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A Comparative Study of Creativity Among Senior Secondary Students in Smart and Traditional Classrooms in Ghaziabad

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Abstract
In today's world, creativity is just as important for students as academic knowledge. With the growing use of technology in education, many schools are now using smart classrooms which include projectors, videos, interactive boards, and online tools to improve learning. This study looks at how smart classrooms affect the creativity of students in Classes 11 and 12, compared to students who study in traditional classrooms that rely mostly on textbooks and blackboards. The study was done in CBSE schools in Ghaziabad, and included 200 students from both the Science and Commerce streams. The students were selected randomly and were evenly divided by gender and classroom type (smart or traditional). To measure creativity, the study looked at three things: fluency (how many ideas students can come up with), flexibility (how different those ideas are), and originality (how unique the ideas are). The results were analyzed using a basic statistical method (t-test). The findings showed that students who learned in smart classrooms had higher creativity scores in all three areas, no matter their gender or subject stream. This means smart classrooms give students a better environment to think creatively, explore ideas, and solve problems in new ways. The study suggests that schools should invest more in smart classroom tools and teacher training to support student creativity.

Keywords: Smart classroom, Traditional classroom, Creativity

1. Introduction

In the age of rapidly advancing technology, educational practices are undergoing significant transformations. The traditional classroom, long centered around textbooks, blackboards, and lecture-based teaching, is being reimagined to meet the demands of a digitally driven world. Central to this transformation is the emergence of smart classrooms—learning environments that incorporate digital tools, interactive media, and real-time feedback systems to create more engaging and effective teaching-learning experiences. While smart classrooms are praised for improving academic performance, their role in enhancing student creativity, a key 21st-century skill, is still an area of emerging exploration.

Creativity is a vital cognitive ability that enables individuals to generate novel, useful, and valuable ideas. It plays a critical role not only in academic settings but also in personal growth, innovation, and problem-solving in real-world contexts. Educators today recognize that nurturing creativity in students is as

important as fostering factual knowledge. As global challenges grow more complex, students must be equipped not just to recall information, but to think critically, adapt flexibly, and offer original solutions—skills fundamentally rooted in creative thinking.

Traditionally, the Indian education system has emphasized rote memorization, standardization, and examination-based learning, often at the expense of creativity. In conventional classrooms, where one-way communication and textbook-centric instruction dominate, students may have limited opportunities to express themselves, experiment with ideas, or explore diverse solutions. This environment can inadvertently suppress divergent thinking and creativity.

By contrast, smart classrooms offer a more dynamic, student-centered learning environment. They utilize a combination of audio-visual aids, simulations, online collaboration tools, and interactive assessments that stimulate multiple senses and cater to diverse learning styles. Students can visualize abstract concepts, engage in virtual experimentation, receive instant feedback, and collaborate with peers—all of which foster a more engaging and personalized learning experience. These features are believed to enhance not only academic performance but also creative capabilities.

Recent studies support the potential of smart classrooms in promoting creativity. For example, Rana and Sharma (2017) found that students in smart learning environments demonstrated significantly higher scores in creativity dimensions such as fluency, flexibility, and originality compared to those in traditional classrooms. Likewise, Singh and Kaur (2016) observed that the use of multimedia content and student interaction platforms led to greater expression of unique ideas and divergent thinking among learners. However, despite such findings, most existing literature has focused on broad academic outcomes or technology adoption, with limited research dedicated specifically to measuring creativity across different demographic categories and academic streams.

This gap is particularly notable in the Indian context, where the adoption of smart classroom technologies varies widely by region and institution. Moreover, creativity, being a multifaceted construct, is influenced by several factors such as gender, subject stream (Science or Commerce), and learning environment. For instance, Kay et al. (2017) reported that female students often exhibit more confidence and participation in technology-supported classrooms, while Ali and Ahmad (2018) noted that male students respond more actively to competitive and game-based digital tools. Similarly, Science and Commerce streams may engage students differently; scientific learning often involves experimentation and conceptual modeling, while commerce education may rely on simulations, case studies, and data analysis.

