

Smart Classroom Integration in Schools

Perspectives of In-Service Teachers in Odisha

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ABSTRACT

The study aimed to explore teachers' perceptions of integrating smart classrooms, with special reference to the availability of resources, student participation, pedagogical practices, professional development training, and the problems and challenges encountered. An explanatory sequential mixed-method design was employed for data collection, and the data were analysed using percentage analysis, t-test, and ANOVA. The results revealed that a high majority of the teachers perceived that a smart classroom makes learning more enjoyable and has a significant impact on student participation. Research findings have shown that implementing a smart classroom has enhanced the teaching performance of secondary school teachers in Odisha. However, several obstacles, including technical issues, digital illiteracy, insufficient technical support, and health concerns, hinder the effective integration of the smart classroom. The NEP 2020 emphasises that technology can significantly improve educational processes and outcomes. Nonetheless, these challenges must be addressed at the appropriate level to fully harness the potential of technology in the classroom.

Keywords: Smart Classroom, Student Participation, Pedagogical Practices, Professional Development Training

Introduction

As the expectations of modern students continue to grow, the integration of technology into educational environments has

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increased significantly. Techno-savvy learners now consider smart classrooms as essential. Various national and international commitments, including the National Education Policy 2020, acknowledge the significance of utilising technological infusion in the teaching-learning process. A smart classroom is outfitted with cutting-edge technology, enhancing its effectiveness and making it more engaging for students. Smart classroom settings offer students more educational opportunities and learning experiences than the traditional classrooms (Macleod et al., 2018). Moreover, when Information and Communication Technology (ICT) based tools are utilised in a creative and meaningful manner within the smart classroom, they enhance learning by promoting student participation, and bridging the gaps between learners and their needs. In general, smart classrooms boost teachers' efficiency and productivity by presenting complex and abstract curriculum topics, fostering engaging learning environments for students, and improving academic performance levels. They also enable formative assessment for learning, resulting in teachers assessing and appraising students during teaching-learning (Noor-ul-amin, 2016). Students find it easier to learn when innovative knowledge construction methods are employed using appropriate tools and technologies. Integrating smart classrooms into educational settings presents a wealth of opportunities, creates a nurturing learning environment, and motivates students to strive for excellence in their studies.

Smart Classroom in Odisha

In 2021, the Odisha Government, as part of the 'Mo School Abhiyan', launched a unique initiative under the 5T framework—Teamwork, Transparency, Technology, Time limit, and Transformation—called the 5T High School Transformation Programme. The programme's objectives include (i) advancing classroom teaching by integrating more technology, moving beyond traditional chalk and board methods, and (ii) fostering an engaging learning atmosphere by aligning with student interests. Schools participating in the programme are outfitted with smart classrooms and other modern facilities. Every school should have at least two smart classrooms furnished with televisions, laptops, screens, projectors, high-speed internet, and audio systems among other facilities. Beyond infrastructural improvements, it also focuses on enhancing teachers' skills and encouraging a sense of ownership among teachers.

Although smart classrooms offer several benefits, previous research has shown that teachers are not particularly eager to adopt ICT-based educational tools. Teachers have struggled to use smart classes effectively because of a range of issues, such as technological challenges, limited time, and inadequate training. Thus, examining teachers' teaching methods, training, and obstacles are essential for enhancing their use of smart classrooms. There is a dearth of research on teachers' perspectives on the adoption of smart classrooms, particularly in secondary schools in Odisha. Investigating this area is reasonable, given that the Odisha government is in the process of introducing smart classes in all government and government-aided schools in the region.

Review of Related Literature

Studies Related to Smart Classroom and School Education

Few studies have examined the effectiveness of smart classrooms in India. A few noteworthy studies are highlighted here. Sharma and Masih (2023) found that digital smart boards in Delhi's government schools enhanced student understanding through novel teaching methods. Bala et al. (2017) compared traditional lecture-based teaching with smart classroom teaching for science students in upper primary school. The results showed a notable difference in the students' learning outcomes between these methods. Anju and Sharma (2016) investigated the effectiveness of Educomp smart classrooms in mathematics learning among elementary students in Haryana. Students taught using Educomp showed higher math scores than those taught using traditional teaching. Tageja and Sood (2014) studied how smart classroom teaching affects high school students' achievement and creativity in commerce. The study showed that interactive whiteboards enhance student performance, integrate ICTs into the learning process, and create new learning opportunities. At the global level, researchers have reviewed studies, such as Hendawi and Nosair (2020), which showed that students using interactive smartboards in social studies instruction in Qatar demonstrated improved abilities in recalling and applying knowledge. In a study by Al-Majali et al. (2016), the effectiveness of using smartboards for teaching social studies in Jordan's public schools was assessed and it was found that this teaching approach was indeed successful. Phoong et al. (2019) also found that smart classrooms in higher

education significantly improved students' academic performance compared to traditional classrooms.

