

A Human-Centred Framework for Integrating Generative AI to Foster Critical Thinking, Learner Autonomy, and Cognitive Engagement in K-12 Education

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Abstract: Artificial intelligence (AI), particularly generative AI, is increasingly used to explain concepts, support research, and provide individualized learning assistance. Its growing presence raises questions about independent reasoning, creativity, verification, and equitable access. This exploratory cross-sectional survey examined respondents' reported AI use, perceived educational benefits, and cognitive abilities they considered important to protect. A total of 66 respondents participated in this exploratory cross-sectional survey, which combined descriptive quantitative analysis with summaries of open-ended responses. Sixty-four respondents (97.0%) reported using ChatGPT or a similar AI assistant. Personalized learning was selected as an expected benefit by 50 (75.8%), while 48 (72.7%) identified understanding difficult concepts as an AI use or benefit. Critical thinking was the most frequently selected cognitive skill to protect (55; 83.3%), followed by creativity (52; 78.8%), problem-solving (48; 72.7%), and decision-making (47; 71.2%). Reported themes included individualized explanations, convenient information access, dependence concerns, verification, equity, and teacher guidance. Based on these findings and relevant literature, the article proposes a preliminary six-principle Future Minds Framework. The small exploratory sample and self-reported data do not support generalization or causal conclusions about cognition. Further research should evaluate the framework and examine measurable learning outcomes.

Keywords: Generative AI; education; critical thinking; AI literacy; cognitive engagement

1. Introduction

AI is increasingly visible in education. Generative AI tools can explain, summarize, suggest ideas, provide feedback, and assist with academic tasks, potentially supporting flexible learning. However, their growing availability raises questions about knowledge development, independent judgment, and higher-order thinking [1,2]. Education requires more than correct answers or efficiency: it develops questioning, evidence evaluation, problem-solving, communication, decision-making, and creativity. AI may support these capacities, but accepting generated answers without independent effort or verification may reduce opportunities to practise them. This remains a pedagogical concern, not an established conclusion about AI's cognitive effects.

AI also raises concerns about misinformation, bias, privacy, academic integrity, unequal access, and teacher preparedness [1,2]. The Future Minds Project explores reported AI use and the human capacities respondents believe should remain central to learning. It neither treats AI as wholly beneficial nor inherently harmful; instead, it considers how AI might be integrated while preserving human judgment, independent learning, creativity, and teacher-student relationships. This perception-based study does not directly measure intelligence or establish causal effects on cognition. It describes reported experiences and proposes a preliminary framework for responsible AI-supported education.

2. Review of Literature

2.1 AI and personalized learning

AI tools can provide explanations, examples, practice questions, and feedback tailored to learners' questions. These features may assist learners needing additional explanations or alternative presentations. Studies of generative AI perceptions identify potential benefits alongside concerns about reliability and responsible academic practice [3,4]. Reviews also emphasize examining the context and outcomes of AI use [4,5]. An AI response's usefulness depends on accuracy, prior knowledge, and context; perceived usefulness is not equivalent to demonstrated learning.

2.2 AI and higher-order thinking

Critical thinking, creativity, problem-solving, and decision-making are important educational capacities. A key question is whether AI encourages deeper engagement or allows learners to bypass reasoning. Reviews emphasize evaluating how AI is integrated rather than assuming access automatically improves learning [5–8]. Asking learners to evaluate an AI explanation, identify errors, compare sources, and justify conclusions differs from simply submitting generated answers. Although this survey did not compare teaching approaches, respondents' priorities support investigating them.

2.3 Human-centred and equitable AI in education

International guidance emphasizes human oversight, responsible use, inclusion, privacy, and AI literacy. Learners

need to understand limitations, verify information, recognize bias, and use AI ethically; teachers need professional development and clear policies [1,2]. Equitable implementation must consider accessibility, language, affordability, connectivity, disability-related needs, and digital confidence. UNESCO's student and teacher competency frameworks guide human-centred AI use [9,10]. This study adds an exploratory account of reported AI use, perceived benefits, and priorities for protecting human cognitive abilities.

3. Aim, Objectives and Research Questions

3.1 Aim

To explore perceptions of AI in education and identify cognitive abilities and educational principles respondents consider important to protect as AI becomes more accessible.

3.2 Objectives

- 1) Describe reported use of ChatGPT or similar AI assistants.
- 2) Identify perceived educational uses and benefits.
- 3) Examine cognitive abilities respondents consider important to protect.
- 4) Summarize concerns and recommendations in open-ended responses.
- 5) Propose a preliminary framework for responsible and equitable AI-supported education.

3.3 Research questions

- 1) What AI tools and educational uses do respondents report?
- 2) What benefits and concerns do they associate with AI in education?
- 3) Which human cognitive abilities do they consider important to protect?
- 4) What principles may guide responsible AI integration in education?

