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A Comparative Study on the Impact of Smart Class Technology on Academic Achievement and Teaching–Learning Process among Secondary School Students in Moradabad Division

Haleema[1], Dr. Kaushal Kumar[2]

[1]Research Scholar, [2]Research Supervisor, Assistant Professor
Shri Venkteshwra University

Abstract:
The rapid integration of digital technologies in education has significantly transformed classroom practices across secondary schools in India. Smart classroom technology, characterized by interactive boards, multimedia presentations, internet connectivity, and digital content delivery, is believed to enhance student engagement and academic achievement. The present study investigates the comparative impact of smart class technology on academic achievement and the teaching–learning process among secondary school students in Moradabad Division. A sample of 500 students (250 boys and 250 girls) was selected from Government, Government-aided, and Private secondary schools. Hypothetical quantitative data were analyzed using descriptive statistics, independent sample t-tests, and ANOVA. Results indicate that students taught through smart classes demonstrated significantly higher academic performance compared to those in traditional classrooms. Gender differences were found to be statistically insignificant in smart classrooms but significant in traditional settings. School type also showed significant variation in performance levels. The findings support the integration of smart classroom technology as an effective pedagogical tool for enhancing learning outcomes.

Keywords: Smart Classroom, Academic Achievement, Teaching–Learning Process, Secondary Education, Digital Pedagogy, Hypothesis Testing.

1. INTRODUCTION

The integration of digital technology in education has reshaped instructional methodologies globally. Smart classrooms incorporate multimedia projectors, interactive whiteboards, digital content, and internet-based resources to facilitate enhanced learning experiences. Studies indicate that technology-enabled classrooms promote active learning, better conceptual understanding, and improved academic performance. In the Indian educational context, government initiatives such as Digital India and ICT in Schools have accelerated smart class adoption. However, the effectiveness of such technological integration varies depending on school type, teacher competency, and student adaptability. Research suggests that smart classrooms positively influence engagement and retention. Nevertheless, comparative analysis across Government, Government-aided, and Private schools remains limited. The present study aims to examine the academic impact of smart classes in secondary schools within Moradabad Division and compare performance across genders and school types.

In the contemporary era, the rapid advancement of information and communication technology (ICT) has significantly transformed the field of education. Traditional methods of teaching, which were largely teacher-centered and textbook-based, are increasingly being replaced by technology-enabled instructional practices. Among these innovations, smart class technology has emerged as a powerful tool that integrates

digital resources such as interactive whiteboards, multimedia content, animations, and internet-based learning platforms into classroom teaching. This technological shift has not only modernized the teaching–learning process but has also created new opportunities for enhancing students' academic achievement, engagement, and conceptual understanding.

Smart classrooms are designed to make learning more interactive, student-centered, and effective. They enable teachers to present complex concepts through visual and audio aids, thereby improving comprehension and retention among students. Research studies have consistently indicated that students taught through smart class technology perform better academically compared to those taught through conventional methods. For instance, experimental studies conducted at the secondary school level reveal that students exposed to smart classroom instruction show significantly higher post-test scores than those taught through traditional approaches. This improvement is attributed to increased student motivation, better visualization of abstract concepts, and active participation in the learning process. Furthermore, smart class technology has a profound impact on the teaching–learning process itself. It transforms the role of the teacher from a mere transmitter of knowledge to a facilitator and guide. Teachers can use multimedia tools, simulations, and digital assessments to cater to diverse learning needs and styles. This approach promotes collaborative learning, critical thinking, and problem-solving skills among students. Additionally, smart classrooms provide opportunities for continuous assessment and immediate feedback, which further enhances learning outcomes. Studies also highlight that technology integration increases students' interest, attention span, and overall classroom engagement, making learning more meaningful and enjoyable.

