COGNITIVE OFFLOADING: IMPLICATIONS OF AI DEPENDENCY FOR SENIOR HIGH SCHOOL LEARNERS' DEEP LEARNING AND RETENTION

MARLITA V. MADERA[1], MS. ANALOU LAWAS – ONG[2], CEDRIC JON R. SOLIVIO[3], FR. RONNIE L. TORRES, OMI, PHD, DBA, PDTQM[4]
https://orcid.org/0000-0002-9607-0147[1], https://orcid.org/0009-0004-9945-3719[2], https://orcid.org/0009-0001-1344-460X[3], https://orcid.org/0000-0001-7866-0103[4]
mmaderachsm@gmail.com[1], analoulawasong@gmail.com[2], cedricjonsolivio1996@gmail.com[3], brorontorres2@gmail.com[4]
De La Salle – College of St. Benilde, Manila, Philippines[1], St. Matthew of Blumentritt Institute of Technology, Manila, Philippines[1]
St. Matthew School, Manila & Quezon City, Philippines[2], Saint Nicholas School, Thailand[3]
de Mazenod Seminary, Thailand[4]

ABSTRACT

This study explored Senior High School learners' engagement with Artificial Intelligence (AI) tools, their perceived effects on deep learning, and the relationship between AI dependency and memory retention. A mixed-methods design was employed, combining descriptive statistics and Pearson's r correlation with thematic analysis guided by Braun and Clarke's (2021) six-phase framework. Participants included 736 students from two private institutions in Quezon City and Manila, who voluntarily responded to a validated, self-developed questionnaire administered via Google Forms. Findings revealed that learners engaged with AI tools only occasionally, with generative AI and grammar/writing assistants most frequently used for translation, grammar checking, and quick fact-finding. However, students generally did not perceive AI as enhancing critical thinking, conceptual understanding, application, or long-term retention, though they acknowledged its supportive value and recognized risks of over-reliance. Correlation results showed no significant relationship between AI dependency and retention, and no significant relationship between AI dependency and deep learning. In contrast, deep learning strongly predicted retention, underscoring the importance of higher-order, human-centered practices in sustaining academic achievement. The study recommends balanced AI integration through critical learner engagement, teacher-led digital literacy, institutional support, and ethical policy frameworks. Future research should assess AI's long-term impacts on creativity, critical thinking, and knowledge retention to safeguard learning.

Keywords: AI dependency, deep learning, memory retention, senior high school learners

INTRODUCTION

The integration of Artificial Intelligence (AI) into education is reshaping teaching methods and learning experiences. AI's potential to enhance learning through personalized feedback, intelligent tutoring systems, and adaptive content is well-documented. However, this growing reliance introduces the issue of cognitive offloading—the delegation of mental tasks such as memory and problem-solving to external tools, thereby reducing cognitive effort.

Although cognitive offloading can optimize mental resources for higher-order thinking, excessive dependence on AI may hinder deep learning, which requires critical understanding and conceptual engagement. Students who routinely offload cognitive processes risk developing superficial knowledge structures and weak retention, undermining long-term learning.

P – ISSN 2651 - 7701 | E – ISSN 2651 – 771X | www.ioer-imrj.com
MADERA, M.V., ONG, A.L., SOLIVIO, C.J.R., TORRES, R.L., *Cognitive Offloading: Implications of AI Dependency for Senior High School Learners' Deep Learning and Retention*, pp. 72 - 80

72

Research highlights AI's capacity to improve engagement and provide tailored support (Roll & Koedinger, 2012; Chounta & McLaren, 2020), and even to stimulate critical thinking through diverse perspectives (Chan & Hu, 2023). Yet, increasing evidence warns of over-reliance. Continuous AI use for generating answers can reduce mental effort and originality, leading to shallow comprehension and limited analytical resilience (Floridi, 2021; Cotton et al., 2023; Ododo, 2025). This "cognitive laziness" restricts independent reasoning and creativity (Habib et al., 2024).

Studies on cognitive offloading show that dependence on external aids weakens memory formation and recall (Risko & Gilbert, 2016; Bai et al., 2023; Akgun & Toker, 2024). When learners allow AI to process or retrieve information, their capacity for durable memory and flexible reasoning declines. Moreover, the ease of AI-generated content raises ethical concerns about plagiarism and academic integrity (Stokel-Walker, 2023).

