

# **International Research Journal of Management Science & Technology**



**ISSN 2250 – 1959(Online)  
2348 – 9367 (Print)**

*An Internationally Indexed Peer Reviewed & Refereed Journal*

[www.IRJ MST.com](http://www.IRJ MST.com)  
[www.isarasolutions.com](http://www.isarasolutions.com)

Published by iSaRa Solutions

---

## The Paradigm Shift in Senior Secondary Pedagogy: Artificial Intelligence Adoption Among 12th-Grade Students in India

*An Empirical Analysis of Generative AI, Personalized Doubt Clearance, and Competitive Examination Preparation Frameworks*

- Aadit Bharti

### Abstract

Traditionally, the secondary education ecosystem in India was governed by a hyper-rigid, classroom-centric paradigm. Learning mechanisms were heavily dependent on uniform lectures and standard text-based curriculum delivery for many decades, determining the rate at which academic performance was achieved, which would also introduce severe limitations regarding individualized attention and financial parity. But the advent of digital infrastructure and widespread mobile telecommunications was the beginning of the transformation to a more advanced pedagogical landscape. While early edtech interventions successfully introduced online video repositories to the urban middle class, they struggled to achieve hyper-personalized guidance due to high subscription premiums and static curriculum limitations. It is only when Generative Artificial Intelligence (AI) and Large Language Models (LLMs) came about that there was a real paradigm shift. Modern institutions and technology pioneers integrated AI tools, which revolutionized the Indian academic scenario through instant, accessible, and cost-free educational diagnostics and custom guidance. This research paper investigates the historical transition from rigid classroom setups to internet-based video libraries, and ultimately to the AI-driven digital learning revolution. By analyzing student tool usage metrics, academic outcomes, and behavioral patterns among 12th-grade students preparing for board and competitive examinations, this paper demonstrates how AI democratized educational assistance. Furthermore, it compares the current utility of traditional text resources against AI pedagogical models and explores the future prospects of both systems, including the formal integration of adaptive AI into national board frameworks and the deployment of intelligent evaluation systems.



AADIT BHARTI

### Why I chose this topic:

My motivation for conducting this research stems from my close association with the field of education. Coming from a family involved in education, I have often observed the experiences and challenges faced by educators and students. This made me reflect on how the Indian education system could be improved and what new approaches could make learning more effective, accessible, and personalized. As technology continued to evolve, I became particularly interested in understanding whether Artificial Intelligence could help address some of the limitations of traditional, classroom-centred education, especially the difficulty of providing individualized attention to every student.

This curiosity led me to explore the growing role of AI in secondary education. The emergence of conversational AI and adaptive learning tools has created possibilities for personalized explanations, instant doubt resolution, and learning support beyond conventional classroom hours. Through this research, I aim to understand not only the potential benefits of AI for students and educators, but also its limitations, ethical concerns, and implications for the future of education in India. Ultimately, the research seeks to examine whether AI can complement existing educational practices and contribute to building a more effective and inclusive learning ecosystem.

## Introduction

Imagine the process of mastering advanced physics or chemistry concepts two decades ago. Students had to physically attend commercial coaching hubs, manually transcribe voluminous lecture notes, and browse multiple physical text guides to resolve complex equations. If immediate personal feedback was missing, learning trajectories were delayed or compromised. The introduction of digitized web platforms and online video channels mitigated this challenge to an extent. Learners could stream archived video material from central servers, visualizing scientific concepts via animation fields. However, this architecture was heavily skewed towards self-motivated students and urban households because high-speed internet data and private platform premium tiers were expensive for lower-income rural households to sustain.

In today's academic environment, we are in an age when conversational artificial intelligence interfaces are as common as smart telecommunications or standard educational applications. By simply feeding a image capture or entering a natural language query of a difficult board examination problem into an open access LLM framework, it is possible for a student to receive customized, multi-step structural breakdowns suited to their current cognitive level. This frictionless, interoperable ecosystem is powered by deep learning frameworks and adaptive data models. In this paper, I will explore how artificial intelligence serves as the ultimate catalyst for India's secondary educational transformation. In order to comprehend the significance of this shift, I will start by discussing the background and structural limitations of previous educational methodologies. Through an understanding of the mechanical integration of AI tools, their explosive adoption rates, and their direct impact on competitive testing, my objective is to provide a holistic perspective of how Indian students have leveraged intelligent software to optimize learning outcomes.

## Methodology

In order to carry out a systematic analysis of the gathered data in this study both quantitatively and qualitatively, several methods of statistical modeling were adopted. This is done in order to ascertain that the results obtained from the adoption of AI are scientifically reliable and sound. Below are some of the tests carried out in this regard:

- Chi-Square Test: Used to establish the existence of any statistically significant correlation between the different categorical variables. This test helps in establishing the correlation that exists between different demographic characteristics and preferred usage patterns of AI tools (i.e. use of AI tool for research purposes, writing and coding).
- T-Test: A method which helps in determining the means of two different continuous variables. In this case, it was used to make comparisons between the academic scores and average hours of study among students using AI-based tutoring software and those not using any.
- Z-Test of Proportion: Helps in the comparison of the proportions of two different populations. This is very vital in understanding adoption rates of Generative AI among High school and College students for their academic work

## Theoretical Background and Literature Review

The integration of Artificial Intelligence in the educational field can be said to be a paradigm shift due to the existence of many studies in the recent period on this subject matter. The rate at which adoption of AI technologies is occurring is extremely high and needs technology and policies to adapt accordingly.

According to an analysis of recent data, this level of adoption is quite massive in nature. It has been found that an extremely high proportion of 92% of the total student population makes use of the AI tools in order to complete their academic work (New Data). Also, the HEPI Student Generative Artificial Intelligence Survey 2026 proves these trends,

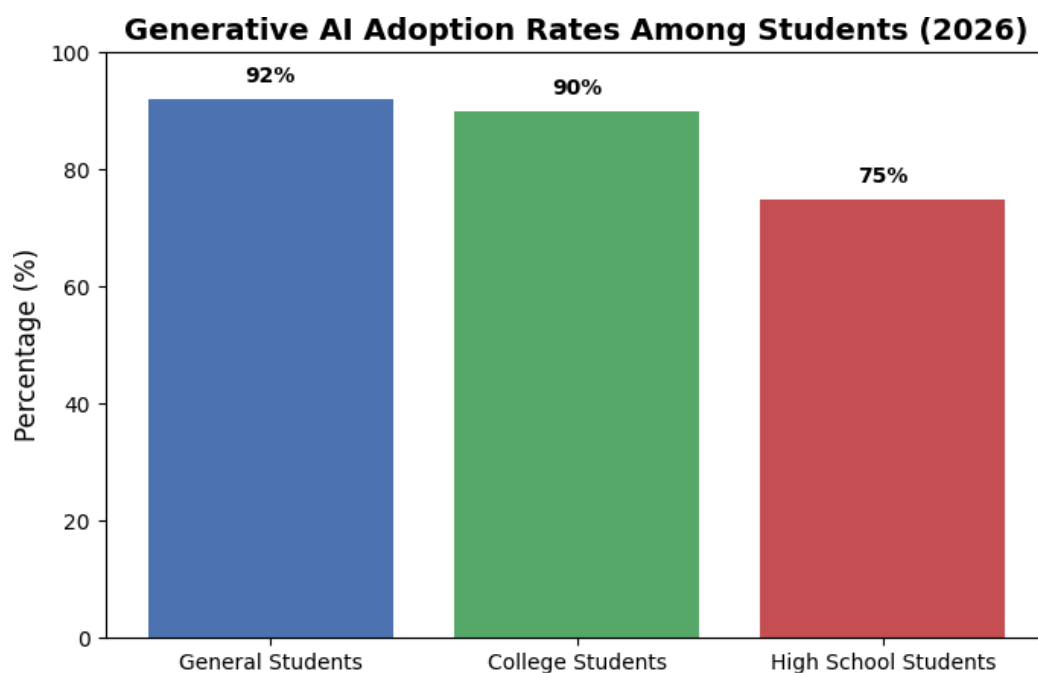
stating that these high rates of adoption are maintained at all levels of education. In the context of higher education, the rate at which AI tools are being used by students reaches up to 90%.

AI impact is also highly pronounced in secondary education. There was a recent study that shows that most high school students use Generative AI in doing their work in school. While this brings about unique educational possibilities such as highly personalized clearing of doubts and custom competition examination preparation, it poses quite some challenges to high school teachers who are working on adapting their curriculum to this new technology (Bowdoin College).

This wide adoption is however fraught with serious dangers. Velvetech discusses serious issues like dangers of breach of data privacy, possibility of AI tutoring models being biased and ethical challenges of implementing AI in schools. On the other hand, Discovery Education offers a balance by comparing the immense benefits that can be brought about by AI such as efficiency and personalized learning with risks involved.

### AI Adoption Trends

The following chart illustrates the reported adoption rates of Generative AI across different student demographics based on the synthesized literature:



## The History and Evolution of Pedagogical Support Systems

### 1.1 The Era of Rote Learning and Static Classroom Formats

For almost all of India's modern educational history following independence, a centralized, static classroom format reigned supreme. There was an overwhelming prevalence of high student-to-teacher ratios, uniform pacing instructions, and a deep cultural tradition of memorization-heavy metrics. This mechanism ensured standardized evaluation systems across highly diverse regions, required minimal advanced technological setups from local authorities, and operated inside an established social fabric. However, the structural reliance on static formats introduced significant macro-level drawbacks. It resulted in significant financial burdens on families due to parallel private commercial tutoring needs, restricted deep cognitive curiosity, and widened performance disparities between socio-economic groups.

