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Effect of Application-Based Learning Using Generative Artificial Intelligence on Information Literacy of First-Year Medical Students in Yunnan Province

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Abstract

Background and Aims: This experimental research aimed to 1) compare students' information literacy before and after learning through Application-Based Learning using Generative Artificial Intelligence, 2) compare students' information literacy after learning through Application-Based Learning using Generative Artificial Intelligence with the determined criterion set at 70%, and 3) assess students' satisfaction after learning through Application-Based Learning using Generative Artificial Intelligence.

Methodology: The research instruments were lesson plans, students' information literacy test, and a satisfaction questionnaire. The appropriateness of the lesson plans overall was at a very high level (M=4.62, SD=0.49). The students' information literacy test had an IOC between 0.67–1.00, item difficulty (p=0.43-0.60), item discrimination (r=0.25-0.50), and KR20 equal to 0.76. The students' satisfaction questionnaire had an IOC between 0.67 and 1.00 and a reliability index of 0.85. The statistics used to analyze data were mean, standard deviation, t-test for dependent samples, and t-test for one sample.

Results: 1) students' information literacy after learning through Application-Based Learning using Generative Artificial Intelligence was higher than before at statistically significant level of .01 (t_{29}=18.53, p=.000), 2) students' information literacy was higher than the determined criterion of 70% at a significance level of .01 (t_{29}=6.00, p=.000) and 3) students' satisfaction after learning through Application-Based Learning using Generative Artificial Intelligence overall was at a high level (M=4.14, SD= 0.85).

Conclusion: The knowledge gained from the research is that a six-step learning management system using Application-Based Learning using Generative Artificial Intelligence (ABL-GAI), which represents an innovative instructional framework that systematically integrates human-AI co-creation into information literacy education. The most significant steps for enhancing students'

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information literacy are step 4: Practice the skills + GAI, and step 5: Apply & create + GAI. Furthermore, this method has been shown to boost students' interest in learning and enhance their proficiency in core information literacy competencies, including information definition & planning, seeking & access, analysis, synthesis & communication, and reflection & self-evaluation.
Keywords: Application-Based Learning; Generative Artificial Intelligence; Information Literacy; Student Satisfaction

Introduction

The 20th National Congress Report positions advancing education digitalization as a national priority, and the China Education Modernization 2035 strategy lists accelerating educational transformation in the era of information as one of its ten key tasks (Central Committee & State Council, 2019). The Ministry of Education's Standard for Digital Campus Construction in Higher Education Institutions (MOE, 2021) explicitly requires universities to use artificial intelligence and other emerging technologies to innovate teaching models and upgrade students' information literacy and data capability. The Yunnan Provincial Department of Education's 2023–2025 Action Plan for Education Digitalization goes further, demanding that by 2025 every undergraduate institution in the province embed generative artificial intelligence into general-education curricula and strengthen students' ability to identify, evaluate, and create information in intelligent environments.

However, the implementation of this policy at the institutional level still faces significant challenges. Kunming Medical University Haiyuan College reveals a clear gap between policy goals and classroom reality: although Information Literacy is a compulsory course, the instructional model remains a teacher-centered lecture, which accounts for 68% of class time and has classroom interaction below 30% (Kunming Medical University Haiyuan College, 2024).

This outdated teaching model not only contradicts the principles of student-centered learning but also creates three salient problems that directly impact students' competencies in the era of Generative Artificial Intelligence (GAI):

1. Students cannot accurately identify their own information needs (Identify): When confronted with massive AI-generated information, students' pre-test score on this dimension was only 54% (Kunming Medical University Haiyuan College, 2024).

2. The conventional classroom shows insufficient integration of generative AI (GAI), leading to students' information evaluation skills and ethical awareness remaining below 60% (Kunming Medical University Haiyuan College, 2024).

3. Students lack authentic creation opportunities, limiting their ability to transfer learned knowledge into problem-solving and resulting in low-quality innovative artefacts (Kunming

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Medical University Haiyuan College, 2024).