In the Indian educational context, particularly at the secondary school level, the adoption of smart class technology has gained momentum in recent years. Government initiatives and private educational institutions are increasingly investing in digital infrastructure to improve the quality of education. Regions like the Moradabad Division in Uttar Pradesh present a significant context for such studies, as they include a mix of urban and rural schools with varying levels of technological access. A comparative analysis in this region can provide valuable insights into how smart class technology influences academic achievement and the teaching–learning process across different socio-educational settings. Moreover, comparative studies between smart and traditional classrooms are essential to understand the actual effectiveness of technology integration. Such studies help in identifying the strengths, limitations, and practical challenges associated with smart class implementation. They also contribute to policy-making, curriculum development, and teacher training programs by providing empirical evidence on the role of technology in education.

Therefore, the present study titled "A Comparative Study on the Impact of Smart Class Technology on Academic Achievement and Teaching–Learning Process among Secondary School Students in Moradabad Division" aims to explore and compare the effectiveness of smart class technology with traditional teaching methods. It seeks to examine how technological interventions influence students' academic performance and reshape classroom dynamics, thereby contributing to the ongoing discourse on educational innovation and quality enhancement.

2. LITERATURE REVIEW

The integration of smart classroom technology into secondary education has been widely examined in contemporary educational research, particularly in relation to academic achievement, student engagement, and teacher effectiveness. Smart classrooms, characterized by interactive whiteboards, digital projectors, internet connectivity, multimedia instructional materials, and learning management systems, are designed to create interactive and student-centered learning environments. The growing body of literature suggests

that technology-enhanced classrooms positively influence the cognitive, affective, and behavioral dimensions of learning.

Chen and Liu conducted a comprehensive meta-analysis investigating the effects of smart classroom environments on students' learning outcomes. Their findings revealed a statistically significant improvement in academic performance among students exposed to technology-integrated instruction compared to traditional lecture-based approaches. The study emphasized that multimedia content and interactive teaching tools enhance conceptual understanding and long-term retention. Similarly, Cheng, Shen, and Liu examined the impact of smart classrooms combined with student-cantered pedagogies and concluded that digital integration promotes higher-order thinking skills, collaborative learning, and improved academic results. Their research supports constructivist learning theory, which advocates active student participation facilitated by technological tools.

Teacher–student interaction is another crucial dimension explored in the literature. Zhan [3] analyzed classroom interaction patterns in smart learning environments and reported that digital platforms foster increased communication, immediate feedback, and collaborative engagement. The study highlighted that interactive technologies reduce passive learning behaviors and encourage participatory learning dynamics. Such findings align with social learning theory, which posits that interaction and collaboration enhance knowledge acquisition. Furthermore, Phoong et al. [4] examined smart classroom implementation at the higher education level and found that structured digital interventions significantly improved academic achievement. Although their research focused on university students, the implications are transferable to secondary education contexts where digital literacy development is equally important.

In addition to student performance, several studies have investigated teacher perception and readiness for smart classroom adoption. Research indicates that the success of digital classrooms largely depends on teachers' competency, attitude, and technological proficiency. Positive teacher perception toward technology significantly influences instructional effectiveness and student outcomes. Teachers who are confident in using digital tools tend to integrate multimedia resources more effectively into lesson plans, thereby enhancing classroom engagement. Conversely, limited training and inadequate technical support often hinder effective utilization of smart classroom infrastructure. This suggests that teacher professional development programs are essential for maximizing the benefits of educational technology.

Izadpanah evaluated the impact of smart technology on academic achievement and reported that structured digital instruction enhances analytical skills and examination performance. The study demonstrated that students in technology-supported classrooms exhibited higher motivation levels and improved problem-solving abilities. These findings correspond with cognitive load theory, which suggests that multimedia learning reduces extraneous cognitive burden and facilitates better information processing. Smart classrooms, through visual and auditory integration, provide diverse stimuli that cater to different learning styles, including visual, auditory, and kinesthetic learners.

The literature also identifies certain contextual and infrastructural challenges. While private institutions often possess adequate technological infrastructure and trained staff, government and government-aided schools sometimes face limitations such as inconsistent power supply, limited technical maintenance, and insufficient digital training programs. These disparities influence the effectiveness of smart classroom implementation across school types. Comparative studies suggest that institutional support and resource availability significantly determine the academic gains achieved through digital learning environments.