### 1.2 The Dawn of Commercial EdTech and Video Mentorship Platforms

Electronic Educational Technology (EdTech) emerged as a potential replacement for purely localized offline academic support systems. Early digital systems found wide consumer acceptance across India in the late 2010s owing to private tech corporations targeting tech-literate families. A digital subscription allowed a student to view pre-recorded instructional modules, while automated multiple-choice tests facilitated immediate grading. The network delivery for these systems was accelerated by international cloud computing architectures and localized telecommunication developments. Though it introduced modern visual elements to learning, the expansion of traditional EdTech formats faced major roadblocks. Families had to shell out substantial yearly subscription premiums per course. For a nation where a large percentage of households operate on tight monthly budgets, dedicating substantial capital to multiple digital subscription services was highly impractical.

## The Genesis of Artificial Intelligence in Secondary Education

### 1.3 How the Conversational AI Learning Journey Started

Considering the structural limitations of offline classrooms and the commercial barriers of premium EdTech platforms, the National Education Policy (NEP) guidelines emphasized the critical role of technology integration. This led to initiatives across both private software enterprises and public open-source consortiums to create scalable, intelligent solutions. The objective was to unify diverse localized learning curricula under cohesive digital environments that adapt directly to the consumer's performance level. Technology labs introduced specialized automated problem-solving models around 2021, which deployed neural processing to identify text elements within scientific equations. However, these early setups required exact syntax inputs and delivered rigid pre-programmed responses, making them unsuitable for addressing multi-layered student doubts. The complete breakthrough occurred with the rollout of refined conversational LLMs and open APIs in late 2022, which allowed the transformation of standard mobile devices into fully responsive personal tutors.

### 1.4 Core Mechanics of Adaptive Learning Engines

The static module pathways strictly comply with the traditional educational digital platforms. It is completely different when artificial intelligence is brought into the picture with the introduction of Prompt-Based Personalization. In other words, text inputs are transformed into specific instructional pathways. The entire architecture works through an interoperable four-party structure, which consists of the Front-End Application Interface, the Core Orchestration Layer (context retrieval management), deep Knowledge Databases (consisting of valid national curriculums), and the Generative Foundation LLM. When the student submits a complex formula of mathematics, the system will analyze the visual input using computer vision algorithms. Then, the system will translate the data matrices into mathematical abstractions and reference pedagogical rules to create customized breakdowns. This entire procedure takes just a few seconds without the need for textbooks and expensive mentors at all.

## How AI Transformed Study Methods for 12th-Grade Students in India

### 1.5 Specialized Competitive Exam Prep (JEE/NEET) and Regional Demands

The advent of artificial intelligence has brought down the geographical distances which have for ages segregated the best coaching centers of metropolitan cities from learners in rural areas. This change is especially significant in the area of competitive entrance exams (JEE, NEET, etc.). The most significant changes can be seen in small non-metropolitan towns. 12th-grade aspirants who were previously excluded from advanced

training systems due to high hostel and coaching expenses have actively adopted specialized AI chat configurations. The accessible nature of open generative platforms ensures that these students can test their analytical steps against institutional rubrics without fee requirements. A basic smartphone has effectively replaced expensive physical coaching infrastructures.

### 1.6 Hyper-Personalized Doubt Clearance and Democratization of Supplementary Learning

AI learning software acts essentially as a scalable public utility rather than a restrictive luxury commodity. This design has initiated a massive wave of educational democratization across tier-2 and tier-3 demographic areas. The technology helps in narrowing the disparity between the inadequately equipped public school environments and organized systems of academic tutoring by providing the students with customized digital learning trails. This is achieved as learners who used to find it difficult to follow rapid classroom instruction can now utilize iterative chats to acquire the basic skills at their own pace.

### Traditional Reference Materials vs. AI Tutoring Platforms: The Current Scenario

The direct structural comparison between legacy physical reference guides and modern automated AI interfaces highlights the ongoing modernization of study workflows for senior secondary students.

| Functional Attribute         | Traditional Reference Materials & Printed Guides                           | AI-Powered Adaptive Tutoring Platforms                                             |
|------------------------------|----------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| <b>Pedagogical Feedback</b>  | Static text blocks; errors in student reasoning remain undetected.         | Dynamic interactive dialogue; parses user step-by-step logic and pinpoints errors. |
| <b>Financial Barrier</b>     | Requires recurrent purchases of updated question banks and guides.         | Extremely low cost or open-access models using standard data connections.          |
| <b>Content Customization</b> | Uniform presentation for all learners, disregarding individual skill gaps. | Hyper-personalized adjustment of difficulty based on real-time accuracy.           |
| <b>Response Velocity</b>     | Time-consuming manual indexing through indexes and answer keys.            | Instantaneous multi-perspective explanation generation within seconds.             |
| <b>Scope of Capability</b>   | Fixed text constraints; cannot parse uploaded handwritten problems.        | Multimodal execution; handles images, voice prompts, and code blocks seamlessly.   |

Table 1: Structural comparison between static printed reference materials and interactive AI tutoring architectures.

### Important statistical data for AI in Education

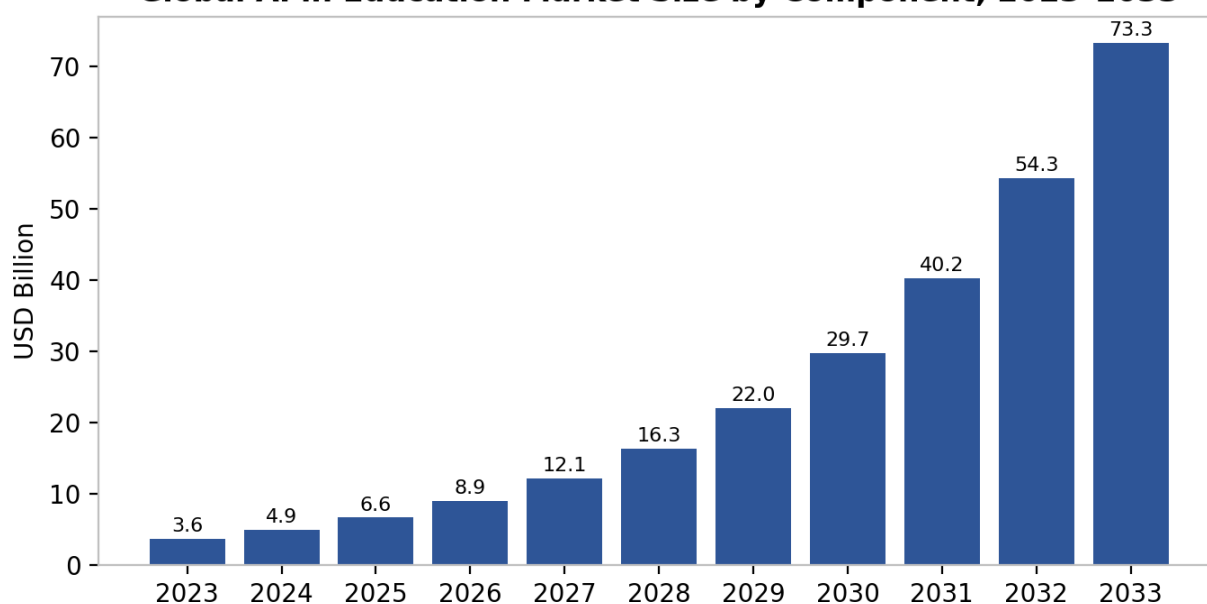
- [Global AI in Education Market — Size by Component](#)

The global AI in education market was estimated at \$3.6 billion in 2023 and is projected to reach \$73.3 billion by 2033, reflecting a compound annual growth rate (CAGR) of 35.10%. The market is segmented into Solution and Services components, with Solutions consistently accounting for the larger share throughout the forecast period.

| Year | Total Market Size (USD Billion) |
|------|---------------------------------|
| 2023 | 3.6                             |
| 2024 | 4.9                             |
| 2025 | 6.6                             |
| Year | Total Market Size (USD Billion) |
| 2026 | 8.9                             |
| 2027 | 12.1                            |
| 2028 | 16.3                            |
| 2029 | 22.0                            |
| 2030 | 29.7                            |
| 2031 | 40.2                            |
| 2032 | 54.3                            |
| 2033 | 73.3                            |

Source: market.us, via Electro IQ.

**Global AI in Education Market Size by Component, 2023-2033**



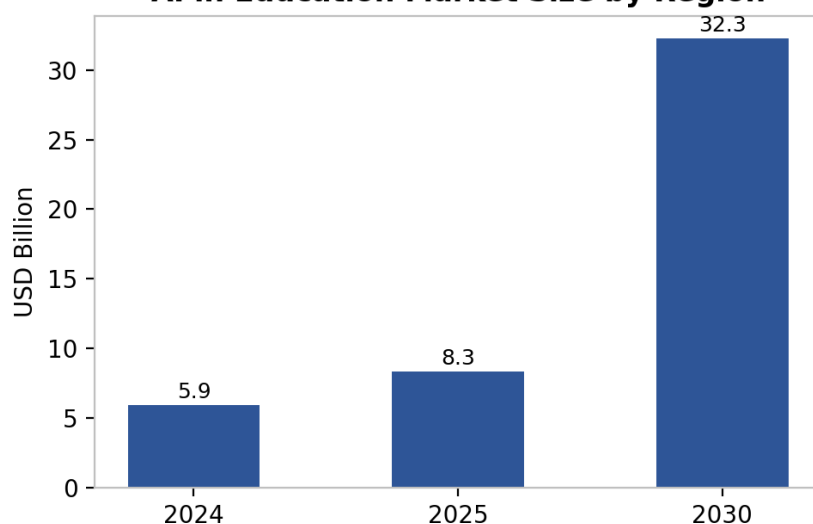
- [AI in Education Market — Size by Region](#)

Grand View Research data (presented via Velvettech) tracks the AI in education market by region from 2018 through 2030. North America has historically represented the largest regional share, with Asia Pacific showing the fastest projected growth. Selected total market-size data points are shown below.

| Year | Total Market Size (USD Billion) |
|------|---------------------------------|
| 2024 | 5.9                             |
| Year | Total Market Size (USD Billion) |
| 2025 | 8.3                             |
| 2030 | 32.3                            |

Source: Grand View Research, via Velvettech.

