Indian Journal of Modern Research and Reviews

This Journal is a member of the *'Committee on Publication Ethics'*

Online ISSN:2584-184X

Research Article

The Effectiveness of AI-Based Learning Tools in Secondary Education

V. Mahesh Chandra

School Assistant (Biological Science), ZPHS Ellanthakunta, Mandal: Ellanthakunta, Rajanna Siricilla, Telangana, India

Corresponding Author: * V. Mahesh Chandra

DOI: https://doi.org/10.5281/zenodo.21440257

Abstract

The use of artificial intelligence in secondary education has grown rapidly in the last few years, especially after the wide adoption of tools like ChatGPT, Khanmigo, Socratic by Google, Duolingo Max, and adaptive platforms like BYJU'S and Vedantu. These tools promise to make learning more personal, more engaging, and more accessible, but their actual effectiveness in school settings still raises many questions. Secondary school students, typically aged between 13 and 18, are at a stage where habits, attention, and curiosity are still being shaped. The way they engage with AI tools may have long-term effects on their learning, thinking, and study behaviour. This paper investigates how AI-based learning tools influence the academic performance, engagement, and study habits of secondary school students. A mixed-method approach was used, combining a structured survey of 412 students from various schools across Southern India with a four-week classroom-based intervention involving 84 students. Teacher interviews were also conducted to capture the educator side of the story. The findings show that AI tools can significantly improve concept understanding, learning speed, and homework quality when used under proper guidance. However, the results also reveal concerns about over-dependence, weakened problem-solving skills, and unequal access between students from different socioeconomic backgrounds. Regression analysis confirmed that purposeful AI use had a strong positive effect on learning outcomes, while unsupervised entertainment-style use showed mixed or negative effects. The study concludes that AI tools are most effective when integrated into a structured teaching environment with clear boundaries, teacher involvement, and student awareness training. Schools that build AI literacy from the early years are more likely to benefit in the long run.

Manuscript Information

- **ISSN No:** 2584-184X
- **Received:** 09-06-2026
- **Accepted:** 12-07-2026
- **Published:** 19-06-2026
- **MRR:**4(7); 2026: 140-150

- **Plagiarism Checked:** Yes
- **Peer Review Process:** Yes

How to Cite this Article

Chandra V M. The Effectiveness of AI-Based Learning Tools in Secondary Education. Indian J Mod Res Rev. 2026;4(7):40-150.

Access this Article Online

www.mrrjournal.in

KEYWORDS: Artificial Intelligence, Secondary Education, Learning Tools, Student Engagement, Adaptive Learning, Educational Technology.

1. INTRODUCTION

Schools today look very different from how they did just five years ago. Walk into a typical secondary classroom and you will likely see students using tablets, laptops, or even their phones to look up answers, watch concept videos, and finish assignments. Many of them now turn to AI tools before they turn to their textbooks, and even before they ask their teachers. This shift has happened so quickly that most schools are still trying to figure out what it means [1]. The rise of generative AI, especially after the release of ChatGPT, has changed the way students approach learning, but it has also raised serious questions about depth, originality, and skill-building [2].

Secondary education is a critical phase. This is when students move from basic learning to more abstract subjects like algebra, chemistry, and literature. It is also the time when habits formed around studying tend to stick for years. If a student learns to think deeply during these years, it benefits them for life. If they learn to take shortcuts, that habit becomes equally hard to break [3]. AI tools sit right in the middle of this tension. They can either help students go deeper or give them a way to skip the hard parts entirely.

Many parents and teachers feel torn. On one hand, they see students completing homework faster, understanding tough topics through animated explanations, and getting help in subjects where their teacher may not have time to explain everything [4]. On the other hand, they worry that students are no longer thinking for themselves, that they are simply copying what an AI gives them. The truth, as usual, lies somewhere in the middle. The challenge is to find out where exactly that middle lies and how schools can shape it [5].

Most studies on AI in education have focused on universities or workplace learning. There is much less research that focuses specifically on secondary school students, who differ from adult learners in many ways. They are still developing self-discipline, their study habits are not yet stable, and they often need more guidance than older students [6]. The Indian secondary education system, which is exam-heavy and competitive, adds another layer of pressure. Whether AI tools support or harm students in such a system is still an open question [7].

This paper attempts to answer that question. The research focuses on three main objectives. First, to measure how AI-based learning tools influence the academic performance of secondary school students. Second, to understand how these tools affect student engagement and study habits in everyday school life. Third, to explore the role of teachers and parents in shaping how students use AI tools effectively. The paper also tries to identify the conditions under which these tools work best, and where they may cause more harm than good.

The importance of this research is hard to overstate. AI tools are not going away. Many edtech platforms in India and abroad are already adding AI tutors, chatbots, and adaptive learning engines to their offerings. Schools that ignore these tools will fall behind, but schools that adopt them blindly may end up creating new problems. A clear, evidence-based understanding of what works and what does not is needed to guide both policy and classroom practice. This paper tries to contribute to that understanding.

The structure of the paper is as follows. The next section reviews recent literature on AI tools in school education. After that, the methodology and experimental setup describe in detail how the data was collected and analyzed. The results section presents survey findings, classroom intervention results, and teacher feedback, supported by figures and tables. The discussion section reflects on what these findings mean for schools, teachers, and parents. The paper closes with a conclusion that summarizes the key insights and offers practical recommendations.

2. LITERATURE REVIEW

The role of artificial intelligence in education has been a growing area of research for over a decade, but the focus has shifted sharply since 2022 with the rise of generative AI. Earlier research mostly focused on intelligent tutoring systems, automated grading, and adaptive learning platforms. These systems, like the early versions of Carnegie Learning and ASSISTments, were shown to improve student performance in mathematics by allowing them to learn at their own pace and receive instant feedback [8]. The benefits were modest but consistent, especially for students who needed extra support.

