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EFFECTIVENESS OF INTERACTIVE SMART BOARD FOR SECONDARY SCHOOL SCIENCE TEACHING

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ABSTRACT

The study was conducted to measure the effectiveness of technology i.e., an interactive smart board for an effective learning process. Furthermore, according to Bloom's taxonomy effect of a smart board was measured on the first three levels. The experimental group utilized the Interactive Smart Board, while the control group received traditional instruction. Post-test results revealed a significant difference in learning outcomes, with high-achiever students in the experimental group showing notably higher improvements than their low achiever counterparts. The collected data was analyzed to see the clear findings. The results highlighted that at all three levels i.e., knowledge, comprehension, and application levels the smart board produced highly better results among high achiever students. That's why the researchers recommended that there should be proper utilization of Interactive Smart Boards in secondary education for better support for low achievers, and professional development for educators, which will produce a better understanding of technology and later on will produce better results in the whole teaching-learning process.

Key Words: Interactive Smart Board, Traditional Teaching Methods, Experimental Study

INTRODUCTION

In the modern era there is very much development in the field of technology. Machinery plays a pivotal role in transforming the traditional teaching and learning process, ushering in a new era of education that is accessible to all students. The integration of technology in classrooms has revolutionized the way information is presented and absorbed, making learning more interactive and personalized. There are multiple aspects of technology i.e., software, internet resources, and multimedia tools that enable educators to create diverse and immersive learning experiences that cater to various learning styles. Students gain practical experience through interactive simulations, virtual labs, and educational games, which help them comprehend difficult ideas more deeply. Additionally, technology makes collaborative learning possible by bridging geographical divides, fostering a sense of community among students, and connecting educators and students worldwide.

Keeping in view the learning experience, technological resources help educators with powerful tools for assessment, monitoring progress, and providing timely feedback (Ylmaz, 2016). Learning management systems and digital platforms enable the creation of adaptive assessments that can gauge individual student performance and tailor learning pathways accordingly. Teachers can pinpoint students' areas of strength and weakness with this data-driven approach, allowing for focused interventions to support each student's learning journey (Tufan, 2013). In general, incorporating technology into the teaching and learning process creates a wealth of opportunities for individualized, effective, and inclusive education in addition to preparing students for the digital age (Wu, & Wang, 2005).

A board known as an interactive smart board has become an essential tools in new education, developing the teaching and learning process. These multiple technologically advanced boards combine the traditional whiteboard with interactive abilities, allowing educators to create versatile and charming lessons (Wall, Higgins, & Smith, 2005). Teachers can seamlessly integrate multimedia content, such as videos, images, and interactive applications, into their presentations, catering to diverse learning styles and making complex concepts more accessible. The interactive nature of smart boards encourages student participation, as they can directly interact with the content, solve problems, and cooperate with peers, encouraging more immersive and practical activities (Beauchamp, & Parkinson, 2005).

Türel, & Johnson, (2012) mentioned that interactive smart boards facilitate real-time response, enabling teachers to know students' conceptual understanding. Educators can gauge the effectiveness of their lessons and adjust their teaching strategies on the spot to address any misconceptions or gaps in comprehension. Additionally, the collaborative characteristics of smart boards endorse interactive discussions and group tasks by nurturing a cooperative learning environment where students actively participate in the investigation and are considerate of the subject knowledge (Stillman, et al., 2007).

Omech, et. al., (2016) highlighted that Interactive boards help inaccessible and a mixture of learning styles, showing their adaptability outside of normal classroom structure. Teachers can use the internet and conferencing i.e., audio/video to perform interactive teaching with students irrespective of their locality (Winzenried, Dalgarno, & Tinkler, 2010). This elasticity increases adoption to education since it can fit with new learning structures and enhance learning in a multiple scenario. So, it can be said that technological smart boards can impact the improvement of teaching teaching-learning process. Keeping in view its multiple aspects, students' cooperation and interdependence increase with the use of the interactive smart board. The learning process improves collaboration and gives teachers the tools they need to provide more effective and flexible teaching to fit the different requirements of their students (Yang, Wang, & Kao, 2012).