#### AI in Education Market Size by Region



- AI in Education Market — Global Forecast (Vision Research Reports)

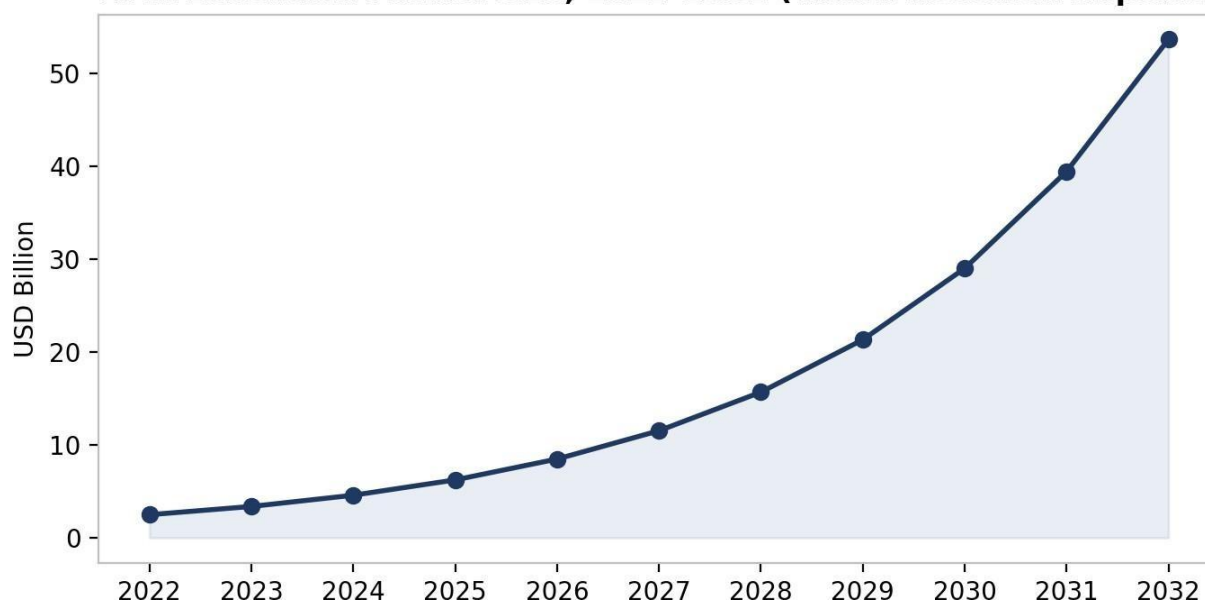
A separate independent forecast from Vision Research Reports estimates the market at \$2.48 billion in 2022, rising steadily to \$53.71 billion by 2032. While the absolute figures differ from other sources due to differing scope and methodology, all forecasts agree on strong double-digit-percentage annual growth through the next decade.

| Year | Market Size (USD Billion) |
|------|---------------------------|
| 2022 | 2.48                      |
| 2023 | 3.37                      |
| 2024 | 4.58                      |
| 2025 | 6.23                      |
| 2026 | 8.48                      |
| 2027 | 11.53                     |

| 2028 | 15.69                     |
|------|---------------------------|
| 2029 | 21.34                     |
| Year | Market Size (USD Billion) |
| 2030 | 29.03                     |
| 2031 | 39.48                     |
| 2032 | 53.71                     |

Source: Vision Research Reports ([visionresearchreports.com](http://visionresearchreports.com)).

#### AI in Education Market Size, 2022-2032 (Vision Research Reports)



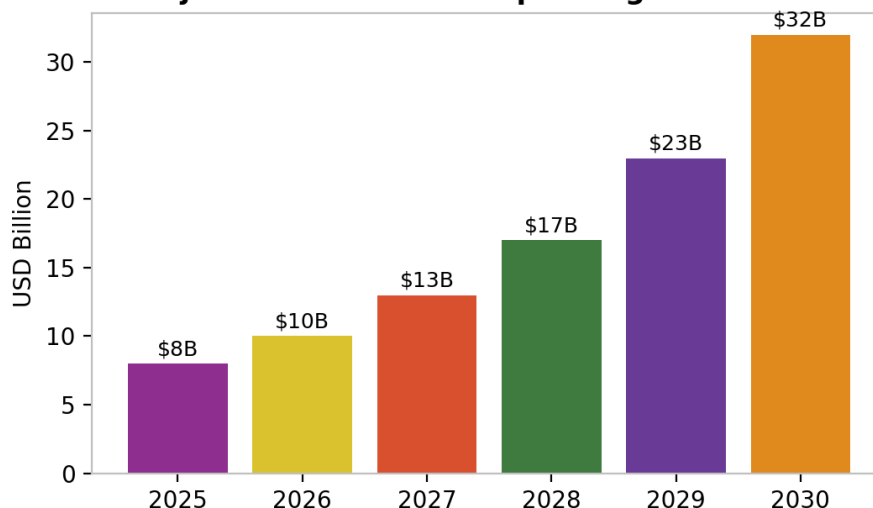
- Projected Growth of AI Spending in Education

SQ Magazine's projection of AI spending in education (a narrower measure than total market size) shows spending rising from \$8 billion in 2025 to \$32 billion by 2030 — a four-fold increase in five years.

| Year | Projected AI Spending (USD Billion) |
|------|-------------------------------------|
| 2025 | 8                                   |
| 2026 | 10                                  |
| 2027 | 13                                  |
| 2028 | 17                                  |
| 2029 | 23                                  |
| 2030 | 32                                  |

Source: SQ Magazine.

### Projected Growth of AI Spending in Education



- Students' Use of AI — Key Statistics

- 92% of students use AI in their studies.
- Over half of students use AI at least once a week.
- Nearly 1 in 5 students (18%) leave unedited AI-generated content in their work.
- Around half of all students who use AI do so to save time and improve their work.
- 66% of students use ChatGPT, making it the most popular AI tool among students.
- 58% of students believe they do not possess sufficient AI knowledge or skills.
- The AI-powered education market is projected to surpass \$20 billion by 2027.

Source: PR Newswire / student AI usage survey.

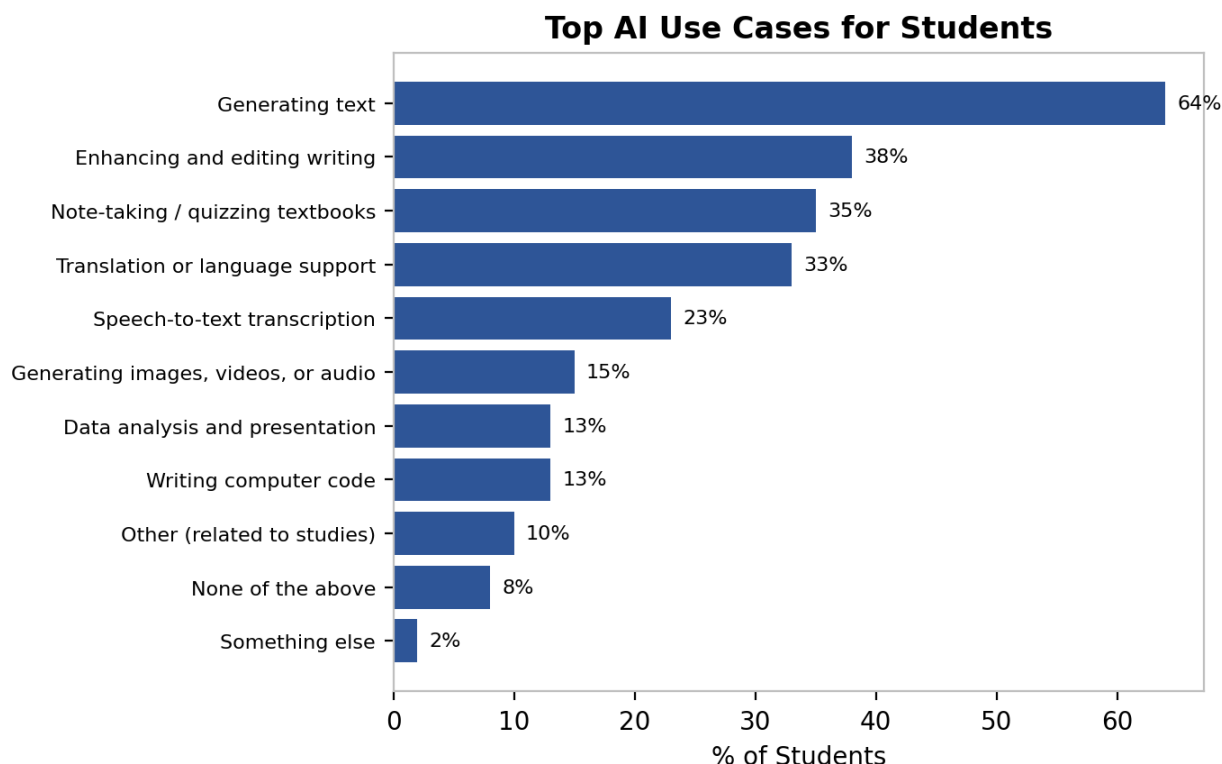
- Top AI Use Cases for Students

Generating text is by far the most common use of generative AI among students at 64% — a figure that has more than doubled in the space of twelve months. Enhancing/editing writing, note-taking and translation support follow as the next most common uses.

| Use Case                                    | % of Students |
|---------------------------------------------|---------------|
| Generating text                             | 64%           |
| Enhancing and editing writing               | 38%           |
| Note-taking / quizzing university textbooks | 35%           |
| Translation or language support             | 33%           |
| Speech-to-text transcription                | 23%           |
| Generating images, videos, or audio         | 15%           |
| Use Case                                    | % of Students |
| Data analysis and presentation              | 13%           |
| Writing computer code                       | 13%           |
| Other (related to studies)                  | 10%           |

|                   |    |
|-------------------|----|
| None of the above | 8% |
| Something else    | 2% |

Source: PR Newswire (values approximated from chart).