Issues and Challenges in Smart Classroom

Sethy and Mohalik (2019) found that secondary schools in West Bengal had desktops and projectors in smart classrooms. However, these schools lacked laptops and interactive boards, and only half of the teachers were ICT-proficient. There is limited subject-specific software and teachers rarely use smart classrooms for instruction. Baby and Chellamani (2018) examined the implementation of smart classroom technology in secondary schools in Puducherry. They found inconsistent usage across schools, with some using it extensively and others rarely using it. According to the study, key obstacles included insufficient teacher training, hardware maintenance issues, and limited integration into daily teaching practices. Similarly Jena (2013), highlighted the key elements affecting smart classroom teaching: teacher participation, lack of self-paced learning, time demands, and inappropriate instructional methods. At the global level, Palanisamy et al. (2020) investigated the incorporation of techno-pedagogical skills into teaching and learning in smart classrooms, emphasising the benefits, challenges, and hurdles.

Turinumukiza et al. (2021), investigated how smart classroom services affect ICT capacity building in Rwandan secondary schools. The findings showed that these services improved ICT capacity in these institutions. Bdiwi et al. (2019) indicated that the teacher plays a crucial role in boosting students' motivation, engagement, and successful learning. Pourciau (2014) explored smart board implementation in middle schools and found that teachers need professional development to integrate Interactive Whiteboard (IWB) technology effectively, as they face difficulties with Smartboard use. Digital participation is essential for fostering an inclusive learning society. Schools must create enabling environments by ensuring universal, equitable, and open access to digital resources, along with their free sharing (Behera, 2021). Kolb (2019) presented the triple E framework—Engage, Enhance, and Extend—for incorporating smart classroom technologies. This model shows how technology involves students in learning, promotes a deeper understanding, and applies learning to real situations. Saini and Goel (2019) contend that the effective incorporation of

smart classroom technologies can be realised by offering intelligent content, engaging strategies, evaluation techniques, and a suitable physical setting.

The literature review revealed numerous studies on smart classrooms, with research demonstrating positive attitudes from both teachers and students. However, several challenges are associated with the absence of favourable attitudes towards the implementation of smart classrooms. There is insufficient research examining teacher implementation and student interaction with smart classroom technology, particularly in India. The trends and insights from previous research in this field serve as a valuable guide for researchers to advance this study.

Rationale of the Study

Emerging technologies such as artificial intelligence, machine learning, blockchain, smart boards, computing devices, and educational software will transform both classroom content and learning methods. These fields require comprehensive research at the technological and educational levels (Ministry of Education, 2020). The Odisha government has implemented smart classrooms in secondary schools across the state. Consequently, it is crucial to examine the application of smart classrooms in teaching and learning processes in Odisha, focusing particularly on teachers' perceptions, their technological proficiency, student engagement, and the obstacles and challenges faced in integrating smart classrooms. This makes the classroom more meaningful and effective for the learner with the help of different media. Moreover, it enhances the learning experience of students. This study adds valuable insights to the existing literature by shedding light on teachers' perceptions and use of smart classroom technology. This study was designed with specific research questions and objectives.

Research Questions

- What are secondary school teachers' views on the adoption of smart classrooms in their schools?
- What challenges and barriers do high school teachers encounter when integrating smart classroom technology?

Research Objectives

The study has the following objectives:

- To examine teachers' views on smart classrooms; focusing on resources, student engagement, teaching methods, and professional development.
- To study the impact of gender, educational stream, and teaching experience on smart classroom integration.
- To identify the obstacles secondary school teachers face when incorporating smart classrooms.