Schmidt, et. al., (2009) mentioned that Interactive smart board improves children's learning, they interact and engage with each other, directly try to understand many things and they make learning fun even if it is boring. Instead of rote learning multiple aspects, they try to understand concepts. They learn through multiple sensory learning. They get information, leave the traditional classroom and move towards multiple aspects of learning that make all-round learning. (Rizwan, 2011). This hands-on approach not only captures students' attention but also makes learning more enjoyable and memorable, leading to a deeper understanding of the material (Rizwan, Ayub, & Khan, 2018).

Instant reinforcement produces better results in effective and conceptual learning as compared to weak and late feedback (Lee, 2010). The capacity to modify instructional tactics in real-time in response to student feedback improves learning process effectiveness and helps provide a more individualized and customized education. Additionally, Harrison, (2013) narrated that interactive boards' cooperative aspects motivate learners to interact with one another and with the tutor and communicate effectively. Accessible group tasks and peer projects increase a sense of community within a classroom. This cooperative component helps students develop critical thinking and problem-solving abilities, which are crucial for their success in the classroom and the workplace in the future (Glover, Miller, Averis, & Door, 2005). Critical thinking is a twenty-first-century skill that has been focused on and studied in different contexts in Pakistan (Jamil et al., 2023; Jamil et al., 2020; Jamil et al., 2021a, 2021b; Naseer et al., 2022).

Immediate feedback is another crucial element in the effectiveness of smart boards in increasing student participation. Through instant assessments and quizzes, educators can gauge student understanding and adapt their teaching strategies accordingly. Students receive timely feedback on their performance, enabling them to identify areas for improvement and reinforcing positive learning experiences. This feedback loop creates a responsive and dynamic learning environment that encourages students to actively seek clarification, ask questions, and engage in meaningful discussions, further enhancing their overall participation in the learning process (Gillen et al., 2007).

Smartboard is a new version of digital words in the present era. This hands-on approach motivates learners to diagnose the concept in independent and interlinked methods which improves collaboration among peers. For conceptual understanding, this level of participation is vital to inculcate creative thinking skills. Learners at the secondary level in Pakistan can get abstract and innovative ideas when they can use technology in their learning process (Akyol, Sungur, & Tekkaya, 2010).

Pakistan is a developing country and needs more development as compared to other developed countries. The smart boards in the present teaching-learning process provided a clear base for eradicating cramming at all levels, particularly at the secondary level (Beauchamp, & Parkinson, 2005). Furthermore, empirical evidence for the effectiveness of smart is needed to investigate the present situation regarding the practicability of the said boards. Presently in Pakistan, multiple styles and structures are followed to make the learning deeper and conceptual. That’s why the researchers decided to conduct experimentation to get tangible results for the betterment of teaching teaching-learning process at the secondary level. The results of the study are mentioned below after complete experimentation of an interactive smart board in the teaching-learning process at the secondary level.

Table 1.
Evaluating Learning Disparities between Low-Achieving and High-Achieving Students in an Experimental Group

Learning Level	Achievement	Students	Mean Value	S. D.	t	*p.*
Learning Level	Low achievement	33	7.939	2.346	-8.083	.002
	High achiever	33	21.788	4.381		

Table 1 presents a comparative analysis of learning outcomes among low-achieving and high-achieving students within an experimental group. The "Learning Level" column differentiates students based on achievement, categorizing them into "Low achievement" and "High achiever" groups. The "Students" column indicates an equal representation of 33 students in each category. The "Mean Value" signifies the average performance scores, revealing a notable contrast between the groups—low-achieving students have a mean value of 7.939 while high-achieving students exhibit a substantially higher mean of 21.788. Standard deviations (S. D.) represent the degree of variability within each group; low-achieving students have a standard deviation of 2.346, and high-achieving students, 4.381. The t-value (-8.083) and p-value (.002) in the last two columns suggest a statistically significant difference in learning between the two groups, underscoring the disparities in educational outcomes within the experimental setting.

