The Society For Transdiciplinary Studies

JTS

The Journal of Transdisciplinary Studies

p-ISSN 2586-5439
e-ISSN 2713-7457

Original Article

Faculty Needs Analysis of AI-Based Team Collaboration Support Functions in University Project Courses: A Comparison between Humanities and Engineering

Sanghyun Song[1], Yunja Hwang[2*]

[1] Associate Professor, Department of Middle Eastern Studies, College of Foreign Languages, Dankook University, Korea (12160258@dankook.ac.kr)
[2] Assistant Professor, Center for Innovative Engineering Education, College of Engineering, Dankook University, Korea (yjhwang@dankook.ac.kr)
*Corresponding Author : yjhwang@dankook.ac.kr

ABSTRACT

Objectives: This study aimed to investigate faculty perceptions of the importance of and need for AI-based team collaboration support functions in project-based courses and Capstone Design, compare these perceptions between the humanities and social sciences and science and engineering disciplines, and propose AI-based team collaboration strategies that reflect both common and discipline-specific needs. **Methods:** A survey was conducted with 65 faculty members from 16 universities who had experience teaching project-based courses or Capstone Design. The questionnaire measured perceptions of AI-based team collaboration support functions and the need for AI-based collaboration design strategies. Data were analyzed using descriptive statistics, Welch's t-tests, and Importance–Need Analysis to examine disciplinary differences. **Results:** The findings indicate that faculty members perceive generative AI not merely as a content generation tool but as an educational partner that supports collaboration throughout the project process. The Importance–Need Analysis identified information search and report writing, problem definition and idea generation, and performance management and learning analytics as priority development areas, whereas team discussion and conflict management was classified as a potential improvement area. Science and engineering faculty assigned significantly higher importance to AI-assisted code generation and debugging than did humanities and social sciences faculty. Faculty members from both disciplinary groups also expressed strong needs for AI-supported feedback, learning analytics and diagnostic support, and project coaching. **Conclusions:** This study identifies priorities for AI-based team collaboration support and provides preliminary design directions for integrating generative AI into collaborative instructional design in higher education. The findings suggest that common core AI support functions should be prioritized, with selected functions strengthened according to disciplinary characteristics.

Keywords: AI-supported team collaboration, Capstone design, Generative AI, Importance–need analysis, Project-based learning

Received 28 Jul 2026
Revised 21 Aug 2026
Accepted 22 Aug 2026

Citation: Song SH, Hwang YJ. Faculty Needs Analysis of AI-Based Team Collaboration Support Functions in University Project Courses: A Comparison between Humanities and Engineering. The Journal of Transdisciplinary Studies. 2026; 10(2): 117-130. https://doi.org/10.22685/jts.2026.10.2.117

1. Introduction

Since the release of ChatGPT in 2022, followed by the emergence of generative artificial intelligence (AI) tools such as Gemini, Claude, and Perplexity, higher education has entered a new phase of educational transformation [1,2]. Generative AI has evolved from a conventional information retrieval tool into an intelligent educational partner that facilitates information search, idea generation, content creation, programming, and problem-solving. Consequently, it has attracted considerable attention as a core technology that enhances both instructors' instructional design and students' self-directed learning through AI-assisted educational support [3,4].

Generative AI has also demonstrated considerable potential for student-centered instructional approaches, including Project-Based Learning (PBL), Problem-Based Learning, and Capstone Design courses [5,6]. Previous studies have reported that generative AI enhances problem-solving ability, academic achievement, self-efficacy, creativity, programming competence, and project performance [7-11]. In engineering education, AI-supported project learning has also been shown to improve students' problem-solving abilities and interdisciplinary competencies by enabling them to experience the entire project process, from problem definition and system design to implementation and evaluation [12].

Despite these educational benefits, the current use of generative AI in higher education remains largely focused on supporting individual learning activities, such as information retrieval, report writing, presentation preparation, and programming. Relatively little attention has been paid to AI-supported instructional strategies that facilitate team-based collaborative learning throughout the project process, including team formation, role assignment, collaboration management, project coaching, collaboration monitoring, learning analytics, and performance assessment.

Recent studies suggest that generative AI can support collaborative learning by facilitating idea generation, integrating diverse opinions, co-authoring documents, supporting discussions, and providing feedback. Furthermore, AI has the potential to function as an active team member that participates in collaborative learning rather than merely serving as an assistive tool [13-17]. Previous research has similarly reported that generative AI can support brainstorming, idea integration, collaborative writing, and team discussions during group-based learning activities [13-17].

Collaborative learning is a representative learner-centered instructional approach in which knowledge is socially constructed through interaction among learners. In Project-Based Learning and Capstone Design courses, the quality of collaboration is widely recognized as a critical determinant of learning outcomes [18-20]. Throughout project implementation, students engage in a variety of collaborative activities, including problem definition, idea generation, role allocation, conflict resolution, product development, and performance evaluation. Consequently, there is an increasing need for AI-supported collaboration strategies capable of effectively facilitating these collaborative processes. Moreover, collaboration patterns differ across academic disciplines. Therefore, the AI functions and team collaboration support strategies required in humanities and social sciences projects may differ from those needed in science and engineering projects.