In this study, a thorough analysis of the identified issues is required. Consequently, the researchers adopted an explanatory sequential mixed-method approach to explore the problem from both quantitative and qualitative perspectives (Ary et al., 2010). Initially, quantitative data were collected via a questionnaire to evaluate teachers' views on the integration of smart classrooms, as they are currently using these facilities in their schools. To further explore the issues and challenges related to smart classrooms, a qualitative approach was adopted using an interview schedule.

Hypotheses of the Study

H1: There is no significant difference between male and female teachers' views on the use of smart classrooms.

H2: There is no significant difference in arts and science teachers' views on using smart classrooms.

H3: There is no significant difference in integration of smart classrooms between varying levels of teaching experience—low (0–2 years), moderate (2–5 years), and high (over 5 years).

Operational Definition of Key Term

Smart Classroom: Smart classroom refers to a technologically sophisticated classroom incorporating multimedia components as part of the Odisha State Government's 5T High School Transformation Programme. These classrooms are equipped with smart boards, computers, audio systems, learning management systems, and other tools. Each room has laptops, projectors, screens or TVs, internet access, and sound systems.

Methods

Population and Sample

Government secondary school teachers in Odisha comprised the study population. Using convenience sampling, the researchers selected 45 and 10 high school teachers for quantitative and qualitative data collection during 2023–2024. Two districts, Puri and Jagatsinghpur, were selected for the sample collection. For the quantitative data, 23 teachers were chosen from Puri district comprising 10 males and 13 females, and 22 teachers from Jagatsinghpur, with an equal distribution of 11 males and 11 females. Subsequently, 10 individuals were selected for further analysis, including 3 males and 2 females from Puri district and 2 males and 3 females from Jagatsinghpur.

Data Collection Tools

The study consisted of a self-developed perception scale for quantitative data. The perception scale is a five-point Likert-type scale ranging from Strongly Agree (SA) to Strongly Disagree (SD), containing 30 items to assess teachers' views on smart classroom integration across five categories: (a) resource availability, (b) student engagement, (c) teaching methods, (d) professional development training, and (e) issues and challenges. The interview schedule, comprising 10 questions, provided detailed explanations of dimension-specific data from the quantitative phase. The researchers followed the ethical guidelines throughout the study.

Data Analysis Techniques

For quantitative data analysis, the researchers used percentages, independent t-tests, and ANOVA (Garrett, 2005), whereas thematic analysis was used for qualitative data analysis (Ary et al., 2010).

Results of the Study

The results are presented in two major sections: quantitative and qualitative.

Quantitative Data Analysis

The data were thoroughly analysed using statistical methods aligned with the research questions and objectives. The results

are presented graphically with interpretations. The outcomes were categorised into descriptive and inferential analyses.