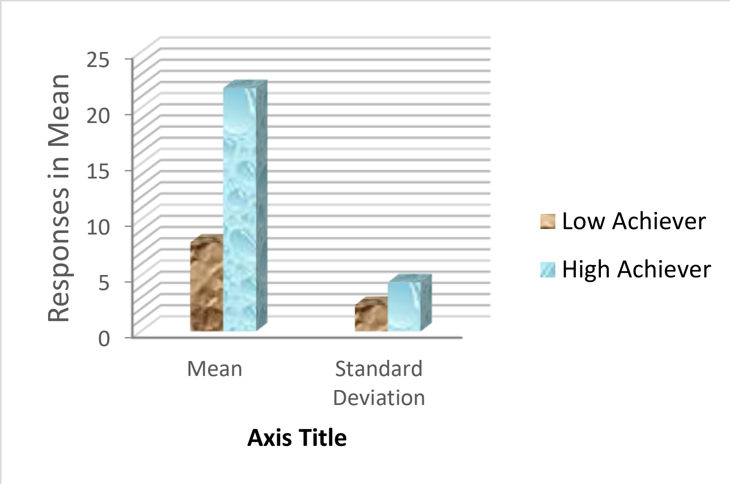

Figure I: ***Evaluating Learning Disparities between Low-Achieving and High-Achieving Students in an Experimental Group***

Table 2.
Evaluating Learning Disparities between Low-Achieving and High-Achieving Students in an Experimental Group at Knowledge Level

Cognitive domain	Achievement	Students	Mean Value	S. D.	t	*p.*
Knowledge level learning	Low achiever	33	4.489	1.291	-7.391	.012
	High achiever	33	7.819	2.891		

Table 2 presents a detailed examination of learning disparities between low-achieving and high-achieving students within an experimental group, specifically focusing on the knowledge level within the cognitive domain. The "Cognitive domain" column indicates the specific aspect of learning being assessed, which, in this case, is knowledge-level learning. The "Achievement" column categorizes students into "Low achiever" and "High achiever" groups based on their performance. The "Students" column denotes an equal representation of 33 students in each category. The "Mean Value" column shows the average scores, revealing a contrast: low-achieving students have a mean value of 4.489 while high-achieving students exhibit a higher mean of 7.819. Standard deviations (S. D.) indicate variability within each group. The t-value (-7.391) and p-value (.012) suggest a statistically significant difference in knowledge level learning between low-achieving and high-achieving students, emphasizing notable variations in cognitive outcomes within the experimental context.

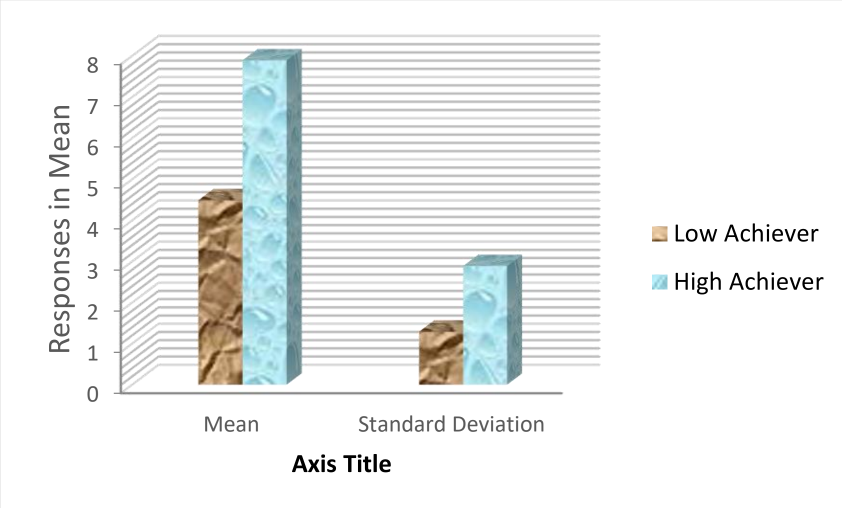

Figure II: ***Evaluating Learning Disparities between Low-Achieving and High-Achieving Students in an Experimental Group at Knowledge Level***

