

AI in Secondary Classroom: A study of its Impact on Student Engagement, Personalized Learning, and Academic Progress

Kavita Sanghvi

Principal of SVKM's CNM School

ABSTRACT

Artificial Intelligence (AI) has increasingly woven itself into the fabric of our lives yet its full potential in education remains untapped. Despite its widespread use AI has not been seamlessly integrated within our education system. To ascertain the transformative impact of AI in education, this study explored the use of AI tools over a one-week period in classroom instruction. Following this, students showcased their learning using AI tools to key stakeholders.

The level of student engagement was closely monitored, and an assessment was conducted to evaluate their academic progress. This study provides valuable insights for educators to inform future curriculum planning and instructional strategies.

INTRODUCTION

As per IBM in their article, Artificial intelligence (AI) is technology that enables computers and machines to simulate human learning, comprehension, problem solving, decision making, creativity and autonomy. In 2024, most AI researchers and practitioners—and most AI-related headlines—are focused on breakthroughs in generative AI (gen AI), a technology that can create original text, images, video and other content.

Artificial Intelligence (AI) has increasingly woven itself into the fabric of our daily lives shaping our interactions with our smartphones, virtual assistants, the internet, home devices, apps, tools, and much more. AI involves creating machines that can mimic human intelligence, enabling them to think, reason, and learn similarly to humans, rather than being programmed for specific tasks. Despite its pervasive presence, AI is often excluded from our teaching and learning practices due to fear, lack of knowledge, or simply a lack of awareness.

In my conversations with various stakeholders about AI and its applications, I encountered a spectrum of perspectives. Some educators praised the use of AI, while others expressed hesitation about integrating it into classroom practices. Additionally, some were unaware of how AI could be incorporated into teaching methods. This diversity of opinions underscores the need to study AI more thoroughly and equip our students with the necessary skills to navigate its impact.

To address these issues, articles on AI from UNESCO which states that school students need to be supported to become active co-creators of AI, as well as potential leaders who will define further iterations of AI, and its interactions with human society for present and future generations was reviewed. The OECD further cites that it holds the potential to address complex challenges from enhancing education and improving health care, to driving scientific innovation, and other esteemed educational organizations. The

research paper by Kyoungwon Seo on the ‘Impact of artificial intelligence on learner – instructor interaction in online learning mentions adopting AI systems in online learning and how it can enable personalized learner–instructor interaction at scale but at the risk violating social boundaries. He mentions that participants were concerned that AI systems could create responsibility, agency, and surveillance issues in online learning if they violated social boundaries in each factor of learner–instructor interaction (i.e., communication, support, and presence). Using the studies, it was decided that the use of AI tools in teaching would be conducted in physical classrooms with students exploring further use of AI tools within their topics at home.

We also invited experts from colleges and schools to train us in using various AI tools and experimented with platforms like Gamma.ai, InVideo, MagicSchool.ai, Microsoft Co-pilot, ChatGPT, Gemin.ai, and several others. Following this, the entire team of Heads and teachers collaborated to develop an action plan to introduce students to AI in education and study its impact on learning.

The objective was to empower students to explore AI across all subjects, facilitating personalized learning through the HI-STEAM [history with STEAM] event planned annually in the school for August. Following this initiative, an impact analysis was conducted in the school that included one week of teaching and learning through AI across all academic subjects, followed by student presentations showcasing their learning during the event. A written evaluation was then performed to assess the effectiveness of the implementation.

REVIEW OF RELATED LITERATURE

AI learning is relatively new and it was important to understand what researches across the globe discovered about its impact.

Yunyi Zhu from College of Education, University of Washington, Seattle conducted research to study ‘The Impact of AI-Assisted Teaching on Students' Learning and Psychology’. He wished to examine the scope and status of AI- assisted learning, its benefits, associated problems and an overview of the evolving educational approach. His study compared the effects of traditional English teaching with AI-assisted language learning on fourth-grade students' English proficiency. The study revealed that while both the control and experimental classes initially had similar average scores and standard deviations in English proficiency, the experimental class, which received AI-assisted instruction, demonstrated significantly better English post-test scores at the end of the semester. With respect to influence on students' psychology, the findings revealed that AI -powered systems, capable of analysing facial expressions, speech patterns, and text to detect emotional cues, hold immense potential in supporting students' emotional well-being. They also enable early intervention by identifying signs of distress or emotional challenges and facilitating timely outreach and support provision from educators and counsellors. One significant issue was the technological barriers that many educational institutions face, such as inadequate infrastructure, insufficient computing power, and lack of access to advanced AI algorithms. These limitations can hinder the effective deployment of AI tools in the classroom, potentially leading to disparities in educational outcomes. There was also negative impact on students' willingness to accept AI- assisted teaching environments.

Almasri Firas, in his research article, ‘Exploring the impact of Artificial Intelligence in Teaching and Learning in Science: A systematic review of empirical research’ addressed impact on learning outcomes, contexts of AI adoption, student and teacher perceptions and pedagogical challenges. He used review methodology, preferred reporting items for systematic review and meta-analyses and evaluated 74

empirical studies. They used a mix of qualitative and quantitative analyses techniques to synthesize the findings of the empirical papers. They concluded that AI-based tools were found to have a positive influence on student' learning outcomes in science-related courses. The experimental group that was exposed to AI integration in their learning environments exhibited significantly higher scores in their academic tests compared to the control group who experienced traditional learning environments. In terms of context of AI adoption, artificial intelligence has been incorporated in a variety of subject areas within science education, including physical and natural sciences. The most papers were in Science followed by Physics followed by Biology and Programming. In terms of student and teacher perceptions, the studies revealed multifaceted perspectives on the integration of AI in science education among both students and teachers. The effectiveness of AI tools in augmenting learning experiences garnered students' attention. Students showcased increased engagement and improved subject understanding through AI-based interventions, indicating positive perceptions of AI's efficacy in enhancing learning outcomes. In terms of pedagogical challenges, one prevalent challenge revolved around AI's capability to comprehend and effectively address specific subject matter. highlighted instances where AI, like ChatGPT, encountered difficulties in understanding complex concepts in chemistry. They argue that the information provided by AI tools such as ChatGPT is limited because it depends on the data it was taught with. It might not have access to the latest or most complete knowledge in a particular domain.