However, the existing literature has generally been limited to evaluating the general educational effectiveness of generative AI or reporting on its application within individual courses. Few studies have comparatively examined the AI-based team collaboration functions required in humanities and social sciences versus science and engineering project courses or proposed discipline-specific AI-supported collaboration strategies based on faculty needs.

Accordingly, this study investigates faculty perceptions regarding the importance of AI-based team collaboration support functions and their needs for AI-supported collaboration design strategies among instructors with experience teaching project-based or Capstone Design courses. Furthermore, it compares these perceptions between the humanities and social sciences and science and engineering disciplines. Based on an importance–need matrix analysis and qualitative analysis of open-ended responses, this study identifies discipline-specific AI-supported team collaboration strategies and priority AI functions for future development. The findings are expected to provide foundational guidelines for developing AI-supported team collaboration models applicable to future project-based courses.

2. Literature review

2.1. Generative AI and its educational applications

Generative artificial intelligence (Generative AI) refers to AI technologies capable of creating new content—including text, images, audio, video, and programming code—based on large-scale pretrained models in response to user prompts. Among these technologies, Large Language Models (LLMs) are trained on extensive textual data to understand and generate natural language, summarize information, answer complex queries, and support a wide range of problem-solving tasks [1,2].

Since the public release of ChatGPT in November 2022, generative AI has rapidly expanded across diverse domains, including education, research, industry, and healthcare. In higher education, generative AI has transformed teaching and learning practices by supporting question answering, concept explanation, information retrieval, academic writing, translation, programming, and formative feedback [3,4,6]. Furthermore, the emergence of general-purpose AI systems such as Gemini, Claude, and Microsoft Copilot, together with domain-specific applications including Canva AI, Notion AI, Gamma, and Figma AI, has substantially broadened the scope of AI-supported learning from information search and writing to presentation design, graphic creation, data analysis, and programming assistance.

Urban et al. [10] reported that the use of ChatGPT in creative problem-solving activities significantly improved university students' problem-solving self-efficacy, enhanced the quality and sophistication of their solutions, and reduced the cognitive effort required for idea generation. These findings suggest that generative AI can function as a cognitive partner, supporting learners throughout the process of solving ill-structured problems by facilitating idea generation, refining solutions, and improving project outcomes. Through continuous interaction with generative AI, learners can clarify problem definitions, explore multiple perspectives and alternative solutions, and iteratively evaluate and refine their own ideas and products. Likewise, instructors can employ generative AI to develop instructional materials, generate learning tasks and questions, provide personalized explanations and formative feedback, and design learning and assessment activities [3,4].

Previous studies have consistently demonstrated the educational benefits of generative AI in terms of academic achievement, self-efficacy, learning engagement, creativity, and problem-solving ability. In particular, the integration of ChatGPT into writing instruction, programming education, and project-based learning has been shown to enhance learners' creative thinking, support complex problem-solving processes, and improve the quality of learning outcomes [6–8].

Generative AI also offers considerable potential in engineering education. It can assist students by explaining mathematical and engineering concepts, answering technical questions, generating and debugging programming code, facilitating idea generation, summarizing research literature, and supporting technical report writing. In a conceptual study exploring the opportunities and challenges of generative AI in engineering education, Qadir [11] argued that ChatGPT can provide personalized explanations and feedback, virtual tutoring, programming support, research assistance, and problem-solving guidance. More importantly, he emphasized that generative AI should not replace students' thinking but rather function as an intelligence augmentation tool, enabling learners to formulate effective questions, critically evaluate AI-generated responses, and continuously refine their own reasoning.

Similarly, Hwang [12] developed a ChatGPT-based AIoT extracurricular program and examined its educational effectiveness among engineering students. The findings revealed significant improvements in students' problem-solving abilities and interdisciplinary competencies, demonstrating that generative AI can effectively support the entire engineering design process—from problem definition and system design to implementation—and serve as an effective learning tool in engineering project education.

Taken together, previous studies indicate that generative AI can support a wide range of project-based learning activities, including problem definition, information retrieval and summarization, idea generation, academic writing, programming, debugging, presentation development, and feedback. Particularly in engineering education, generative AI can facilitate programming and technical problem-solving throughout the project lifecycle—from problem definition and system design to implementation—thereby enhancing students' problem-solving experiences and interdisciplinary competencies [11-12].

2.2. Generative AI-supported collaborative learning in project-based learning

Project-Based Learning (PBL) is a student-centered instructional approach in which learners investigate authentic and complex problems over an extended period and develop tangible outcomes as a result of their inquiry [18–20]. Similarly, Capstone Design is a project-based educational approach that requires students to integrate the knowledge and skills acquired in their major disciplines to design solutions and develop practical products for real-world problems.