- Top 10 Most Beneficial AI Use Cases (Students)

Among students who actively use AI tools, resume and cover-letter building is rated the most beneficial use case, followed closely by AI writing assistants and personalized content recommendations.

| Rank | Use Case                                | Area of Focus         |
|------|-----------------------------------------|-----------------------|
| 1    | AI for resume and cover letter building | Placement             |
| =2   | AI writing assistants                   | Learning support      |
| =2   | Personalized content recommendations    | Personalized learning |
| Rank | Use Case                                | Area of Focus         |
| 4    | AI research tools                       | Research              |
| 5    | Adaptive assessment                     | Assessment            |
| 6    | AI tutoring chatbots                    | Tutoring              |
| 7    | AI personalized learning paths          | Personalized learning |
| 8    | Mock interview with an AI avatar        | Placement             |

|    |                                                   |                 |
|----|---------------------------------------------------|-----------------|
| 9  | AI for assessing skills and recommending careers  | Career guidance |
| 10 | AI live transcription and/or translation in class | Accessibility   |

*Note: exact percentage values for ranks 4–10 were not fully legible in the source image; ranking order is reproduced as captured.*

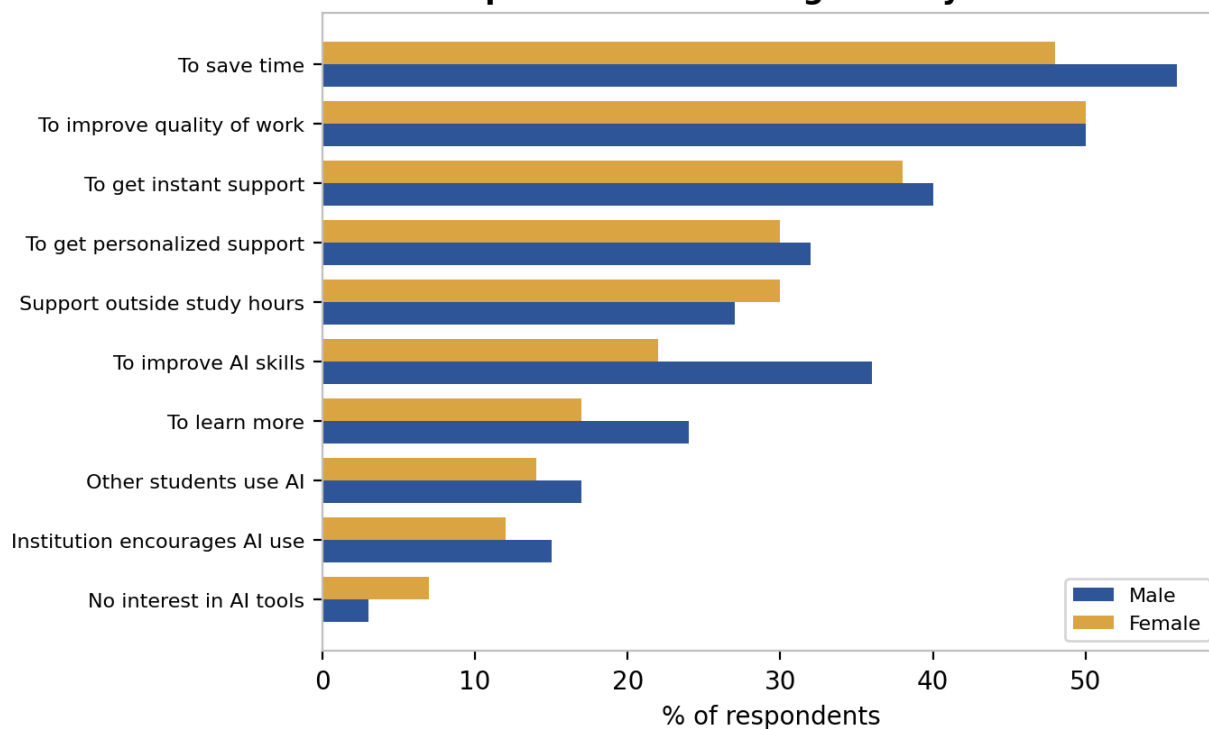
- Reasons for Using AI — by Gender

Time-saving is the top reason both genders use AI, though men cite it noticeably more often (56% vs. 48%). The largest gender gap is in the desire to improve AI skills: 36% of men cite this versus 22% of women.

| Reason                                         | Male | Female |
|------------------------------------------------|------|--------|
| To save time                                   | 56%  | 48%    |
| To improve the quality of work                 | 50%  | 50%    |
| To get instant support                         | 40%  | 38%    |
| To get personalized support                    | 32%  | 30%    |
| To get support outside traditional study hours | 27%  | 30%    |
| To improve AI skills                           | 36%  | 22%    |
| To learn more                                  | 24%  | 17%    |
| Because other students use AI                  | 17%  | 14%    |
| Their institution encourages AI use            | 15%  | 12%    |
| Nothing: no interest in AI tools               | 3%   | 7%     |

*Source: Higher Education Policy Institute (values approximated from chart).*

### Top Reasons for Using AI — by Gender



- Reasons for NOT Using AI in Studies — by Gender

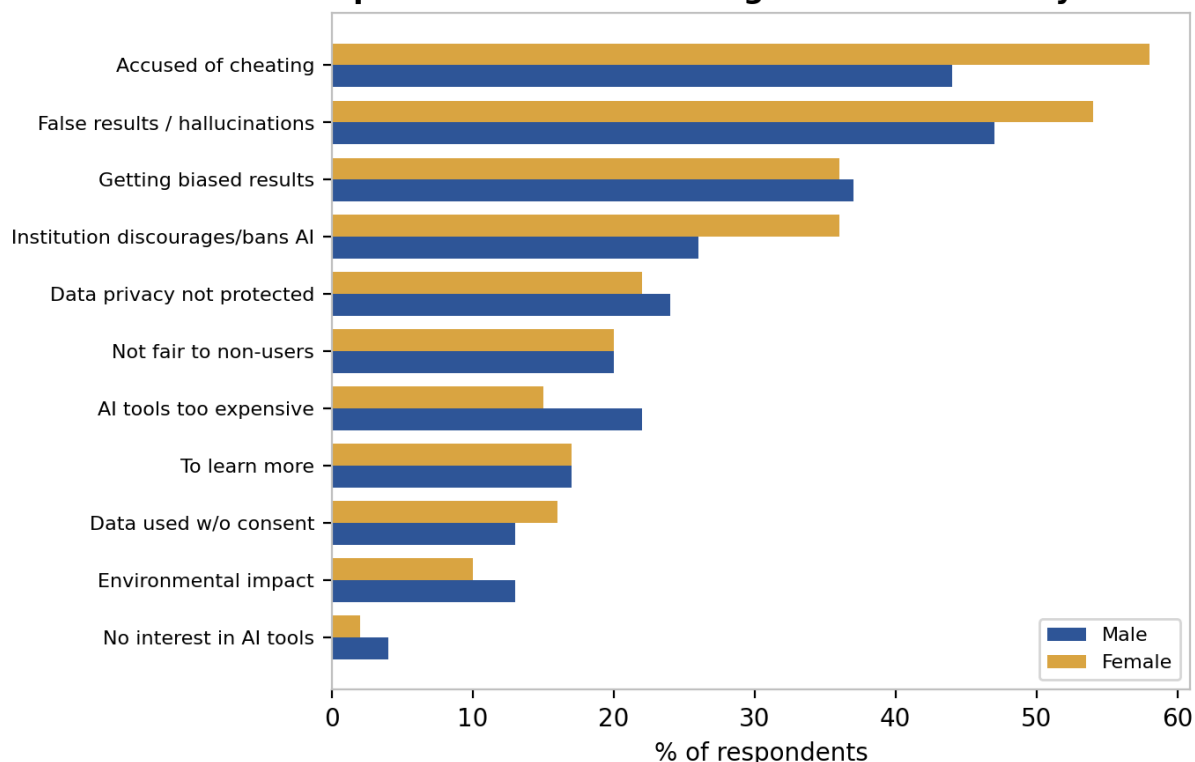
Fear of being accused of cheating is the leading reason students avoid AI, cited by 53% overall and disproportionately by women (58% vs. 44% for men). Women are also 10 percentage points more likely than men to be discouraged by institutional bans on AI use (36% vs. 26%).

| Reason                                                  | Male | Female |
|---------------------------------------------------------|------|--------|
| Being accused of cheating by their institution          | 44%  | 58%    |
| Getting false results / hallucinations                  | 47%  | 54%    |
| Getting biased results                                  | 37%  | 36%    |
| Their institution discourages or bans the use of AI     | 26%  | 36%    |
| Not enough is done to protect data privacy              | 24%  | 22%    |
| It is not fair to other students who do not use AI      | 20%  | 20%    |
| AI tools are too expensive                              | 22%  | 15%    |
| To learn more                                           | 17%  | 17%    |
| Use of data to train AI models without authors' consent | 13%  | 16%    |
| Reason                                                  | Male | Female |
| The environmental impact                                | 13%  | 10%    |

|                                  |    |    |
|----------------------------------|----|----|
| Nothing: no interest in AI tools | 4% | 2% |
|----------------------------------|----|----|

Source: Higher Education Policy Institute (values approximated from chart).