The overall impact of AI in education is promising but more efforts have to be made to ensure AI uses current data.


PURPOSE OF THE STUDY

The primary goal of the present study was to review the impact of AI tools on teaching and learning in all subjects, specifically focusing on the student progress and supporting personalized learning. The research question guiding this investigation was: **“AI in Secondary Classroom: A study of its Impact on Student Engagement, Personalized Learning, and Academic Progress”**

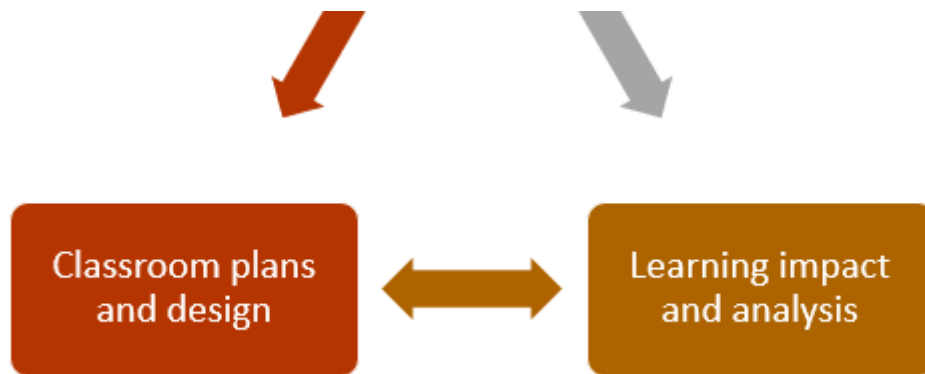
To structure the inquiry, the following hypotheses were formulated:

1. There is no significant difference in student engagement levels when AI tools are utilized.
2. There is no significant difference in students' academic progress following the implementation of AI tools.
3. There is no significant difference in the personalization of learning when AI tools are integrated into the learning process.

These hypotheses served as the foundation for assessing the effectiveness of AI tools in enhancing student engagement, performance, and personalized learning. A conceptual framework was established to test these hypotheses, and the analysis was conducted after the completion of the HI-STEAM event, which incorporated AI tools across various subjects. The subsequent evaluation of the event provided insights into the impact of AI on student learning outcomes.



Teaching learning
Process and
monitoring



Conceptual Framework

Input	Process	Output
<ul style="list-style-type: none"> ➤ A one-week initiative where AI tools are integrated into classroom teaching and learning across all subjects by educators. ➤ Planning and designing the HI-STEAM event for students to present their learning to peers, parents and students. 	<ul style="list-style-type: none"> ➤ Learning activities ➤ Worksheets ➤ Collaborative activities between students ➤ Teacher intervention where support is required ➤ Implementation of variety of AI tools in school subjects. 	<ul style="list-style-type: none"> ➤ Student engagement ➤ Student attendance during the teaching classes and HI-STEAM event ➤ Student presentations ➤ Student academic progress (measured through a written test)

METHODOLOGY

A mixed method study was conducted to comprehensively analyse the impact of AI tools on personalized learning and academic performance of 832 secondary students of Std. VII to X of one school. The quantitative data comprised the academic performance data of the students. It considered pre-intervention Unit test scores and post-intervention test scores after the HI-STEAM event. Comparison of the scores were used to measure academic improvement.

Attendance records during the AI-integrated teaching week and the HI-STEAM event was recorded.

The qualitative data included parent and student surveys. The survey gathered parents’ perceptions of the impact of AI tools on their children’s learning and engagement.