Beyond these competency gaps, a critical ethical dimension demands attention. Medical students must navigate the risks of AI hallucinations—factually incorrect AI-generated content that can appear deceptively plausible. In medical contexts, where information accuracy directly impacts patient safety, the inability to verify AI outputs against authoritative sources poses significant professional risks. This ethical imperative underscores the necessity of integrating critical AI evaluation skills into information literacy curricula, ensuring that future medical professionals can discern reliable information from AI-generated misinformation.

These circumstances clearly indicate that the traditional lecture model can no longer respond to the rapid development of GAI technology and has failed to effectively foster the necessary information literacy competencies (Kunming Medical University Haiyuan College, 2024).

Before university, most students' exposure to information literacy is limited to demonstration-style searches in language or IT classes; they rarely receive training on critically evaluating or creatively reusing content produced by generative AI. Classroom observations at Kunming Medical University Haiyuan College reveal that, when asked to complete open-ended medical-information tasks, first-year undergraduates routinely display three inadequacies: they cannot formulate a searchable clinical question, they cannot judge the credibility or ethical boundaries of AI-generated text, and they cannot transform retrieved information into an authentic product or proposal for a real audience (Zhang et al., 2023). If these foundational gaps are not systematically remedied in the first academic year, they are likely to generate a ripple effect in subsequent courses in evidence-based medicine, clinical reasoning, and research methods, ultimately compromising the quality of medical education.

The first two years of medical education in China are devoted to general and basic-science courses; this period also represents the last opportunity to embed a common set of information-literacy standards. The National Standards of Teaching Quality for Undergraduate Medical Education (Ministry of Education, 2018) list "information acquisition and critical appraisal" as a core competency that must be "attained early." Intervening in Year 1, therefore, offers two advantages: (a) the compulsory course "Information Literacy" provides complete-cluster access without the selection bias typical of electives, and (b) students' academic load is still manageable before clinical clerkships, allowing sufficient time for a full application-based ABL-GAI cycle. Longitudinal work indicates that information-literacy reinforcement in the first semester produces lasting gains in research-topic quality and literature-review scores throughout the remaining four years of study (Wang, Zhang & Li, 2024); consequently, the present intervention is targeted at first-year students.

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To counter low Information literacy, three remedial pathways have been proposed:

1) Embedded librarianship, integrating Information literacy training into subject courses (Wang & Zhang, 2022). 2) Problem-based learning (PBL), using authentic clinical or research questions to foster searching and evaluation skills (Chen et al., 2023). 3) AI-augmented learning, employing generative AI to reduce cognitive load and provide real-time feedback (Hu et al., 2025).

Among these, Application-Based Learning (ABL) has proved most effective for developing higher-order thinking and knowledge transfer (Feild et al., 2015). Application-Based Learning is an instructional strategy in which students transfer previously acquired knowledge to authentic, concrete tasks that operate at the application and analysis levels of Bloom's taxonomy (Lynch, 2022). Its educational value lies in: 1) Situating learning in real-world contexts to enhance motivation and transfer. 2) Cycling through challenge–investigate–act–reflect to cultivate critical thinking and creativity. 3) Using generative assessment and peer review to foster metacognition and self-regulation (Gibbs, 1988).

Generative Artificial Intelligence (GAI) refers to AI technologies that can produce text, images, audio, or other content forms by learning from large-scale data (Huang et al., 2024). Educationally, GAI functions as 1) an intelligent learning companion that offers personalized feedback and dynamic resources (Shan & Liu, 2024). 2) A creativity booster that lowers the barrier to production and increases ideational fluency through "prompt–generate–human curation" loops (Huang et al., 2024). 3) An analytics engine that processes multimodal learning data to support evidence-based instructional decisions (DfE, 2024).