### Top Reasons for NOT Using AI in Studies — by Gender

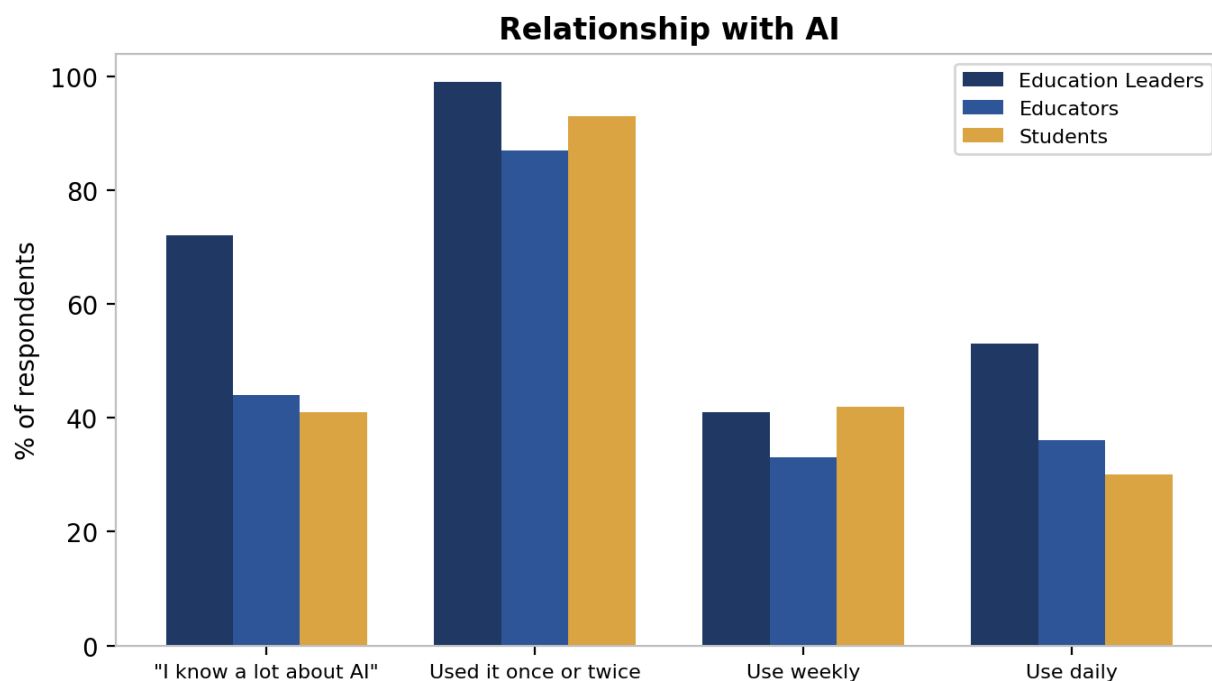


- Relationship with AI — Leaders, Educators & Students

Education leaders report the highest self-assessed AI knowledge and the highest daily usage rates of the three groups. Nearly all respondents across all three groups — 87–99% — have used AI at least once or twice for school-related purposes.

| Measure                                                    | Education Leaders | Educators | Students |
|------------------------------------------------------------|-------------------|-----------|----------|
| Likely to say "I know a lot about AI"                      | 72%               | 44%       | 41%      |
| Used it at least once or twice for school-related purposes | 99%               | 87%       | 93%      |
| Use it weekly for school-related purposes                  | 41%               | 33%       | 42%      |
| Use it daily for school-related purposes                   | 53%               | 36%       | 30%      |

Source: Microsoft, *AI in Education Report*, 2025. Student figures are US only.

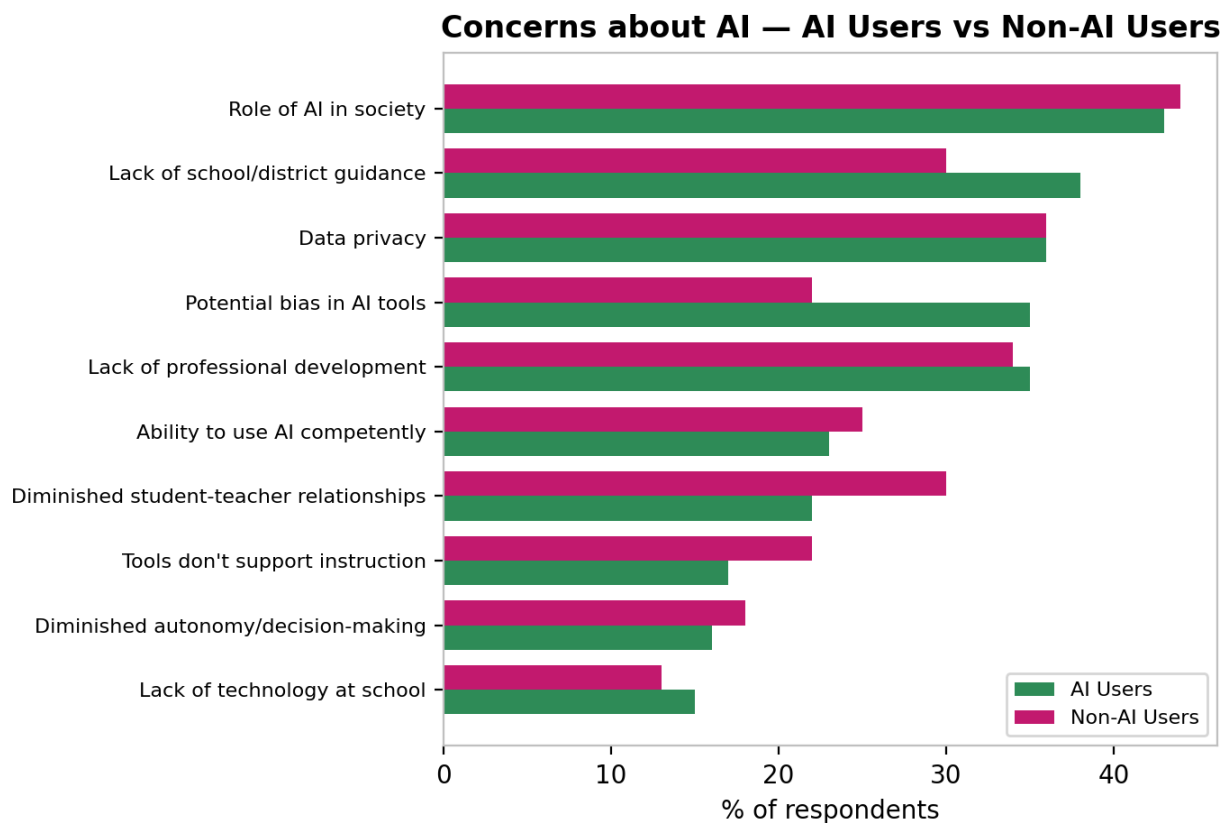


- Educator & Teacher Concerns about AI

Concerns about AI's broader role in society rank highest for both AI users and non-users alike. AI users are notably more concerned about the lack of school or district guidance (38% vs. 30%) and about potential bias in AI tools (35% vs. 22%) than non-users, while non-users are more worried about diminished student-teacher relationships (30% vs. 22%).

| Concern                                                   | AI Users | Non-AI Users |
|-----------------------------------------------------------|----------|--------------|
| Concerns regarding the role of AI in society as a whole   | 43%      | 44%          |
| Lack of school or district guidance on using AI tools     | 38%      | 30%          |
| Concerns about data privacy                               | 36%      | 36%          |
| Concerns about potential bias in AI tools and products    | 35%      | 22%          |
| Lack of professional development for using AI tools       | 35%      | 34%          |
| Concerns about my ability to use AI tools competently     | 23%      | 25%          |
| Concerns AI will diminish student-teacher relationships   | 22%      | 30%          |
| AI tools do not meaningfully support my instruction       | 17%      | 22%          |
| Concerns AI will diminish my autonomy and decision-making | 16%      | 18%          |
| Concern                                                   | AI Users | Non-AI Users |
| Lack of technology at my school/district to use AI tools  | 15%      | 13%          |

Source: RAND, American School District Panel, and CRPE, via AIPRM (values approximated from chart).



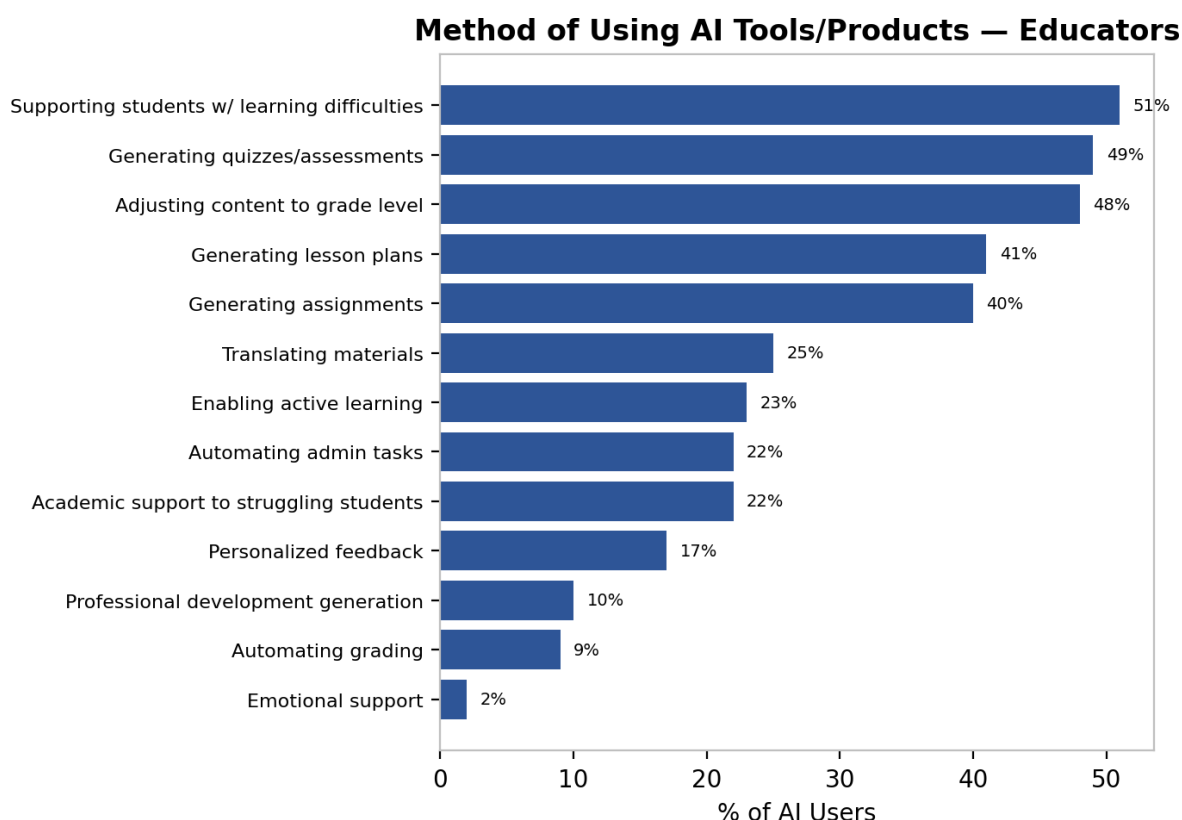
- Methods of Using AI Tools — Educators

Among educators who use AI, the most common applications are instructional support tasks: supporting students with learning difficulties (51%), generating quizzes and assessments (49%), and adjusting content to grade level (48%). Emotional support to struggling students is the least common use case at just 2%.