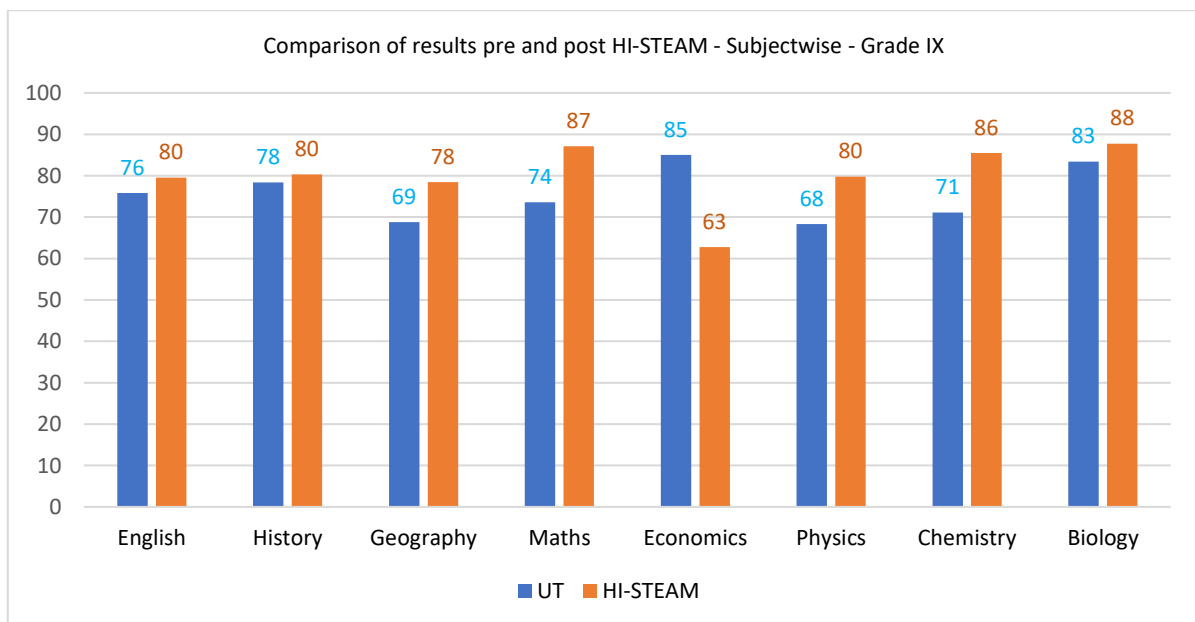
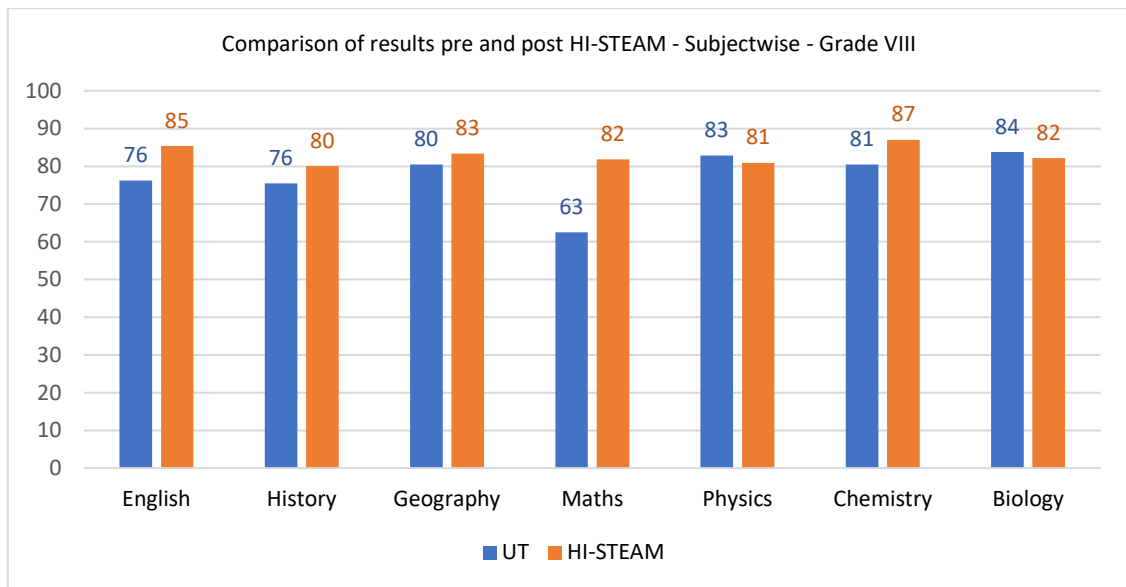
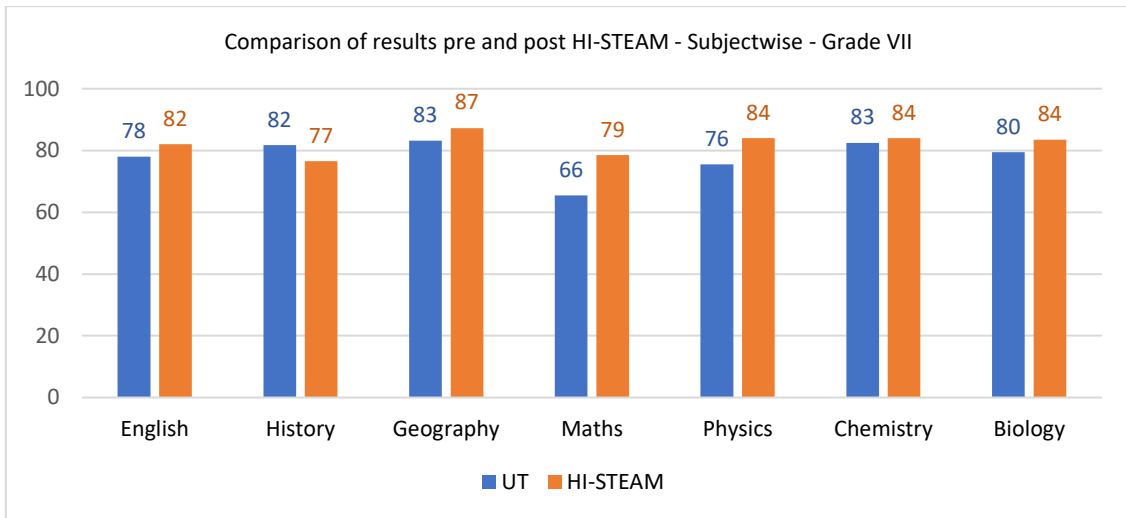
Survey was conducted to capture students’ experiences, attitudes, and perceptions regarding the use of AI tools in their learning process. Interviews with teachers was taken to understand their observations and insights on the effectiveness of AI tools in personalized learning.

