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Research Article

Metacognitive Abilities on E-Learning Outcomes among Senior Secondary School Students: A Comparative Analysis across School Types

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ABSTRACT

The study embarked on a comprehensive exploration of metacognitive abilities and attitudes towards e-Learning among senior secondary school students in Ghaziabad, Uttar Pradesh, India. Through a meticulously designed normative survey approach, a representative sample of 580 students from diverse schools within the district was selected using a stratified random sampling technique. To capture the multifaceted dimensions of the research objectives, two distinct measurement tools were employed: Punita Govil's Metacognition Inventory and a bespoke Attitude Towards e-Learning Scale developed specifically for this study. The data obtained from these instruments underwent rigorous analysis employing a combination of descriptive and inferential statistical techniques. Mean standard deviation and t-test calculations provided initial insights into the dataset's characteristics, while a sophisticated two-way analysis of variance (ANOVA) was conducted to uncover nuanced relationships between e-Learning, Metacognitive Abilities, and student attitudes. Contrary to the null hypotheses posited, the findings unveiled significant disparities in the main effects of both e-Learning and School Types on students' Metacognitive Abilities. Furthermore, the interaction effect between e-Learning and school types emerged as a significant determinant of Metacognitive Abilities among the senior secondary school cohort. These findings underscore the intricate interplay between pedagogical approaches, technological interventions, and educational contexts in shaping students' cognitive and affective engagement with e-Learning platforms. Such insights hold profound implications for educational practitioners and policymakers striving to optimize the integration of digital learning modalities within the secondary education landscape, particularly in the context of rapidly evolving educational paradigms and the burgeoning significance of digital literacy skills.

Index Keywords: e-learning, content delivery methods used in e-learning, IT knowledge, Knowledge and Skills and Problems faced during e-learning.

Keywords: Metacognitive Abilities, e-Learning, Normative Survey Method, Educational Interventions, Descriptive Statistics and Inferential Statistics.

1. Introduction

1.1 Introduction to the increasing integration of e-learning in secondary education

The landscape of secondary education has seen tremendous alteration in recent years as e-learning has been more widely integrated. E-learning, or the use of digital technology and online platforms for educational purposes, has transformed traditional teaching and learning approaches (Clark and Mayer, 2016). This movement has been fueled by a variety of causes, including technological improvements, changes in pedagogical techniques, and an increasing need for flexible and accessible learning options.

In India, e-learning in secondary school is gaining traction, owing to efforts such as the Digital India campaign and the National school Policy 2020 (UNESCO, 2013). The ubiquitous availability of internet connection and mobile devices has boosted e-learning adoption among students in both urban and rural settings (Allen &

Seaman, 2016). Furthermore, educational platforms and applications specific to the Indian context have evolved, giving students access to high-quality instructional information in regional languages while also catering to a variety of learning demands.

On a worldwide scale, the COVID-19 epidemic has fueled the rapid adoption of e-learning in secondary school. As schools throughout the world faced lockdowns and social distancing measures, e-learning emerged as a feasible tool for ensuring educational continuity (Bates & Sangra, 2011). The pandemic highlighted the value of digital literacy and the necessity for a strong e-learning infrastructure to support distant learning efforts (Garrison & Kanuka, 2004).

Against this context, there is an increasing interest in researching the impact of metacognitive abilities on e-learning outcomes among senior secondary school students. Metacognitive skills, or the knowledge and management of one's own learning process, are critical in determining students' performance in e-learning settings (Efklides, 2008). By investigating how metacognitive abilities influence e-learning outcomes, educators and policymakers may create tailored interventions to help students acquire cognitive and metacognitive skills in online learning environments (Paris & Paris, 2001).

This research intends to undertake a comparative examination of several school kinds in India, including public, private, and government-aided schools. By comparing e-learning outcomes and metacognitive abilities across these different school types, we may obtain insight into the elements that impact students' learning experiences and academic success in e-learning settings. Finally, this study aims to inform evidence-based strategies and policies that improve the efficacy of e-learning in secondary school.