| Method                                                     | % of AI Users |
|------------------------------------------------------------|---------------|
| Supporting students with learning difficulties             | 51%           |
| Generating quizzes and assessments                         | 49%           |
| Adjusting content to an appropriate grade level            | 48%           |
| Generating lesson plans                                    | 41%           |
| Generating assignments (e.g. worksheets)                   | 40%           |
| Method                                                     | % of AI Users |
| Translating speech or written materials to other languages | 25%           |
| Enabling active learning experiences                       | 23%           |
| Automating or assisting administrative tasks               | 22%           |
| Providing academic support to struggling students          | 22%           |

|                                                          |     |
|----------------------------------------------------------|-----|
| Providing personalized feedback to my students           | 17% |
| Generating professional development opportunities        | 10% |
| Automating or assisting grading of tests and assessments | 9%  |
| Providing emotional support to struggling students       | 2%  |

Source: RAND, American School District Panel, and CRPE, via AIPRM.



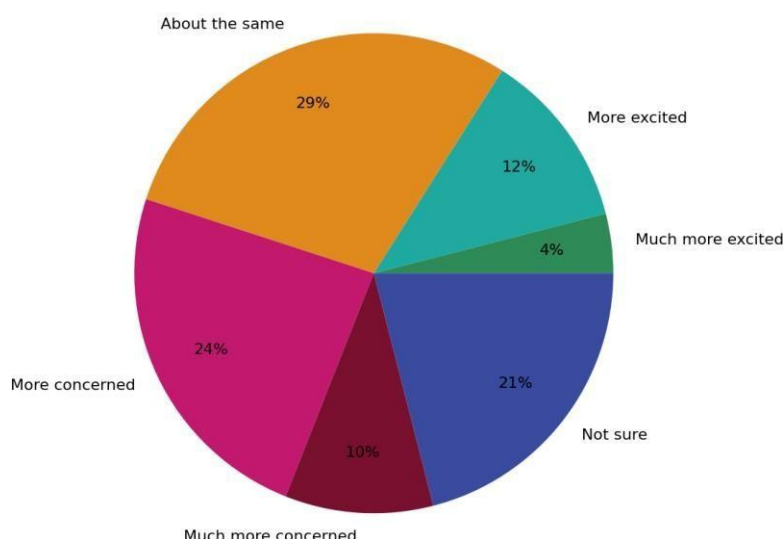
- Parent Sentiment on AI in Their Child's Life

Parents are more divided than excited: 34% report being more or much more concerned about AI's role in their child's life, versus 16% who report being more or much more excited. Nearly a third (29%) feel about the same, and 21% are unsure.

| Sentiment           | % of Parents |
|---------------------|--------------|
| Much more excited   | 4%           |
| More excited        | 12%          |
| About the same      | 29%          |
| More concerned      | 24%          |
| Much more concerned | 10%          |
| Not sure            | 21%          |

Source: *Internet Matters*, via AIPRM.

#### How Parents Feel About AI in Their Child's Life



- AI Research Publications in STEM Education (2016–2023)

Publication volume in AI-for-STEM-education research shows two distinct phases: an initial slow-growth stage from 2016 to 2019 with a low volume of published articles, followed by a period of rapid, accelerating growth from 2019 through 2023, during which both the annual and cumulative publication counts rose sharply — cumulative output reached its highest point in 2023.

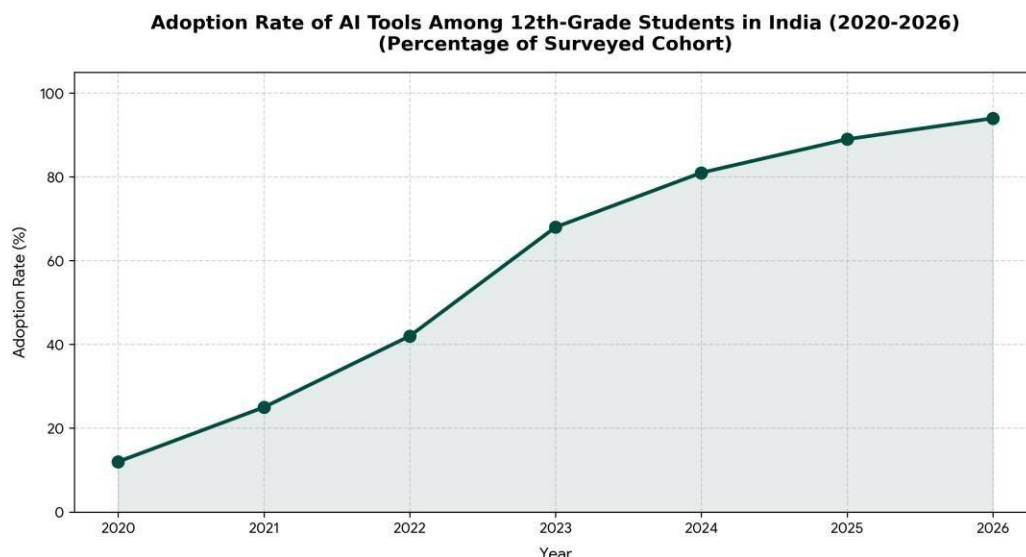
*Note: precise publication counts were not legible in the source figure; only the described growth trend is reproduced. Source: ResearchGate, figure uploaded by Junjie Gavin Wu.*

- Notes on Sources & Methodology

This report compiles statistics captured from a series of market-research and survey screenshots (market.us/Electro IQ, DemandSage, Grand View Research/Velvetech, Microsoft, AIPRM, Vision Research Reports, SQ Magazine, ResearchGate, and Higher Education Policy Institute/PR Newswire sources). Figures reproduced from bar and line charts without printed data labels are approximate, read visually from the chart axes, and are flagged as such above. Where sources disagree on total market size, this reflects differing scope, segmentation, and methodology across research firms rather than an error in transcription.

#### Data Analysis: Growth of AI Adoption in Secondary Education

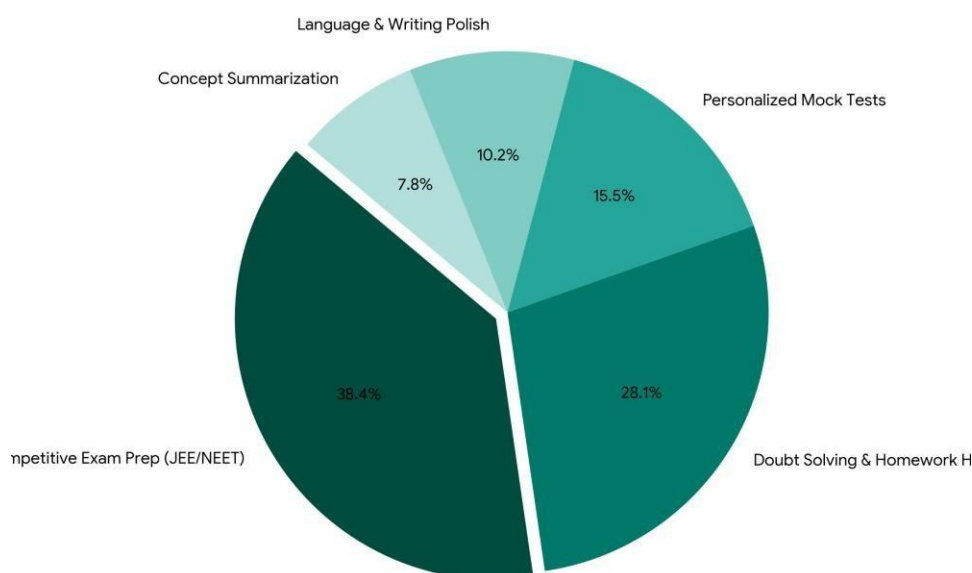
Analysis of student usage analytics reveals a major acceleration in the integration of AI tools within national study routines over the past few years. The total adoption rate among senior secondary students has shown an intense upward path, particularly following the widespread availability of fine-tuned language applications. The deep footprint of these intelligent tools indicates that AI has transitioned from an experimental utility to a core academic support mechanism across diverse regional boards.



*Figure 1: Evolution of AI-tool utilization rates among 12th-grade students preparing for national exams (2020-2026).*

The categorical distribution of usage metrics reveals a balanced relying profile. While competitive entrance training remains the dominant driver of AI interactions, automated doubt clearance platforms and responsive evaluation engines have captured massive shares, showing how deeply AI has integrated into everyday study workflows.

