Correlation between Metacognition and Teaching Competency in Biology Teacher-Trainees

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Abstract

The study looks at the relationship between metacognition and teaching competency among biology teacher trainees. Metacognition, defined as awareness and modulation of one's own learning processes, is thought to play an important part in the development of successful teaching abilities. This study uses a quantitative survey method to determine the metacognition and teaching skill of biology teacher trainees. In addition, the association between metacognition and teaching ability of biology teacher trainees will be investigated in terms of gender, location, and educational qualifications. The study was done in Bihar's Darbhanga district. Quantitative data were collected using Punita Govil's Metacognition Inventory (MI) and Dorathy Rani's Teaching Competency Scale (TCS). The MI assesses two main components: cognitive knowledge and cognitive regulation. The TCS analyses basic teaching skills such as lesson design, instructional delivery, the use of appropriate strategies, the effective use of teaching aids, teaching efficacy and so on. The study's findings revealed that there was no significant difference in knowledge-cognition, regulation-cognition, metacognition and efficacy in teaching competency across genders and that there is a significant relationship between metacognition and teaching competency among biology teacher-trainees at Teachers Training Colleges in Bihar's Darbhanga district.

Key Words: *Correlation, Metacognition, Teaching Competency, Biology Teacher-Trainees.*

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Introduction

Metacognition, or self-awareness and management of cognitive processes, is critical to effective teaching. The correlation between metacognition and teaching competency has garnered considerable attention in educational research, highlighting how teachers' reflective practices influence their instructional strategies and student outcomes. Metacognition enables teachers to critically assess their teaching methods, understand their strengths and weaknesses and adapt their approaches to meet diverse student needs.

Research indicates that teachers with high metacognitive skills are better equipped to plan, monitor and evaluate their instructional practices, leading to improved teaching efficacy and student engagement. For instance, a study by Wilson and Bai (2010) found that teachers who regularly engaged in metacognitive reflection demonstrated greater instructional adaptability and student-centered teaching practices. Additionally, Zohar (2006) emphasized the importance of metacognitive pedagogical knowledge, which allows teachers to foster students' higher-order thinking skills, thereby enhancing overall educational quality. Alam, M. A. (2014) explores the Metacognition: A Variable of Learning.

The development of metacognitive skills in teachers has been linked to their professional growth and lifelong learning. Kramarski and Michalsky (2009) showed that metacognitive training programs significantly enhance teachers' ability to implement innovative teaching strategies and respond effectively to classroom challenges. These findings underscore the necessity of integrating metacognitive development into teacher education programs to cultivate teaching competencies that align with contemporary educational demands. Alam, M. A. (2017) conducted a study on Metacognitive Abilities of Secondary School Biology Teachers.

Therefore, the correlation between metacognition and teaching competency underscores the critical role of self-reflective practices in effective teaching. By fostering metacognitive awareness, educators can enhance their instructional methodologies, contribute to student success, and engage in continuous professional development. As such, ongoing research and

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practical interventions in this area remain essential for advancing educational practices and teacher effectiveness.

Review of Related Studies

Schraw and Moshman (1995) provide a foundational understanding of metacognition, emphasizing its role in effective teaching. They outline how metacognitive strategies, such as planning, monitoring, and evaluating one's own understanding and teaching methods, contribute to enhanced teaching performance. This study underpins much of the current research linking metacognition to teaching competency, suggesting that teachers with high metacognitive awareness are better equipped to adapt their instruction to meet diverse student needs.

Kramarski and Michalsky (2009) explore the impact of metacognitive training on the teaching practices of pre-service teachers. Their study reveals that teacher trainees who received metacognitive instruction demonstrated significant improvements in lesson planning, problem-solving, and adaptive teaching techniques. This research highlights the potential of metacognitive training in teacher education programs to foster higher levels of teaching competency. Alam, M. A. (2017) also conducted a study on assessment of metacognitive abilities of secondary school teachers.

Reflective practice, a component of metacognition, is widely studied in relation to teaching effectiveness. Fendler (2003) discusses how reflective practice enables teachers to critically analyze their teaching methods and student interactions, leading to continuous improvement in teaching competency. Biology teacher trainees who engage in reflective practices are likely to develop a deeper understanding of their teaching processes and outcomes, thereby enhancing their overall teaching skills.

Zohar and Dori (2012) focus on metacognitive instruction in science education, including biology. Their study indicates that biology teacher trainees who implement metacognitive strategies in their teaching exhibit better student engagement and learning outcomes. The research emphasizes that metacognitive skills help teacher trainees to better organize and present complex biological concepts, making them more effective educators.

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Wilson and Bai (2010) conduct a correlational study specifically examining the relationship between metacognitive awareness and teaching efficacy among pre-service teachers. Their findings demonstrate a strong positive correlation, indicating that trainees with higher metacognitive awareness tend to exhibit higher teaching efficacy. This study reinforces the importance of integrating metacognitive skill development in teacher training programs to enhance teaching competency. Alam, M. A. (2017) emphasized the impact of metacognitive abilities of teachers and their ninth class students on the achievement in biological sciences.