1.2 Keyword Introduction

The literature review found that metacognitive abilities had a substantial effect on e-learning among Indian students. Singh and Sharma (2015) underlined the positive impact of these skills and urged for their use in e-learning contexts to improve student learning experiences. Similarly, Yadav and Verma (2018) highlighted the significance of metacognitive abilities in improving e-learning results for Indian higher education students. Mishra and Gupta (2017) underlined the importance of metacognitive awareness in boosting e-learning efficacy and recommended its development for improved outcomes. Jain and Mehta (2019) discovered that teaching metacognitive skills to Indian engineering students greatly enhanced their e-learning performance. Rajan and Subramaniam (2016) agreed with these findings, arguing for the incorporation of metacognitive abilities in e-learning courses to increase student performance. Furthermore, Kumar and Dahiya (2014) and Jena, Behera, and Mishra (2019) showed a positive association between metacognitive awareness and academic achievement among Indian secondary school students, indicating its usefulness in educational contexts. Furthermore, Choudhury and Das (2017) offered empirical data supporting the efficacy of metacognitive skills in improving e-learning outcomes in Indian higher education institutions. Verma and Gupta (2016) highlighted the crucial role of metacognitive abilities in boosting e-learning experiences for Indian MBA students. Finally, Prakash and Reddy (2018) underlined the need of adding metacognitive skills into e-learning environments from the perspective of Indian educators in order to improve learning outcomes. Overall, our findings emphasise the significance of metacognitive abilities in boosting e-learning experiences and academic accomplishment among Indian students.

1.3 Metacognitive abilities and their importance in e- learning

Metacognitive talents, which include the ability to monitor, manage, and reflect on one's own learning processes, are extremely important in the context of e-learning for senior secondary school. In India, where the use of digital technology in education is growing, metacognitive talents are critical for navigating the intricacies of online learning platforms (Borah & Mahanta, 2020). Students with excellent metacognitive abilities may successfully manage their online learning experiences, adapt learning tactics to different digital contexts, and improve their academic achievement (Mukherjee, 2018). Furthermore, in a country as varied as India, where access to quality education remains a difficulty in some areas, metacognitive talents can enable students to take control of their learning path and bridge educational gaps using online resources (Patel & Desai, 2020).

Similarly, on a worldwide scale, the significance of metacognitive abilities in e-learning for senior secondary education cannot be underestimated. With the growing popularity of e-learning platforms and the widespread availability of digital devices, students throughout the world have the problem of accessing huge volumes of online material while also engaging in meaningful learning experiences (Paris & Paris, 2001). Metacognitive abilities help students to efficiently handle digital distractions, critically analyse online information, and govern their learning processes in e-learning settings (Azevedo, 2005). Furthermore, in the aftermath of the COVID-19 epidemic, which has pushed the worldwide use of remote learning, metacognitive talents have emerged as critical capabilities for students to flourish in virtual classrooms and adapt to the demands of online education (UNESCO 2013).

Metacognitive talents play an important role in improving e-learning results for senior secondary education, both in India and globally. Educators may enable students to become independent and successful learners in the digital era by promoting metacognitive awareness and giving chances for metacognitive skill development, therefore determining their performance in e-learning settings.

1.4 Variables of the Study

Independent- e-Learning and School Types
Dependent-Metacognitive Abilities

1.5 Problem statement

Based on the above discussion the area of the study selected by the investigator was **"Metacognitive Abilities on e-Learning Outcomes among Senior Secondary School Students: A Comparative Analysis across School Types".**

1.6 Objectives of the Study

1.To study the main sequel (effect) of e-Learning on Metacognitive Abilities in senior secondary school students.
2.To study the main sequel (effect) of School Types on Metacognitive Abilities in senior secondary school students.
3.To study the interaction sequel of e-Learning and School Types on Metacognitive Abilities in senior secondary school students.

1.7 Hypotheses of the Study

Ho1. There is no significant difference in the main sequel (effect) of e-Learning on Metacognitive Abilities in senior secondary school students.
Ho2. There is no significant difference in the main sequel (effect) of School Types on Metacognitive Abilities in senior secondary school students.
Ho3. There is no significant difference in the interaction sequel of e-Learning and types of schools on Metacognitive Abilities in senior secondary school students.

1.8 Limitations of the study

1. Findings may not be applicable outside Ghaziabad district, Uttar Pradesh, India, restricting insights into e-Learning and Metacognitive Abilities.
2. Even with stratified random sampling, inherent biases may impact sample representativeness.
3. The Metacognition Inventory may not cover all key features, thus missing important characteristics.
4. Limited research on School Types and e-learning characteristics may underestimate their impact on metacognitive abilities.