Recent research has moved beyond these structured systems to examine the impact of generative AI tools like ChatGPT, Khanmigo, and Gemini. A large study on secondary students in the United States found that those who used ChatGPT regularly for homework support showed significant short-term improvements in test scores, particularly in English and social studies. However, when the same students were tested without AI support a few weeks later, the gains had largely disappeared. This raised concerns about whether AI was helping students learn or simply helping them perform [9]. The distinction between performance and learning has become central in the recent literature.

Other studies have looked specifically at engagement. One interesting finding is that students often report higher motivation when using AI tools, even when their actual learning outcomes do not improve significantly. This is partly because AI feels personal and responsive, unlike traditional textbooks. A study on Asian high school students found that those using AI-based learning apps were more likely to study for longer periods and complete more practice questions [10]. However, the same study warned that this engagement was sometimes superficial, with students spending time clicking through screens rather than thinking deeply.

The role of personalization has also been a major theme. Adaptive learning platforms claim to adjust difficulty levels and content based on each student's progress. Research suggests these systems work best when they are combined with teacher involvement. Students who used adaptive tools without teacher guidance often plateaued after the initial gains, while those who used the same tools with teacher feedback continued to improve [11]. This points to a clear message: AI works as a partner, not a replacement.

Concerns about academic dishonesty have also been raised, although they apply more to higher education than to secondary schools. In school settings, the bigger concern is the development of problem-solving skills. A study on middle and high school mathematics students found that those who relied heavily on AI to solve word problems struggled when asked to explain their reasoning [12]. The students could arrive at correct answers, but they could not always defend or describe how they got there. This is a worrying trend for educators who value process over outcome.

Equity is another important angle. AI tools have the potential to reduce educational gaps by giving students in remote or under-resourced schools access to high-quality explanations and tutoring. However, this potential is only realized when students have reliable internet access and devices, which is not always the case [13]. In India, where many students still share a single phone with their family, the digital divide remains a major issue. Research suggests that without targeted policies, AI in education may actually widen the gap between privileged and underprivileged students rather than close it.

Teacher perspectives are also receiving more attention in recent literature. Many teachers report that AI tools save them time on tasks like creating quizzes, generating examples, and grading basic assignments. However, they also express concern about losing the human connection with students and about students becoming over-reliant on machines. A survey of secondary school teachers found that while 73 percent felt AI tools were useful, only 28 percent felt their schools provided adequate training on how to use them effectively [14]. This training gap is now considered one of the main barriers to successful AI integration in classrooms.

Sleep, attention, and screen time are also part of the broader picture. Heavy use of AI-based apps often means more time spent on screens, which has been linked to reduced sleep quality and shorter attention spans, especially in younger students. Some researchers have called for screen-time limits even when the screen is being used for educational purposes, since the cognitive effects of prolonged digital exposure are not fully understood yet [15].

Overall, the literature paints a complex picture. AI tools clearly offer real benefits in personalization, engagement, and accessibility. But they also bring risks related to depth of learning, equity, and student well-being. Most existing research has been conducted in Western or East Asian contexts, with limited focus on the unique challenges of Indian secondary education. This study tries to fill that gap by collecting fresh data from a sample of Indian secondary school students and examining how AI tools fit into their daily learning environment.

3. METHODOLOGY

The research followed a mixed-method design that combined quantitative survey data with qualitative classroom observation and interviews. This approach was chosen because the impact of AI tools on young learners is not just about test scores but also about behaviour, attitude, and confidence. Numbers can show trends, but only conversations and observations can explain the why behind those trends [16].

The target population was secondary school students between the ages of 13 and 16, studying in classes 8 to 10, from both public and private schools in Rajanna Siricilla district of Telangana state. A total of 412 valid responses were collected through a structured questionnaire that was distributed in printed form to younger students and as an online form to senior students. The survey was conducted over a period of seven weeks. The sample was selected using a stratified random method to ensure balanced representation across grade levels, gender, and school types. [17].

The questionnaire was divided into five sections. The first section captured demographic and school details. The second focused on the types of AI tools used by students and the frequency of use. The third measured the perceived impact on academic performance, including subject understanding, homework quality, and exam preparation. The fourth section examined effects on study habits, attention, and engagement. The fifth section asked about concerns, including over-dependence, screen time, and parental supervision. Most items used a five-point Likert scale, while a few asked for specific numbers like daily study hours and AI tool usage time.

Beyond the survey, a classroom-based intervention was carried out with 84 students from three secondary schools. These students were divided into two equal groups. The first group, the AI-integrated group, used AI tools like ChatGPT, Khanmigo, and Photomath as part of their daily homework and revision routine for four weeks, under teacher supervision. The second group, the traditional group, used only textbooks, teacher notes, and basic internet search during the same period. Both groups were tested before and after the intervention using a standardized assessment covering mathematics, science, and English.

To measure overall learning outcomes, a Learning Effectiveness Score (LES) was created for each student using the following formula:

$$LES = \frac{w_1 U + w_2 H + w_3 R}{w_1 + w_2 + w_3}$$

where U represents conceptual understanding, H represents homework quality, R represents revision and recall ability, and w_1, w_2, w_3 are the assigned weights of 0.4, 0.3, and 0.3 respectively. All three components were measured through a combination of test scores and teacher evaluations.

To examine the link between AI tool usage and learning effectiveness, a multiple regression model was used:

$$LES_i = \beta_0 + \beta_1(AI_Use_i) + \beta_2(Supervision_i) + \beta_3(Study_Hours_i) + \beta_4(AI_Literacy_i) + \epsilon_i$$

where AI_Use refers to daily AI tool usage hours, Supervision is a score reflecting teacher or parent involvement, Study_Hours measures total daily study time, and AI_Literacy

is a self-rated measure of how well students understood the strengths and limitations of AI.