**Primary Modalities of AI Tool Utilization by 12th-Grade Students (2026)**



*Figure 2: Allocation of student-AI interactions across primary study tasks during the academic cycle (2026).*

### 1.7 Case Studies of High-Stakes Exam Integration

The implementation of AI diagnostics within semi-urban government schools in competitive clusters offers an instructive case study. Prior to this integration,

students relied on limited remedial classes to clarify doubts in complex Science and Mathematics domains, which often resulted in performance drops due to time constraints and lack of personal feedback loops. The deployment of voice-enabled, localized language models changed this operational cycle entirely. By providing immediate speech-to-text inputs and multilingual translations of advanced physics principles, the deployment enabled students to bypass vocabulary barriers. The schools recorded a measurable rise in mock test averages and structural problem comprehension, showing that accessible AI can level the playing field.

An identical dynamic is visible in the usage patterns of students preparing for national board English and elective subject evaluations. In the past, descriptive answer writing has been affected by the absence of an immediate grading rubric for the answers written. Through the use of automated grading APIs to give instant feedback on the structure, grammar, and context of the essays, students were able to improve their essay structures before evaluation, thus relieving themselves of performance anxiety.

### Statistical Analysis of AI Usage among Students

#### Chi-Square Goodness-of-Fit Test

This test evaluates whether the various factors students consider are equally important, i.e. whether the observed distribution of responses matches a uniform (equally weighted) expected distribution.

$H_0$ : All parameters (usage factors) are equally important — expected share is equal across all categories (100% distributed equally).

$H_1$ : The parameters are not equally important.

$$\chi^2 = \sum_{i=1}^k \frac{(O_i - E_i)^2}{E_i}$$

| Factor                      | Observed (O) | Expected (E) | (O – E) <sup>2</sup> / E | Expected Share |
|-----------------------------|--------------|--------------|--------------------------|----------------|
| Daily user                  | 47           | 50           | 0.18                     | 16.67%         |
| Formal training in AI       | 8            | 50           | 35.28                    | 16.67%         |
| Session length > 15 min     | 66           | 50           | 5.12                     | 16.67%         |
| Uses AI output as-is        | 12           | 50           | 28.88                    | 16.67%         |
| Too dependent on AI         | 64           | 50           | 3.92                     | 16.67%         |
| Provides correct/right info | 40           | 50           | 2.00                     | 16.67%         |
| Improved grades             | 57           | 50           | 0.98 (≈ equal)           | 16.67%         |

$$\chi^2(\text{calculated}) = 76.36$$

$$df = 8$$

$$p\text{-value} = \approx 0 \text{ (} p < 0.001 \text{)}$$

**Decision: Reject  $H_0$  — the usage factors are not equally weighted by students; some factors (e.g. formal training, using AI output as-is) diverge sharply from the expected uniform share.**

### Chi-Square Tests of Independence

The following tests examine whether frequency of AI use (Daily vs. Occasional) is associated with other survey categories, using the same statistic:

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

#### ➤ Frequency of Use vs. Survey Categories (Overall Table)

| Category                      | Daily User | Occasional | Total |
|-------------------------------|------------|------------|-------|
| [label not legible in source] | 27         | 31         | 58    |
| Formal training in AI         | 54         | 4          | 58    |
| Session length                | 38         | 20         | 58    |
| Uses AI output as-is          | 7          | 51         | 58    |
| Too dependent on AI           | 37         | 21         | 58    |
| Provides right/correct info   | 23         | 35         | 58    |
| Improved grades               | 33         | 25         | 58    |
| Uses paid version             | 2          | 56         | 58    |

$H_0$ : Category of usage practice is independent of frequency of use (Daily / Occasional).

$H_1$ : Category of usage practice is dependent on frequency of use.

$$\chi^2(\text{calculated}) = 139.9$$

$$df = 7$$

$$p\text{-value} = \approx 0$$

**Decision: Reject  $H_0$  — usage practices are significantly dependent on how frequently AI is used.**

#### ➤ Frequency of Use vs. Grade Improvement

|  | Grade Improved | Not Improved | Total |
|--|----------------|--------------|-------|
|  |                |              |       |

|                    |    |    |    |
|--------------------|----|----|----|
| Daily AI user      | 21 | 6  | 27 |
| Occasional AI user | 12 | 19 | 31 |
| Total              | 33 | 25 | 58 |

H<sub>0</sub>: AI-usage frequency and grade improvement are independent. H<sub>1</sub>: AI-usage frequency and grade improvement are dependent.  $\chi^2_1(\text{calculated}) = 8.98$

**p-value = 0.0027**

**Decision: Reject H<sub>0</sub> — daily AI use is significantly associated with reported grade improvement.**

➤ Frequency of Use vs. Dependency Level

|                      | Grade Improved Group | Not Improved Group | Total |
|----------------------|----------------------|--------------------|-------|
| Too dependent on AI  | 23                   | 14                 | 37    |
| Not / less dependent | 10                   | 11                 | 21    |
| Total                | 33                   | 25                 | 58    |

H<sub>0</sub>: Dependency level and grade-improvement grouping are independent. H<sub>1</sub>: Dependency level and grade-improvement grouping are dependent.  $\chi^2_2(\text{calculated}) = 1.155$

**p-value = 0.282**

**Decision: Fail to reject H<sub>0</sub> — no significant association found (independent).**

➤ Formal Training vs. Grade-Improvement Grouping

|                    | Grade Improved Group | Not Improved Group | Total |
|--------------------|----------------------|--------------------|-------|
| No formal training | 30                   | 24                 | 54    |
| Formal training    | 3                    | 1                  | 4     |
| Total              | 33                   | 25                 | 58    |

H<sub>0</sub>: Formal AI training and the grade-improvement grouping are independent. H<sub>1</sub>: Formal AI training and the grade-improvement grouping are dependent.  $\chi^2_3(\text{calculated}) = 0.574$

**p-value = 0.449**

**Decision: Fail to reject H<sub>0</sub> — no significant association found (independent).**

➤ Answer Accuracy vs. Grade-Improvement Grouping

|                  | Grade Improved Group | Not Improved Group | Total |
|------------------|----------------------|--------------------|-------|
| Correct answer   | 13                   | 10                 | 23    |
| Incorrect answer | 20                   | 15                 | 35    |
| Total            | 33                   | 25                 | 58    |

$\chi^2_{(calculated)} = 2.183$

**p-value** = 0.927 (as recorded)

**Decision:** Fail to reject  $H_0$  — no significant association found (independent).

• Z-Test for Population Proportion

Tests whether more than half of students found AI genuinely helpful.  $H_0: p = 0.50$  (50% of students find AI helpful).

$H_1: p > 0.50$  (more than 50% find AI helpful) one-tailed, right-sided test. Sample size  $n = 58$ , sample proportion  $\hat{p} = 0.57$  (57% reported AI as helpful).

Validity Check

$$n \cdot p_0 = 58 \times 0.50 = 29 \geq 10 \quad \checkmark$$

$$n \cdot (1 - p_0) = 58 \times 0.50 = 29 \geq 10 \quad \checkmark$$

Standard Error

$$SE = \sqrt{\frac{p_0(1 - p_0)}{n}} = \sqrt{0.50 \times 0.50 / 58} \approx 0.0657$$

Test Statistic

$$z = \frac{\hat{p} - p_0}{SE} = \frac{0.57 - 0.50}{0.0657} \approx 1.066$$

**Critical value (5% significance, one-tailed)** = 1.645

**p-value** = 0.143

Comparison:  $z = 1.066 < \text{critical} = 1.645$

**Decision:** Fail to reject  $H_0$ . At the 5% significance level, there is insufficient evidence to conclude that more than half of students found AI genuinely helpful ( $p = 0.143 > \alpha = 0.05$ ).

Although the sample proportion (57%) is directionally above the hypothesized 50%, this difference is not statistically significant given the sample size ( $n = 58$ ).

- **Welch's t-Test — Global vs. India AI Market Size**

Compares the mean AI-market size (USD Billion) of the Global market against India, using annual figures from 2019–2026.

| Year             | Global (USD Bn) | India (USD Bn) |
|------------------|-----------------|----------------|
| 2019             | 64              | 2.3            |
| 2020             | 94              | 3              |
| 2021             | 207             | 3.9            |
| 2022             | 127             | 5.2            |
| 2023             | 168             | 6.2            |
| Year             | Global (USD Bn) | India (USD Bn) |
| 2024             | 192             | 8.7            |
| 2025             | 381             | 11.4           |
| 2026 (projected) | 540             | 12.2           |

Adoption-rate context noted alongside the dataset: school-level adoption 82–92%, college-level adoption 89–95%, and roughly 50% of users engaging with AI tools at least once a week.

$H_0: \mu(\text{Global}) = \mu(\text{India})$  — mean market size is equal.

$H_1: \mu(\text{Global}) > \mu(\text{India})$  — the global market mean exceeds India's.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\frac{s}{\sqrt{n}}}$$

| Statistic          | Global  | India  |
|--------------------|---------|--------|
| Mean ( $\bar{x}$ ) | 221.625 | 6.6125 |
| Std. Dev. (s)      | 160.721 | 3.773  |
| n                  | 8       | 8      |

**t (calculated)** = 3.783

**df (Welch-adjusted)** = 7.00

**p-value** =  $3.426 \times 10^{-3} \approx 0.003$

**Decision:** Since **p (0.003) < 0.05**, reject **H<sub>0</sub>** — the global AI market size is significantly larger than India's.