When ABL is fused with GAI, the resulting paradigm, Application-Based Learning using Generative Artificial Intelligence (ABL-GAI), is defined as an instructional model that begins with authentic, complex tasks situated in real-world contexts, centers on the co-creative partnership between students and generative AI, and employs iterative cycles of generation–validation–refinement to produce a deployable Minimum Viable Product (MVP) (DfE, 2024; Shan&Liu, 2024). A meta-analysis of 31 experiments reported a medium-to-large effect size (g=0.46) of ABL-GAI on higher-order thinking and creativity (Hu et al.,2025). However, empirical evidence within Chinese medical universities remains scarce.

Therefore, the present study aims to investigate the effect of Application-Based Learning using a Generative Artificial Intelligence instructional model on the information literacy of First-year students at Kunming Medical University, Haiyuan College. The findings of this research are expected to provide evidence-based guidance for reconstructing information literacy curricula in medical universities in the GAI era, setting learning-outcome standards, and scaling up human-AI co-creative instructional models.

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Objectives

1. To compare students' information literacy before and after learning through Application-Based Learning using Generative Artificial Intelligence.

2. To compare students' information literacy after learning through Application-Based Learning using Generative Artificial Intelligence, compared with the determined criterion set at 70%.

3. To assess students' satisfaction after learning through Application-Based Learning using Generative Artificial Intelligence.

Literature Review

Application-Based Learning

Application-Based Learning is a learner-centered pedagogical approach that emphasizes the transfer of theoretical knowledge to real-world contexts, enabling students to solve authentic problems or produce tangible outcomes. It is an instructional strategy that situates learning in authentic tasks, fosters active inquiry and reflection, and culminates in the application of knowledge to real-world problems.

Generative Artificial Intelligence

Generative Artificial Intelligence is defined here as an intelligent technology that uses a "prompt–generate–validate–refine" loop to support learners and AI in co-creating transferable outcomes.

Application-Based Learning using Generative Artificial Intelligence

Application-Based Learning using Generative Artificial Intelligence refers to an instructional paradigm that begins with authentic, complex tasks situated in real-world contexts, centers on the co-creative partnership between students and Generative AI, and employs iterative cycles of generation–validation–refinement to produce a deployable or commercially viable Minimum Viable Product (MVP) as the final learning outcome (DfE, 2024; Shan & Liu, 2024).

Information Literacy

Information literacy has evolved into a multidimensional, AI-enabled literacy that empowers citizens to navigate, critique, and co-create knowledge in complex digital ecosystems.

Student Satisfaction

Student satisfaction in the context of Gen-AI-enhanced, application-based information-literacy courses is defined as students' overall evaluative judgement of how well the instructional design, human–AI interaction, support services, and learning outcomes meet their academic needs, social expectations, and personal growth aspirations.

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Conceptual Framework

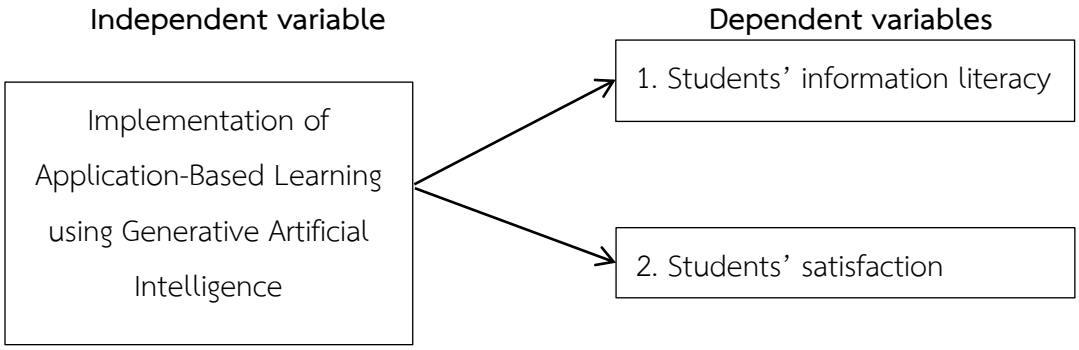


Figure 1 Conceptual Framework

Mothodology

Population and Sample

1. The population of this study is 150 first-year Students (5 classrooms) who enroll in the Information Literacy course at Kunming Medical University, Haiyuan College.