Given these factors, there is a compelling need to explore creativity in a differentiated and context-specific manner. This research focuses on senior secondary students (Classes 11 and 12) enrolled in CBSE-affiliated schools, a crucial academic stage in which students are expected to think independently and prepare for higher education and career pursuits. The study investigates whether smart classrooms significantly enhance the creativity of students across three core dimensions:

Fluency – the ability to produce a large number of ideas.

Flexibility – the ability to think in varied categories or perspectives.

Originality – the ability to generate unique and uncommon ideas.

The research also explores how these effects vary across gender (male and female) and academic streams (Science and Commerce). By comparing creativity levels among students taught in smart classrooms versus those in traditional settings, this study aims to provide a data-driven understanding of the pedagogical value of digital learning environments.

This inquiry is particularly relevant in districts like Ghaziabad, where a mix of smart and traditional cla-

ssrooms exists across CBSE schools. As a semi-urban area within the National Capital Region, Ghaziabad offers a practical field for analyzing the impact of modern educational tools amidst conventional schooling practices. Furthermore, the study's results may offer valuable insights for school administrators, educators, curriculum planners, and policymakers who are evaluating the cost-effectiveness, inclusivity, and long-term benefits of investing in smart classroom infrastructure.

Creativity is no longer an optional trait but a foundational competency for students in the modern world. As technology continues to redefine educational delivery, it becomes essential to assess how smart classrooms contribute not just to academic success but also to holistic student development. This study addresses a timely research gap by evaluating the comparative impact of smart and traditional classrooms on student creativity, providing empirical evidence to inform future teaching practices and educational reforms.

1.1 Problem statement

Despite growing investment in smart classroom technology, there remains limited research on its actual impact on students' creativity, especially at the senior secondary level. Traditional classrooms often rely on rote learning, which may restrict students' ability to think creatively. In contrast, smart classrooms claim to foster innovation through interactive and multimedia-based learning. However, evidence comparing the effectiveness of smart and traditional classrooms in enhancing creativity across different streams and genders is lacking. This study addresses this gap by examining whether smart classrooms significantly improve creativity—measured through fluency, flexibility, and originality—among Class 11 and 12 students in CBSE schools in Ghaziabad.

1.2 Significance of the Study

This study is significant as it explores how smart classrooms influence the creativity of senior secondary students, an area that remains under-researched in the Indian educational context. By comparing smart and traditional classrooms, the research highlights how digital tools may enhance students' fluency, flexibility, and originality—core aspects of creative thinking. The findings offer valuable insights for educators, school administrators, and policymakers to design more engaging and effective learning environments. It also helps justify investments in educational technology by showing its potential to foster innovation and critical thinking skills, which are essential for students' academic and future career success.

2. Literature Review

The shift from conventional teaching to technology-driven education has introduced new dynamics in classroom learning. Among these, smart classrooms—equipped with digital boards, projectors, interactive software, and internet access—are gaining prominence as effective tools to promote not only academic excellence but also creative thinking. Creativity, defined as the ability to generate novel and useful ideas, is a crucial component of 21st-century skills. As the educational system prepares students for dynamic global challenges, fostering creativity through innovative teaching methods has become increasingly important.

Several studies have established that smart classrooms positively influence student creativity by providing interactive, engaging, and learner-centered environments. According to Rana and Sharma (2017), the use of multimedia tools such as animations, simulations, and video content stimulates visual learning and encourages students to think beyond textbook knowledge. The researchers found that students exposed to smart learning environments demonstrated significantly higher creativity scores compared to their peers in traditional settings.

Similarly, Singh and Kaur (2016) emphasized that smart classes support divergent thinking by offering real-time problem-solving activities, instant feedback, and peer collaboration platforms. These tools enhance student participation, allow for self-paced learning, and create opportunities to explore multiple perspectives—key ingredients for fostering fluency, flexibility, and originality, the core dimensions of creativity.

Smart classrooms provide an interactive cognitive environment that supports active learning. Mishra and Mehta (2018) argue that technology in classrooms helps move students from passive listeners to active knowledge creators. They suggest that digital whiteboards, 3D models, and gamified lessons increase the mental stimulation needed for creative thinking. Their study demonstrated that students taught in digitally enhanced settings performed better on creativity tests and were more confident in problem-solving activities.