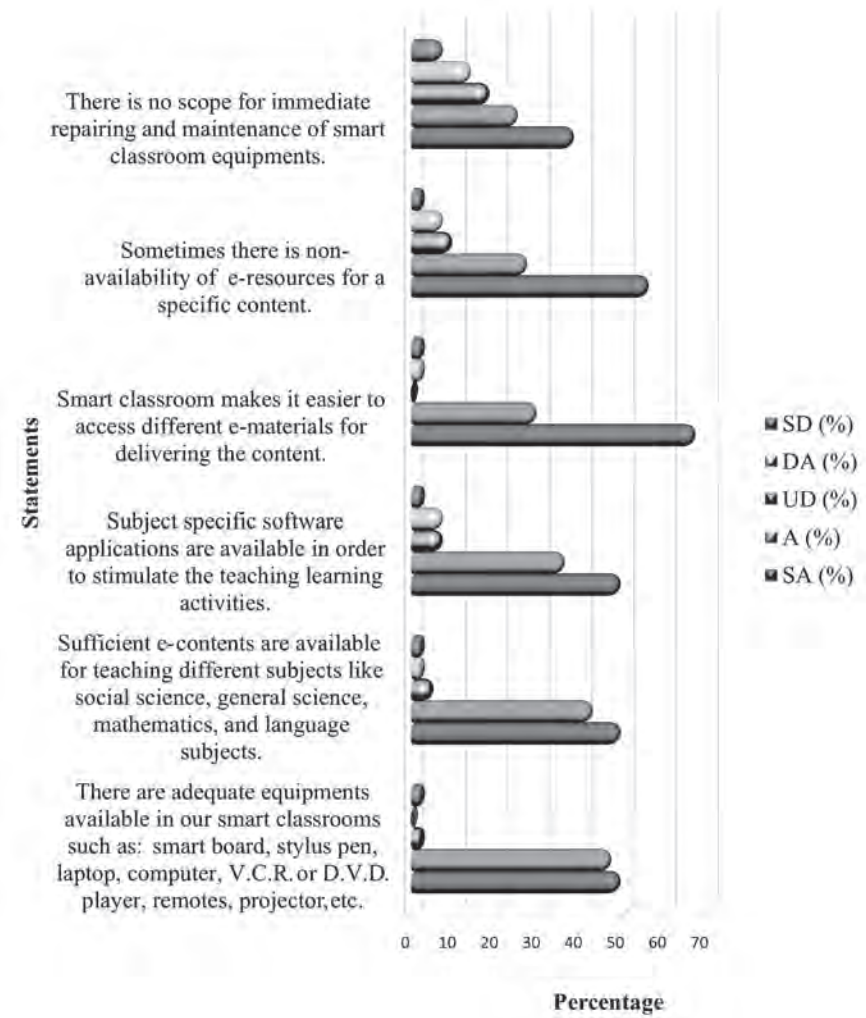


Figure 1: Perception of teachers: Availability of resources in smart classroom

Figure 1 illustrates the availability of resources in the smart classrooms. A total of 95.56 per cent (SA + A) of teachers reported that sufficient equipment is available in smart classrooms, viz., smart boards, laptops, computers, VCR or DVD players, and

projectors. Smart classrooms provide easier access to electronic materials for content delivery and learning. Government schools in Odisha are well-equipped with smart classroom tools and subject-specific software, although the occasional absence of e-resources remains a concern.

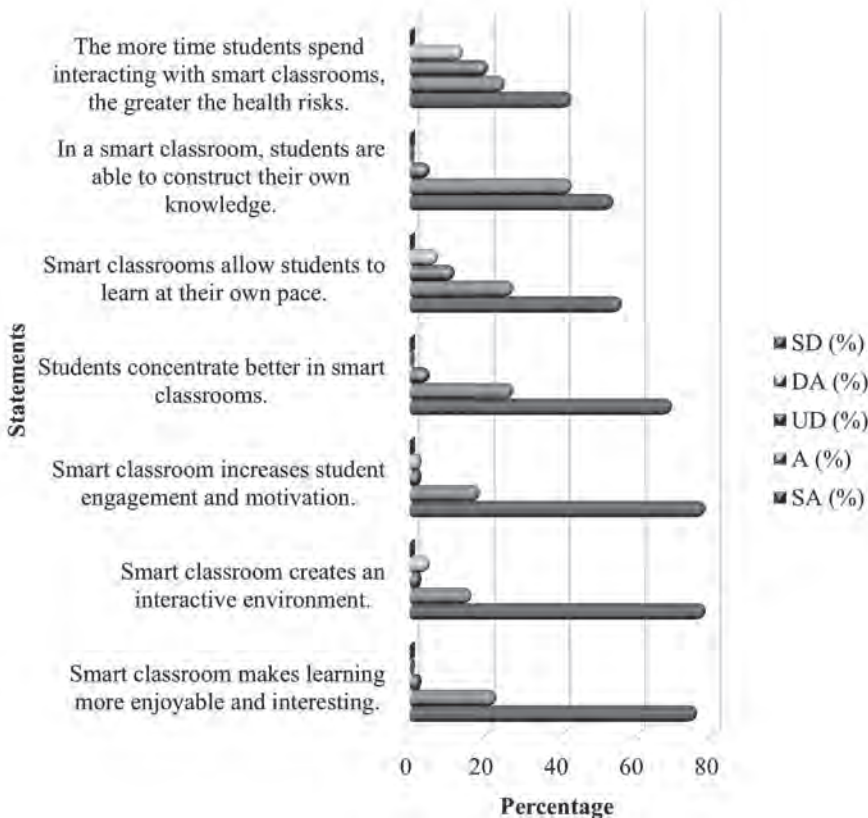


Figure 2: Teachers' perceptions: Smart classroom integration and its impact on participation

Figure 2 shows that 97.78 per cent (SA + A) of teachers perceive smart classrooms to boost students' interest in learning. Additionally, 95.56 per cent (SA + A) of teachers noted increased student participation, motivation, and knowledge-building capacity, along with improved concentration. Therefore, smart classrooms significantly improve student engagement.