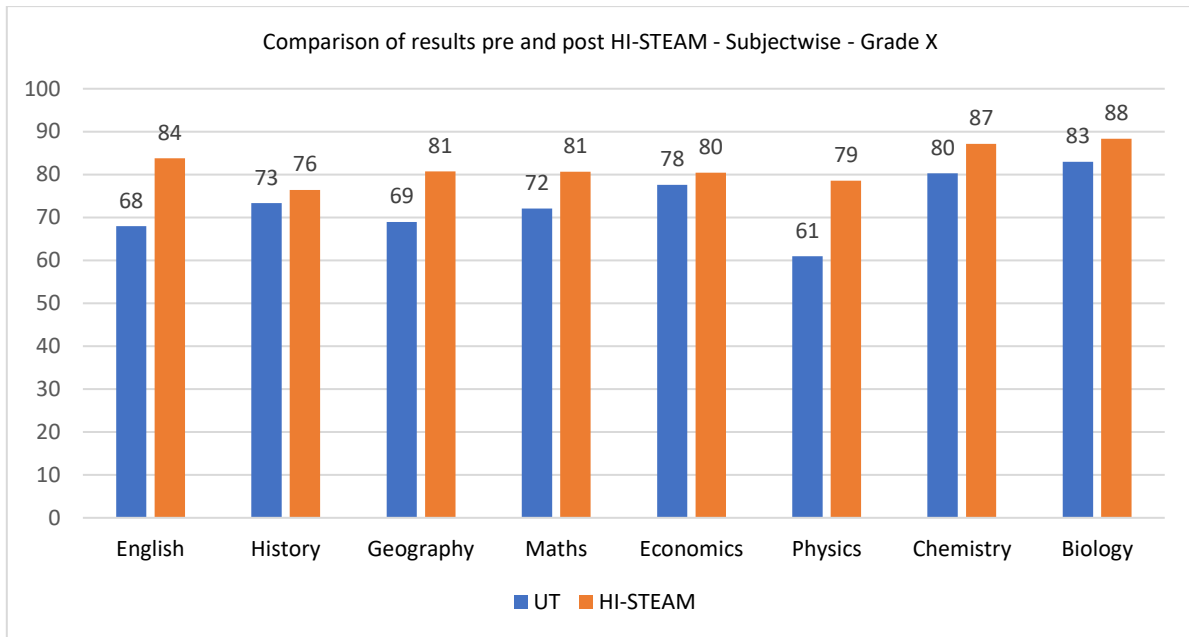
DATA ANALYSIS

Quantitative analysis:

I. Student academic performance in Unit Test and test post HI-STEAM

Comparison of performance in class subjects





Descriptive analysis

	VII-UT	VII-HI-STEAM	VIII-UT	VIII-HI-STEAM	IX-UT	IX-HI-STEAM	X-UT	X-HI-STEAM
Mean	78.0	82.3	77.4	83.0	75.5	80.1	73.0	82.0
Standard Error	2.3	1.4	2.7	0.9	2.2	2.8	2.5	1.5
Median	79.5	83.5	80.5	82.2	74.7	80.0	72.7	80.7
Mode	#N/A	84.0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Standard Deviation	6.1	3.6	7.3	2.5	6.3	7.9	7.2	4.1
Sample Variance	37.5	13.2	52.7	6.2	40.1	63.0	51.7	17.0
Kurtosis	3.1	-0.3	3.3	-0.5	-1.3	3.6	-0.4	-0.8
Skewness	-1.7	-0.5	-1.7	0.7	0.4	-1.7	-0.2	0.5
Range	17.7	10.7	21.3	7.0	16.7	25.0	22.0	12.0
Minimum	65.5	76.6	62.5	80.0	68.3	62.8	61.0	76.4
Maximum	83.2	87.3	83.8	87.0	85.0	87.8	83.0	88.4
Sum	545.9	575.9	541.8	580.7	604.3	641.2	584.2	656.1
Count	7.0	7.0	7.0	7.0	8.0	8.0	8.0	8.0
Largest(1)	83.2	87.3	83.8	87.0	85.0	87.8	83.0	88.4
Smallest(1)	65.5	76.6	62.5	80.0	68.3	62.8	61.0	76.4
Confidence Level(95.0%)	5.7	3.4	6.7	2.3	5.3	6.6	6.0	3.4

P(T<=t) two-tail 0.003803809

The results show that academic performance in tests post HI-STEAM has improved. In certain cases, like

Economics in Grade IX, Physics in Grade VIII, Biology in Grade VIII the performance post HI-STEAM has dropped.

As the p-value associated with the two-sample t-test is less than the chosen significance level, typically 0.05, we reject the null hypothesis.

II. Student attendance during HI-STEAM event

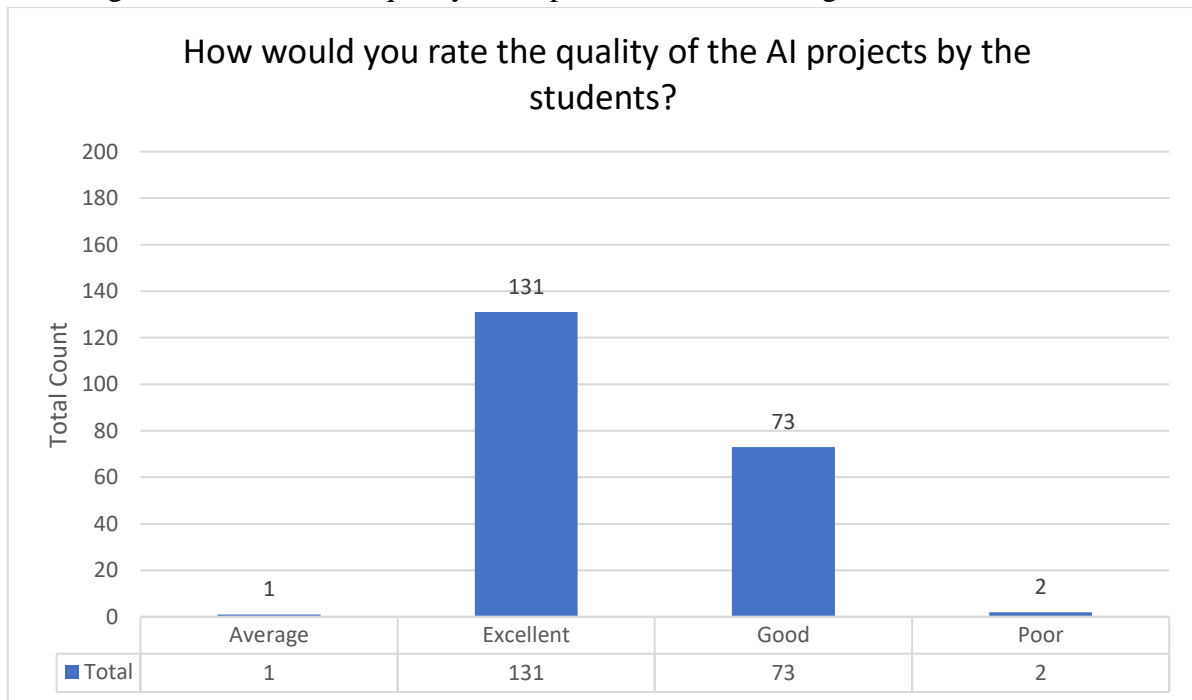
Std.	Attendance
VII	97%
VIII	97%
IX	93%
X	93%
Average Attendance	95%