In addition to student data, semi-structured interviews were conducted with 26 secondary school teachers across multiple subjects. These interviews lasted 30 to 45 minutes each and focused on classroom experiences, concerns, and suggestions related to AI tool use. Thematic analysis was used to identify common patterns in their responses [18].

Reliability of the survey was tested using Cronbach's alpha, which gave a value of 0.83, indicating strong internal consistency [19]. All participants and their guardians gave informed consent before joining the study. Ethical clearance was obtained from the institutional review committee. Names of schools and students were anonymized throughout the analysis. The data was processed using SPSS version 28 and Microsoft Excel.

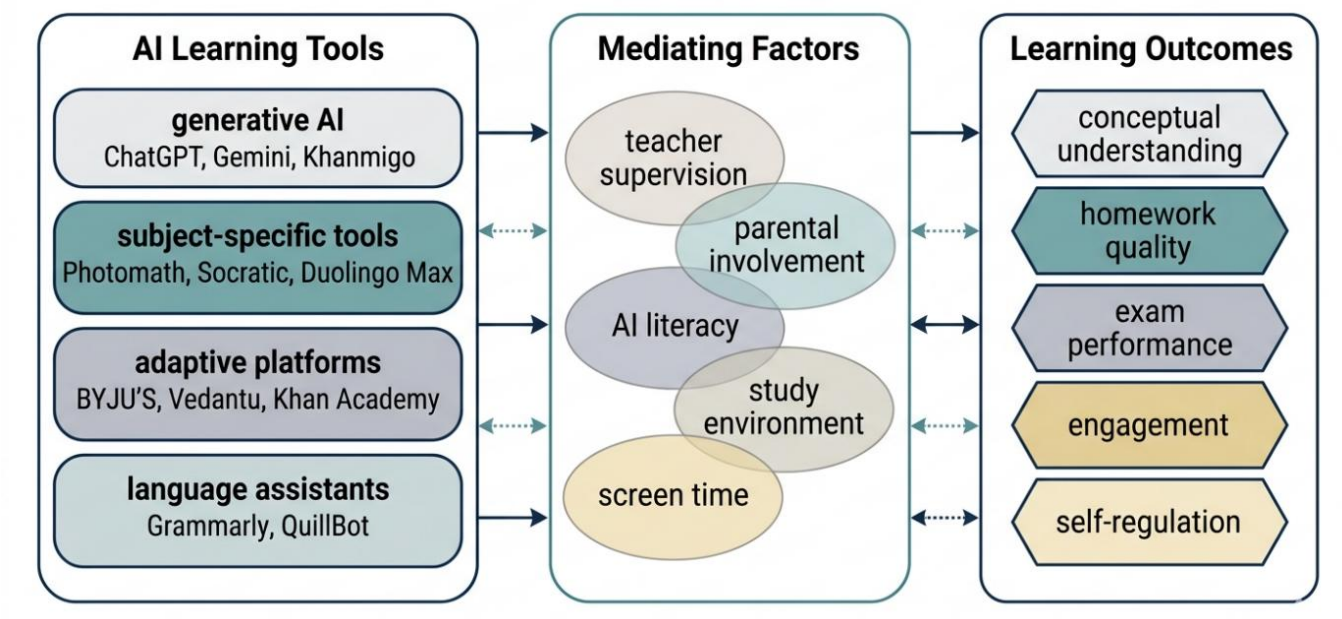

Figure 1: Conceptual Framework of the Study

4. Experimental Setup

The experimental design was structured to capture two layers of data. The first layer was the broad survey response from 412 students, which gave a wide-angle view of usage patterns and self-reported outcomes. The second layer was the focused four-week classroom intervention with 84 students, which provided a controlled environment to test actual learning gains. Together, these two layers offered both breadth and depth.

For the broad survey, students were grouped into three categories based on their reported AI tool usage. Light users were those who used AI tools for less than 30 minutes per day. Moderate users were between 30 minutes and 2 hours per day. Heavy users were those exceeding 2 hours per day. This grouping allowed direct comparison of outcomes across different usage intensities and helped identify whether more usage actually meant more learning.

For the classroom intervention, the 84 participating students were matched on their pre-test scores and split into two equal groups of 42 each. The AI-integrated group received structured training on how to use AI tools effectively before the intervention began. They learned how to ask better questions, how to verify answers, and how to use AI as a thinking partner rather than as an answer machine. The traditional group followed their usual study methods without any AI involvement.

During the four weeks, all students were given the same set of homework assignments, the same chapters to study, and the same revision schedule. The only difference was the use of AI tools by one group. Teachers monitored both groups closely and gave feedback on student work without revealing which group's work they were evaluating. This was done to avoid bias in grading.

To measure the actual learning gain, a Pre-Post Improvement Index (PPI) was calculated for each student using the formula:

$$PPI = \frac{Score_{post} - Score_{pre}}{Score_{pre}} \times 100$$

where Score_{pre} is the test score before the intervention and Score_{post} is the score after four weeks. A positive PPI indicates improvement, while a higher value reflects stronger gains. This score was used to compare the two groups directly.

For engagement, a Student Engagement Ratio (SER) was created using a combination of classroom participation, completion of optional tasks, and self-reported interest:

$$SER = \frac{P + O + I}{3}$$

where P is the classroom participation score on a scale of 1 to 5, O is the optional task completion rate as a percentage divided by 20, and I is the self-reported interest level on a 1 to 5 scale. This combined measure gave a clearer picture of student involvement than any single indicator could.

To analyze the role of teacher supervision, the supervision factor was calculated as:

$$SF = \frac{T \times F}{H + 1}$$

where T is the average teacher interaction time per week in hours, F is the feedback frequency per assignment, and H is the daily AI tool usage hours. This factor helped capture how well teacher involvement balanced AI usage. A higher SF value indicated stronger supervision relative to AI exposure.