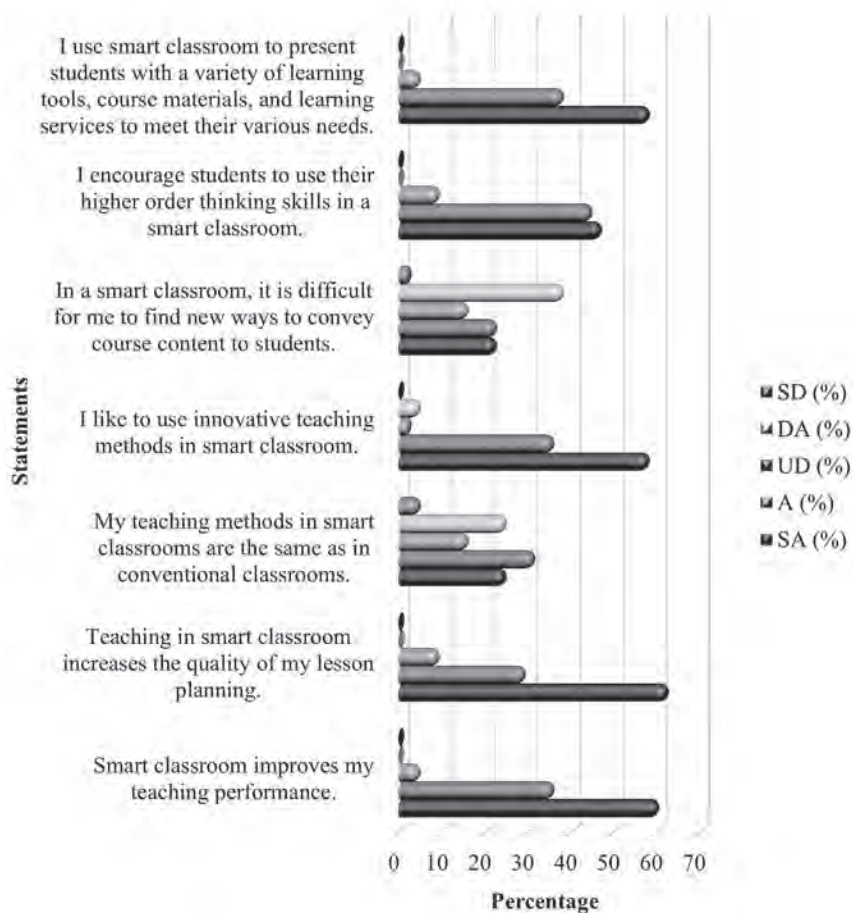


Figure 3: Teachers' perceptions: Pedagogical practices in smart classroom

According to Figure 3, 95.56 per cent (SA + A) of teachers believe smart classrooms enhance teaching effectiveness. They use smart classrooms to provide students with learning tools and materials tailored to their needs. The adoption of smart classrooms improves teaching performance and affects lesson quality. When asked about teaching methods, 55.55 per cent (SA + A) of teachers indicated their methods remained similar to traditional classrooms,

suggesting that despite interest in new approaches, teachers face obstacles in acquiring new teaching methods.