The attendance of students in Std. VII and VIII is higher than Std. IX and X. Overall it is very high showing that students enjoyed presenting their work and learning from each other.

III. Parents feedback by Survey method

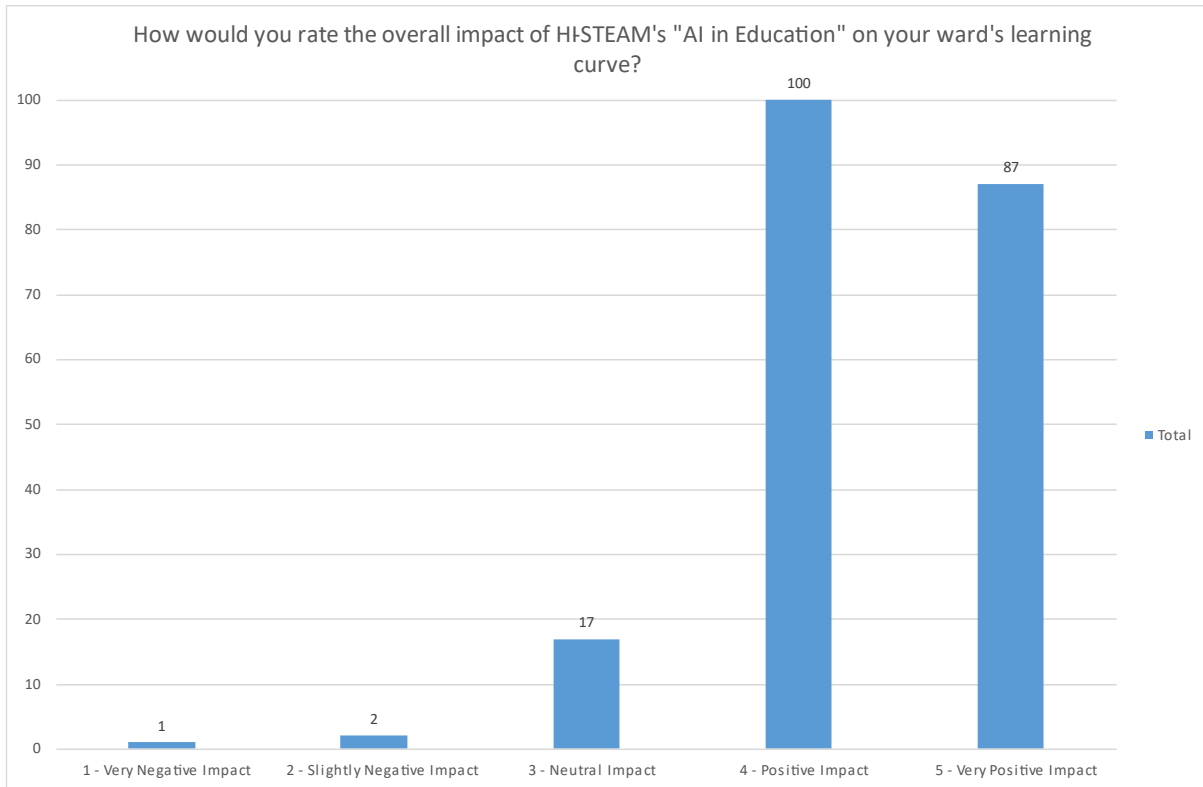
a. Student presentations

Around 207 parents were shared a survey form to ask about the quality of projects created by students. 131 parents found them excellent. 73 parents found them good. 2 parents found them poor and 1 parent found it average. Thus overall, the quality if the presentations were high.