Collectively, these studies underscore the critical role of metacognition in the development of teaching competency among biology teacher trainees. The consistent positive correlation across various educational contexts and teaching disciplines suggests that fostering metacognitive skills can significantly enhance teaching effectiveness. Future teacher education programs should prioritize metacognitive training to better prepare trainees for the complexities of classroom teaching. Additionally, ongoing professional development focusing on reflective practice and adaptive teaching strategies can further support teachers in maintaining high levels of teaching competency throughout their careers.

Significance of the study

Understanding the correlation between metacognition and teaching competency among biology teacher-trainees is crucial for several reasons, which span educational quality, professional development, and student outcomes. This study has significant implications across multiple facets of education, including teacher training programs, pedagogical strategies and the broader educational landscape. Investigating the link between metacognition and teaching competency can inform the design and implementation of teacher education curricula. By integrating metacognitive training into biology teacher-trainees' programs, educators can cultivate future teachers who are reflective, adaptive, and self-regulated. This ensures that trainees develop a deep understanding of how to monitor, evaluate, and improve their teaching practices continuously. Research by Kramarski and Michalsky (2009) underscores the

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importance of metacognitive training in enhancing teaching strategies, suggesting that structured metacognitive exercises should be a staple in teacher education.

Metacognitive skills enable teachers to better understand and manage their cognitive processes, leading to more effective teaching strategies. For biology teacher-trainees, this means they can design and implement instructional practices that cater to diverse student needs, fostering an environment conducive to active learning and critical thinking. Wilson and Bai (2010) demonstrated that teachers with higher metacognitive awareness are more capable of employing student-centered teaching methods, which are particularly important in science education where inquiry-based and hands-on learning are key. Metacognition is not only about improving current teaching practices but also about fostering a mindset of lifelong learning. For biology teacher-trainees, developing strong metacognitive skills early in their careers can lead to sustained professional growth and adaptability in the face of evolving educational demands. This continuous professional development is essential for maintaining high teaching standards and adapting to new scientific discoveries and pedagogical innovations.

Teachers who possess strong metacognitive skills are better equipped to facilitate student learning and engagement. By modeling metacognitive strategies and encouraging students to develop their own metacognitive abilities, biology teacher-trainees can significantly enhance students' understanding and retention of complex biological concepts. Zohar (2006) highlighted that teachers' metacognitive knowledge directly impacts their ability to teach higher-order thinking skills, which are crucial for student success in science education. Alam, M. A. (2020) also highlighted metacognitive ability and academic achievement in Biology. Understanding the correlation between metacognition and teaching competency aligns with broader educational standards and policies that emphasize reflective practice and continuous improvement. This study can provide evidence-based recommendations for policymakers and educational leaders to support the inclusion of metacognitive training in teacher certification requirements and professional development programs. Finally, this study contributes to the body of educational research by providing empirical evidence on the specific relationship between metacognition and teaching competency in the context of biology education. It fills a gap in the literature by

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focusing on a specialized subject area, offering insights that can be generalized to other science disciplines and beyond.

Thus, examining the correlation between metacognition and teaching competency among biology teacher-trainees has profound implications for enhancing teacher education, improving pedagogical practices, promoting lifelong learning, enhancing student outcomes, aligning with educational policies, and contributing to educational research. This study highlights the critical role of metacognitive skills in developing competent, reflective, and effective biology teachers, ultimately leading to a higher quality of science education.

Objectives of the Study

- To determine the degrees of metacognition and teaching competency of biology teacher-trainees.
- To determine if male and female biology teacher-trainees differ significantly in terms of metacognition and teaching competency.
- To find out the relationship between metacognition and teaching competency of biology teacher-trainees.
- To investigate the relationship between metacognition and teaching competency among biology teacher-trainees.

Hypotheses of the Study

- There is no significant difference between male and female biology teacher-trainees in their metacognition and its dimensions.
- There is no significant difference between male and female biology teacher-trainees in their teaching competency and its dimensions.
- There is no significant relationship between metacognition and teaching competency of biology teacher-trainees.

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Methodology of the Study

The survey approach was employed in this inquiry. This is a fact-finding method. So the investigator applied this methodology in the present study.

Sample of the Study

The samples for this analysis were collected from B.Ed students at Teachers Training Colleges in Bihar's Darbhanga district. This investigation included 150 B.Ed Biology teacher trainees from ten Teachers Training Colleges.

Tools Used in the Study

For this investigation, the researcher employed the following instruments:

- Metacognition Inventory (MI) by Punita Govil (2000)
- Teaching Competency Scale (TCS) by Dorathy Rani (2000).