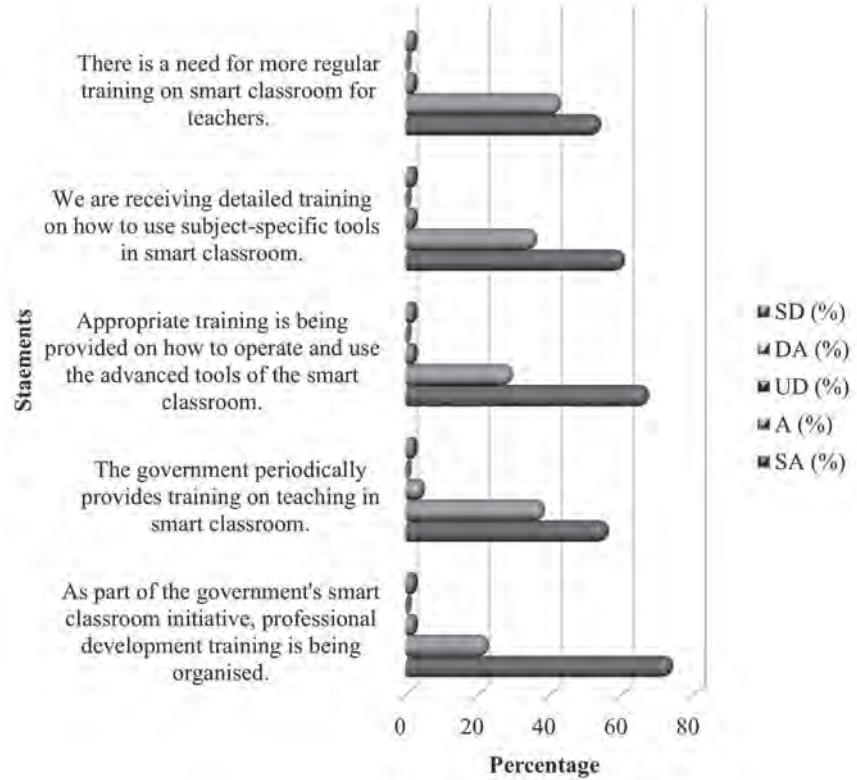


Figure 4: Teachers' perception of professional development training

As indicated in Figure 4, teachers said that professional development sessions were being organised for the smart classroom initiative. These sessions covered the operation of advanced tools and subject-specific applications in smart classrooms. The results also showed that teachers occasionally participated in professional development involving smart classroom tools. However, many teachers highlighted the need for additional training to effectively use smart classrooms, focusing on integrating technologies that align with the subject matter, teaching methods, and student needs.

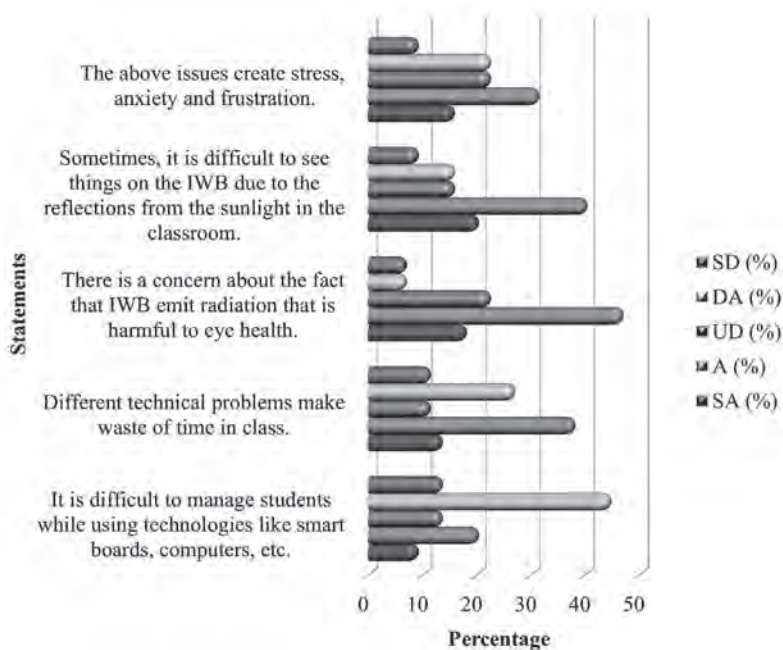


Figure 5: Teachers’ perception: Problems and challenges in integrating smart classroom

Figure 5 presents the difficulties teachers face when incorporating smart classrooms. Participants highlighted the factors that impede the successful adoption of smart classes. Major challenges include technical issues, such as software glitches, slow internet, and hardware malfunctions. Health concerns include eye problems from prolonged screen exposure and long classes, which cause headaches, dry eyes, and vision issues. The reflection of sunlight on display screens poses another challenge due to the classroom infrastructure.

Statistical Analysis

Table 1: Male and Female Teachers’ Views on the Use of Smart Classroom

Gender	N	Mean	SD	SE	p-value
Male	21	121.33	12.93	2.82	0.990
Female	24	121.29	9.24	1.89	

As shown in Table 1, the p-value was 0.990, which exceeded the 0.05 significance threshold. This demonstrates no significant difference between the male and female teachers' perceptions of smart classrooms. Therefore, the null hypothesis (H1) states that there is no significant difference between the male and female teachers' views on the use of smart classrooms, and is upheld.