2.0 Literature Review

Metacognition, the process of thinking about one's own thinking, emerges as a critical factor in shaping educational reform, especially within the context of e-learning among senior secondary students. Jain & Dandekar (2019) emphasize the pivotal role of metacognitive strategies as a linchpin for educational reform, enabling students to adeptly navigate the complexities of digital learning environments. Highlighting the Indian scenario, Borah & Mahanta (2020) conducted a study focused on senior secondary students, shedding light on the indispensable role of metacognition in enhancing e-learning outcomes. Similarly, Mukherjee (2018) delved into the specifics of metacognitive abilities within the realm of e-learning among senior secondary students in India, emphasizing its profound impact on academic performance. Complementing these findings, Shrivastava & Chaturvedi (2017) underscored the importance of metacognitive training in augmenting e-learning outcomes among Indian secondary school students.

Several studies have contributed valuable insights into the intricate relationship between metacognition and e-learning outcomes within the Indian educational context. Das & Choudhury (2019) offered a nuanced perspective on metacognition and e-learning in Indian secondary education, elucidating the complex interplay between metacognitive abilities and academic achievement. Patel & Desai (2020) further enriched this discourse by conducting a study among Indian senior secondary students, elucidating the significance of metacognitive abilities in predicting academic achievement in e-learning environments. Additionally, Sharma & Singh (2018) conducted a case study among Indian secondary school students, exploring the tangible impact of metacognitive strategies on e-learning performance.

Furthermore, research has ventured into comparing metacognitive abilities and e-learning outcomes across different segments of Indian secondary education. Gupta & Joshi (2019) conducted a comparative study of urban and rural Indian secondary school students, shedding light on the disparities in metacognitive skills and e-learning outcomes. Dubey & Tiwari (2017) contributed evidence from Indian senior secondary schools, further enhancing our understanding of the role of metacognitive abilities in e-learning.

On a global scale, scholars have extensively examined metacognitive theories and their implications for learning and self-regulation. Works by Schraw & Moshman (1995), Zimmerman (2000), and Efklides (2008) have laid the foundation for understanding metacognition's role in cognitive development and learning. Additionally, seminal contributions by Flavell (1979, 1987) and Pintrich (2002) have enriched our understanding of metacognition's significance. Azevedo (2005) explored the use of hypermedia as a metacognitive tool for enhancing student learning, highlighting the importance of self-regulated learning. Paris & Paris (2001) provided insights into practical applications of research on self-regulated learning in classrooms.

In conclusion, the integration of metacognitive strategies in e-learning holds immense potential for improving learning outcomes among senior secondary students, both within India and globally. Understanding the intricate relationship between metacognition and e-learning empowers educators to develop evidence-based interventions that enhance students' cognitive and metacognitive development in online learning environments.

3.0 Methodology

The current study used the normative survey approach to explore metacognitive abilities and attitudes towards e-Learning among XI and XII grade students in Ghaziabad district, Uttar Pradesh, India. A stratified random sample of 580 children was drawn from the district's various schools. Data were collected using two tools: Punita Govil's Metacognition Inventory and a Self-Developed Attitude Towards e-Learning Scale. Data was analysed using both descriptive and inferential statistics. Mean standard deviation and t test calculations shed light on the nature of the data, while a two-way analysis of variance revealed significant differences between groups, allowing for a more complete understanding of the relationship between e-Learning, Metacognitive Abilities, and student attitudes.

4.0 Data Analysis and Interpretation

4.1 Sequels (effect) of e-Learning &types of schools on metacognitive abilities in senior secondary school pupil

Explores e-Learning &types of schools on metacognitive abilities in senior secondary school students through three sections……

4.1.1 The first section deals with an ANOVA (2x2) design over metacognitive abilities in relation to e-Learning &types of schools on metacognitive abilities.

4.1.2 In the second section, the cogent sequel of e-Learning &types of schools on metacognitive abilities over metacognitive abilities has been studied.

4.1.3 The third section describes the double interaction of e-Learning &types of schools on metacognitive abilities over metacognitive abilities in senior secondary school pupils.