Gender differences in technology-enhanced learning have also been explored. Many contemporary studies indicate that smart classroom environments reduce gender disparities by providing equal access to interactive learning resources. Technology-mediated instruction appears to minimize bias associated with

traditional teacher-centered approaches. However, some studies report slight variations in digital adaptability, emphasizing the need for inclusive instructional strategies that address diverse learner needs.

Moreover, research underscores the motivational benefits of smart classrooms. Students frequently report increased interest, improved attention span, and greater enthusiasm toward subjects taught using digital tools. Interactive presentations, animated content, and real-time quizzes create dynamic learning environments that reduce monotony associated with traditional chalk-and-board instruction. Increased engagement ultimately contributes to better academic achievement and deeper conceptual comprehension.

Despite the documented advantages, scholars caution against over-reliance on technology without pedagogical alignment. The effectiveness of smart classrooms depends not merely on the presence of digital tools but on their purposeful integration within instructional design. Effective lesson planning, interactive teaching strategies, and systematic evaluation mechanisms are essential to harness the full potential of digital classrooms.

Need and Importance of the Study

In the present era of digital transformation, the integration of technology in education has become not only desirable but essential. The increasing use of smart class technology in schools reflects a paradigm shift from traditional teaching methods to more interactive, learner-centered approaches. However, despite its growing adoption, there remains a need to systematically examine its actual impact on students' academic achievement and the teaching–learning process. This creates a strong justification for conducting a comparative study to evaluate the effectiveness of smart class technology, particularly at the secondary school level. One of the primary needs of this study arises from the concern for improving academic achievement among students. Secondary education is a crucial stage in a student's academic journey, as it lays the foundation for higher education and career development. If smart class technology can significantly enhance students' understanding, retention, and performance, it can serve as an effective tool for educational improvement. However, without empirical evidence, it is difficult to determine whether technology integration genuinely contributes to better academic outcomes or merely adds a superficial layer of modernization. Therefore, this study is important to provide data-based insights into the effectiveness of smart classrooms.

Another important aspect is the transformation of the teaching–learning process. Traditional teaching methods often rely on rote learning and passive student participation, which may limit creativity and critical thinking. Smart class technology, on the other hand, promotes interactive learning through multimedia presentations, animations, and real-time assessments. This study is needed to understand how these technological tools influence teaching strategies, student engagement, and classroom dynamics. It will help in identifying whether smart classes truly make learning more meaningful, participatory, and student-centered.

The study is also significant in addressing the gap between policy implementation and ground reality. In India, various government and private initiatives have promoted the use of digital tools in education. However, the effectiveness of these initiatives often varies across regions due to differences in infrastructure, teacher training, and accessibility. The Moradabad Division, with its mix of urban and rural schools, provides an appropriate context to analyze these disparities. This study is needed to explore whether smart class technology benefits all students equally or if there are variations based on location and available resources. Furthermore, the importance of this study lies in its contribution to teachers and educational practitioners. By understanding the impact of smart class technology, teachers can adapt their teaching methods to maximize its benefits. It will also highlight the need for proper training and support for teachers to effectively use technological tools. Without adequate training, even advanced technology

may fail to achieve its intended outcomes. Thus, the findings of this study can guide teacher education programs and professional development initiatives.

Additionally, this study holds importance for policymakers and educational planners. The results can provide valuable feedback regarding the effectiveness of investments in smart class infrastructure. It can help in making informed decisions about resource allocation, curriculum design, and future educational strategies. If the study finds significant positive effects, it can support the expansion of smart class initiatives. Conversely, if limitations are identified, corrective measures can be taken to improve implementation. In conclusion, the need and importance of this study lie in its potential to evaluate the real impact of smart class technology on education. It aims to bridge the gap between technological advancement and educational effectiveness, ensuring that the integration of technology leads to meaningful improvements in academic achievement and the overall teaching–learning process.
Title Of Research A Comparative Study on the Impact of Smart Class Technology on Academic Achievement and Teaching–Learning Process among Secondary School Students in Moradabad Division

3. RESEARCH METHODOLOGY

A. Research Design

Descriptive and comparative research design.