Table 3.
Evaluating Learning Disparities between Low-Achieving and High-Achieving Students in an Experimental Group at Comprehension Level

Cognitive domain	Achievement	Students	Mean Value	S. D.	t	*p.*
Comprehension level learning	Low achiever	33	4.939	1.346	-7.381	.007
	High achiever	33	6.788	2.381		

Table 3 provides a comprehensive evaluation of learning disparities between low-achieving and high-achieving students within an experimental group, focusing on the comprehension level within the cognitive domain. The "Cognitive domain" specifies the aspect of learning under consideration, in this instance, comprehension level learning. The "Achievement" column categorizes students into "Low achiever" and "High achiever" groups based on their performance. The "Students" column indicates an equal representation of 33 students in each category. The "Mean Value" column reveals the average scores, highlighting a contrast: low-achieving students with a mean value of 4.939 and high-achieving students with a higher mean of 6.788. Standard deviations (S. D.) signify variability within each group. The t-value (-7.381) and p-value (.007) indicate a statistically significant difference in comprehension level learning between low-achieving and high-achieving students. This underscores notable variations in cognitive outcomes at the comprehension level within the experimental context.

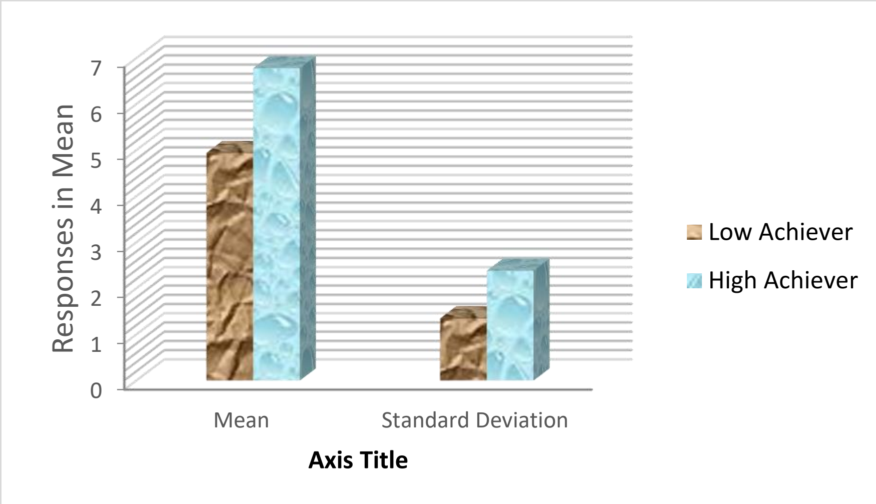

Figure III: ***Evaluating Learning Disparities between Low-Achieving and High-Achieving Students in an Experimental Group at the Comprehension Level***

Table 4.
Evaluating Learning Disparities between Low-Achieving and High-Achieving Students in an Experimental Group at the Application Level

Cognitive domain	Achievement	Students	Mean Value	S. D.	t	*p.*
Application level learning	Low achiever	33	3.939	1.346	-6.982	.000
	High achiever	33	5.788	2.381		

Table 4 conducts a thorough assessment of learning disparities between low-achieving and high-achieving students in an experimental group, with a specific focus on the application level within the cognitive domain. In the "Achievement" column, students are categorized as either "Low achiever" or "High achiever" based on their performance. The "Students" column reveals an equal representation of 33 students in each category. The "Mean Value" column displays average scores, illustrating a difference: low-achieving students have a mean value of 3.939 while high-achieving students exhibit a higher mean of 5.788 in application-level learning. The "S. D." column signifies the standard deviation, reflecting the variability within each group. The t-value (-6.982) and p-value (.000) in the last two columns suggest a statistically significant difference in application-level learning between low-achieving and high-achieving students. This indicates substantial variations in cognitive outcomes at the application level within the experimental context, with low-achieving students demonstrating lower mean scores compared to their high-achieving counterparts. The noteworthy p-value of .000 emphasizes the robust statistical significance, underscoring the importance of these findings in the context of applied learning within the experimental group.