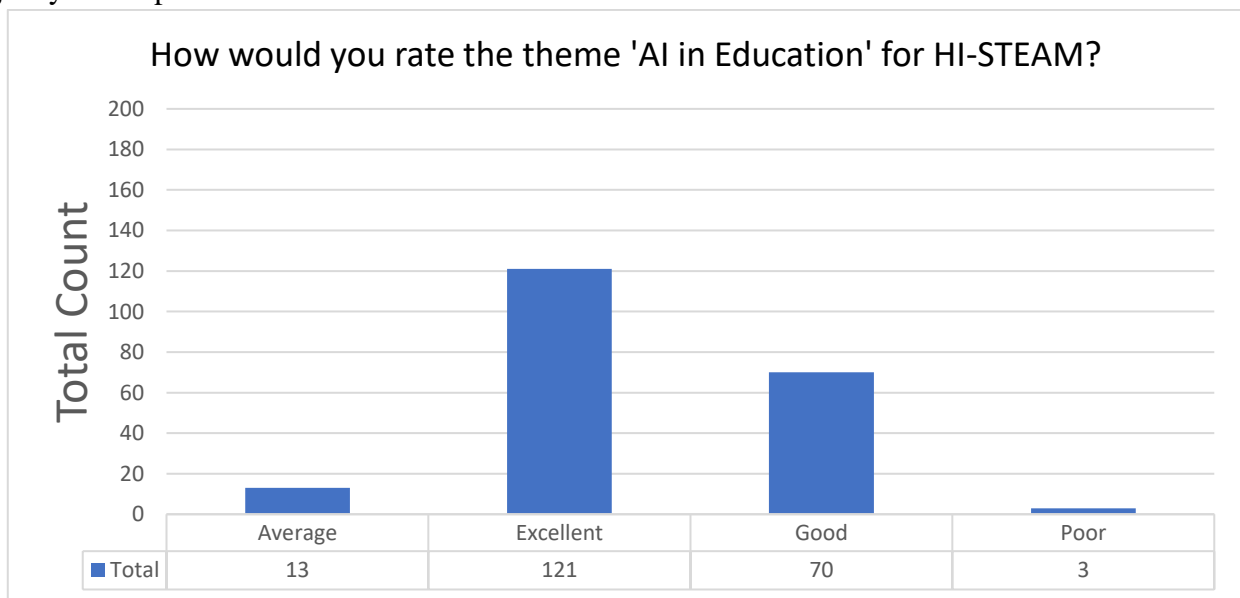
b. Impact of AI tools on students learning curve

Out of 207 parents who participated in the survey, 187 parents rated that the overall impact of AI tools on student’s learning curve ranged from positive to very positive. 17 parents mentioned a neutral impact and 3 parents shared negative impact. Thus, the overall impact has been positive.



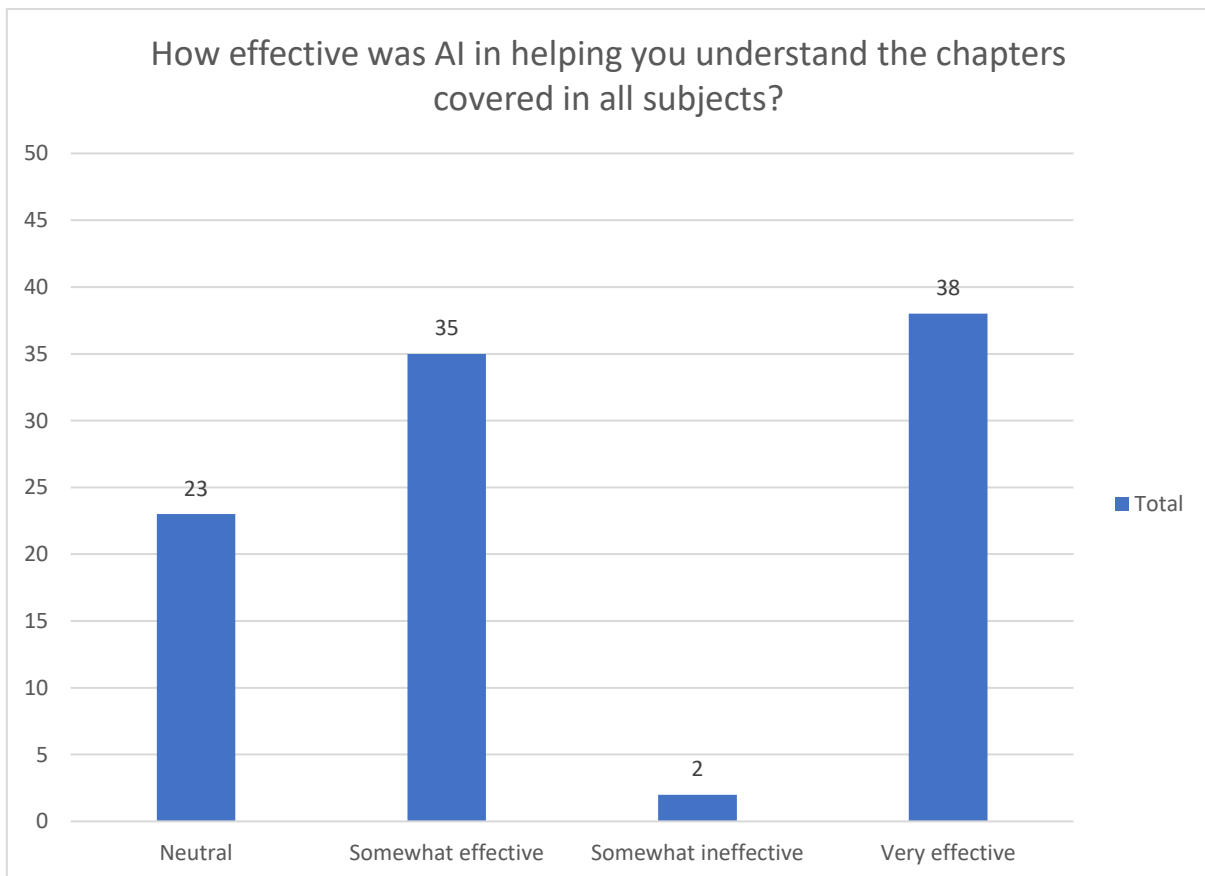
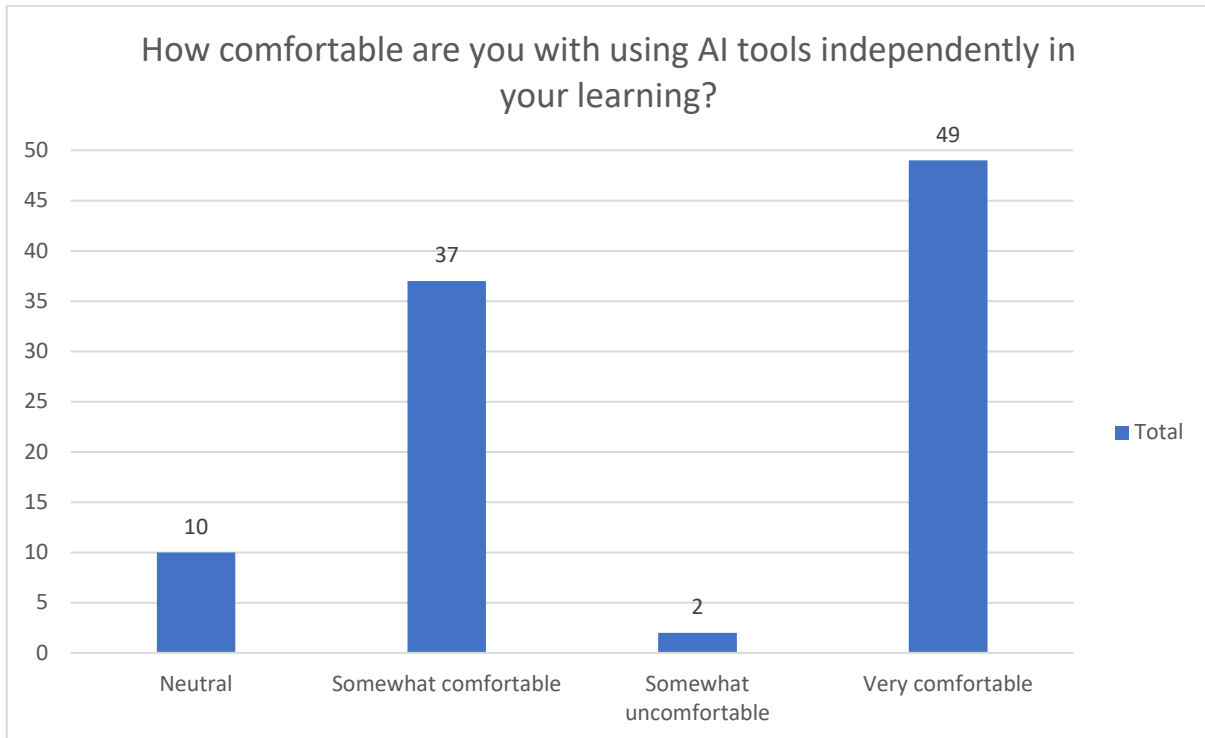
c. Theme for HI-STEAM