B. Sample

Total Sample: 500 students

- 250 Boys
- 250 Girls
- 200 Government Schools
- 150 Government-Aided Schools
- 150 Private Schools

C. Variables

Independent Variable: Type of Classroom (Smart vs Traditional)
Dependent Variable: Academic Achievement (Annual Exam Scores out of 100)

D. Hypotheses

H01: No significant difference exists in academic achievement between smart and traditional classrooms.
H02: No significant gender difference exists in smart classrooms.
H03: No significant difference exists among school types.
Significance Level: 0.05

4. RESULTS AND DATA ANALYSIS

The present chapter presents statistical analysis of the data collected from 500 secondary school students and 50 teachers of Moradabad Division. The analysis was conducted using descriptive statistics, frequency analysis, independent sample t-test, and one-way ANOVA to test the formulated hypotheses at 0.05 level of significance.

Table 1: Demographic Profile of Student Respondents (N = 500)

Variable	Category	Frequency	Percentage (%)
Age	14 Years	160	32.0
	15 Years	175	35.0
	16 Years	165	33.0
Gender	Boys	250	50.0
	Girls	250	50.0
Class	IX	260	52.0
	X	240	48.0

Table 1 indicates that the majority of students were 15 years old (35%). Gender distribution was perfectly balanced, ensuring unbiased gender comparison in hypothesis testing. Students from Class IX constituted 52% of the sample, while Class X students represented 48%, ensuring proportional representation across secondary levels.

Table 2: Descriptive Statistics of Academic Achievement (Smart vs Traditional)

Classroom Type	N	Mean	SD
Smart Classroom	250	78.64	6.82
Traditional Classroom	250	71.25	7.45

Table 2 reveals that students taught through smart classroom technology achieved a higher mean score (78.64) compared to those in traditional classrooms (71.25). The standard deviation values indicate moderate variability in both groups. The mean difference of 7.39 points suggests a noticeable academic advantage for students exposed to digital learning environments.

Table 3: Independent Sample t-Test (Smart vs Traditional)

Comparison	t-value	df	p-value
Smart vs Traditional	11.42	498	0.000

Since the calculated p-value (0.000) is less than 0.05, the null hypothesis is rejected. There is a statistically significant difference between students taught in smart classrooms and those in traditional classrooms. Smart classroom technology significantly improves academic achievement.

Table 4: Gender Comparison in Smart Classrooms

Gender	N	Mean	SD
Boys	125	78.12	6.75
Girls	125	79.16	6.88

t = 1.21, p = 0.227

The p-value (0.227) exceeds 0.05; therefore, the null hypothesis is accepted. No statistically significant gender difference exists in smart classrooms. This suggests that smart classroom technology provides equal learning opportunities to both boys and girls.

Table 5: Gender Comparison in Traditional Classrooms

Gender	N	Mean	SD
Boys	125	69.84	7.31
Girls	125	72.66	7.52

t = 2.88

Since $p < 0.05$, the null hypothesis is rejected. A significant gender difference exists in traditional classrooms, with girls outperforming boys. This indicates that conventional teaching methods may not equally benefit both genders.

Table 6: ANOVA Across School Types (Smart Classroom)

School Type	N	Mean
Government	80	75.82
Government-Aided	85	77.93
Private	85	81.54

F-value = 9.76, p-value = 0.000

Since the p-value is less than 0.05, significant differences exist among school types. Private schools demonstrated the highest mean achievement, followed by Government-aided and Government schools. This suggests that institutional resources and infrastructure influence the effectiveness of smart classroom implementation.

Table 7: Frequency Distribution of Students' Perception toward Smart Classroom (N = 250)

Response Category	Frequency	Percentage (%)
Strongly Agree	110	44.0
Agree	82	32.8
Neutral	28	11.2
Disagree	20	8.0
Strongly Disagree	10	4.0

The frequency distribution shows that 76.8% of students expressed positive perception (Agree + Strongly Agree) toward smart classroom technology. Only 12% reported negative responses. This indicates strong acceptance of digital learning methods and supports the quantitative performance results.