Statistical Techniques Used in the Study

The following statistical methods were employed by the researcher to analyze the study's data:

- Mean
- Standard Deviation
- t-test
- Pearson's Product Moment Correlation Coefficient

Analysis and Findings of the Study

Table-1: Level of Metacognition among Biology Teacher-Trainees

Metacognition	Low		Moderate		High	
	N	%	N	%	N	%
Knowledge of Cognition	12	9	41	19	50	25
Regulation of Cognition	26	16	51	27	83	31
Metacognition	55	28	73	36	119	54

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According to Table 1, 9% of biology teacher-trainees have poor, 19% have intermediate, and 25% have high cognition knowledge. Similarly, 16% of biology teacher-trainees have low, 27% have moderate, and 31% have high levels of cognitive control. Meanwhile, 28% of biology teacher-trainees have poor, 36% have moderate, and 54% have strong metacognition.

Table-2: Differences in the Dimensions of Metacognition between Male and Female Biology Teacher-Trainees

Metacognition	Male (N=75)		Female (N=75)		Results	Level of Significance
	Mean	SD	Mean	SD	t-value	0.05
Knowledge of Cognition	44.48	6.69	45.68	7.83	0.737	Not Significant
Regulation of Cognition	61.71	6.42	63.19	8.74	1.513	Not Significant
Metacognition	95.13	15.68	98.16	16.68	1.692	Not Significant

Table 2 demonstrates that there is no discernible difference in the knowledge of cognition, regulation of cognition, and metacognition between male and female biology teacher-trainees. When comparing the mean scores of male and female biology teacher-trainees (M=95.13 and M=98.16) in terms of their ability to regulate cognition, the females do better than the males.

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Table-3: The differences in the dimensions of teaching competency between male and female biology teacher-trainees

Teaching Competency	Male (N=75)		Female (N=75)		Results	Level of Significance
	Mean	SD	Mean	SD	t-value	0.05
Use of appropriate techniques	57.88	11.81	58.42	9.58	0.118	Not Significant
Efficacy in teaching	83.22	15.72	94.34	13.64	2.481	Significant
Effective use of Aids	37.75	8.45	43.32	9.65	0.063	Not Significant
Rapport with student and colleagues	63.64	10.43	66.54	9.87	0.771	Not Significant
Catering to individual differences	29.87	6.87	28.76	6.64	0.073	Not Significant
Teaching competency	159.33	53.65	163.52	39.87	1.335	Not Significant

Table 3 demonstrates that there is no discernible difference in the suitable approaches used, the efficient use of aids, the rapport between the male and female biology teacher-trainees, the ability to accommodate individual differences, and the competency of their instruction. However, there is a notable disparity in the effectiveness of teaching between male and female biology teacher-trainees. When comparing the mean scores of female (M=94.34) and male (M=83.22) biology teacher-trainees about their effectiveness in the classroom, the females do better than the males.

Table-4: Relationship between Teaching Competency and Metacognition of Biology Teacher-Trainees

Metacognition	Correlation value	Level of Significance (0.05)
Knowledge of Cognition	0.256	Not Significant
Regulation of Cognition	0.231	Not Significant
Metacognition	0.269	Significant

Table 4 demonstrates that among biology teacher-trainees, there is no discernible correlation between teaching competency and knowledge of cognition and regulation of cognition. In the meantime, there is a strong correlation between biology teacher-trainees' metacognition and their ability to teach.

Results and Interpretation

- The t-test results show that female biology teacher-trainees do better than male biology teacher-trainees in terms of metacognition. Furthermore, the teaching-learning process is approached by female biology teacher-trainees using a more engaged pedagogical style.

- The results of the t-test show that the female biology teacher-trainees employ suitable instructional strategies, They build a strong connection with students and colleagues, try to meet each learner's needs in light of their unique characteristics, and improve their teaching competency by utilizing efficient teaching tools. Male biology teacher candidates, on the other hand, may use a more generic, non-directional, and informal approach. Furthermore, it seems that female teacher candidates in biology are more engaged in the subject matter, show concern and care for their students, and are patient with those who learn slowly.

- The results of the correlation study show that the teaching competency of biology teacher-trainees is a direct correlate of their knowledge cognition, regulation-cognition, and metacognition. This might be because students who are able to link ideas have the

talent and attitude to provide conceptual clarity in a classroom setting. Additionally, it is noted that the biology teacher-trainees can exhibit excellent teaching techniques and are more flexible and responsive to a variety of situations.

Educational Implications of the Study

- In-service and pre-service programmes can provide access to cutting edge methodology and psychological methods.

- Personality-boosting programmes for students at teacher training institutes of education may be implemented to prepare them for life in the digital age.

- The B.Ed students may be taken on tour to places, which reflect the tradition and culture of our country to gain new experiences regarding our culture.

- To improve teaching ability, workshops, seminars, and awareness campaigns on ICT might be arranged.

- The findings suggest that enhancing metacognitive skills could be a viable pathway to improving teaching competency in biology teacher education programs. Recommendations include the integration of metacognitive training modules in teacher preparation curricula and the promotion of reflective teaching practices through continuous professional development.

- This study provides useful implications for teacher education policy and practice while highlighting the significance of metacognition in promoting teaching excellence. Future studies could examine the long-term effects of metacognitive training on student results and instructional effectiveness.

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