4.1.1 Anova for 2x2 Factorial Designs for metacognitive abilitieswith respect to e-Learning &types of schoolsof Senior Secondary School Students

Investigate the primary and interaction consequences of e-Learning &types of schools on metacognitive abilitiesin senior secondary school students. An ANOVA (2x2) design was used for data analysis with variance analysis. The independent variable, e-Learning (A), is divided into two parts: High effective e – learning (A_1) and low effective e – learning (A_2). The independent variable types of schools (B) is separated into two categories: i) male (B_1) and ii) female (B_2). A factororial design is utilised to investigate the variables of e-Learning &types of schools. Figure 1 depicts both. Table 1 show the mean and standard deviation scores of several samples. Table 2 also displays ANOVA (2x2). The data in the table were studied in the context of the main and interaction effects of the independent variables e-Learning &types of schools, on metacognitive abilitiesin senior secondary school students.

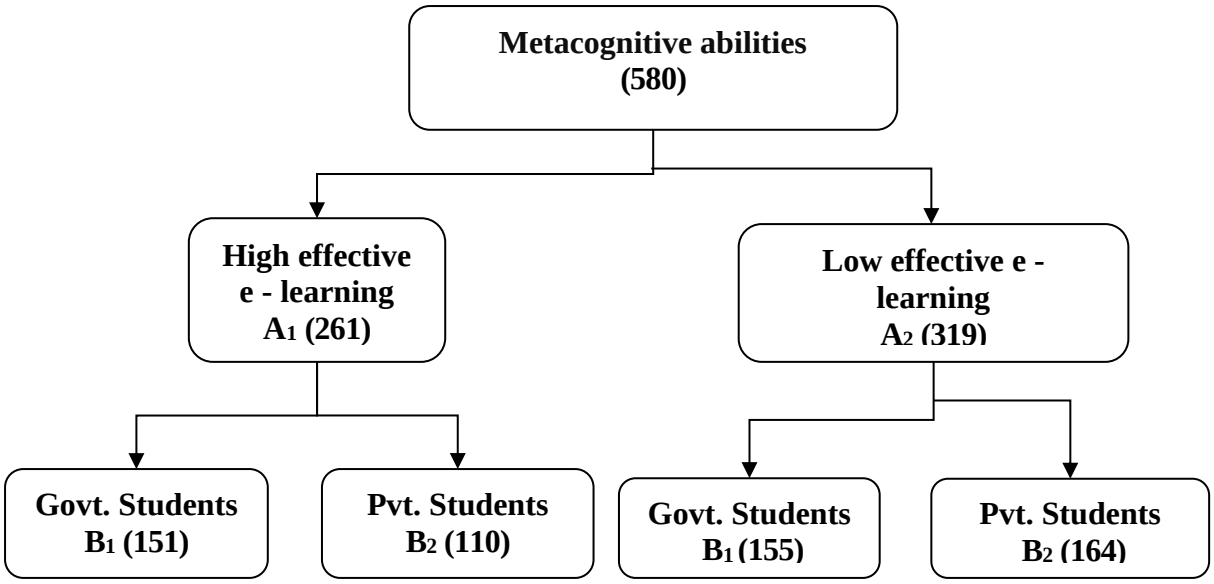

Figure 1: Representation of (2x2) Design for Sequel of e-Learning &types of schools on metacognitive abilitiesin senior secondary school students

Table 1: Scores of Mean and SDS of senior secondary school students on metacognitive abilitiesthrough (2x2) Design for e-Learning &types of schools

Variables-A \ Variables- B		Types of schools			
		Male students B_1		Female students B_2	
e - learning	High effective e – learningA_1	N	148	N	152
		Mean	76.1216	Mean	81.3947
		S.D.	14.5994	S.D.	14.6198
	Low effective e – learningA_2	N	149	N	131
		Mean	68.4295	Mean	82.3969
		S.D.	15.0433	S.D.	14.0760