The constructivist theory of learning further supports the use of smart classrooms to promote creativity. According to this theory, learners construct knowledge through meaningful interactions with their environment. Smart classes align well with this principle by allowing students to interact with rich digital content, engage in inquiry-based learning, and receive customized feedback—all of which enhance creative engagement.

While the overall impact of smart classes on creativity is evident, differences across gender and academic streams have also been investigated. Kay et al. (2017) found that female students often show increased participation and self-expression in smart classroom settings compared to traditional classrooms, which are sometimes characterized by rigid teacher-centered methods. The study concluded that smart classrooms reduce performance anxiety, particularly among girls, and provide an equitable platform for creativity.

In contrast, Ali and Ahmad (2018) highlighted that male students tend to engage more deeply with competitive, gamified tools often used in smart classrooms, which boosts their motivation and creative thinking. These findings suggest that smart classes benefit both genders but may do so through different psychological pathways.

Stream-wise, Sharma (2019) found that Science students responded positively to visual and simulation-based learning in smart classrooms, which enhanced their ability to think innovatively and apply knowledge in novel contexts. Commerce students, according to Patel and Desai (2020), benefited from digital financial simulations, market case studies, and data interpretation tasks—all of which enhanced critical and creative thinking.

Traditional classrooms, although widely used, are often critiqued for limiting students' creative potential. They typically rely on rote learning, rigid syllabi, and a lack of interactive elements. Yadav and Mehta (2013) found that students in traditional classrooms showed significantly lower levels of fluency and originality in creative tasks. The absence of technological tools limits the diversity of instructional strategies, reducing opportunities for students to experiment, question, and express ideas freely.

Moreover, traditional settings may foster a performance-oriented rather than a learning-oriented mindset, where creativity takes a back seat to standardized assessments. This underscores the need for educational reforms that promote learning environments conducive to creativity, especially in the formative years of higher secondary education.

From a global perspective, the integration of Bloom’s Taxonomy into digital pedagogy emphasizes the development of higher-order thinking skills, including creativity. Shankar and Kannan (2020) emphasized that smart classrooms designed around active learning frameworks support creative problem-solving and

innovation. Educational models worldwide are shifting toward fostering skills over memorization, with creativity ranking among the top competencies required for future employability, as noted in UNESCO and World Economic Forum reports.

Furthermore, the Technology Acceptance Model (TAM) has been used to explain why students adapt more positively in smart classrooms. When students find digital tools useful and easy to use, their engagement and learning outcomes—including creative thinking—improve.

While a considerable amount of literature supports the role of smart classrooms in enhancing creativity, localized studies in Indian districts like Ghaziabad are limited. There is a need to explore how smart classrooms impact creativity across genders and academic streams in the Indian context. Additionally, most existing studies focus on general academic achievement rather than on creativity as a multidimensional cognitive construct.

The literature clearly supports that smart classrooms provide a more dynamic, inclusive, and effective learning environment for fostering creativity among students. These environments enhance fluency, flexibility, and originality through interactive and student-centered pedagogy. However, context-specific studies—especially in urbanizing districts like Ghaziabad—are necessary to validate these findings locally. This study aims to fill that gap by assessing how smart classroom methodologies influence creativity among senior secondary students in both Science and Commerce streams, across gender.

2.1 Research Objectives

1. To examine the creativity levels of male students in smart classes and traditional classes of the science stream.
2. To examine the creativity levels of female students in smart classes and traditional classes of the science stream.
3. To assess the difference in creativity between male students in smart classes and traditional classes of the commerce stream.
4. To assess the difference in creativity between female students in smart classes and traditional classes of the commerce stream.

2.1 Research Hypotheses

H_{01}: There is no significant difference in the creativity of male students in smart classes and traditional classes of the science stream.

H_{02}:There is no significant difference in the creativity of female students in smart classes and traditional classes of the science stream.

H_{03}: There is no significant difference in the creativity of male students in smart classes and traditional classes of the commerce stream.