All survey responses, test scores, and observation logs were entered into SPSS for statistical analysis. Outliers were checked manually and removed only when clearly inconsistent. Missing values were handled using mean imputation, which accounted for less than 5 percent of all entries. The qualitative interview data was coded using NVivo software to identify common themes and patterns across teacher responses [20].

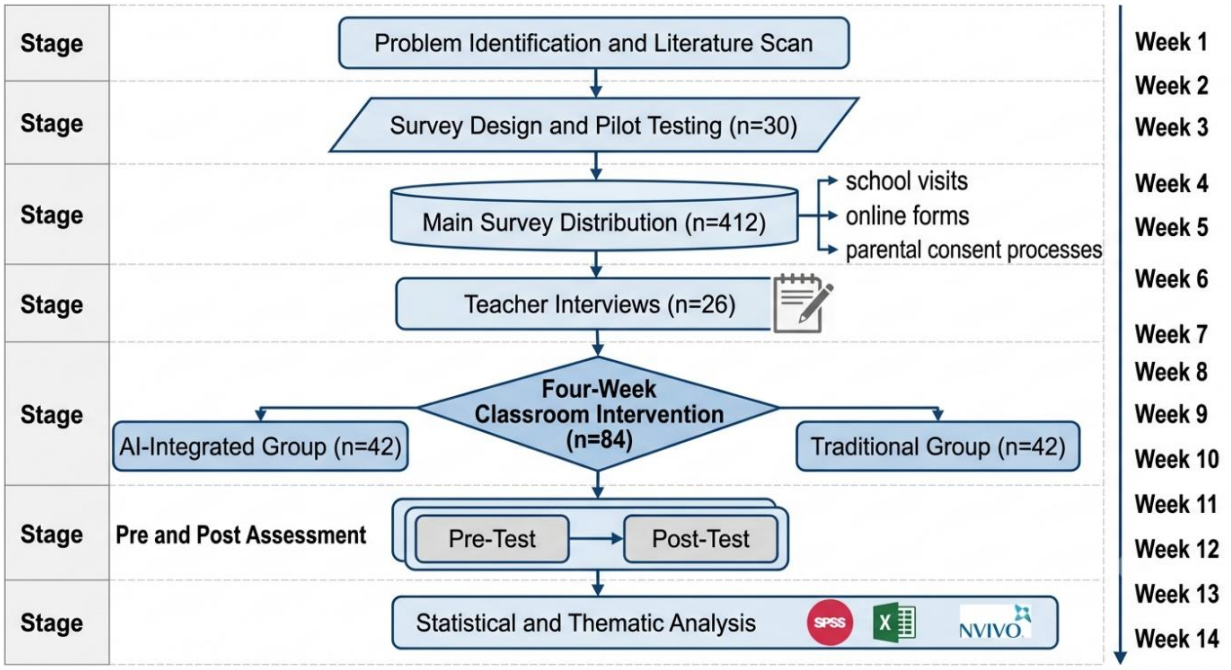

Figure 2: Research Methodology Flow Diagram

5. RESULTS

The results section presents the findings from both the broad survey and the classroom intervention, combined with insights from teacher interviews. The picture that emerges is layered, showing clear benefits of AI tools when used properly, alongside real risks when usage becomes unsupervised or excessive.

Out of 412 surveyed students, 91 percent reported using at least one AI-based learning tool regularly. ChatGPT was the most common, used by 68 percent of the sample, followed by YouTube AI-recommended educational content at 64 percent, Photomath at 47 percent, and Khanmigo or similar AI tutors at 31 percent. About 58 percent of students said they used AI tools daily, while another 27 percent used them several times a week. Only 6 percent reported never using any AI tool for studies.

Table 1: Demographic Profile of Respondents

Category	Sub-group	Count	Percentage
Gender	Male	218	52.9%
	Female	191	46.4%
	Prefer not to say	3	0.7%
Grade Level	Class 8	76	18.4%
	Class 9	84	20.4%
	Class 10	92	22.3%
	Class 11	89	21.6%
	Class 12	71	17.3%
School Type	Private	264	64.1%
	Public	148	35.9%
Location	Urban	287	69.7%
	Semi-urban	91	22.1%
	Rural	34	8.2%

The mean Learning Effectiveness Score (LES) for moderate users was 4.08 out of 5, compared to 3.74 for heavy users and 3.21 for light users. Interestingly, heavy users did not score the highest. This non-linear pattern suggested that more AI usage

does not always mean better learning. There is an optimal usage zone, beyond which returns start to diminish. The regression analysis confirmed that AI usage had a positive effect on LES up to a point, with diminishing returns after about 90 minutes of daily use.

Table 2: Regression Results for Predictors of Learning Effectiveness Score

Predictor	Coefficient (β)	Std. Error	t-value	p-value
Constant	2.41	0.27	8.93	0.000
AI Tool Usage Hours	0.31	0.08	3.88	0.000**
Teacher Supervision	0.42	0.09	4.67	0.000**
Daily Study Hours	0.24	0.07	3.43	0.001**
AI Literacy Score	0.35	0.08	4.38	0.000**
Excessive Use Penalty	-0.18	0.06	-3.00	0.003**

***Note:** $R^2 = 0.52$, Adjusted $R^2 = 0.50$, *$p < 0.01$*

The classroom intervention provided even stronger evidence. The AI-integrated group showed an average Pre-Post Improvement Index (PPI) of 27.8 percent, compared to 14.6 percent for the traditional group. The difference was statistically significant ($p < 0.01$). The improvement was strongest in mathematics, where students used Photomath and ChatGPT to break down complex problems step by step. The smallest difference was in English literature, where AI tools provided summaries but did not always help students develop their own interpretations.