2. The sample of this study is 30 first-year Students (1 classroom) who enroll in the Information Literacy course at Kunming Medical University, Haiyuan College, selected using a cluster random sampling method.

Experimental Design

This study adopts the one-group pretest-posttest design (Campbell and Stanley, 1963), which was used as a procedure to investigate the effectiveness of curriculum implementation, as shown in the following figure.

Group	Pretest	Treatment	Posttest
Experimental	O_1	X	O_2

O_1 was a measurement of the students' information literacy before an experiment.

X was the implementation of Application-Based Learning using Generative Artificial Intelligence.

O_2 was a measurement of the students' information literacy and their satisfaction after an experiment.

Research Instruments

1. Lesson Plans: The appropriateness of lesson plans overall was at a very high level (*M*=4.62, *SD*=0.49).

2. Information Literacy Test: For this study had IOC value was between 0.67–1.00, item difficulty (p=0.43-0.60), item discrimination (r=0.25-0.50), and KR20 equals 0.76.

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3. Satisfaction Questionnaire: Students' satisfaction questionnaire with an IOC between 0.67 and 1.00, with a reliability index of 0.85.

Research Limitations: This study employed a one-group pretest-posttest design, which presents inherent limitations in internal validity. Specifically, the observed improvements in students' information literacy scores may be influenced by extraneous variables such as natural maturation effects, testing effects from repeated exposure to assessment instruments, or historical events occurring during the intervention period. To mitigate these threats, the study utilized a validated instrument with demonstrated reliability (KR20 = 0.76) and implemented standardized instructional protocols across all sessions. Future research should employ controlled experimental designs with comparison groups to establish stronger causal inferences. Additionally, the information literacy assessment tool specifically incorporated items measuring students' ability to evaluate AI-generated content credibility, fact-check AI outputs against authoritative medical sources, and identify potential AI hallucinations in medical information contexts.

Data Collection

1. The sample was given a pretest to measure information literacy.

2. The sample was taught using Application-Based Learning using Generative Artificial Intelligence in an information literacy course with 6 lesson plans and 12 total hours.

3. After finishing the instruction, the sample received the posttest using the same instrument that was used in the pretest.

4. The sample was given the students' satisfaction questionnaire.

Data Analysis

1. Compare the students' information literacy before and after receiving Application-Based Learning using Generative Artificial Intelligence by using a t-test for dependent samples.

2. Compare the students' information literacy with the determined criteria set at 70 percent by using a t-test for one sample.

3. Assess the students' satisfaction with Application-Based Learning using Generative Artificial Intelligence by using the arithmetic mean and standard deviation.

Results

1. The result of comparing the mean score of students' information literacy before and after learning through Application-Based Learning using Generative Artificial Intelligence in the Information Literacy course.

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Table 1 The results of comparing the mean score of students' information literacy before and after learning.

Group1	Full scores	n	Pretest scores		Post-test scores		*t*	*p*
			M	*SD*	*M*	*SD*		
Experimental group	30	30	12.43	2.99	22.77	1.61	18.53**	.000

**p<0.01

As presented in Table 1, the mean scores of the pretest of students' information literacy were 12.43 (*SD* = 2.99), and the posttest of students' information literacy was 22.77 (*SD* = 1.61). On average, Posttest scores were higher than pretest scores. The result of this table showed that after learning through Application-Based Learning using Generative Artificial Intelligence in the Information Literacy course in the classroom, posttest scores of students'information literacy were higher than pretest scores at the .01 level of statistical significance (t_{29}=18.53, *p*=.000). The average scores of the study developed increasingly higher than pretest.

2. The result of comparing the mean score of students' information literacy after learning through Application-Based Learning using Generative Artificial Intelligence in the Information Literacy course with the determined criterion set at 70 percent of full scores.

Table 2 The results of comparing the mean score of students' information literacy after learning with the determined criterion set at 70 percent of full scores.