Table 2: Arts and Science Teachers' Views on Using Smart Classrooms

Stream	N	Mean	SD	SE	p-value
Arts	28	122.96	11.88	2.24	0.198
Science	17	118.59	9.00	2.18	

According to Table 2, the p-value of 0.198 exceeds the 0.05 significance level. This shows no notable difference in how arts and science teachers perceive smart classrooms. The null hypothesis (H2) states that there is no significant difference in arts and science teachers' views on using smart classrooms, and is upheld. The views of arts and science teachers were almost identical.

Teachers' perceptions of the integration of smart classrooms in relation to teaching experiences

To determine the difference between low (0–2 years), moderate (2–5 years), and high (above 5 years) experienced teachers' perception towards smart classrooms one-way ANOVA was used. The details of the analysis and its interpretation are provided in Table 3.

Table 3: Integration of Smart Classrooms Between Varying Levels of Teaching Experience

Teaching Experience	Sources	Df	Sum of Square	Mean Square	F-ratio	p-value
Low (0–2 years)	Between Groups	2	160.434	80.217	0.655	0.525
Medium (2–5 years)						
High (above 5 years)	Within Groups	42	5147.210	122.553		
Total		44	5307.644			

Table 3 shows that the p-value of 0.525 exceeds the 0.05 significance level, indicating no statistical significance. The null hypothesis (H3) states there is no difference in views of teachers with low (0–2 years), moderate (2–5 years), and high (over 5 years) experience regarding smart classroom adoption. The results

show that teachers' perceptions remain consistent across these experience levels.

Qualitative Data Analysis

Employing thematic analysis, the researchers discerned five themes from the quantitative data: (a) resources in smart classrooms, (b) teacher-student involvement, (c) teaching methods, (d) obstacles in smart classroom implementation, and (e) ICT training for smart classroom integration.

Resources in Smart Classroom

The interview data revealed that smart boards, stylus pens, speakers, and educational apps were available in the smart classroom. However, participants noted auditory issues with the smart board's built-in speaker due to the lack of external speakers. Aveti, the learning application, provides digital content for Grades 8–10, including videos, audio, and images. Teachers reported that the Odisha School Education Programme Authority (OSEPA) initially supplied e-resources on a Hard Disk Drive (HDD), which they duplicated as needed. Teachers developed electronic materials for teaching using smart boards. Support teams maintained the smart classrooms and resolved reported issues, while a designated teacher oversaw each classroom.

Teacher-student Involvement

The second theme explores how smart classrooms influence teacher and student involvement in learning processes. Participants noted that smart classroom features energised teachers and learners, and that integrating subject-specific software and audio-visual content can enhance student engagement in classroom activities. Many respondents noted that the classroom setting went beyond the theoretical knowledge. Audio-visual techniques allow for the communication of complex ideas. A social science teacher showed that photographs, animations, and videos in smart classrooms can effectively teach the geography of volcanic eruptions. Similarly, a science teacher explained how video of experiments on a smartboard aid student understanding and facilitate for doing experiments in the laboratory. This method boosts teacher engagement. They used pre-installed software and resources for subjects, with some developing their own digital content.

Teaching Methods

During the interviews, the participants were questioned about their teaching techniques. Most reported that they mainly depended on lectures to complete the curriculum. Teachers primarily use smart classroom tools to clarify content rather than for interactive engagement. Some utilise smart classroom features, including audio, video, animation, and multimedia. They recognise that smart classrooms offer opportunities for interactive teaching and innovation. However, they noted that non-academic duties and extensive syllabi hindered the full adoption of smart classrooms.

Obstacles in Smart Classroom Implementation

The interview data revealed the various obstacles faced by teachers. Participants identified problems including inadequate audio systems, technical issues, digital illiteracy, poor technical support, electrical problems, network connectivity, and health concerns. Smart classrooms can reduce meaningful teacher-student interactions due to excessive reliance on technology. Both teachers and learners are becoming too dependent on digital tools, neglecting face-to-face engagement in the classroom. Additionally, respondents noted that not all secondary school teachers are equally equipped to effectively use smart classroom technologies, resulting in poor integration of teaching methods.