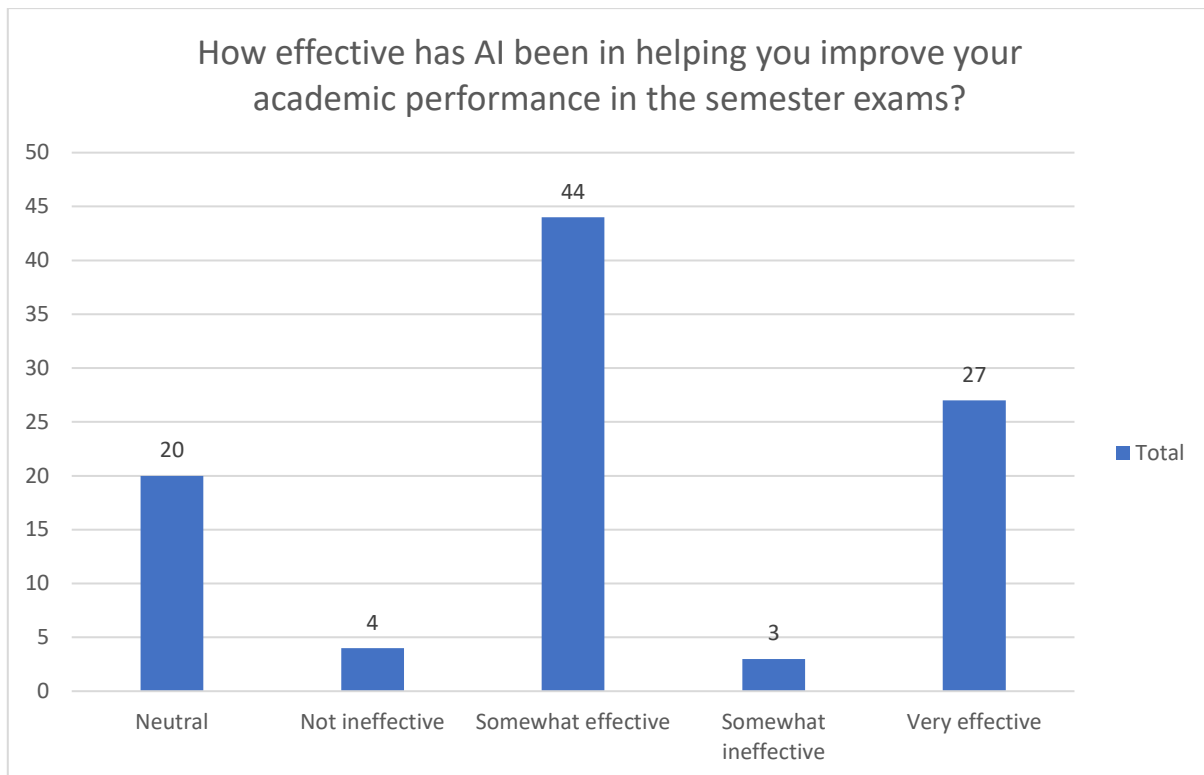
Majority of the parents were more than satisfied with the theme.