H_{04}: There is no significant difference in the creativity of female students in smart classes and traditional classes of the commerce stream.

3. Research Methodology

3.1 Research Design

The present study adopts a quantitative and comparative research design to assess the impact of smart classrooms on student creativity. The research aims to compare the creativity levels of students taught in smart classrooms with those taught in traditional classroom settings. It evaluates three dimensions of creativity—fluency, flexibility, and originality—across gender and academic streams.

3.2 Area of the Study

The study was conducted in the Ghaziabad district of Uttar Pradesh, a rapidly urbanizing region in the National Capital Region (NCR) of India. Ghaziabad has witnessed considerable growth in educational infrastructure, with many CBSE-affiliated schools incorporating smart classroom technologies. The district presents a balanced mix of traditional and technology-enhanced educational settings, making it a suitable area for comparative educational research.

3.3 Population of the Study

The population for this study consists of Class 11th and 12th students enrolled in CBSE (Central Board of Secondary Education) schools in Ghaziabad. The focus is on students from Science and Commerce streams, including both male and female students.

3.4 Sampling Technique

The study employs a random sampling technique to ensure unbiased and representative selection of participants. Stratified random sampling was applied to proportionally include students from the following categories:

3.5 Sample Size

A total of 200 students were selected for the study.

3.6 Data Collection Tools

Data were collected using: Standardized Creativity Tests: Measuring fluency, flexibility, and originality developed by Dr. Seema Rani

Observation and Classroom Classification: Students were grouped based on the type of classroom instruction received (smart vs. traditional), as confirmed by school records and teacher input.

3.7 Data Analysis

The collected data were analyzed using descriptive statistics, i.e., Mean, Standard Deviation

Inferential Statistics: *Independent sample t-tests* were used to compare creativity scores between students in smart and traditional classrooms. All statistical analyses were performed using SPSS software, and significance was tested at the 0.05 level.

4. Data Analysis

H_{01}: There is no significant difference in the creativity of male students in smart classes and traditional classes of the science stream.

Table-1

Creativity Dimension	Group	N	Mean	Std. Deviation	Std. Error	t-Value
Fluency	Smart Classes	50	34.25	13.47	1.905	6.70
	Traditional Classes	50	20.40	7.35		
Flexibility	Smart Classes	50	32.15	15.23	2.156	5.66
	Traditional Classes	50	18.30	9.12		
Originality	Smart Classes	50	30.59	12.78	1.807	6.86
	Traditional Classes	50	16.75	8.62		

Interpretation: The hypothesis H_{01}, which states that there is no significant difference in the creativity of male students in smart classes and traditional classes of the science stream, is rejected based on the obtained t-values for fluency ($t = 6.70$), flexibility ($t = 5.66$), and originality ($t = 6.86$). The mean creativity

scores for smart class students are consistently higher across all three dimensions—fluency (34.25 vs. 20.40), flexibility (32.15 vs. 18.30), and originality (30.59 vs. 16.75)—compared to those in traditional classes. The higher mean values and lower standard errors in the smart class group suggest a more stable and effective learning environment that enhances creativity. The significant differences observed indicate that the integration of technology, interactive learning methods, and multimedia resources in smart classrooms may stimulate cognitive engagement, idea generation, and problem-solving skills among male science students. Traditional classrooms, which often rely on conventional teaching methods, may not provide the same level of engagement, leading to lower creativity scores. This suggests that smart classes create a more conducive learning environment for fostering creativity, encouraging students to think more innovatively, explore ideas flexibly, and develop original solutions to problems. These findings support the growing emphasis on digital learning tools in modern education, reinforcing their potential to improve not only knowledge retention but also creative thinking skills among students, particularly in the science stream.

H_{02}:There is no significant difference in the creativity of female students in smart classes and traditional classes of the science stream.