4. Methodology

4.1 Research design

The project used an exploratory cross-sectional survey combining descriptive quantitative summaries and open-ended responses. It was not designed to establish causality or measure changes in intelligence, academic achievement, or cognitive performance.

4.2 Participants and data collection

The study included 66 respondents who completed an online questionnaire administered through Google Forms. The questionnaire explored AI use, perceived educational benefits, concerns about AI in learning, and cognitive abilities considered important to protect. The findings are exploratory and should not be interpreted as representative of a wider population.

4.3 Research instrument

A project-developed online questionnaire collected structured responses and open-ended comments. Available materials do not establish psychometric validation or reliability testing; it should not be described as validated without supporting evidence.

4.4 Data analysis

Quantitative results were summarized using counts and percentages in the project materials. Table 1 uses 66 as the denominator where counts were available. The original Google Forms export should be checked for counts, valid denominators, and missing responses. Multiple-selection questions may total more than 100%. Open-ended responses were summarized into recurring themes in the project report; original responses and coding records should be checked before submission. No formal qualitative coding protocol or inter-rater reliability is claimed.

4.5 Ethical considerations

The study was conducted for the first author's M.Sc. research at Jain University under Dr. Hemanth Babu R. Participants were informed of the academic purpose and applicable confidentiality arrangements; findings are presented in aggregate to protect privacy. Ethics review/approval or exemption should be reported accurately according to university requirements, and consent and confidentiality statements should match the procedures actually followed.

5. Results

5.1 Reported use of AI assistants

Sixty-four of 66 respondents (97.0%) reported using ChatGPT or a similar AI assistant. This indicates familiarity within the sample, not frequency of use or prevalence in a wider population.

5.2 Perceived educational benefits

Personalized learning was selected as an expected benefit by 50 respondents (75.8%); 48 (72.7%) identified understanding difficult concepts as an AI use or benefit. These are reported perceptions, not measured gains in comprehension or performance.

5.3 Cognitive skills considered important to protect

Critical thinking was selected by 55 respondents (83.3%), creativity by 52 (78.8%), problem-solving by 48 (72.7%), and decision-making by 47 (71.2%). These are participants' priorities and do not show that AI has strengthened or weakened these abilities.

Table 1: Selected survey findings

Survey finding	Number	Percentage
Reported using ChatGPT or similar AI assistant	64	97.0%
Understanding difficult concepts as an AI use/benefit	48	72.7%
Personalized learning as an expected benefit	50	75.8%
Critical thinking as a skill to protect	55	83.3%
Creativity as a skill to protect	52	78.8%
Problem-solving as a skill to protect	48	72.7%
Decision-making as a skill to protect	47	71.2%

Note: Percentages use 66 as denominator based on the supplied summary. Verify counts and item-specific denominators against the original data. Multiple-selection items may exceed 100%.

5.4 Themes summarized from open-ended responses

The project report identifies six preliminary themes, which should be checked against original responses before publication:

- 1) **Personalized explanations and learning support:** AI may explain difficult concepts, offer alternatives, and support individual pacing.
- 2) **Information access and continuous assistance:** AI offers convenient information and support when immediate human help is unavailable.
- 3) **Dependence and reduced independent effort:** concern that learners may rely on generated answers instead of attempting tasks or reasoning independently.
- 4) **AI as assistant, not replacement:** AI should support learning without replacing educators, learner responsibility, or human relationships.
- 5) **Verification, policies, and AI literacy:** check generated information, set clear expectations, and teach critical, responsible use.
- 6) **Equity and teacher development:** consider fair access, guidance, and teacher preparation.

These are summaries, not a fully documented qualitative analysis. The article would benefit from explaining how themes were identified and, where ethical, including short anonymized excerpts from actual responses.

6. Discussion

The findings provide an exploratory picture of AI perceptions: AI assistants were commonly reported as used, personalized learning and difficult-concept explanations were perceived benefits, and critical thinking, creativity, problem-solving, and decision-making were frequently selected as abilities to protect. These observations relate to published discussions of generative AI's opportunities and challenges [3–8], but this study does not establish whether AI improves or reduces cognitive abilities.

The findings suggest a balance between technological assistance and human cognitive engagement. AI should not be judged only by convenience, speed, or answer production. The study's contribution is to bring together reported AI use, perceived benefits, and priorities for protecting human cognitive engagement in a preliminary framework. The framework provides a basis for

investigating independent reasoning, critical evaluation, creativity, equitable access, and teacher involvement.

6.1 Supporting learning without replacing thinking

An activity may be completed correctly without demonstrating understanding. Teachers can ask learners to attempt problems independently before consulting AI, evaluate generated explanations, verify claims, and justify acceptance or rejection of suggestions. The survey did not test these practices; respondents' emphasis on critical thinking provides a rationale for future research.

6.2 Personalization and learning quality

Responses suggest that participants valued individualized assistance. However, access to an explanation does not guarantee understanding. Outcomes may depend on accuracy, suitability, prior knowledge, and active processing. Future studies should distinguish perceived usefulness from demonstrated learning [5,7].