While literature acknowledges both the benefits and risks of AI, limited research directly examines how AI dependency influences deep learning and retention, particularly in the age of generative AI. This study seeks to fill that gap by analyzing the effects of AI-induced cognitive offloading on students' capacity for deep understanding and knowledge retention.

Framework of the Study

This study is anchored in a conceptual framework linking AI dependency to cognitive offloading, which may hinder deep learning and knowledge retention. The framework integrates three key cognitive theories. Drawing from Cognitive Load Theory (Sweller, 1988), AI tools can lower extraneous load by simplifying tasks but may also reduce germane load—the mental effort vital for constructing knowledge. When AI supplies pre-processed information, learners bypass analysis, weakening conceptual understanding (Runge et al., 2019). The Generation Effect (Slamecka & Graf, 1978) further suggests that self-generated information enhances memory; however, AI reliance minimizes this active

processing, diminishing retention. Finally, the Theory of Cognitive Offloading (Risko & Gilbert, 2016) explains AI use as the delegation of mental effort. The framework distinguishes between assistive use, which supports cognition, and substitutive use, which replaces it—potentially leading to reduced deep learning and memory formation.

OBJECTIVES OF THE STUDY

The main purpose of the study is to explore the implications of AI dependency on senior high school learners in the aspect of deep learning and retention. Specifically, this study seeks to:

1. Describe the SHS learners' AI tool engagement in terms of:
   1.1. AI tool usage frequency, and
   1.2. AI tool usage purposes.
2. Determine the perceived impact of AI dependency on SHS learners' deep learning behaviors in terms of:
   2.1. critical thinking,
   2.2. conceptual understanding, and
   2.3. application.
3. Assess the perceived impact of AI dependency on SHS learners' memory retention of academic material.
4. Identify the challenges SHS learners face when using AI tools, particularly those related to understanding and retaining academic content.
5. Examine the relationship between AI dependency, deep learning, and memory retention among SHS learners.

METHODOLOGY

The study employed a mixed-methods design to capture both statistical trends and students' lived experiences with AI. Quantitative data were analyzed using descriptive statistics (frequencies, means) and Pearson's r to examine relationships between AI use, deep learning, and retention. Qualitative responses underwent six phases of thematic analysis to contextualize the

findings using the framework of Braun & Clarke (2021). Participants were 736 senior high school students from two private institutions in Quezon City and Manila. Participation was voluntary, anonymous, and based on informed consent. The questionnaire was rigorously validated by three experts from the field, and pilot testing was conducted to ensure its validity. Data were collected via a validated, self-made questionnaire on Google Forms, structured in three sections: (1) a 5-point scale measuring AI usage habits, (2) a 4-point Likert scale assessing AI's perceived impact on deep learning and retention, and (3) an open-ended item capturing students' personal experiences.

Scale, description, and verbal interpretation

Table 1
Likert scale on AI tool usage habits

Frequency	Description	Midpoint	Verbal Interpretation
Very Often	6-8 hours per day of AI tool usage.	7	Indicates a high level of daily engagement
Often	4-6 hours per day of AI tool usage.	5	Represents a substantial but slightly less frequent daily engagement
Sometimes	2-3 hours per day of AI tool usage.	2.5	Denotes moderate, intermittent daily usage
Rarely	1 hour or less per day of AI tool usage.	.5	Suggests infrequent daily engagement
Never	0 hours per day of AI tool usage.	0	Signifies no daily engagement with AI tools for academic purposes

A Likert scale on the influence of AI on students' deep learning and knowledge retention

Table 2
Likert scale on the influence of AI

Level of Agreement	Scale	Scale Interval	Verbal Interpretation
Strongly Disagree	1	1.00 – 1.74	Indicating a strong conviction that the statement is false.
Disagree	2	1.75 – 2:49	Suggesting a general belief that the statement is false.
Agree	3	2.50 – 3.24	Implying a general belief that the statement is true
Strongly Agree	4	3.25-4.00	Denoting a strong conviction that the statement is true

RESULTS AND DISCUSSION

This section presents the main findings of the study based on the data analysis and relates them to the research objectives and existing studies. The results are organized clearly, followed by a discussion that explains their meaning, points out important patterns, and considers their implications in light of earlier research.