ICT Training for Smart Classroom Integration

Participants were asked about professional development sessions for smart classroom technology. Continuous Professional Development (CPD) is mandatory for educators and equips them with advanced smart classroom tools. The training covers hardware and software management, including the Microsoft Office Suite, Microsoft Paint, YouTube, and educational apps. The training lasted five days, with three days of theory and two days of practical training. The respondents reported improved digital skills after regular training.

Discussion

This study explored teachers' views on smart classroom integration, focusing on resources, student engagement, teaching methods, professional development, and challenges. The investigation revealed that secondary schools in Odisha have smart classrooms with sufficient resources, including interactive boards and digital content for teaching. This contrasts with Sethy and Mohalik (2019),

who showed that West Bengal secondary schools lack laptops and interactive whiteboards needed for smart classrooms. The study found that students in smart classrooms were more engaged, motivated, and better at constructing knowledge, with improved concentration. This aligns with studies showing higher student participation in smart classrooms than in traditional classrooms (Yu et al., 2022). Olori and Dosunmu (2024) also confirmed the impact of smart classrooms on enhancing student motivation and involvement. This study found that implementing smart classrooms enhances teaching effectiveness and influences high-quality lesson planning. This aligns with the findings of Blau (2011), who found that teachers facilitated student engagement through interactive smart boards. However, this contrasts with the findings of Bala et al. (2017), who indicated that traditional lectures are more effective than smart classrooms.

There were no notable differences found in the teachers' perceptions of smart classroom integration across gender, academic stream, and teaching experience. These findings align with those of Gupta (2023), who found that academic streams do not influence perceptions of barriers to smart classroom adoption. Batu (2016), noted that gender, age, and profession do not affect teachers' views, although experience level shapes perceptions. Similarly, Zhao (2006) found no significant variation in smart classroom usage based on teachers' age and gender. Some challenges, including technical difficulties, health issues, lack of technical support, digital illiteracy, and sunlight reflection, hindered smart classroom integration. These findings align with Dimitriadou and Lanitis (2023), who noted that infrastructure issues, the digital divide, inadequate training, and internet connectivity impede smart classroom implementation. Additionally Pourciau (2014), identified resource acquisition, technological issues, and insufficient professional development as barriers to smart board integration.

Implications of the Study

The results of this study have important implications for educational stakeholders, including policymakers, curriculum designers, teachers, and parents in Odisha. The study has implications towards integration of smart classrooms in school education.

- **Enhancing ICT Skills:** Government schools in Odisha have smart classroom technology with subject-specific electronic content to enhance ICT skills. However, there is inadequate integration of these resources into the subject material. Teachers must develop ICT skills and Techno-Pedagogical Content Knowledge (TPACK) to create student-focused environments and optimise technological resources in smart classrooms.
- **Enhancing Student Involvement:** Research has shown that smart classrooms encourage student engagement in discussions. Teachers should use creative strategies, such as gamified tools and personalised platforms, to address learner needs. School policies should focus on enhancing participation through the use of smart classroom technologies.
- **Mechanism for Maintenance of ICT:** This research emphasises the need for essential resources, such as smart boards, computers, audio systems, and internet access in smart classrooms. Governments and educational authorities should enhance smart classroom facilities and implement regular ICT infrastructure monitoring.
- **Continuous Professional Development (CPD):** The study emphasises improving professional development for teachers by integrating smart classroom technologies with curriculum and instruction at the in-service level. The School and Mass Education Department of Odisha should organise training sessions focused on smart classrooms and ICT to prepare teachers for effective technology integration.
- **Addressing Health-related Concerns:** Health issues have emerged from the overuse of smart classrooms and extended student exposure to technology. The Health and Education Departments must initiate awareness campaigns for students and teachers to address technology-related health problems.

Conclusion

In line with the National Education Policy (NEP) 2020 recommendations for ICT integration, smart classrooms can improve educational content delivery and student engagement. The Government of Odisha has equipped government schools

with ICT resources to create smart classrooms in the state. However, obstacles such as technical difficulties, health issues, insufficient support, and digital illiteracy impede smart classroom implementation. These challenges necessitate specialised training to utilise the capabilities of smart classrooms. Therefore, a plan is needed to enhance ICT skills and provide ICT-based CPD training for teachers.

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