6.3 Importance of human guidance

Concerns about dependence and verification highlight the need for guidance on appropriate AI use, academic integrity, privacy, and source evaluation. Teachers need professional development and institutional support to assess tools and design meaningful learning activities. International guidance emphasizes student AI literacy and teacher preparedness [1,2,9,10].

6.4 Equity and responsible implementation

Implementation should consider differences in access, language, accessibility, digital confidence, and resources. Without planning, benefits may be unevenly distributed [1,2]. The exploratory sample cannot establish how common these views are beyond the participants.

7. The Proposed Future Minds Framework

Drawing on the survey and human-centred literature, this article proposes a preliminary six-principle framework. It has not been independently validated or tested as an intervention.

- 1) **Human agency:** Learners remain responsible for questioning, evaluating, deciding, creating, and explaining; AI suggestions are material for consideration, not automatic answers.
- 2) **Cognitive engagement:** Activities preserve independent attempts, reasoning, problem-solving, creativity, reflection, and metacognition. Meaningful learning matters more than task completion alone.
- 3) **Guided and transparent AI use:** Teachers and institutions clarify when AI is permitted, what assistance is acceptable, and how contributions should be acknowledged.
- 4) **Equity and accessibility:** Consider device access, connectivity, affordability, language, disability-related accessibility, and digital confidence.
- 5) **Critical and ethical AI literacy:** Learners evaluate generated information, identify potential bias and

limitations, protect personal data, and verify claims with reliable sources.

- 6) **Teacher-led accountability and human connection:** Educators retain responsibility for instruction, assessment, safeguarding, and supportive relationships; AI complements rather than displaces these responsibilities.

The principles synthesize reported priorities and human-centred, ethical, and competency-oriented literature [1,2,9,10]. They require expert review, teacher consultation, classroom pilots, and empirical evaluation. Their clarity, feasibility, contextual relevance, and contribution to learning should be tested before effectiveness is claimed.

8. Implications for Educational Practice

The findings and conceptual discussion suggest practices for educators to consider and evaluate:

- Encourage independent attempts before learners consult AI.
- Teach verification by checking important AI-generated claims against appropriate sources.
- Assess reasoning, evidence, reflection, and decision-making alongside final answers.
- Clarify policies on AI assistance, attribution, privacy, and academic integrity.
- Provide teacher development on AI capabilities, limitations, and classroom applications.
- Consider equity so implementation does not disadvantage learners with fewer resources or accessibility needs.

These recommendations were not evaluated in this survey.

9. Limitations and Future Research

The study included 66 respondents and may not represent a wider population. Data reflect self-reported perceptions, not direct measures of cognitive ability or academic performance. Formal questionnaire validation and reliability testing are not documented. Incomplete sampling procedures and participant characteristics limit assessment of representativeness and transferability. The design cannot support causal claims about AI's effects on intelligence, critical thinking, creativity, or learning. Qualitative themes require checking against original responses and transparent reporting of the analysis. Sampling details, demographics, and collection dates should be documented where possible.

Future research could use larger, more diverse samples, validated instruments, and direct measures of learning and critical thinking. Longitudinal or quasi-experimental studies could examine whether forms of guided AI use relate to learning behaviours or outcomes. The framework could be refined through expert review, teacher interviews, classroom pilots, and empirical evaluation.

10. Conclusion

The Future Minds Project explored AI-in-education perceptions among 66 respondents. AI assistants were

commonly reported as used; personalized learning and explanations of difficult concepts were perceived benefits; and critical thinking was the most frequently selected skill to protect. Open-ended themes highlighted dependence, verification, equitable access, clear policies, and human guidance.

The article proposes a preliminary framework centred on human agency, cognitive engagement, guided AI use, equity, critical AI literacy, and teacher-led accountability. Educational AI should be considered by how it supports meaningful learning and human development, not only speed or convenience. This study does not show that AI protects or harms intelligence; it offers exploratory findings and a conceptual basis for further research into responsible, equitable, human-centred AI-supported education.

Author Declarations

Ethics Approval: This study was conducted as part of the author's M.Sc. research at Jain University under the academic guidance of Dr. Hemanth Babu R. Ethics approval or exemption status should be reported in accordance with the university's requirements.

Informed Consent: The informed consent procedures followed in this study should be reported accurately based on the information provided to participants and the procedures actually followed.

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Conflict of Interest: The author declares no conflict of interest related to this research.

Data Availability: Aggregate findings are presented in this article. Individual participant responses are not publicly available to protect participant confidentiality. Access to anonymized data may be considered for legitimate academic purposes, subject to confidentiality commitments and institutional requirements.

Author Contributions

Avula Chandrakala conceptualized the study, conducted the research, collected and analysed the data, interpreted the findings, and prepared the manuscript.

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