• **CAGR Growth Projection — India AI Market**

A compound annual growth rate (CAGR) projection carried the India AI-market figure forward year by year.

$$CAGR = \left( \frac{FV}{IV} \right)^{\frac{1}{n}} - 1$$

(FV = future value, IV = initial value, n = number of years — the average annual growth rate.)

| Year | Projected Value (USD Bn) |
|------|--------------------------|
| 2020 | 1.32                     |
| 2021 | 1.82                     |
| 2022 | 2.48                     |
| 2023 | 3.37                     |
| 2024 | 4.58                     |
| 2025 | 6.23                     |
| 2026 | 8.48                     |
| 2027 | 11.53                    |
| 2028 | 15.69                    |
| 2029 | 21.34                    |
| 2030 | 29.03                    |
| 2031 | 39.48                    |
| 2032 | 53.71                    |

Applying the CAGR formula to the endpoints of this series (IV = 1.32 in 2020, FV = 53.71 in 2032, n = 12 years):

$$CAGR = \left( \frac{53.71}{1.32} \right)^{\frac{1}{12}} - 1 \approx 0.362 (\approx 36.2\% \text{ per year})$$

- **Adoption-Rate Trend (% of Users), 2019–2026**

| Year | Adoption Rate |
|------|---------------|
| 2019 | < 15%         |
| 2020 | 18%           |
| 2021 | 23%           |
| 2022 | 29%           |
| 2023 | 48%           |
| 2024 | 67%           |
| 2025 | 87%           |
| 2026 | 92%           |

- **Supplementary Data — Health Management Practices (n = 30)**

A smaller, separate worksheet (sample n = 30) recorded self-management practice splits. Included here for completeness; no hypothesis test accompanied this table in the source notes.

| Practice                            | Group A | Group B | Total |
|-------------------------------------|---------|---------|-------|
| Daily monitoring / other            | 10      | 20      | 30    |
| Doctor-prescribed / self-medication | 21      | 9       | 30    |
| Follows diet / no diet-precaution   | 15      | 15      | 30    |
| Yoga / no yoga                      | 11      | 19      | 30    |

### **Challenges, Algorithmic Bias, and Academic Integrity Concerns**

Despite its massive potential, integrating millions of high-stakes learners into a centralized AI learning grid presents significant operational and ethical challenges. A major concern is the risk of cognitive dependency and the potential decline of deep critical thinking. Unlike guided physical mentorship, purely automated solutions can occasionally generate inaccurate information or 'hallucinations' with high confidence, leading students to absorb incorrect concepts if not verified. Furthermore, the over-reliance on conversational engines for instantaneous solutions can lead to plagiarism in assignments and homework submission compromises.

Additionally, the rapid growth of premium, high-speed model editions could recreate systemic equity challenges if access to advanced reasoning capabilities is restricted by paywalls. The system also faces regional variations; while urban centers boast high smartphone penetration and robust internet connectivity, deeply rural educational spaces still struggle with basic digital infrastructure, language translation accuracy, and digital literacy among instructors.

### **Future Prospects of Institutional Artificial Intelligence**

Looking ahead toward the end of the decade, the secondary education landscape in India will continue to evolve, blending structural state guidelines with advanced intelligent frameworks.

The future of senior secondary learning is characterized by systematic integration. National and state board authorities are exploring options to move away from isolated assessment models toward Continuous AI Evaluation frameworks. Plans for adaptive national portals are set to link student performance profiles with targeted remedial modules in real time, minimizing the intense stress associated with high-stakes terminal examinations and creating a more holistic learning arc.

Concurrently, the expansion of localized, offline-first edge models allows the delivery of powerful conversational support without continuous high-speed web reliance. With state-backed digital public infrastructures, integrated ethical guidelines, and specialized teacher-support systems, AI is well-positioned to serve as a permanent foundation for India's evolving educational landscape.

### **Conclusion**

In summary, the transition from legacy rote systems to video libraries and ultimately to interactive AI tutoring frameworks highlights an educational landscape that is rapidly adopting technology to resolve core systemic challenges. Traditional digitized videos served as an important foundational step by expanding access to high-quality visual content for the growing middle class. However, their uniform pace and lack of active dialogue limited their capacity to provide a scalable framework for personalized guidance.

The introduction of conversational AI completely transformed this environment. By deploying advanced adaptive algorithms and creating highly accessible, zero-cost conversational interfaces, India is bridging decades of educational access gaps within a brief timeframe. It has converted the mobile screen into an open, responsive lecture hall, empowering everyone from metropolitan toppers to rural aspirants. Moving forward, the most effective educational models will be those that strike a healthy balance between human mentorship and automated feedback, ensuring rigorous data security and academic integrity. Ultimately, artificial intelligence is no longer an optional supplementary tool; it has become the digital backbone of the modern Indian educational framework.

### **Bibliography**

1. Ministry of Education, Government of India. (2024). National Education Policy Technology Integration Framework and Digital Public Infrastructure Report.

2. National Council of Educational Research and Training (NCERT). (2025). AI in Classrooms: Transforming Senior Secondary Learning and Assessment Paradigms.
  3. Subramanian, V., & Iyer, R. (2023). 'The Metrics of Generative AI in Regional Classrooms: An Empirical Analysis of Student Outcomes.' Indian Journal of Educational Technology, 16(3), 88-105.
  4. Banerjee, S. (2025). Democratizing the Boardroom: How Conversational AI is Disbursing Elite Mentorship to Emerging Rural Catchments. Mumbai Academic Press.
  5. Department of Electronics and Information Technology, Government of India. (2024). Strategic Guidelines for Mitigating Algorithmic Hallucinations and Plagiarism in Secondary Institutions.
- Risks of AI in Education: Key Concerns Explained | Velvetech (<https://share.google/oxFU7qpAEdc1CTG40>)
  - New Data: 92% of Students Use AI - (<https://share.google/TJEilaWZUvmebx1ji>)
  - 90% Of College Students Use AI: Higher Ed Needs AI Fluency Support Now (<https://share.google/dv6hWGMD8DAvPrGux>)
  - AI in High School Education: Trends, Challenges, and Opportunities | Bowdoin College (<https://share.google/21fcOjeoo2jT3U7do>)
  - New Research: Majority of High School Students Use Generative AI for Schoolwork – Newsroom (<https://share.google/sgWyh5lkdhXBOcszu>)
  - The Pros and Cons of AI in Education: Benefits, Risks, and Real Examples | Discovery Education (<https://share.google/ZRNjX6dTK4AczMknX>)
  - Student Generative Artificial Intelligence Survey 2026 - HEPI (<https://share.google/PhFcUJ6CvGPO55Fcn>)

### Biographies:

Aadit Bharti

- YS Public School, Barnala

#### Achievements:

- **John Locke Institute Global Essay Prize** — USD 500 Scholarship, Summer School (Oxford/Princeton/Cambridge) — 2026
- **Academic Excellence Minister** — Certificate of Appreciation, YS Public School (Top 50 in India) — 2025–26
- **FGMUN × 3** — 2 Special Mentions + 1 High Commendation — 2025
- **Pennsylvania MUN** — 3rd Prize — 2025
- **Blue Ocean Competition** — Certificate of Recognition (173 countries, 23,000+ students) — 2026
- **Wharton Entrepreneurship Specialization** — 100%, all 5 courses incl. Capstone (Coursera) — 2025
- **IIT Madras Certification** — 100/100, Economics, Finance & Money Matters — 2026
- **AP Examinations** — 5/5, Microeconomics & Macroeconomics — 2026 Under the guidance of:

**Dr. Mamta Jain**

- M.Sc (Mathematics) (Double gold medalist).
- M.Phil (Computer Applications) with honours From University of Roorkee (now IIT Roorkee).
- PhD (Mathematics).
- Various papers published in international journals.

- *Former Lead Auditor ISO 9001, ISO -22000 School Accreditation Examiner by QCI.*
- *26 years of teaching experience.*

***Er. Raunaq Jain***

- *B.E Mechanical Engineering graduate from Thapar Institute of Engineering and Technology.*
- *School Physics Topper.*
- *Mechanical Mentor from session 2019-2020.*
- *Technical Data Associate at Deloitte.*
- *Multiple research papers published.*



EARN YOUR

# MBA

WWW.IIMPS.IN



Accreditation & Ranking



UGC / NCTE Approved.

INFO@IIMPS.IN

☎ 011-41005174

RESEARCH  
GATEWAY

## STOP PLAGIARISM



**Arogyam Ayurveda**  
Holistic Healing through herbs



AROGYAM  
ONLINE

## PARIVARTAN PSYCHOLOGY CENTER

परिवर्तन

### COLOR PSYCHOLOGY : HOW COLOR AFFECT YOUR CHILD



BLUE

Calms your Child's  
Mind & Body

YELLOW

Promotes Concentration,  
Stimulates the Memory

PINK

Evokes Empathy,  
makes your Child Calm

RED

Excites and energizes  
your Child's body

GREEN

Improves Reading speed  
and Comprehension

www.parivartan4u.com



परिवर्तन

Confuse about your children's future?

**भारतीय भाषा, शिक्षा, साहित्य एवं शोध**

ISSN 2321 – 9726

[WWW.BHARTIYASHODH.COM](http://WWW.BHARTIYASHODH.COM)



**INTERNATIONAL RESEARCH JOURNAL OF  
MANAGEMENT SCIENCE & TECHNOLOGY**

ISSN – 2250 – 1959 (O) 2348 – 9367 (P)

[WWW.IRJMSST.COM](http://WWW.IRJMSST.COM)



**INTERNATIONAL RESEARCH JOURNAL OF  
COMMERCE, ARTS AND SCIENCE**

ISSN 2319 – 9202

[WWW.CASIRJ.COM](http://WWW.CASIRJ.COM)



**INTERNATIONAL RESEARCH JOURNAL OF  
MANAGEMENT SOCIOLOGY & HUMANITIES**

ISSN 2277 – 9809 (O) 2348 - 9359 (P)

[WWW.IRJMSH.COM](http://WWW.IRJMSH.COM)



**INTERNATIONAL RESEARCH JOURNAL OF SCIENCE  
ENGINEERING AND TECHNOLOGY**

ISSN 2454-3195 (online)

[WWW.RJSET.COM](http://WWW.RJSET.COM)



**INTEGRATED RESEARCH JOURNAL OF  
MANAGEMENT, SCIENCE AND INNOVATION**

ISSN 2582-5445

[WWW.IRJMSI.COM](http://WWW.IRJMSI.COM)



**JOURNAL OF LEGAL STUDIES, POLITICS  
AND ECONOMICS RESEARCH**

[WWW.JLPER.COM](http://WWW.JLPER.COM)

**JLPE**