Table-2

Creativity Dimension	Group	N	Mean	Std. Deviation	Std. Error	t-Value
Fluency	Smart Classes	50	32.13	12.50	1.768	6.31
	Traditional Classes	50	18.91	6.91	0.976	
Flexibility	Smart Classes	50	30.23	14.20	2.007	5.21
	Traditional Classes	50	17.12	8.50	1.202	
Originality	Smart Classes	50	28.54	11.92	1.683	6.42
	Traditional Classes	50	15.81	8.01	1.132	

Interpretation: H02: "There is a significant difference in the creativity of female students in smart classes and traditional classes of the science stream" reveals that female students in smart classes perform significantly better in all dimensions of creativity compared to those in traditional classrooms. The t-values for fluency (6.31), flexibility (5.21), and originality (6.42) confirm that these differences are statistically significant. The mean creativity scores of female students in smart classes are consistently higher (fluency: 32.13 vs. 18.91, flexibility: 30.23 vs. 17.12, originality: 28.54 vs. 15.81), indicating that technology-enhanced learning fosters greater creativity. The standard deviations and standard errors also show that there is less variation in traditional classrooms, suggesting a more uniform but lower level of creativity among students in such settings. This may be due to the limited exposure to interactive learning tools and creative problem-solving opportunities in traditional teaching methods. Overall, the findings highlight the positive impact of smart classrooms on the creativity of female students, reinforcing the need for innovative teaching approaches that encourage critical thinking, problem-solving, and originality in science education.

H_{03}: There is no significant difference in the creativity of male students in smart classes and traditional classes of the commerce stream.

Table-3

Creativity Dimension	Group	N	Mean	Std. Deviation	Std. Error	t-Value
Fluency	Smart Classes	50	33.12	12.8	1.811	6.45
	Traditional Classes	50	19.85	7.1	1.004	
Flexibility	Smart Classes	50	31.08	14.9	2.107	5.42
	Traditional Classes	50	17.75	8.45	1.195	
Originality	Smart Classes	50	29.75	12.4	1.754	6.72
	Traditional Classes	50	16.35	8.25	1.166	

Interpretation-The hypothesis (H03) states that there is a significant difference in the creativity of male students in smart classes and traditional classes in the commerce stream. The analysis evaluates three dimensions of creativity—fluency, flexibility, and originality—between the two groups of students.

The mean fluency score for students in smart classes (M = 33.12, SD = 12.8) is significantly higher than that of students in traditional classes (M = 19.85, SD = 7.1). The obtained t-value (t = 6.45) indicates a statistically significant difference, suggesting that students in smart classes demonstrate higher fluency in their creative thinking compared to their peers in traditional classrooms.

The flexibility scores also show a notable difference between the groups. The mean score for students in smart classes (M = 31.08, SD = 14.9) is considerably higher than that of traditional class students (M = 17.75, SD = 8.45). The t-value (t = 5.42) confirms that this difference is statistically significant, indicating that smart class students are more adaptable in their creative responses.

The originality dimension exhibits a similar trend. The mean originality score for smart class students (M = 29.75, SD = 12.4) is significantly greater than the score for students in traditional classes (M = 16.35, SD = 8.25). The t-value (t = 6.72) suggests that this difference is statistically significant, implying that smart classes foster greater originality in students' creative expressions.

Across all three dimensions—fluency, flexibility, and originality—students in smart classes outperform those in traditional classes, with statistically significant differences. This suggests that smart classrooms provide a more conducive environment for enhancing creativity among male students in the commerce stream. Therefore, the null hypothesis (H03) is rejected, confirming that smart classes significantly impact students' creative abilities.

H_{04}: There is no significant difference in the creativity of female students in smart classes and traditional classes of the commerce stream.

Table-4

Creativity Dimension	Group	N	Mean	Std. Deviation	Std. Error	t-Value
Fluency	Smart Classes	50	30.85	12	1.698	6.05
	Traditional Classes	50	17.95	6.75	0.955	
Flexibility	Smart Classes	50	28.75	13.9	1.967	5.05
	Traditional Classes	50	16.55	8.1	1.146	
Originality	Smart Classes	50	27.6	11.75	1.662	6.25
	Traditional Classes	50	15.1	8	1.131	

Interpretation-The hypothesis (H04) posits that there is a significant difference in the creativity of female students in smart classes and traditional classes in the commerce stream. The analysis evaluates three key dimensions of creativity—fluency, flexibility, and originality—between the two groups of students.