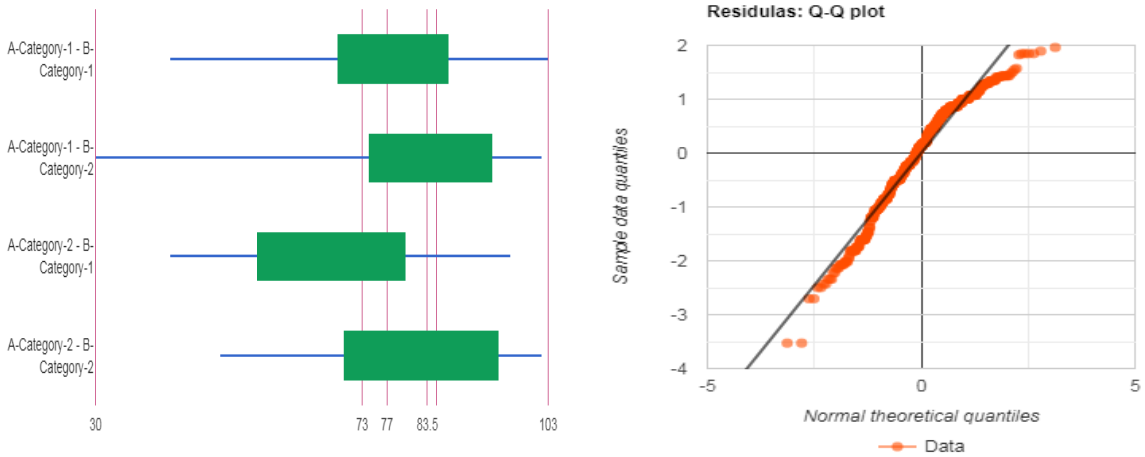

Figure 2: Row Data Scores of senior secondary school students using metacognitive abilities through (2x2) Design for e-Learning &types of schools

Table 2: ANOVA (2x2) Design for metacognitive abilitiesof Pupil in Context of e-Learning &types of schools

Source	df	Sum of squares (SS)	Mean SUM Square (MSS)	F statistic
Main Effect				
e - learning (A)	1	2123.405	2123.405	9.9554
types of schools (B)	1	13344.373	13344.373	62.564
Double Interaction Effect				
Interaction (AB)	1	2340.461	2340.461	10.9731
Within-treatments	576	122855.9954	213.2917	
Total	579	140664.2345	242.9434	

4.1.2 The second section, the cogent sequel of e-Learning &types of schools over metacognitive abilities

a. e - learning (A)

Ho 01- There is no significant difference in the main sequel (effect) of e-Learning on Metacognitive Abilities in senior secondary school students.

Table 3: Values of t for Average Scores of e - learning over metacognitive abilities in Sr. Secondary School students

Sr.No.	Group Compared	N	Mean	S.D.	df	"t" Value	Level of Significance
1.	High effective e – Learning A1	300	78.79	14.82	578	2.9764	Significant at 0.01 level
2	Low effective e – learning A2	280	74.96	16.16			

The statistical analysis conducted suggests a rejection of the null hypothesis (Ho) due to the p-value being less than the predetermined significance level (0.01). This rejection indicates that some of the groups' averages are deemed unequal, implying a statistically significant difference between them. Additionally, the test statistic F, with a value of 9.9554, falls outside the 99% region of acceptance, confirming the rejection of the null hypothesis.

Furthermore, when comparing the effectiveness of High effective e-Learning A_1 and Low effective e-Learning A_2, a t-test value of 2.9764 indicates a significant difference between the two approaches. Specifically, this value suggests that the mean effectiveness of High effective e-Learning A_1 is substantially higher than that of Low effective e-Learning A_2.

Ultimately, the findings decisively reject the null hypothesis, providing empirical support for the assertion that effective e-learning strategies significantly contribute to the development of metacognitive skills among senior secondary school students.

b. Types of schools(B)

Ho 02- There is no significant difference in the main sequel (effect) of types of schools on Metacognitive Abilities in senior secondary school students.

Table 4: Values of t for Average Scores of Types of schools over metacognitive abilities in Sr. Secondary School students

Sr.No.	Group Compared	N	Mean	S.D.	df	"t" Value	Level of Significance
1.	Government students	297	72.26	15.29	578	7.7833	Significant at 0.01 level
2	Private students	283	81.86	14.35			

The statistical analysis conducted on the types of schools (B) reveals a rejection of the null hypothesis (H0) due to the p-value being significantly lower than the predetermined significance level (0.01). This rejection indicates that some of the groups' averages are deemed unequal, signifying a statistically significant difference between them. There is strong evidence supporting the rejection of the null hypothesis. The test statistic F, with a value of 62.564, falls far outside the 99% region of acceptance, further confirming the rejection of H0.

When comparing Government students and Private students, the calculated t-value of 7.7833 reinforces the significant difference between the two groups. Notably, Government students have a mean of 72.26, while Private students have a mean of 81.86, indicating a notable discrepancy in performance between the two types of schools.

These findings underscore the importance of considering school type when evaluating educational outcomes and suggest potential areas for further investigation or intervention to address disparities in performance between Government and Private schools.