Group	n	criterion score	*M*	*SD*	*t*	*p*
Experimental group	30	21	22.77	1.61	6.00**	0.000

**p<0.01

As presented in Table 2, the mean scores of the students' information literacy after learning through Application-Based Learning using Generative Artificial Intelligence in the Information Literacy course were 22.77 from a full mark of 30, and the standard deviation was 1.61. This was statistically higher than the criterion of 70% at the .01 level of statistical significance (t_{29}=6.00, *p*= .000).

3. The results of research to assess the students' satisfaction with the Application-Based Learning using Generative Artificial Intelligence in the Information Literacy course.

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Table 3 The results of research to assess the students' satisfaction with the Application-Based Learning using Generative Artificial Intelligence in the Information Literacy course.

Items	*M*	*SD*	Satisfaction level
Content			
1. Are you satisfied with the organization and content of the course?	4.23	0.81	High level
2. The course covers relevant topics that align with your interests.	4.17	0.86	High level
3. The course materials were clearly presented and easy to understand.	4.00	0.89	High level
4. The course challenges your understanding of daily routines.	4.20	0.83	High level
total	**4.15**	**0.85**	**High level**
Teaching strategies			
5. The context-setting activities and conceptual explanations effectively.	4.13	0.87	High level
6. You can actively participate in class discussions and activities.	4.07	0.88	High level
7. Your understanding of activities deepens your comprehension.	4.27	0.80	High level
8. The instructor actively encourages participation and engagement during class sessions.	4.10	0.87	High level
9. The teaching method used in this class was more effective than traditional instruction.	4.03	0.89	High level
total	**4.12**	**0.86**	**High level**
Media and resources			
10. The learning resources (e.g., multimedia, worksheets, tools) were helpful and appropriate.	4.20	0.83	High level
11. The provided materials and learning aids contributed to improving my understanding.	4.17	0.86	High level

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Items	*M*	*SD*	Satisfaction level
12. The course materials support your understanding of daily activities and routines.	4.07	0.88	High level
total	**4.15**	**0.86**	**High level**
Evaluation			
13. The assessment activities clearly reflected the content and learning objectives.	4.13	0.87	High level
14. The assessment and evaluation criteria for the course are clear.	4.23	0.81	High level
15. Are you satisfied with the evaluation method after class?	4.10	0.87	High level
Total	**4.15**	**0.85**	**High level**
Over all	**4.14**	**0.85**	**High level**

As shown in Table 3, students' overall satisfaction with the ABL-GAI instructional model was at a high level (*M*=4.14, *SD*=0.85). Key findings reveal that the highest satisfaction scores were observed in Media and Resources (*M*=4.15, *SD*=0.86), reflecting students' appreciation for GAI tools' accessibility and utility. Content Organization (*M*=4.15, *SD*=0.85) and Evaluation Methods (*M*=4.15, *SD*=0.85) also received high ratings, indicating that the course structure and assessment transparency effectively supported student learning. Teaching Strategies scored slightly lower (*M*=4.12, *SD*=0.86), suggesting potential areas for refinement in instructional delivery. These results collectively demonstrate the successful transition from teacher-centered to student-centered learning, with GAI integration playing a pivotal role in enhancing student engagement and learning experience.

Conclusion

Through research, it aims to 1) compare information literacy before and after learning through Application-Based Learning using Generative Artificial Intelligence. 2) compare information literacy with the determined criterion of 70 percent, and 3) assess students' satisfaction after learning through Application-Based Learning using Generative Artificial Intelligence. The conclusions were as follows: 1) students' information literacy after learning through Application-Based Learning using Generative Artificial Intelligence was higher than before at statistically significant level of .01 (t_{29}=18.53, p=.000), 2) students' information literacy was higher than the determined criterion of 70% at a significance level of .01 (t_{29}=6.00, p=.000) and 3) students'

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satisfaction after learning through Application-Based Learning using Generative Artificial Intelligence overall was at a high level (M=4.14, S.D.= 0.85).

Therefore, the implementation of Application-Based Learning using Generative Artificial Intelligence is feasible for teaching in the Information Literacy course, which helps to improve the students' information literacy. The experimental results validated the research objectives.