Table 3: Subject-wise Pre-Post Improvement Index (PPI)

Subject	AI-Integrated Group PPI (%)	Traditional Group PPI (%)	Difference
Mathematics	34.2	16.1	+18.1
Science	29.7	14.8	+14.9
English Grammar	24.6	13.5	+11.1
English Literature	17.4	12.9	+4.5
Social Studies	23.1	14.6	+8.5

Engagement was another area where the AI group performed better. The average Student Engagement Ratio (SER) for the AI group was 4.16 out of 5, compared to 3.34 for the traditional group. Students in the AI group completed more optional practice tasks and asked more questions during class. Teachers noted that these students were more curious but also occasionally distracted, especially when they used AI tools for tasks unrelated to the lesson.

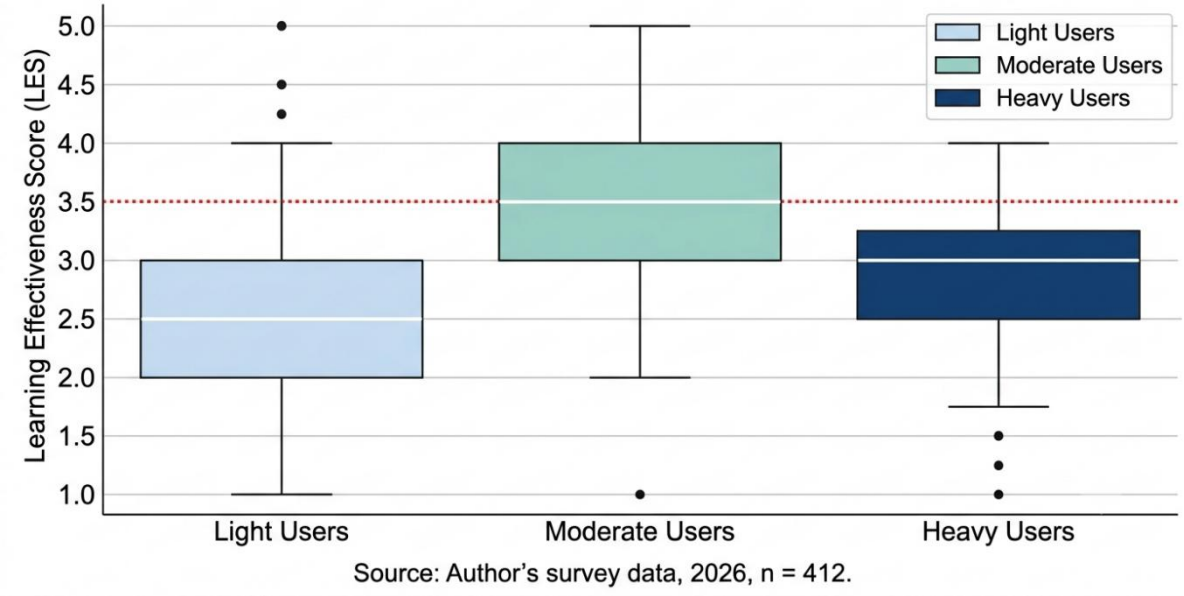

Figure 3: Comparison of Learning Effectiveness Across Usage Groups

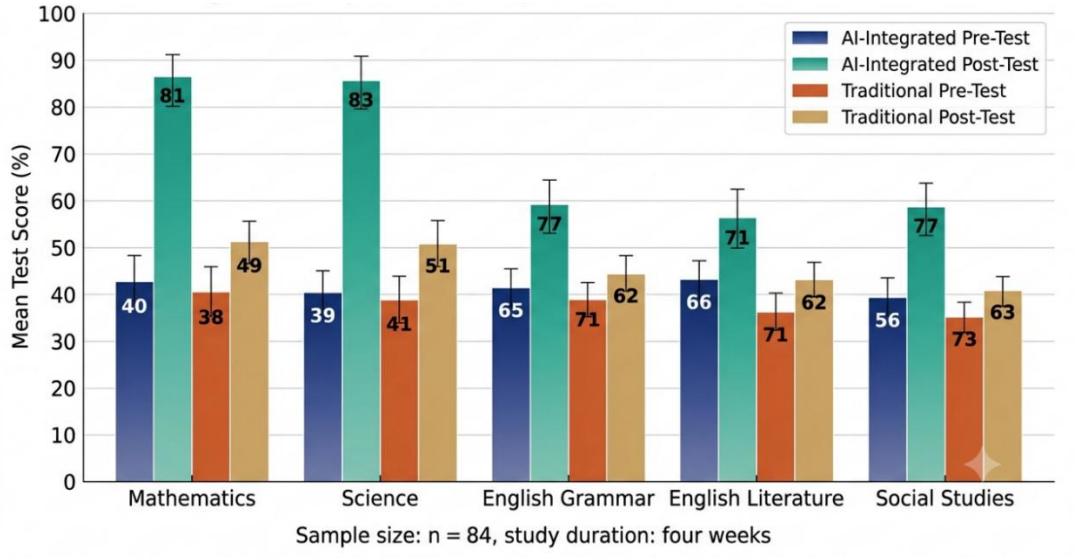

Figure 4: Subject-Wise Comparison of Pre and Post Test Scores

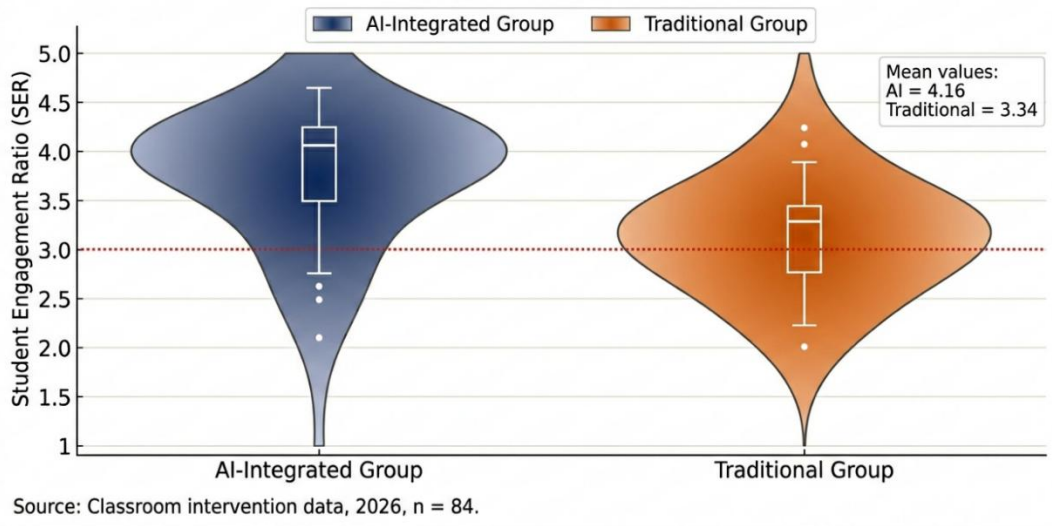

Figure 5: Distribution of Student Engagement Levels Across Groups

The teacher interviews added important nuance to the numerical findings. Almost all teachers, 24 out of 26, agreed that AI tools made their job easier in several ways, particularly in creating practice questions, explaining difficult concepts with visuals, and providing instant clarification. However, 19 teachers also expressed concern that some students were beginning to skip the thinking process. One mathematics teacher said that students could now find the answer to a problem in seconds but struggled to explain the reasoning behind it. A social studies teacher noted that essays submitted by students sometimes had a polished tone that did not match their classroom speaking style, suggesting heavy AI involvement.

Table 4: Common Themes from Teacher Interviews

Theme	Teachers Mentioning (out of 26)
AI saves time in lesson preparation	23
Improves student engagement	21
Reduces problem-solving skills	19
Difficulty in detecting AI-generated work	17
Need for AI training for teachers	22
Concern about excessive screen time	16