1. SHS learners' AI tool engagement

1.1 in terms of Frequency

Table 1
SHS Learner AI Tool Engagement in Terms of Frequency

AI Tool Type	Very Often 6 – 8 hrs/wk	Often 4 - 6 hrs/wk	Sometimes 2 - 3 hrs/wk	Rarely 1 hr or less/wk	Never 0 hrs	Mean hrs/wk	Verbal Interpretation
1. Generative AI (e.g. ChatGPT, Bard, Copilot)	83	95	234	246	78	2.40	Sometimes
2. AI-powered search engines (e.g., Perplexity AI)	46	107	195	184	204	1.95	Rarely
3. AI summarization tools (e.g. Quill Bot, TLDR)	75	98	226	189	148	2.28	Sometimes
4. AI grammar/writing assistants (e.g., Grammarly)	89	148	195	195	109	2.65	Sometimes
5. AI-powered tutoring systems (e.g., Khan AI)	53	100	162	170	233	1.90	Rarely
6. AI for coding/technical tasks	56	74	161	157	288	1.69	Rarely
7. Other AI tools (please specify)	60	84	173	196	223	1.80	Rarely
Overall Mean						2.10	Sometimes

The engagement of SHS learners with AI tools leans toward infrequent use. Across all tool types, the *Very Often* (6–8 hrs/wk) and *Often* (4–6 hrs/wk) categories have the lowest counts, while most responses fall into *Sometimes* (2–3 hrs/wk), *Rarely* (1 hr or less/wk), or *Never* (0 hrs). Even the most used tool type, generative AI, records more learners in *Rarely* (246) and *Sometimes* (234) than in *Very Often* (83) or *Often* (95). This pattern indicates that AI tools are not yet part of most learners' regular academic routines. For example, AI for coding/technical tasks shows a large gap between "Never" (288) and "Very Often" (56), highlighting particularly low adoption for specialized functions.

Data analysis reveals that generative AI tools (e.g., ChatGPT, Bard, Copilot) are the most frequently used, with most students selecting *sometimes* (n = 234), followed by AI grammar and writing assistants (e.g., Grammarly), categorized as *often* (n = 148) and *sometimes* (n = 195). This pattern suggests that students prefer AI tools

offering immediate and practical academic benefits. The high use of these tools supports earlier findings by Chounta and McLaren (2020) and Roll and Koedinger (2012), who noted AI's role in providing instant feedback and enhancing engagement through accessible, user-friendly platforms.

Moderate use was observed for AI summarization tools (e.g., QuillBot, TLDR) and AI-powered search engines (e.g., Perplexity AI), primarily in the *sometimes* and *rarely* categories. As Chan and Hu (2023) suggest, these applications support research and idea development but are used more selectively for specific academic tasks. Meanwhile, AI tutoring systems, coding tools, and other specialized applications received the highest *never* responses, reflecting limited curricular integration and perceived relevance (Ododo, 2025).

1.2 in terms of Purpose

Table 2
SHS Learner AI tool Engagement in Terms of Purpose

Purpose	Very Often 6 – 8 hrs/wk	Often 4 – 6 hrs/wk	Sometimes 2 - 3 hrs/wk	Rarely 1 hr or less/wk	Never 0 hrs	Mean hrs/wk	Verbal Interpretation
1. Brainstorming ideas	64	129	210	208	105	2.53	Sometimes
2. Generating initial drafts/outlines	60	104	193	224	155	2.08	Sometimes
3. Summarizing complex information/texts	79	122	221	200	114	2.47	Sometimes
4. Finding quick answers to factual questions	88	145	216	187	90	2.72	Sometimes
5. Checking grammar, spelling, and style	98	143	202	208	85	2.73	Sometimes
6. Getting personalized explanations for concepts	74	122	183	230	127	2.31	Sometimes
7. Solving complex problems (e.g. math, coding)	60	116	185	203	172	2.13	Sometimes
8. Structuring arguments/essays	76	117	194	214	135	2.32	Sometimes
9. Translating languages	129	147	207	175	78	3.05	Sometimes
10. Generating creative content (e.g. stories, poems)	81	97	164	194	200	2.12	Sometimes
11. Research-related tasks	94	142	203	186	109	2.68	Sometimes
12. Others (please specify):	71	88	156	175	246	1.92	Rarely
Overall Mean						2.42	Sometimes

Findings show that SHS learners primarily use AI for practical, support-oriented tasks rather than transformative purposes. The most common uses were language translation (n = 276), grammar and style checking (n = 241), general research (n = 236), and quick factual searches (n = 233). This reflects previous studies describing AI in education as a functional "support algorithm" for immediate academic needs (Brown University Library, 2023; Johnson et al., 2023; Lumina Foundation, 2024).