IV. Students Feedback by Survey method

98 students completed the survey. The overall experience and effectiveness are illustrated below:





- **Overall Experience:** Students rated their overall experience with AI integration highly, giving it an average score of **4.41** out of 5. This reflects a generally positive reception to AI as a tool for learning.
- **Effectiveness in Understanding Subjects:** The AI's effectiveness in helping students understand the chapters across all subjects scored **4.11**, indicating that most students found AI supportive in their studies.
- **Effectiveness in Improving Academic Performance:** AI's role in improving academic performance in semester exams received a moderate score of **3.89**. This suggests that while AI has been beneficial, there may be room for improvement in leveraging AI tools to better assist students in achieving higher exam scores.

Student Engagement and Comfort with AI

- **Engagement and Motivation:** Students rated their engagement and motivation to learn with AI at **4.07**. This suggests that AI tools have been successful in making learning more engaging for a majority of the students.
- **Comfort with AI Tools:** Students expressed a high level of comfort using AI tools independently in their learning, with an average score of **4.36**. This indicates that the majority of students are confident in navigating AI technology as part of their education.

V. Qualitative analysis of Teacher's Feedback

Twelve teachers from the Secondary Section were interviewed about their subjects using AI tools. The subjects covered were English, Geography, History, Math, Biology, Chemistry and Physics.

1. What are your thoughts on incorporating AI in Education?
2. Can you share your experiences with teaching and learning practices using AI tools?
3. What level of engagement did you observe among students during HI-STEAM activities?
4. What academic impact have you noticed from using AI tools on students 'progress'?
5. How have AI tools helped students personalize their learning?

6. Any negative impact of using AI tools.

QDA Miner Lite qualitative analysis software was used to analyse the responses. The themes and codes that emerged from the feedback were as follows:

In reviewing the research question, "AI in Secondary Classrooms: A Study of its Impact on Student Engagement, Personalized Learning, and Academic Progress," the first component—academic progress of students—was analysed based on teacher feedback. The themes that emerged was academic performance, content understanding and learning beyond textbook and learning outcomes. The teachers mentioned that the student presentations and academic performance improved, students were exploring beyond the textbook and learning, AI tools helped students learn the content. Moreover, they observed a positive impact on students learning, skills of students improving and long-term memory progressing.

For the second part of the research question i.e. student engagement and interaction, the themes that emerged were use of AI tools in class, student teacher interaction and engagement and attendance. The teachers mentioned that students found the theme interesting and significant, the peer interaction and teamwork improved, teacher student bonding increased and the classroom was student centred. The teachers mentioned that the student engagement and attendance during that period was high and excitement of students was exalted.

For the third part of the research question i.e. personalization of learning, the themes that emerged was role of teacher with AI and ways AI promoted personalized learning. The teacher acted more as a facilitator in the classroom allowing students to use AI to support personalized learning. Students were using AI at their own personal pace and they had the freedom to delve into the world of knowledge.

Teachers were also questioned on the challenges they experienced using AI tools and they mentioned resource constraint in terms of time and finances. They urged that students lacked the expertise to evaluate authenticity and information provided by AI, they felt burdened by present curriculum assessment patterns and lack of expertise of using AI. They also feared that students were finding an easy way out to complete assignments and the research they produced was not in-depth.

RESULTS AND CONCLUSION

The quantitative analysis indicates a clear positive improvement in students' academic scores following the implementation of AI tools. Additionally, student attendance during the period of AI tool usage was notably high. Parent feedback overwhelmingly suggested that the quality of student presentations fell predominantly within the "excellent" to "high" range. Furthermore, a majority of parents assessed the overall impact of AI tools on their children's learning as ranging from positive to very positive.

The feedback from students reveal that they view AI integration within the classroom teaching positively, particularly in terms of their overall experience and engagement. However, there is potential for further improvement in using AI to directly enhance academic performance in exams. Additionally, school could increase efforts to deepen the use of AI tools to raise academic performance. They could include more targeted AI interventions, personalized learning paths, or AI-driven tutoring sessions for the students. A study over a longer period of teaching with AI tools in the classrooms will help to understand the academic outcomes in the future.

Interviews with teachers revealed a general enthusiasm for utilizing AI tools; however, concerns were raised regarding the authenticity of the information provided and the potential for students to rely on these tools as an easy way to learn concepts. Teachers also noted that many AI tools required payment, which limited accessibility.

Importantly, teachers displayed adaptability to this technological shift and expressed a willingness to learn and integrate AI tools into their teaching practices.

In light of these findings, the hypotheses proposed for investigation have been reviewed as follows:

Hypothesis: There is no significant difference in student engagement levels when AI tools are utilized.

Result: Hypothesis rejected. A positive difference in student engagement levels was observed when AI tools were employed.

Hypothesis: There is no significant difference in students' academic progress after the implementation of AI tools.

Result: Hypothesis rejected. A positive difference in students' academic progress was noted post-implementation of AI tools.

Hypothesis: There is no significant difference in the personalization of learning when AI tools are integrated into the learning process.

Result: Hypothesis rejected. A significant difference in the personalization of learning was identified with the integration of AI tools.

AI has many benefits and it also supports the teacher extensively if used judiciously. Celik, I., Dindar., Muukkonen, H in their research paper reveal that teachers have limited involvement in the development of AI -based education systems. AI can assist teachers in identifying their students' needs so that they can determine the most suitable learning content and activities for their students. Teachers can monitor their students in a timely manner and give them immediate feedback. All this will definitely have a positive impact on students learning outcomes. These findings conducted in one school accentuate the potential benefits of incorporating AI tools in educational settings, while also highlighting the need for further exploration into the authenticity of information and accessibility of resources.

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