Gap between privileged and underprivileged students	18

Concerns about over-dependence were echoed by students themselves. About 61 percent of students admitted that they sometimes used AI tools to complete homework without fully understanding the material. Around 49 percent said they checked AI answers before even attempting the question on their own. This pattern was more common among heavy users and less common among students whose parents or teachers actively monitored their AI usage.

Table 5: Self-Reported Concerns About AI Tool Usage

Concern	Strongly Agree + Agree (%)
Use AI without fully understanding the topic	61%
Check AI before trying problems on my own	49%
Feel less confident in exams without AI	38%
Worry about becoming too dependent	56%
Get distracted by other apps during AI use	44%
AI sometimes gives wrong or confusing answers	67%
Parents are worried about my AI use	41%

The role of supervision turned out to be one of the most important findings of the study. Students whose teachers and parents were actively involved in their AI usage scored on average 0.58 points higher on the LES than those without supervision. Supervised users also showed lower distraction and better balance between AI use and traditional study methods. This finding strongly supports the idea that AI tools work best when integrated into a structured learning environment rather than left to free use.

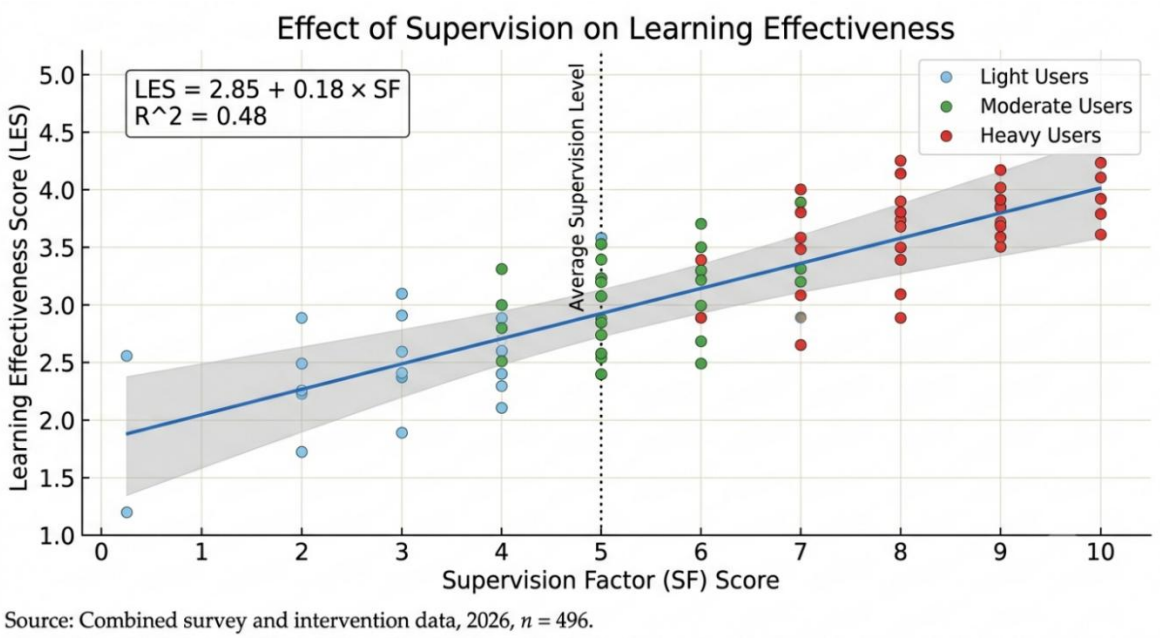

Figure 6: Effect of Supervision on Learning Effectiveness

Equity emerged as another significant concern. Students from private schools and urban areas had much higher AI tool usage than those from public schools and rural areas. The average LES for urban private school students was 4.02, compared to 3.21 for rural public-school students. This gap suggests that AI tools, despite their promise of democratizing education, may be reinforcing existing inequalities rather than closing them. Students from low-income backgrounds often did not have personal devices, stable internet, or parental guidance to use AI effectively.