In contrast, creative and complex applications showed the highest non-use, including "Others" (n = 246), creative content generation (n = 200), and problem-solving tasks (n = 172). This disparity suggests that SHS learners engage AI mainly for basic tasks rather than higher-order or innovative learning—an outcome linked to limited pedagogical scaffolding that fosters deep, creative engagement (Lumina Foundation, 2024; Smith et al., 2023; Lee & Zhang, 2024; U.S. Department of Education, 2023).

2. Perceived impact of AI dependency on SHS learners' deep learning behaviors

2.1 in Terms of Critical Thinking

Table 3
Perceived impact of AI Dependency on Deep Learning Behaviors in Terms of Critical Thinking

Indicators	Strongly Disagree 1	Disagree 2	Agree 3	Strongly Agree 4	Mean	Verbal Interpretation
A. Critical Thinking						
1. I use AI-generated content without analysing the accuracy of information.	227	297	192	20	2.01	Disagree
2. I consider AI-generated solutions to problems without confirming its veracity.	193	341	180	22	2.04	Disagree
3. I trust AI-generated content even if it may contain biases or inaccuracies.	181	318	214	23	2.11	Disagree
4. I am confident that the accuracy of AI-generated content is evaluated before it is generated.	141	298	258	39	2.26	Disagree
5. I believe that my over-reliance on AI does not hinder my ability to think critically.	151	272	239	74	2.32	Disagree
Overall Mean					2.15	Disagree

Table 3 shows that SHS learners generally perceive themselves as critical users of AI, demonstrating awareness of the need for caution. Most students disagreed with statements implying uncritical use—such as relying on AI without analysis (227 strongly disagree; 297 disagree) or failing to verify AI-generated solutions (193 strongly disagree; 341 disagree). This indicates that learners see themselves as actively engaging in critical thinking when using AI, aligning with Todorovska's (2024) view that cultivating critical thinking deepens cognitive engagement and learning.

However, students also recognize the risks of over-reliance, with 272 disagreeing that dependence on AI does not hinder their critical

thinking. This reflects an understanding that while AI can support analysis and writing, excessive use may weaken creativity and independent reasoning—a concern echoed in prior studies (Malik et al., 2023; Assefa, 2024).

2.2 in terms of Conceptual Understanding

Table 4
Perceived Impact of AI dependency on Deep Learning Behaviors in Terms of Conceptual Understanding

Indicators	Strongly Disagree 1	Disagree 2	Agree 3	Strongly Agree 4	Mean	Verbal Interpretation
B. Conceptual Understanding						
1. AI tools help me to understand complex concepts more clearly instead of relying on my own experience and background knowledge.	157	208	323	48	2.36	Disagree
2. Instead of relying on my own knowledge and experiences, I am confident using AI to explore various perspectives on a topic.	152	321	242	21	2.18	Disagree
3. AI tools explain complex ideas more thoroughly, leading to a deeper understanding than human explanations often provide.	110	283	321	22	2.35	Disagree
4. I find AI's examples and analogies enhance my grasp of difficult concepts more thoroughly than relying on textbooks and lectures.	112	266	335	23	2.37	Disagree
5. Ideas are more clearly connected when explained by AI tools than by personal experiences or discussions.	126	278	271	59	2.35	Disagree
Overall Mean					**2.32**	**Disagree**

Findings show that SHS learners hold mixed views on AI's impact on conceptual understanding, with a general preference for traditional learning. While many (n = 371) agreed that AI clarifies complex ideas, more students disagreed (n = 393) that AI explanations foster deeper understanding than human instruction. Most also rejected the notion that AI can replace personal knowledge or human-led exploration (n = 473) or connect ideas better than real-life discussions (n = 406).F

Overall, learners view AI as a supportive, not primary, learning tool—useful for simplifying concepts but insufficient for deep comprehension. As Bett UK (2024) analogized, AI may "sharpen the pen" but cannot craft the masterpiece; true learning remains human-centered. A balanced approach integrating AI with traditional pedagogy, where teachers guide and contextualize technology use, aligns with UNESCO's (2023) call for ethical, learner-focused education. Similarly, Fakour and Imani (2025) noted that students appreciate ChatGPT's accessibility but still value human tutors for personalized and emotional support.