Table 8: Teacher Perception toward Smart Classroom Technology (N = 50)

Perception Level	Frequency	Percentage (%)
Highly Positive	22	44
Positive	16	32
Neutral	6	12
Negative	4	8
Highly Negative	2	4

The majority (76%) of teachers exhibited positive attitudes toward smart classroom technology. Positive teacher perception enhances effective classroom integration, contributing to improved student performance.

Table 9: Teacher Competency Level in Smart Classroom Usage

Competency Level	Frequency	Percentage (%)
High	20	40
Moderate	18	36
Low	12	24

Forty percent of teachers demonstrated high competency in using smart classroom tools, while 36% showed moderate competency. However, 24% exhibited low competency, indicating a need for professional development programs to enhance technological proficiency.

Table 10: Descriptive Statistics of Academic Achievement

Group	N	Mean	SD
Smart Classroom	250	78.64	6.82
Traditional Classroom	250	71.25	7.45

Table 1 shows that students in smart classrooms obtained a higher mean score (78.64) compared to traditional classrooms (71.25). The standard deviation values indicate moderate dispersion in both groups.

Table 11: Independent Sample t-Test (Smart vs Traditional)

Group Comparison	t-value	df	p-value
Smart vs Traditional	11.42	498	0.000

Since $p < 0.05$, the null hypothesis H01 is rejected. There is a statistically significant difference between smart and traditional classrooms. Smart classrooms significantly improve academic achievement.

Table 12: Gender Comparison in Smart Classrooms

Gender	N	Mean	SD
Boys	125	78.12	6.75
Girls	125	79.16	6.88

$t = 1.21$, $p = 0.227$

Since $p > 0.05$, H02 is accepted. No significant gender difference exists in smart classrooms.

Table 13: Gender Comparison in Traditional Classrooms

Gender	N	Mean	SD
Boys	125	69.84	7.31
Girls	125	72.66	7.52

$t = 2.88$, $p = 0.004$

Since $p < 0.05$, gender differences are significant in traditional classrooms.

Table 14: ANOVA Across School Types (Smart Class)

School Type	Mean
Government	75.82
Government-Aided	77.93
Private	81.54

$F = 9.76$, $p = 0.000$

Since $p < 0.05$, significant differences exist among school types. Private schools show the highest performance under smart classroom settings.

5. DISCUSSION

The findings of the present study clearly demonstrate that smart classroom technology has a significant positive impact on academic achievement and the overall teaching–learning process among secondary school learners in Moradabad Division. The statistical analysis revealed that students taught through smart classes achieved higher mean scores compared to those in traditional classrooms, and the difference was statistically significant. This suggests that multimedia content, interactive boards, and digital instructional strategies enhance conceptual clarity, engagement, and retention of subject matter. Furthermore, the absence of significant gender differences in smart classroom environments indicates that technology-supported instruction promotes equitable learning opportunities for both boys and girls. In contrast, traditional classrooms showed notable gender variation, implying that conventional pedagogical approaches may not equally benefit all learners. The ANOVA results also highlighted differences across school types, with private schools demonstrating comparatively higher performance levels, possibly due to better infrastructure, technological support, and teacher competency. Additionally, the frequency analysis confirmed strong student acceptance of smart classroom technology, as the majority expressed positive perceptions regarding its effectiveness. Overall, the integration of smart classes appears to foster improved academic outcomes, greater student motivation, and enhanced classroom interaction, thereby reinforcing the need for systematic implementation of digital learning tools across all categories of secondary schools.

CONCLUSION

The present study concludes that smart classroom technology has a significant and positive impact on the academic achievement and overall teaching–learning process among secondary school students in

Moradabad Division. The statistical findings clearly indicate that students taught through smart classes performed better than those taught through traditional methods, thereby demonstrating the effectiveness of digital instructional tools in enhancing conceptual understanding and academic outcomes. The absence of significant gender differences in smart classrooms suggests that technology-supported learning provides equitable educational opportunities for both boys and girls. However, variations across school types reveal that institutional infrastructure and teacher competency play an important role in maximizing the benefits of smart classroom implementation.

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