Discussion

1. Students' information literacy scores were higher after Application-Based Learning using Generative Artificial Intelligence than before. This is because Application-Based Learning using Generative Artificial Intelligence integrates the advantages of Application-Based Learning (ABL) and Generative Artificial Intelligence (Generative Artificial Intelligence), creating an active learning ecosystem. ABL's six-step process (Encounter the Situation, Investigate & Reflect, Conceptualize Knowledge, Practice the Skills, Apply & Create, Conclude & Improve) aligns with Bloom's Revised Taxonomy, promoting the development of higher-order thinking skills such as analysis, evaluation, and creation. Generative Artificial Intelligence, as an intelligent learning companion, provides personalized feedback and dynamic resources, reducing students' cognitive load and accelerating the learning cycle.

From the perspective of Constructivist Theory, Application-Based Learning using Generative Artificial Intelligence situates learning in authentic tasks (e.g., campus plastic reduction campaigns), allowing students to construct knowledge through hands-on practice rather than passive lecture reception. Generative Artificial Intelligence's "prompt–generate–validate–refine" loop enables students to iteratively optimize solutions, deepening their understanding of information literacy's core components (Define & Plan, Seek & Access, Analyze, Use, Synthesize & Communicate, Reflect & Self-Evaluate). This aligns with Wang, Zhang & Li's (2024) finding that AI-integrated information literacy training significantly improves critical literacy, as students in this study showed marked progress in identifying information needs, evaluating AI-generated content, and creating practical information products.

Additionally, Cognitive Theory emphasizes metacognitive development. Application-Based Learning using Generative Artificial Intelligence's reflection links (e.g., AI-generated learning diagnoses, peer reviews) encourage students to monitor and regulate their learning processes, transforming experiential learning into transferable competencies. This explains why posttest scores improved by 10.34 points on average, with statistical significance mirroring Hu et al.'s (2025) meta-analysis result that AI-supported ABL produces a medium-to-large effect (g=0.46) on higher-order thinking, particularly evident in medical students' information analysis and application abilities.

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2. Students' information literacy scores after Application-Based Learning using Generative Artificial Intelligence learning exceeded the 70% criterion. This is because Application-Based Learning using Generative Artificial Intelligence addresses the core gaps of traditional information literacy teaching identified in the research background: insufficient connection to real-world contexts, lack of Generative Artificial Intelligence integration, and limited creation opportunities. The course's six topics (Need Identification to Public Sharing) fully cover the entire information literacy chain, while Generative Artificial Intelligence tools (DeepSeek, Kimi) provide instant access to campus data, search strategies, and feedback, enabling students to master practical skills efficiently.

While the 70% criterion (21 out of 30) is defensible in light of national digitalization policies and medical education quality standards, relying on a single threshold may oversimplify learning quality and mask variations across competency dimensions (e.g., information evaluation, ethical judgment, and clinical application). Although the ability of Application-Based Learning using Generative Artificial Intelligence (GAI) to surpass this benchmark indicates policy alignment and relevance to medical students' practical needs, exceeding a minimum standard does not necessarily demonstrate higher-order mastery or long-term transfer. Therefore, future improvement should incorporate multi-level performance benchmarks, analytic rubrics aligned with evidence-based medicine competencies, and longitudinal assessments to capture skill retention and ethical reasoning over time. In addition, integrating structured reflection, explicit ethical frameworks for GAI use, and formative feedback loops within authentic medical scenarios would strengthen the depth of learning and ensure that performance gains translate into sustainable professional competence rather than short-term score improvement.

This finding is consistent with Hu et al.'s (2025) meta-analysis, which reported a medium-to-large effect size (g=0.46) of AI-supported ABL on higher-order thinking. It also supplements empirical evidence for medical universities in China, where Generative Artificial Intelligence-integrated information literacy courses were previously scarce. Notably, it responds to Zhang et al. 's (2023) observation that LLM-generated simulations improve clinical reasoning scores (d=0.41). The study extends this to information literacy, showing that structured AI-literacy interventions prevent over-reliance on AI answers, a risk identified in 27% of medical students without such training.