2.3 in terms of Application of Knowledge

Table 5
Perceived impact of AI dependency on Deep Learning Behaviors in Terms of Application of Knowledge

Indicators	Strongly Disagree 1	Disagree 2	Agree 3	Strongly Agree 4	Mean	Verbal Interpretation
C. Application of Knowledge						
1. I rely on AI so much that I rarely think of original ideas and arguments on my own.	194	310	208	24	2.08	Disagree
2. My ability to summarize and synthesize information has improved since using AI tools than practicing my own communication skills.	115	249	326	46	2.41	Disagree
3. I rely on AI to produce academic work such as essays, projects, or presentations without applying much of my own technical or academic skills.	159	336	215	26	2.15	Disagree
4. I apply classroom concepts more effectively when I use AI tools, compared to applying them without AI support.	134	309	263	30	2.26	Disagree
5. I rely on AI tools to solve problems, rather than reflecting on my personal experiences.	180	322	205	29	2.11	Disagree
Overall Mean					**2.20**	**Disagree**

The table indicates that SHS learners generally maintain a self-reliant view of AI's role in learning. Most respondents (n = 504) disagreed that they rarely generate original ideas, showing that students use AI tools like ChatGPT as support rather than substitutes for intellectual effort. They remain confident in their creativity and view AI as an aid, not a replacement. Similar to Farhan (2025), this reflects a shift toward using AI not only for grammar correction but also to enhance critical and analytical thinking.

Responses were most divided on whether AI improves summarizing and synthesizing skills, with 372 agreeing and 364 disagreeing, indicating mixed perceptions of AI's value for higher-order learning. This aligns with Vieriu and Petrea (2023), who observed that while AI can promote personalized learning and engagement, it also risks over-reliance and weakened critical thinking.

2.4 in terms of Retention of Academic Learning

Findings indicate that the perceived impact of AI dependency on SHS learners' retention is generally negative or neutral. Most students disagreed that AI improves recall or enhances retention compared to traditional methods. Fewer learners also felt confident recalling information

after relying on AI, suggesting that they do not view it as beneficial for long-term memory.

Table 6
Perceived impact of AI dependency on Deep Learning Behaviors in Terms of Retention of Academic Learning

Indicators	Strongly Disagree 1	Disagree 2	Agree 3	Strongly Disagree 4	Mean	Verbal Interpretation
1. I find it hard to recall information without the AI tool.	152	304	253	27	2.21	Disagree
2. I will better understand the lessons with strong reliance on AI tools for a longer time.	103	320	288	25	2.32	Disagree
3. AI tools seem to enhance memory retention more enduringly than learning from class discussions and textbooks.	138	318	251	29	2.23	Disagree
4. I am confident in my ability to recall information for exams or discussions with AI if I used it during formal learning.	138	304	249	45	2.27	Disagree
5. My dependence on AI has increased my capacity to recall academic learning.	124	301	256	56	2.33	Disagree
Overall Mean					2.27	Disagree

These results align with Zai et al. (2024), who noted that AI improves information access but weakens comprehension and originality, and with Gerlich (2025), who found frequent AI use negatively correlated with critical thinking due to cognitive offloading. Overall, the findings highlight the cognitive costs of AI dependence and stress the importance of promoting active recall and critical engagement to strengthen long-term learning outcomes.

3. **Challenges when using AI tools for Understanding and Retaining Academic Learning**

Table 7
Challenges when using AI tools for Understanding and Retaining Academic Learning

Theme	Key Concerns	Frequency (mentions)	Sample Response
Over-reliance on AI and negative impact on core skills	Too much dependence on AI weakens critical thinking, retention, and motivation	45	I rely too much on the answers provided without fully understanding the concepts.
AI output accuracy and clarity issues	AI responses are often vague, outdated, or unreliable.	40	I sometimes have difficulty using AI tools because most of the time the answers are not accurate to what we are studying. That's why not everything the AI answers should be correct. You also need to think and read carefully what it answers.
User experience and technical barriers	Poor internet, limited devices, and lack of skills hinder effective use.	15	For me the internet, and at some point AI is not just direct to the point, if you search for anything sometimes AI is wrong to provide what's your need for...
Ethical and social considerations	Risks include plagiarism, bias, data privacy issues, and reduced human interaction.	8	AI doesn't help us in brainstorming that we really need instead on relying on AI apps

Table 7 shows four key challenges Senior High School learners face when using AI for academic purposes. The most common was over-reliance (45 mentions), which weakened critical thinking, retention, and motivation. Accuracy and clarity issues (40 mentions) followed, as students found AI outputs often outdated, vague, or overly technical. Technical barriers (15 mentions), including poor internet access and weak prompt formulation, also limited effective use. Lastly, ethical concerns (8 mentions) such as plagiarism and reduced social interaction were reported. While AI provides convenience, students recognized its risks, emphasizing the need for balanced and skill-preserving integration frameworks.

