogical practices, thereby enhancing their overall techno-pedagogical competence.

The results of this study will be valuable for policymakers and educationists by acquainting them with the significance of cognitive flexibility in boosting techno-pedagogical competence among pre-service teachers.

Additionally, curriculum developers can leverage these insights to incorporate both conceptual knowledge and practical aspects of cognitive flexibility into educational programs. Teacher training institutions can create tailored learning environments that foster cognitive flexibility by incorporating activities that expose pre-service teachers to a variety of instructional strategies, teaching methods and encouraging the experimentation with new technological tools. These experiences enable pre-service teachers to develop creative solutions to teaching challenges, thereby enhancing their mental flexibility. Workshops and seminars should be organized with speakers from diverse backgrounds to offer a range of viewpoints and perspectives to future teachers. This exposure to multiple perspectives can serve as a catalyst for fostering cognitive flexibility (Liew,2019) among pre-service teachers, thus enhancing their 21st century skill of teaching profession i.e. techno-pedagogical competence.

7. Conclusions

The present study found a moderate relationship between techno-pedagogical competence and cognitive flexibility among pre-service teachers, revealing that an increase in cognitive flexibility correlates with a rise in techno-pedagogical competence. This research recommends incorporating cognitive flexibility activities into teacher training curricula to enhance techno- pedagogical competence among pre-service teachers.

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