3. Students showed high satisfaction with Application-Based Learning using Generative Artificial Intelligence teaching. The overall satisfaction mean (M=4.14) and high scores across all dimensions (content, teaching strategies, media and resources, evaluation) reflect the method's comprehensive effectiveness. One key reason is the relevance of learning tasks: the "Sustainable Campus Life" theme and group project-based campaign proposals connect information literacy

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to students' daily lives and future careers, increasing learning motivation as noted by Lynch (2022) in ABL research.

Generative Artificial Intelligence's role in enhancing satisfaction is prominent. Media and resources received the highest satisfaction (M=4.15) because DeepSeek and Kimi lower the barrier to information retrieval, content creation, and peer collaboration. Students no longer need advanced technical skills to produce digital posters or pitches, allowing them to focus on information quality and creativity, addressing the concern raised by Zhang et al (2023) that insufficient IL preparation leads to over-reliance on AI, as our design embeds critical evaluation of AI outputs into every step. Teaching strategies (M=4.12) benefited from Application-Based Learning using Generative Artificial Intelligence's student-centered design: 70% of class time was dedicated to hands-on group work, and teachers provided targeted feedback based on AI-generated diagnostic reports, transforming traditional lectures into interactive co-creation sessions. Evaluation methods (M=4.15) also contributed to satisfaction. Formative assessments (peer feedback, in-class sharing) and summative assessments (digital pitches using AAC&U VALUE Rubrics) were transparent and aligned with learning objectives, enabling students to clearly track their progress. This aligns with Watermark's (2025) view that domain-specific, transparent assessment enhances student satisfaction.

Despite these positive outcomes, several challenges and limitations warrant critical consideration. First, technical constraints associated with GAI platforms, including intermittent server instability of DeepSeek and Kimi during peak usage periods, occasionally disrupted the learning flow. Approximately 15% of students reported experiencing delays in AI response generation, which may have affected their learning efficiency. Second, while the majority of students expressed high satisfaction, a small subset (approximately 10%) indicated discomfort with AI-dependent learning activities, preferring traditional instructional methods. This divergence suggests that ABL-GAI implementation should accommodate diverse learning preferences and provide alternative pathways for students less inclined toward technology-mediated learning. Third, the assessment of information literacy in the GAI era presents unique challenges, as students may demonstrate different competencies when working with AI assistance versus independent problem-solving. Future iterations of the assessment instrument should distinguish between AI-assisted and unassisted performance to more accurately gauge students' intrinsic information literacy development.

Recommendation

1. At the implementation level, institutions should establish clear GAI usage standards for medical information literacy education. Specifically, (a) develop institutional guidelines that

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mandate verification of AI-generated medical information against authoritative sources such as PubMed, Cochrane Library, and clinical practice guidelines; (b) implement a tiered assessment framework where 30% of examination questions evaluate students' ability to identify AI hallucinations and misinformation, 40% assess independent information retrieval skills, and 30% measure AI-assisted synthesis capabilities; (c) require documentation of AI tool usage in student assignments, including prompt history and verification procedures; (d) establish faculty development programs focused on AI pedagogy, with minimum 20 hours of training on GAI integration strategies; and (e) create technical support infrastructure ensuring stable access to GAI platforms during instructional hours.

2. At the research level, future studies should employ randomized controlled trial designs with at least 100 participants per group to establish robust causal evidence. Longitudinal tracking should extend beyond the semester to assess retention of information literacy competencies at 6-month and 12-month intervals. Comparative research examining the differential effectiveness of various GAI platforms (DeepSeek, Kimi, ChatGPT, Claude) in medical education contexts would inform platform selection decisions. Additionally, an investigation into the impact of ABL-GAI on diverse learner populations, including students with varying prior technology experience and those from underrepresented backgrounds, is essential for ensuring equitable educational outcomes. Finally, development and validation of domain-specific information literacy assessment instruments that specifically measure AI-era competencies, including hallucination detection and source verification skills, should be prioritized.

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