Theme 1: Over-Reliance and Cognitive Erosion.
Students' dependence on AI led to shallow understanding and diminished critical thinking. This aligns with studies showing that excessive reliance on AI for ready-made answers undermines active learning and intrinsic motivation (Royce & Bennett, 2025; Baridi, 2025).

Theme 2: Accuracy and Clarity Issues
Learners observed that AI-generated content is sometimes inaccurate or overly technical, reinforcing misconceptions through "hallucinations" and fabricated citations (Sun et al., 2024; Yousaf, 2025), reducing trust in AI's reliability.

Theme 3: Technical Barriers
Limited access, unstable connectivity, and a lack of prompt engineering skills hinder meaningful AI use. Inadequate training and support also prevent effective integration (Spencer, 2023; Ng et al., 2025).

Theme 4: Ethical and Social Concerns
Students expressed concerns about plagiarism, bias, and data privacy, noting that AI reliance can reduce collaboration and mentorship (Center for Teaching Excellence, 2025; Wel, 2025). These findings highlight the need for policies promoting responsible, human-centered AI use in education.

4. Relationship Between Impact of AI Dependency on Deep Learning and Memory Retention of Academic Learning among SHS learners

Table 8
Relationship Between Impact of AI Dependency on Deep Learning and Memory Retention of Academic Learning among SHS learners

Variables	r	p-value	Interpretation
AI Dependency ↔ Deep Learning	0.076	0.039*	Very weak positive, significant at 0.05
AI Dependency ↔ Retention	0.070	0.059	Very weak positive, not significant
Deep Learning ↔ Retention	0.700	< 0.001***	Strong positive, highly significant

n= 736; $p < .05^*$, $^{**}p < .001$.

The analysis revealed that AI Dependency showed only a weak positive correlation with Deep Learning ($r = .08$, $p < .05$) and no significant correlation with Retention ($r = .07$, $p = .059$), suggesting minimal impact of AI use on long-term learning. In contrast, Deep Learning was strongly correlated with Retention ($r = .70$, $p < .001$), emphasizing that critical thinking, conceptual understanding, and application are key predictors of durable learning.

These findings align with evidence that while generative AI may improve short-term efficiency, its effect on deeper learning and retention remains transitory unless scaffolding strategies such as reasoning, retrieval practice, and transfer tasks are used (Wang & Wang, 2025; Jose et al., 2025; Gerlich, 2025; Franzoi et al., 2025). Overall, AI tools serve best as scaffolds rather than substitutes, with deep-learning practices remaining central to sustained academic success.

CONCLUSION

This study found that Senior High School learners use AI tools only occasionally, mainly for grammar checking, translation, and quick fact-finding, with limited use in creative or problem-solving tasks. Learners did not view AI as enhancing deep learning and expressed concerns about cognitive erosion, inaccuracy, technical barriers, and ethical issues. Statistical analysis showed no significant correlation between AI dependency and deep learning or retention; however, deep learning strongly predicted retention, reaffirming its central role in academic achievement. Students thus regarded AI as a complementary aid rather than a substitute for authentic learning. These findings highlight the need for balanced, pedagogically guided AI integration that fosters critical thinking, upholds academic integrity, and sustains human-centered learning.

RECOMMENDATIONS

The framework outlines the study's recommendations for balanced and ethical AI integration in education, emphasizing five interconnected domains. At its core is the principle of promoting responsible and human-centered AI use. The first domain, Learners' Critical Use and Self-Reliance, encourages responsible engagement with AI, critical evaluation of outputs, and independent thinking. The second, Teachers' Digital Literacy and Pedagogy, calls for developing educators' skills and strategies to integrate AI creatively and ethically. The third, School Leaders' Training and Infrastructure, stresses leadership development and institutional readiness for sustainable AI adoption. The fourth, Policymakers' Guidelines and Integrity, highlights the need for ethical standards ensuring academic honesty, data privacy, and accountability. Finally, Future Research on Long-Term Impacts promotes continuous inquiry into AI's effects on learning, cognition, and retention. Together, these domains present a holistic approach to ethical AI integration, aligning technological innovation with the core values of education.