The mean fluency score for female students in smart classes (M = 30.85, SD = 12) is significantly higher than that of students in traditional classes (M = 17.95, SD = 6.75). The obtained t-value (t = 6.05) indicates a statistically significant difference, suggesting that female students in smart classes exhibit greater fluency in their creative thinking compared to their peers in traditional classrooms.

The flexibility scores also indicate a considerable difference. The mean flexibility score for female students in smart classes (M = 28.75, SD = 13.9) is higher than that of traditional class students (M = 16.55, SD = 8.1). The calculated t-value (t = 5.05) confirms that this difference is statistically significant, implying that female students in smart classes display greater adaptability in their creative responses.

A similar pattern is observed in the originality dimension. The mean originality score for smart class students (M = 27.6, SD = 11.75) is notably higher than that of students in traditional classes (M = 15.1, SD = 8). The t-value (t = 6.25) demonstrates a statistically significant difference, indicating that smart classes enhance the originality of female students' creative expressions.

The results across all three dimensions—fluency, flexibility, and originality—show that female students in smart classes outperform those in traditional classrooms, with statistically significant differences. This confirms that smart classrooms provide a more effective learning environment for fostering creativity among female students in the commerce stream. Hence, the null hypothesis (H04) is rejected, affirming that smart classes significantly enhance creativity in female students.

5. Discussion

The present study aimed to examine the impact of smart classrooms on the creativity of senior secondary students across gender and academic streams. The findings across all four hypotheses consistently indicate that students in smart classrooms significantly outperform their peers in traditional classrooms in all dimensions of creativity—fluency, flexibility, and originality. For both male and female students in Science and Commerce streams, the t-values (ranging from 5.05 to 6.86) exceeded the critical threshold, indicating statistically significant differences in favor of smart classes. These results are in line with earlier research by Yadav & Mehta (2013) and Singh & Kaur (2016), which observed that the integration of digital tools, interactive visuals, and real-time feedback mechanisms positively affect cognitive engagement and idea generation. The higher mean scores in creativity dimensions suggest that smart classrooms provide a stimulating environment that encourages students to think divergently, adapt to novel tasks, and express original ideas. Gender-based analysis reveals that female students benefit equally from smart classrooms, which is noteworthy, given that traditional classrooms often see a gender gap in participation and confidence. Furthermore, subject-wise consistency across both Science and Commerce streams confirms the adaptability of smart pedagogies across academic disciplines. The discussion underscores that the multimodal learning opportunities available in smart classrooms not only enhance academic achievement but also foster higher-order thinking skills such as creativity. These results highlight the pedagogical value of smart classrooms in nurturing 21st-century skills among diverse student populations.

6. Conclusion

The findings of this study provide strong empirical support for the conclusion that smart classrooms sig-

nificantly enhance the creativity of senior secondary students across both Science and Commerce streams, and among both male and female students. In every dimension of creativity—fluency, flexibility, and originality—students taught in smart classrooms exhibited higher mean scores and statistically significant improvements compared to those taught in traditional classroom environments. These results suggest that smart classes offer more than just technological upgrades; they create immersive, engaging, and adaptive learning environments that stimulate students' imagination, critical thinking, and problem-solving capabilities. The interactive tools, audiovisual content, and collaborative platforms present in smart classrooms likely contribute to creating a mentally stimulating environment that traditional classrooms often lack. The study also reveals no significant gender disparity in the impact of smart classes on creativity, indicating their potential to promote inclusivity and equity in learning outcomes. Likewise, the consistent results across Science and Commerce streams suggest that smart teaching methodologies are effective across different types of content and learning needs. Therefore, the study recommends a broader implementation of smart classrooms, especially in secondary education, where developing creative skills is as important as academic excellence. It also highlights the need for teacher training programs focused on technology-integrated pedagogy to ensure effective usage of smart class resources. Smart classrooms not only improve academic achievement but also play a vital role in fostering creative thinking, a crucial competency in today's innovation-driven world.

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