METACOGNITIVE SKILLS EFFECT TOWARDS DEVELOPMENT OF SCIENTIFIC TEMPER OF PROSPECTIVE TEACHERS

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Abstract

Scientific temper is a critical attribute that fosters an individual's ability to think critically, evaluate evidence, and approach problems systematically. In the context of education, prospective teachers play a vital role in shaping the scientific temper of future generations. The study intended to explore the influence of metacognitive skills on the development of Scientific temper of prospective teachers. The descriptive survey design has been employed to investigate the effect of Metacognitive Skills on the Scientific Temper of prospective teachers. Meta-Cognitive Skills Scale (Madhu Gupta and Suman) and Scientific Temper Inventory (K.S. Misra) have been used to measure metacognitive skills and scientific temper of 82 B.Ed. students studying in the Unity College of Teacher Education, Dimapur, Nagaland. The hypothesis of the study stated as "The distribution of Scientific Temper is the same across categories of Metacognitive skill levels". Kruskal-Wallis Test has been administered to test the hypothesis using SPSS software. The null hypothesis rejected and confirmed that there is significant effect of Metacognitive skills of prospective teachers on their Scientific Temper.

Keywords: *Attitude, Behaviour, Efficacy, Metacognitive Skills, Motivation, Prospective Teachers, Scientific Temper*

Introduction

It shall be the duty of every citizen of India to develop the scientific temper, humanism and the spirit of inquiry and reform and the Constitution of India highlights that, teachers are the social engineers. The teachers shape the future of the students and prepare them to be a part of nation building. We required the generation with critical, analytical and rational thinking. Here the role of teachers is crucial, not only to impart the knowledge and insights to students in academic context but also need to transfer these into social context. Intolerance, Superstitions, Pseudoscience are needed to remove and accommodate democratic and secular values. Teacher with scientific temper can only create sound democratic and secular environment in the classroom and outside. Teachers' metacognitive skills and scientific temper play a crucial role here. People with high scientific temper are required for Democratic and Secular country hence constitution states "It shall be the duty of every citizen of India to develop the scientific temper, humanism and the spirit of inquiry and reform". Scientific temper may be defined as the cognitive and emotional disposition that stimulates the individuals to think critically, analytically, and

objectively. It involves the capacity to question, investigate, make evidence-based decisions, situate closely with the principles of scientific method. Metacognition, often defined as "thinking about thinking," refers to an individual's awareness and control over their thought processes. Metacognitive skills encompass various aspects, such as self-awareness, self-regulation, and self-monitoring, which play a crucial role in learning and problem-solving. The relationship between metacognition and scientific temper is relatively unexplored in the literature. However, it is plausible to hypothesize that prospective teachers with strong metacognitive skills show better scientific temper.

Review of Literature

Metacognition is defined as learning to learn, is very important for students to improve their thinking skills (Lukitasari et al., 2019). Flavell (1978) first introduced the concept of metacognition and defined it as the highest level of thinking skills. Costa (1984) defined metacognition as being aware of whether one knows and being aware of the mental methods used in problem-solving. Papleontiou-Louca (2003) defined metacognition as controlling and realizing one's emotions and motivation. Metacognition is a high-level mental skill that is effective in realizing the educational goals of students and increases the effectiveness of teaching activities, occurs at an early age, and can develop until the end of adolescence (Benton, 2014; Brown, 1987). Metacognition stimulates awareness about instructional decisions and the reasons behind them in the classroom environment by defining, reflecting, and assessing (Griffith et al., 2016). Research in the literature indicates that learners will become more skilful in the utilization of learning strategies if they learn more about the nature of strategies and grasp when a specific approach should be used (Boström & Lassen, 2006; Oxford, 1989). Furthermore, the development of students' metacognitive skills will foster their learning outcomes (Davidowitz & Rollnick, 2003; Thomas & McRobbie, 2001), problem-solving skills (Sperling et al., 2002), thinking skills (Chen, 2020; Orion & Kali, 2005; Preus, 2012), critical thinking (Akama, 2006; Ku & Ho, 2010; Magno, 2010) and self-efficacy (Muwonge et al., 2017; Şen & Yılmaz, 2016).As the significance of these competencies in education is known well, the importance of students' having metacognitive skills is apparent. Another fact that becomes visible at this point is that for students to have these skills, teachers who educate them should also have developed metacognition skills (Jones et al., 1995). Thus, teachers need certain competencies to train students in metacognition skills and competencies include having an attitude that will increase students' metacognition (Goos et al., 2002), helping students to build their learning processes(Williamson, 1996), giving feedback that will enable students to control their learning processes (Pintrich, 2002; Toney, 2000), allowing students to practice and encouraging them (Gourgey, 2001), knowing which strategies are effective in the development of students' metacognition and how to use them within the curriculum (Kiewra, 2002; Veenman et al., 2006), and organizing learning environments (Blakey & Spence, 1990; Hartman, 2002). Although metacognition has different definitions, it has two