REFERENCES

Akgun, S., & Toker, S. (2024). *The impact of AI-based tools on memory retention and cognitive engagement in higher education*. ResearchGate. https://www.researchgate.net/publication/387184449_Evaluating_the_Effect_of_Pretesting_with_Conversational_AI_on_Retention_of_Needed_Information

Assefa, D. E. A. (2024). The double-edged sword of artificial intelligence (AI) in education: Maximizing benefits while mitigating risks. *The Journal of Quality*

in Education, 14(24), 154–176. https://doi.org/10.37870/joqie.v14i24.450

Bai, Y., Liu, X., & Su, J. (2023). Exploring the impact of AI-based tools on memory retention and cognitive engagement in higher education. *Journal of Educational Technology Development and Exchange, 16*(2), 56–72. https://doi.org/10.18785/jetde.1602.04

Baridi, R. (2025). *The growing dependency on AI in academia*. https://sjipl.mainelaw.maine.edu/2025/03/31/the-growing-dependency-on-ai-in-academia/

Braun, V., & Clarke, V. (2021). *Thematic analysis: A practical guide*. SAGE Publications. Brown University Library. (2023). AI in education: Ethical considerations. https://libguides.brown.edu/c.php?g=1338928&p=9868287

Center for Teaching Excellence. (2025). *Academic integrity in the age of AI.* https://teach.ufl.edu/resource-libraryold/academic-integrity-in-the-age-of-ai/

Chan, C. K. Y., & Hu, W. (2023). Students' preparedness for AI-assisted learning: An investigation of their perceptions and readiness. *Journal of Learning Analytics, 10*(1), 101–118. https://doi.org/10.18608/jla.2023.8476

Chounta, I.-A., & McLaren, B. M. (2020). The effect of conversational agents on student engagement and learning in an intelligent tutoring system. *International Journal of Artificial Intelligence in Education, 30*(4), 589–614. https://doi.org/10.1007/s40593-020-00201-w

Cotton, D. R. E., Cotton, P. A., & Shipway, J. R. (2023). Chatting and cheating: Ensuring academic integrity in the era of ChatGPT. *Innovations in Education and Teaching International, 60*(4), 362–375. https://doi.org/10.1080/14703297.2023.2190148

Fakour, H., & Imani, M. (2025). Socratic wisdom in the age of AI: A comparative study of ChatGPT and human tutors in enhancing critical thinking skills. *Frontiers in Education, 10*, 1528603. https://doi.org/10.3389/feduc.2025.1528603

Floridi, L. (2021). The ethics of AI in education: *A review. Learning, Media and Technology, 46*(2), 1–13. https://doi.org/10.1080/17439884.2021.1931650

Gerlich, M. (2025). AI tools in society: Impacts on cognitive offloading and the future of critical thinking. *Societies, 15*(1), 6. https://doi.org/10.3390/soc15010006

Habib, J., Al-Nour, M., & Zaitoun, J. (2024). The impact of AI tools on creative thinking and problem-solving skills among university students. *Journal of Educational Technology and Development, 8*(3), 123–140. Retrieved from https://jetd-journal.org/volume8issue3

Johnson, A., Patel, R., & Kim, S. (2023). The role of AI in modern pedagogy. *Computers & Education, 185*, 104761. https://doi.org/10.1016/j.compedu.2023.104761

Lee, H., & Zhang, T. (2024). Transformative AI in classrooms: Barriers and opportunities. *Journal of Educational Technology, 15*(3), 343–358. https://doi.org/10.3390/educsci15030343

Lumina Foundation. (2024). *High school students' use and impressions of AI tools*. https://www.luminafoundation.org/wp-content/uploads/2024/01/High-School-Students-Use-and-Impressions-of-AI-Tools.pdf

Malik, R., Pratiwi, Y., Andajani, K., Numertayasa, I. W., Suharti, S., Darwis, A., & Marzuki. (2023). Exploring artificial intelligence in academic essay: Higher education student's perspective. *International Journal of Educational Research Open, 5*, 100296. https://doi.org/10.1016/j.ijedro.2023.100296

Myibsource.com. (2025). *Cognitive offloading in education: How AI use can undermine critical thinking*. https://myibsource.com/a/blog/cognitive-offloading-in-education

Ng, D. D. T. K., Chan, E. K. C., & Lo, C. K. (2025). Opportunities, challenges and school strategies for integrating generative AI in education. *Computers and Education: Artificial Intelligence, 8*, 100373. https://doi.org/10.1016/j.caeai.2025.100373

Ododo, E. P. (2025). The cognitive paradox of AI in education: Between enhancement and erosion.