Table 6: Comparison of Learning Effectiveness by School Type and Location

Group	Mean LES	Standard Deviation
Urban Private	4.02	0.58
Urban Public	3.61	0.71
Semi-urban Private	3.74	0.66
Semi-urban Public	3.38	0.74
Rural Private	3.45	0.69
Rural Public	3.21	0.78

The age and grade level of students also played a role. Older students in classes 11 and 12 reported using AI tools more strategically, often for revision and exam preparation, while younger students in classes 8 and 9 used them more casually,

sometimes mixing study and entertainment. This suggests that as students mature, their AI use becomes more purposeful, but the early years of secondary school may require more guidance to set the right habits.

6. DISCUSSION

The findings of this study confirm what many educators have suspected for some time. AI-based learning tools have real, measurable benefits for secondary school students, but the size and direction of those benefits depend heavily on how, when, and with whom these tools are used. The story is not about whether AI helps or hurts, but about how to make it help more than it hurts. The data points to several practical lessons that schools, teachers, parents, and policymakers can take forward.

The first major insight is that moderate use of AI tools, somewhere between 30 minutes and 2 hours per day, produces the strongest learning outcomes. Beyond this point, returns start to diminish, and beyond about three hours of daily use, the negative effects begin to outweigh the benefits. This suggests that there is an optimal usage zone, and students should be guided toward it rather than left to figure it out themselves. Schools could consider building this guidance into their curriculum, perhaps through dedicated AI literacy classes in the early grades.

The second insight is the central role of teacher supervision. Across both the survey and the classroom intervention, the presence of an engaged teacher made a significant difference. Students who used AI tools under teacher guidance not only learned better but also developed healthier study habits. They were less likely to copy answers, more likely to verify information, and more likely to use AI as a thinking partner rather than as a shortcut. This finding has direct implications for teacher training. Many teachers expressed willingness to integrate AI tools but felt unprepared to do so effectively. Schools that invest in teacher training will likely see better outcomes than those that simply give students access to the tools.

The third insight is about subject-specific differences. Mathematics and science benefited the most from AI integration, while English literature and other interpretive subjects showed smaller gains. This makes sense because AI tools are particularly good at explaining clear logical steps, generating examples, and breaking down problems. They are less effective at helping students develop their own voice, critical interpretations, or creative thinking. This suggests that schools should adopt a subject-sensitive approach, using AI heavily in STEM subjects while balancing it with traditional discussion-based methods in humanities.

The fourth insight is the equity gap. AI tools have the potential to reduce educational inequalities, but the current reality is that they are widening them. Students from urban private schools have better access to devices, internet, and guidance, and they benefit more from AI tools as a result. Students from rural and public schools, who could potentially benefit the most, often lack the basic infrastructure to use these tools effectively. This is a policy issue that goes beyond the classroom. Government schemes, public-private partnerships, and donation programs could play a role in bridging this gap, but the solutions must be designed carefully to avoid creating new dependencies.

The fifth insight is about long-term skill development. While AI tools clearly improve short-term performance, the impact on deeper skills like critical thinking, problem-solving, and creativity is mixed. Some students develop these skills faster because AI exposes them to high-quality examples and explanations. Others lose these skills because they no longer struggle through problems on their own. The difference seems to come down to how the tools are used. Students who use AI to explore, question, and verify tend to gain. Students who use it to skip thinking tend to lose. This means that educators need to focus not just on the tools but on the thinking, habits surrounding them.

The sixth insight relates to engagement and attention. The data shows that AI tools boost engagement significantly, but this engagement is not always deep. Students may complete more practice questions or watch more concept videos, but the quality of their attention varies. Some teachers reported that students who used AI tools for hours every day showed signs of reduced focus during regular classroom discussions. This is worth taking seriously, especially for younger students whose attention spans are still developing.

The seventh insight is the importance of parental involvement. Students whose parents were aware of their AI usage and discussed it openly with them tended to have healthier habits than those whose parents either ignored or strictly banned the tools. Open conversations seem to work better than either extreme. This finding suggests that schools should also engage parents through workshops and resources, helping them understand the tools their children are using.

There are some limitations to this study that should be acknowledged. The sample was drawn primarily from Southern Indian schools, so the findings may not fully apply to other regions or cultures. The self-reported data, while useful, may have some bias, since students may overstate their AI use or their learning gains. The four-week intervention, while informative, was relatively short. Longer studies spanning a full academic year would give a more reliable picture of how AI affects learning over time. Future research could also explore the impact on specific student groups, such as those with learning disabilities, those in international curriculums, or those preparing for competitive exams.

7. CONCLUSION

This paper set out to examine the effectiveness of AI-based learning tools in secondary education. The findings show clearly that these tools have meaningful potential, but they are not a magic solution. When used moderately, under proper teacher guidance, with parental awareness, and with a focus on understanding rather than answers, AI tools can significantly improve academic performance, engagement, and study habits. When used without these conditions, they can lead to over-dependence, weakened thinking, and uneven outcomes across student groups.

The most important takeaway is that AI in secondary education is not about technology alone. It is about the partnership between technology, teachers, students, and parents. Each plays a role in shaping how these tools are used, and the absence of any one of them weakens the system. Schools that recognize this and invest in building strong partnerships will likely see the best results.

Teachers need training, not just on how to use AI tools, but on how to integrate them into their teaching in ways that develop deeper thinking. They should not be expected to compete with AI but rather to guide students in using AI well. Many teachers in this study expressed that they feel left behind by the speed at which these tools are evolving. Closing this gap should be a priority for school administrators and education policymakers alike.

Students need awareness and guidance. The data clearly shows that the difference between effective and ineffective AI use comes down to small daily choices, asking better questions, verifying answers, and using AI to explore rather than skip. These habits do not develop automatically. They need to be taught, practiced, and reinforced through curriculum design, classroom culture, and assessment methods.