fundamental dimensions: metacognitive awareness and metacognitive strategies. Metacognitive awareness refers to what learners know about their learning, whereas metacognitive strategies refer to learners' regulation and management of their learning (Schraw et al., 2006). When we examined the literature, we discovered that there are different approaches and instruction typesto enhance individuals' metacognition (Alderman et al., 1992; Blakey & Spence, 1990; Chen, 2020; Costa, 1984; Oxford, 1990; Preus, 2012). Metacognition theory has significant potential to help teachers create a flexible and creative learning environment in their classrooms (Borkowski & Muthukrishna, 1992). Based on the results of the relevant research (Davidowitz & Rollnick, 2003; Paris & Winograd, 1990; Thomas & McRobbie, 2001), one can observe that students' learning outcomes can improve when metacognition development strategies are used effectively in the classroom. In addition, metacognition has an important role in programs aiming to develop higher-level thinking skills (Chen, 2020; Swartz, 2003; Zohar, 1999). Also, there is a positive and significant relationship between metacognition and problem-solving skills (Bakioğlu et al., 2015; Kaplan et al., 2016). Studies have revealed that metacognition enhancement programs develop participants' problem-solving skills (Safari & Meskini, 2016; Serin, 2014).Lin (2001) revealed that metacognition provided people the ability to understand and to monitor their own thoughts and assumptions which were the implications of the people's activities and the attitude can be facilitated by the mastery of metacognitive skills, which means that if students have high metacognitive skills, they will be able to increase their positive attitudes. Thus, metacognitive skill can improve not only students' scientific attitudes but also their cognitive learning results, it is essential to pay more attention to metacognitive skills in l21st century earning activities.

Methodology

The present study adopted descriptive survey design. 82 B.Ed. students of the Unity College of Teacher Education, Dimapur, Nagaland have participated in the survey study. Meta-Cognitive Skills Scale (Madhu Gupta and Suman) and Scientific Temper Inventory (K.S. Misra) have been used to measure metacognitive skills and scientific temper respectively and after the collection of the data descriptive analysis has been done. Prospective teachers were categorized in to three groups based on their Metacognitive skills like High Metacognitive skills, Medium Metacognitive skills and Low Metacognitive skills. Since the data failed to achieve normality and homogeneity in variance non-parametric test has been administered to test the hypothesis.

Design if the Study: Descriptive Survey

Variables of the Study: Metacognitive skills(Independent variable) and Scientific Temper (Dependent variable)

Tools Used in the Study: Meta-Cognitive Skills Scale (MadhuGupta andSuman) and Scientific Temper Inventory (K.S. Misra)

Objective of the Study: To study the effect of Metacognitive Skills of Prospective Teachers on Scientific Temper.

Hypothesis of the Study: H01: The distribution of Scientific Temper is the same across categories of Metacognitive skill levels.

Major Statistics: Kruskal- Wallis Test (Non parametric Test)

Analysis and Findings

The different levels of metacognitive skills and their relationship with scientific temper has been analysed using descriptive statistics and the Table-1 shows the descriptive analysis of the levels of metacognitive skills and their relationship with scientific temper. The table is divided into three levels of metacognitive skills: low, medium, and high. For each level, the table provides various statistical measures such as the mean, median, standard deviation, skewness, kurtosis, Shapiro-Wilk test(Normality Test)and Levene's test(Homogeneity of Variances Test) results.