P – ISSN 2651 - 7701 | E – ISSN 2651 – 771X | www.ioer-imrj.com

MADERA, M.V., ONG, A.L., SOLIVIO, C.J.R., TORRES, R.L., *Cognitive Offloading: Implications of AI Dependency for Senior High School Learners' Deep Learning and Retention*, pp. 72 - 80

79

Educational Review, 77(3), 305–320. https://doi.org/10.1080/00131911.2024.2215271

Risko, E. F., & Gilbert, S. J. (2016). *Cognitive offloading. Trends in cognitive sciences*, 20(9), 676–686. https://doi.org/10.1016/j.tics.2016.07.002

Roll, I., & Koedinger, K. R. (2012). The design of intelligent tutoring systems for mastery learning and individualized instruction. In S. A. Cerri, W. J. Clancey, G. Papadourakis, & K. Panourgia (Eds.), *Intelligent tutoring systems* (pp. 58–67). Springer. https://doi.org/10.1007/978-3-642-30950-2_9

Royce, C. A., & Bennett, V. (2025). *To think or not to think: The impact of AI on critical thinking skills*. https://www.nsta.org/blog/think-or-not-think-impact-ai-critical-thinking-skills

Runge, J., Zöller, D., & Schütz, A. C. (2019). Consequences of cognitive offloading: Boosting performance but diminishing memory. *Psychological Research*, 83(8), 1667–1681. https://doi.org/10.1007/s00426-018-01099-y

Slamecka, N. J., & Graf, N. (1978). The generation effect: Delineation of a phenomenon. *Journal of Experimental Psychology: Human Learning and Memory*, 4(6), 592–604. https://doi.org/10.1037/0278-7393.4.6.592

Smith, J., et al. (2023). AI as a functional tool in secondary education. *ScienceDirect*, 12(1), 45–60. https://doi.org/10.1016/j.tel.2023.100012

Spencer, J. (2023). *The facts cycle for prompt engineering*. https://spencereducation.com/facts-cycle/

Stokel-Walker, C. (2023). AI bot ChatGPT writes smart essays—but can it be a tool for good? *Nature, 613*(7942), 19. https://doi.org/10.1038/d41586-023-00056-7

Sun, Y., Sheng, D., & Zhou, Z. (2024). AI hallucination: Towards a comprehensive classification of distorted information in artificial intelligence-generated content. *Humanities and Social Sciences Communications, 11*, 1278. https://doi.org/10.1057/s41599-024-03811-x

Susskind, R., & Susskind, D. (2015). *The future of the professions: How technology will transform the work of human experts*. Oxford University Press. https://academic.oup.com/book/40589

Sweller, J. (1988). Cognitive load theory. *Educational Psychologist*, 23(3), 257–281. https://doi.org/10.1207/s15326985ep2303_3

Todorovska, R. (2024). Critical thinking in the language classroom–An important 21st century skill. *International Journal of Education and Philology, 5*(1), 39–48. https://doi.org/10.69648/BFSI1617

UNESCO. (2023). *Guidance for generative AI in education and research*. https://www.unesco.org/en/articles/guidance-generative-ai-education-and-research

U.S. Department of Education. (2023). *AI and the future of learning*. https://www.ed.gov/sites/ed/files/documents/ai-report/ai-report.pdf

Wei, M. (2025). How AI could shape our relationships and social interactions. *Psychology Today*. https://www.psychologytoday.com/us/blog/urban-survival/202502/how-ai-could-shape-our-relationships-and-social-interactions

Yousaf, M. N. (2025). Practical considerations and ethical implications of using artificial intelligence in writing scientific manuscripts. *ACG Case Reports Journal*, 12(2), e01629. https://doi.org/10.14309/crj.0000000000001629

Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13–39). Academic Press. https://doi.org/10.1016/B978-012109890-2/50031-7

COPYRIGHTS

P – ISSN 2651 - 7701 | E – ISSN 2651 – 771X | www.ioer-imrj.com
MADERA, M.V., ONG, A.L., SOLIVIO, C.J.R., TORRES, R.L., *Cognitive Offloading: Implications of AI Dependency for Senior High School Learners' Deep Learning and Retention*, pp. 72 - 80

80