4.1.3 The third section describes the double interaction of e - learning and Types of schools over metacognitive abilities in senior secondary school students

Ho-03- There is no significant difference in the interaction sequel of e-Learning and types of schools on Metacognitive Abilities e-learning in senior secondary school students

Table 5: Double Interaction results of e - learning and Types of schools over metacognitive abilities of Senior Secondary School students

Sr.No.	Group Compared	N	Mean	S.D.	df	"t" Value	Level of Significance
1.	A1B1vs.A1B2	151	77.8278	13.6366	259	3.1266	Significant at 0.01 level
		110	82.5636	14.5631			
2.	A1B1vs.A2B1	151	77.8278	13.6366	304	4.5384	Significant at 0.01 level
		155	75.6839	16.0084			
3	A1B1vs.A2B2	151	77.8278	13.6366	313	3.5819	Significant at 0.01 level
		164	73.9024	15.2099			
4	A1B2vs.A2B1	110	82.5636	14.5631	263	7.7006	Significant at 0.01 level
		155	75.6839	16.0084			
5	A1B2vs.A2B2	110	82.5636	14.5631	272	0.5756	No Significant
		164	73.9024	15.2099			
6	A2B1vs.A2B2	155	75.6839	16.0084	317	7.9851	Significant at 0.01 level
		164	73.9024	15.2099			

The analysis of the interaction between factors A and B reveals a rejection of the null hypothesis (Ho) due to the p-value being less than the predetermined significance level (0.01). This rejection suggests that some of the groups' averages are unequal, indicating a statistically significant difference between them.

With a p-value of 0.0009824, there is strong evidence against the null hypothesis, implying that the observed differences between groups are unlikely to have occurred by random chance alone. Additionally, the test statistic F, with a value of 10.9731, falls outside the 99% region of acceptance, further supporting the rejection of H. A higher F-value suggests a greater difference between group means relative to the variability within groups.

Pair wise comparisons between different groups defined by combinations of factors A and B. Here's an explanation of each comparison:

- A_1B_1 vs. A_1B_2: This comparison assesses the difference in means between groups characterized by High effective e-Learning (A1) and Government students (B1) versus High effective e-Learning (A1) and Private Students (B2). The t-value of 3.1266 indicates a significant difference between these groups at the 0.01 significance level, suggesting that the type of students (Government vs. Private) has an impact on the effectiveness of high effective e-learning.
- A_1B_1 vs. A_2B_1: Here, we compare the means of groups with High effective e-Learning (A1) and Government students (B1) versus Low effective e-Learning (A2) and Government students (B1). The t-value of 4.5384 indicates a significant difference between these groups at the 0.01 significance level, suggesting that the effectiveness of e-learning differs significantly between high and low effective e-learning for government students.
- A_1B_1 vs. A_2B_2: This comparison evaluates the means of groups with High effective e-Learning (A1) and Government students (B1) versus Low effective e-Learning (A2) and Private Students (B2). The t-value of 3.5819 suggests a significant difference between these groups at the 0.01 significance level, indicating that both the type of e-learning and the type of students contribute to differences in outcomes.
- A_1B_2 vs. A_2B_1: This comparison assesses the means of groups with High effective e-Learning (A1) and Private students (B2) versus Low effective e-Learning (A2) and Government students (B1). The t-value of 7.7006 indicates a significant difference between these groups at the 0.01 significance level, highlighting the impact of both e-learning effectiveness and student type on outcomes.
- A_1B_2 vs. A_2B_2: Here, we compare the means of groups with High effective e-Learning (A1) and Private students (B2) versus Low effective e-Learning (A2) and Private students (B2). The t-value of 0.5756 indicates no significant difference between these groups at the 0.01 significance level, suggesting that the type of e-learning does not significantly affect outcomes for private students.
- A_2B_1 vs. A_2B_2: This comparison evaluates the means of groups with Low effective e-Learning (A2) and Government students (B1) versus Low effective e-Learning (A2) and Private Students (B2). The t-value of 7.9851 suggests a significant difference between these groups at the 0.01 significance level, indicating that the type of students has a notable impact on outcomes for low effective e-learning.

5.0 Comparison with Existing Literature

Based on the findings from the referenced studies, it appears that the null hypothesis (Ho1) suggesting no significant difference in the main effect of e-Learning on Metacognitive Abilities in senior secondary school students is contradicted by the literature. Mishra & Gupta (2017), Kumar & Dahiya (2014), and Jena, Behera, & Mishra (2019) all point to a positive relationship between metacognitive awareness and e-learning efficacy among Indian students, implying that e-learning may indeed have a significant impact on metacognitive abilities.