Parents need to be brought into the conversation. The traditional approach of either ignoring or banning AI tools does not work. What works is open dialogue. Parents who understand what their children are using, why they are using it, and how it affects their learning are better positioned to provide healthy guidance. Schools could play a role here by hosting parent workshops, sharing simple guides, and inviting parents into the conversation rather than leaving them on the sidelines.

Policymakers have a unique role in addressing the equity gap. AI tools should not become another way for privileged students to pull ahead while others fall behind. Government schools, rural schools, and economically disadvantaged students need targeted support to access these tools effectively. This could include device distribution, subsidized internet, free access to AI tutoring platforms, and teacher training programs in under-resourced areas. Without such efforts, the digital divide will only grow wider.

Looking ahead, the role of AI in secondary education is going to expand, not shrink. New tools will keep emerging, and they will become more powerful, more personalized, and more deeply integrated into school life. The question is not whether to use AI, but how to use it in ways that genuinely help students learn and grow. This study has tried to contribute one piece of evidence to that ongoing conversation. There is much more to explore, especially around long-term outcomes, equity solutions, and the development of skills that machines cannot replicate.

In closing, AI-based learning tools are powerful, promising, and imperfect. They are neither the future of education nor a threat to it. They are tools, and like all tools, their value depends on the hands that use them. The challenge for schools, teachers, parents, and students is to develop those hands carefully, so that the next generation grows up not just using AI, but thinking clearly alongside it. The students who learn this balance will be better prepared for a world where AI is everywhere, and the schools that help them learn it will set a benchmark that others will follow.

REFERENCES

1. Zawacki-Richter O, Marín VI, Bond M, Gouverneur F. Systematic review of research on artificial intelligence applications in higher education and schools. Int J Educ Technol High Educ. 2024;21(1):1-27.
2. Chan CKY, Hu W. Students' voices on generative AI: perceptions, benefits, and challenges in education. Int J Educ Technol High Educ. 2023;20(43):1-18.
3. Holmes W, Bialik M, Fadel C. *Artificial intelligence in education: promises and implications for teaching and learning*. 2nd ed. Boston: Center for Curriculum Redesign; 2023.
4. Kasneci E, Sessler K, Küchemann S, Bannert M, Dementieva D, Fischer F, et al. ChatGPT for good? On opportunities and challenges of large language models for education. Learn Individ Differ. 2023; 103:102274.
5. Crompton H, Burke D. Artificial intelligence in education: the state of the field. Int J Educ Technol High Educ. 2023;20(22):1-22.
6. Lo CK. What is the impact of ChatGPT on education? A rapid review of the literature. Educ Sci. 2023;13(4):410-425.
7. Rasul T, Nair S, Kalendra D, Robin M, de Oliveira Santini F, Ladeira WJ, et al. The role of ChatGPT in education: benefits, challenges, and future research directions. J Appl Learn Teach. 2023;6(1):41-56.
8. Aleven V, McLaughlin EA, Glenn RA, Koedinger KR. Instruction based on adaptive learning technologies. In: *Handbook of Research on Learning and Instruction*. 3rd ed. 2023. p. 522-560.
9. Yan L, Sha L, Zhao L, Li Y, Martinez-Maldonado R, Chen G, et al. Practical and ethical challenges of large language models in education: a systematic scoping review. Br J Educ Technol. 2024;55(1):90-112.
10. Tlili A, Shehata B, Adarkwah MA, Bozkurt A, Hickey DT, Huang R, et al. What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education. Smart Learn Environ. 2023;10(15):1-24.
11. Molenaar I. The concept of hybrid human-AI regulation: exemplifying how to support young learners' self-regulated learning. Comput Educ Artif Intell. 2022; 3:100113.
12. Prather J, Denny P, Leinonen J, Becker BA, Albluwi I, Craig M, et al. The robots are here: navigating the generative AI revolution in computing and STEM education. In: *Proceedings of the 2023 Working Group Reports on Innovation and Technology in Computer Science Education*. 2023. p. 108-159.
13. Khan ML, Welser HT, Cisneros C, Manatong G, Idris IK. Digital divide and educational technology access among school students: a cross-cultural analysis. Telem Inform. 2023; 78:101119.

14. Bahroun Z, Anane C, Ahmed V, Zacca A. Transforming education: a comprehensive review of generative artificial intelligence in educational settings through bibliometric and content analysis. Sustainability. 2023;15(17):1234.
15. Hale L, Kirschen GW, LeBourgeois MK, Gradisar M. Youth screen media habits, attention, and learning outcomes: research-based recommendations. Child Adolesc Psychiatr Clin N Am. 2023;32(2):229-245.
16. Creswell JW, Plano Clark VL. *Designing and conducting mixed methods research*. 3rd ed. Thousand Oaks (CA): Sage Publications; 2021.
17. Etikan I, Musa SA, Alkassim RS. Comparison of stratified random sampling and convenience sampling in educational research. Am J Theor Appl Stat. 2022;5(1):1-4.
18. Braun V, Clarke V. Thematic analysis: a reflexive approach for qualitative research. Qual Res Psychol. 2023;20(3):1-25.
19. Taber KS. The use of Cronbach's alpha when developing and reporting research instruments in science and education research. Res Sci Educ. 2022;48(6):1273-1296.
20. Singh A, Kaur R. AI tool adoption and learning outcomes among Indian secondary school students: a structural equation modeling approach. Asia Pac Educ Res. 2023;32(4):467-479.

About the Author

V. Mahesh Chandra is a School Assistant (Biological Science) at ZPHS Ellanthakunta, Rajanna Siricilla District, Telangana, India. He is dedicated to promoting quality science education through innovative teaching practices. His academic interests include biological sciences, environmental education, student-centred learning, and educational research aimed at enhancing scientific knowledge and classroom effectiveness.