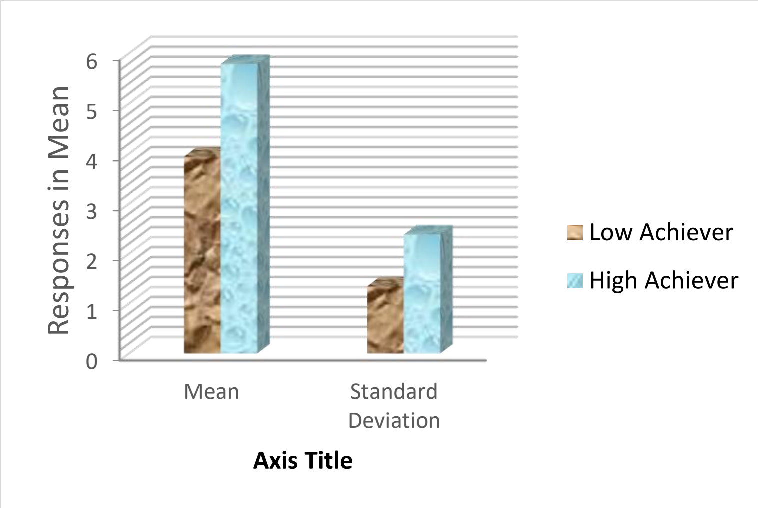

Figure IV: ***Evaluating Learning Disparities between Low-Achieving and High-Achieving Students in an Experimental Group at the Application Level***

Main findings

- High achiever students in the experimental group showed highly better results (21.788) when compared to low achiever students (7.939), which means that the Interactive Smart Board is beneficial for the teaching-learning process.
- As per Bloom's Taxonomy, at knowledge level results narrated good improvements for high achiever students (7.819) as compared to low achiever students (4.489) while using Interactive Smart Board for teaching the learning process.
- The comprehension level analysis also showed a substantial difference in mean scores, with high achiever students (6.788) benefiting more from the Interactive Smart Board than low achievers (4.939).
- Application-level learning outcomes demonstrated a similar trend, with high-achiever students (mean of 5.788) exhibiting a significantly greater improvement compared to low achievers (mean of 3.939).
- The statistical significance of the t-values and p-values across all analyses reinforced the rejection of the null hypothesis, affirming that the Interactive Smart Board had a significant impact on students' learning outcomes.
- The graphical representations (Figures I-IV) visually supported the findings, illustrating the disparities in learning outcomes between low and high-achiever students in the experimental group when exposed to the Interactive Smart Board. Overall, the study provided empirical evidence supporting the positive influence of Interactive Smart Boards on students' academic achievements, particularly benefiting high achiever students across different cognitive levels.
- The findings clarified that an interactive smart board is an effective digital addition to the teaching-learning process particularly for high achiever students. Furthermore, this digital tool also produced conceptual learning which is why have a high impact on high achievers as compared to low achievers.

RECOMMENDATIONS

Keeping in view the results of the study it is recommended that:

- **Integration of Interactive Smart Boards:** Based on the significant positive impact observed, recommend the widespread integration of Interactive Smart Boards in secondary education to enhance overall learning outcomes.
- **Tailored Support for Low Achievers:** Recognizing the disparities in improvement, suggest implementing additional support strategies, such as

targeted tutoring or differentiated instruction, to address the specific needs of low-achiever students using Interactive Smart Boards.

- **Professional Development for Educators:** Advocate for comprehensive training programs for teachers to effectively utilize Interactive Smart Boards, ensuring they can maximize the technology's potential in catering to diverse learning needs.
- **Ongoing Assessment and Adjustment**: Emphasize the importance of continuous assessment and adjustment of teaching methods, incorporating feedback from both low and high-achiever students, to refine the integration of Interactive Smart Boards for sustained positive impacts on learning outcomes.

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