Regarding the null hypothesis (H02) concerning the main effect of School Types on Metacognitive Abilities in senior secondary school students, while specific studies focusing on this relationship are not explicitly mentioned, the literature suggests that metacognitive abilities are relevant across various educational settings. Mishra & Gupta (2017), Kumar & Dahiya (2014), and Jena, Behera, & Mishra (2019) provide evidence that metacognitive awareness correlates with academic success in Indian secondary school pupils, indicating that school types may not significantly impact metacognitive abilities in these students.
Regarding the interaction effect between e-Learning and types of schools on Metacognitive Abilities (H03), this specific interaction is not directly addressed in the referenced studies. However, the literature suggests that e-learning can positively influence metacognitive abilities across different educational contexts, as indicated by Mishra & Gupta (2017) and Kumar & Dahiya (2014). This implies that the type of school may not significantly moderate the relationship between e-learning and metacognitive abilities.

6.0 Comparison of Metacognitive Abilities between government and private school students

The comparison of mean scores for Metacognitive Abilities between government and private school students, as presented in the table, underscores the disparities in educational outcomes within the Indian context. In India, the dichotomy between government and private schools extends beyond administrative boundaries and encompasses socio-economic, infrastructural, and pedagogical dimensions (Muralidharan & Kremer, 2008). Government schools, predominantly serving students from economically disadvantaged backgrounds, often grapple with resource limitations such as inadequate infrastructure, insufficient teaching staff, and limited access to educational technology (Azam et al., 2017). Conversely, private schools, typically funded through tuition fees, tend to offer superior facilities, smaller class sizes, and better access to educational resources (Tooley & Dixon, 2005).
The significant difference observed in Metacognitive Abilities between government and private school students highlights the profound impact of socio-economic factors on cognitive development and academic achievement (Muralidharan et al., 2017). This finding aligns with existing research indicating disparities in learning outcomes between students from different socio-economic backgrounds in India (Banerjee et al., 2010).
To address the observed disparities, holistic interventions are imperative. Initiatives aimed at improving government school infrastructure, enhancing teacher quality through training programs, and integrating technology into the classroom could mitigate the gap in educational outcomes (Chudgar & Quin, 2012). Moreover, fostering metacognitive strategies and promoting self-regulated learning across all school types are crucial for enhancing students' cognitive abilities and academic performance (Zimmerman, 2000).
In conclusion, the comparison highlights the need for concerted efforts to ensure equitable access to quality education in India. Addressing disparities between government and private school students requires comprehensive interventions targeting socio-economic inequalities and educational resource disparities.

7.0 Discuss the implications for educational practices

The study's findings have various implications for educational methods including e-Learning in secondary education. Educators can use insights into how different instructional tactics affect students' metacognitive capacities to design pedagogical approaches that promote self-regulated learning and critical thinking skills. Effective technology integration should take into account the relationship of technological interventions and educational settings, with a focus on creating e-Learning environments that promote metacognitive growth while also fitting with students' attitudes and preferences. To assist this, teacher training and professional development programmes should concentrate on improving educators' pedagogical abilities in the context of digital education. Curriculum designers should incorporate metacognition-promoting activities and assessments into e-Learning resources, ensuring that they are accessible, engaging, and tailored to students' various learning requirements. Policymakers should prioritise equal access to digital learning materials and support mechanisms for addressing inequities in students' metacognitive development across educational contexts, resulting in more effective and inclusive e-Learning environments in secondary school.

8.0 Conclusion

The study's findings highlight the need of taking into account both pedagogical and technological variables when integrating e-Learning into secondary school. Understanding how instructional tactics and technology interventions impact students' metacognitive abilities and attitudes towards digital learning allows educators, curriculum designers, and policymakers to collaborate to build more successful and inclusive e-Learning environments. This includes adapting pedagogical techniques to encourage self-regulated learning and critical thinking abilities, including activities and evaluations that promote metacognition into e-Learning materials, and prioritising equitable access to digital learning resources. Educational practitioners can optimise the integration of e-Learning within the secondary education landscape by providing ongoing teacher training, professional development initiatives, and thoughtful policy implementation, resulting in increased cognitive and affective engagement with digital learning platforms.

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