Table 1 The Descriptive Analysis of the Levels of Metacognitive Skills and their Relationship with Scientific Temper

Levels Meta cognitive Skills	Scientific Temper								
	N	Mean	Median	Mode	SD	Skewness	Kurtosis	Normality Test (Shapiro Wilk)	Homogeneity of Variances Test (Levene's)
Low level Meta cognitive skills	27	88.9	90	81	28.0	-0.99	2.78	P=0.0009	P=0.081
Medium level Meta cognitive skills	26	106	108	109	16.1	-0.05	0.322		
High Level Meta cognitive skills	29	106	106	135	18.3	-0.29	0.694		

The table shows sample size for each level of metacognitive skills is quite similar, with 27 participants in the low-level group, 26 in the medium level group, and 29 in the high-level group. The mean scientific temper score increases as the level of metacognitive skills increases, with the low-level group having a mean score of 88.9, the medium level group having a mean score of 106, and the high-level group also having a mean score of 106. The median and mode values show a similar trend. The standard deviation values indicate that there is more variability in the scientific temper scores for the low-level metacognitive skills group (28.0) compared to the medium (16.1) and high (18.3) level

groups. The skewness values indicate that the distribution of scientific temper scores is negatively skewed for all three groups, with the low-level group having the most negative skewness value (−0.99). The kurtosis values indicate that the distribution of scientific temper scores is leptokurtic (more peaked than a normal distribution) for the low-level group (2.78) and platykurtic (less peaked than a normal distribution) for the medium (0.322) and high (0.694) level groups. The Shapiro-Wilk test is a statistical test used to determine if a sample of data is normally distributed. In this case, the p-value for the Shapiro-Wilk test on "Scientific Temper" is 0.009, which is considered low. This suggests that the assumption of normality has been violated for this variable, meaning that the data for "Scientific Temper" is not normally distributed. Levene's test is a statistical test used to assess the equality of variances for a variable calculated for two or more groups. In this case, the p-value for Levene's test on "Scientific Temper" is 0.081, which is greater than the typical significance level of 0.05. This suggests that we cannot reject the null hypothesis that the population variances are equal for this variable. This means that there is not enough evidence to suggest that the assumption of homogeneity of variance has been violated for "Scientific Temper". Since the assumptions of parametric tests have been violated the hypothesis of the study needs to be tested with non-parametric tests. Kruskal- Wallis Test has been administered using SPSS software.

Table 2 The Hypothesis Test Summary

Null Hypothesis	Test	Significance	Decision
The distribution of Scientific Temper is the same across categories of Levels Metacognitive Skills	Independent samples Kruskal-Wallis Test	0.011	Reject the null hypothesis

The table exhibits the summary of a hypothesis test conducted using SPSS. The null hypothesis being tested is that the distribution of Scientific Temper is the same across categories of Levels-Metacognitive Skills. An Independent samples Kruskal-Wallis Test was used to test this hypothesis, and the resulting p-value (Sig) was 0.011. Since this p-value is less than the significance level of 0.05, the decision was made to reject the null hypothesis. This means that there is evidence to suggest that the distribution of Scientific Temper is not the same across categories of Levels-Metacognitive Skills and this indicates that there exists a significant effect of the metacognitive skills of prospective teachers on their scientific temper.

Conclusion, Discussion and Summary

Scientific temper is a fundamental attribute that empowers individuals to think critically, evaluate evidence, and approach problems systematically and prospective

teachers play a vital role in shaping the scientific temper of future generations. The present study explored the metacognitive skills of prospective teachers and this ability can foster their scientific temper. The findings suggest a positive effect of metacognitive skills on the development of scientific temper, highlighting the importance of incorporating metacognition into 21st century teacher training programs and educational practices.

Educational Implications and Suggestions

- Teacher training programs should incorporate metacognitive skill development into their curriculum like workshops and coursework that help prospective teachers enhance their self-awareness, self-regulation, and self-monitoring abilities.
- Programs should emphasize the importance of nurturing scientific temper in students and provide strategies for doing so effectively.
- In-service teacher professional development should continue to support the development of metacognitive skills and the promotion of scientific temper.
- Teachers should have opportunities for ongoing training and support in these areas to ensure they remain effective in fostering these attributes in their students.
- Curriculum designers should consider ways to embed metacognitive skill development and the promotion of scientific temper across subject areas.
- It can help ensure that students are exposed to these critical concepts throughout their education.
- As education continues to evolve in a rapidly changing world, it is crucial to recognize the role of metacognition in nurturing scientific temper and preparing students to navigate a complex and data-driven society successfully.
- Further research in this area is warranted to better understand the nuanced connections between metacognition and scientific temper and to develop more effective strategies for promoting both in 21st century educational settings.
- Teachers should also place more attention on the empowerment of students' metacognitive skills through the implementation of appropriate learning strategies, because the contribution of metacognitive skills towards students' academic success.

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