Throughout the project process, students engage in a series of learning activities, including problem definition, information search, idea generation, role assignment, solution design, product development, presentation, and reflection. During this process, communication among team members, shared goal setting, coordination of roles and tasks, knowledge sharing, mutual feedback, and conflict management are critical factors influencing project success [18-20]. Therefore, project-based learning emphasizes not only individual knowledge and technical competence but also collaborative processes through which team members jointly construct knowledge and solve problems.

Generative AI can serve not only as an information-support tool during team projects but also as a collaborative partner that facilitates idea generation, integrates diverse perspectives, supports collaborative writing, promotes discussion, and provides timely feedback. AI can help teams organize and compare ideas, generate alternative solutions, structure meeting discussions, and draft and refine collaborative documents.

Kwon and Kwon [13] investigated team-based problem-solving activities involving eleven university students who were permitted to use conversational generative AI. Based on analyses of team activity reports and pre- and post-tests, they identified several key roles of generative AI, including facilitating brainstorming, organizing ideas systematically, integrating team members' opinions, and drafting, revising, and reviewing collaborative writing that reflected collective team perspectives.

Similarly, Kang [14] incorporated ChatGPT into group discussions in a German literature course that combined Project-Based Learning with flipped learning. Students used ChatGPT to search for information, ask questions, and support classroom discussions. Furthermore, AI-generated responses served as discussion materials, encouraging students to refine their questions and collaboratively evaluate the accuracy and validity of the generated information.

Park [15] also demonstrated that ChatGPT can function as a collaborative learning tool by promoting cognitive interaction, fostering critical thinking, and supporting teamwork during AI-assisted collaborative learning activities.

International studies have likewise reported that generative AI functions as a collaborative partner by facilitating brainstorming, communication, collaborative knowledge construction, and problem solving, thereby promoting more effective teamwork. An et al. [16] integrated generative AI into a mind map-based collaborative learning environment and found that students using generative AI achieved higher task performance than those participating in conventional collaborative learning. Furthermore, generative AI facilitated collaborative knowledge construction by enabling learners to develop individual ideas into shared knowledge at both peer and group levels.

Wei et al. [17] conducted a 20-week digital storytelling project in which one group utilized ChatGPT, Midjourney, and Runway, while another group completed the same tasks using traditional methods. Their findings revealed that students in the AI-supported group demonstrated significantly higher collaborative problem-solving abilities than those in the comparison group. Moreover, the AI-supported group achieved superior team creativity, particularly in terms of user experience and originality.

Taken together, previous studies indicate that generative AI can effectively support project-based and collaborative learning by facilitating information retrieval, idea generation, opinion integration, collaborative writing, interaction, and collaborative problem solving [13-17]. Several studies have also reported improvements in task performance and team creativity [16,17]. Nevertheless, existing research has primarily focused on evaluating the educational effectiveness of generative AI within specific courses or examining learners' experiences with AI-supported learning. Consequently, relatively little attention has been devoted to comprehensively investigating AI-supported functions required throughout the project lifecycle, including team building, role assignment, project coaching, collaboration monitoring, team member contribution analysis, learning analytics, performance management, and assessment support.

Furthermore, project-based learning varies across academic disciplines and project types, resulting in different instructional processes and support requirements. Projects in the humanities and social sciences typically emphasize information exploration and interpretation, discussion, academic writing, and content creation, whereas science and engineering projects generally involve technical activities such as problem definition, system design, experimentation, programming, prototype development, and debugging. Despite these disciplinary differences, few studies have compared faculty perceptions of the importance and necessity of AI-based team collaboration support functions across the humanities and social sciences and science and engineering disciplines.

Accordingly, the present study investigates faculty perceptions regarding the importance of AI-based team collaboration support functions and the need for AI-supported collaboration design strategies among instructors who have experience teaching Project-Based Learning or Capstone Design courses. Furthermore, it compares these perceptions between the humanities and social sciences and science and engineering disciplines to propose AI-supported team collaboration design strategies tailored to project-based learning environments.

3. Research method

3.1. Research participants

This study investigated faculty needs for AI-based team collaboration strategies among university instructors who had experience teaching project-based courses or Capstone Design courses. An online survey was administered using Google Forms, and a total of 65 valid responses were included in the final analysis.

The participants were faculty members from 16 domestic and international universities. Regarding academic discipline, 35 respondents (53.8%) were from the humanities and social sciences, 28 (43.1%) were from science and engineering, and 2 (3.1%) were from other disciplines, including arts, physical education, and medicine. For comparative analyses between disciplines, only responses from the humanities and social sciences and science and engineering groups were included, whereas responses from the other disciplines were considered only in the overall descriptive statistics.

With respect to teaching experience, 47 respondents (72.3%) had more than seven years of teaching experience, followed by 12 respondents (18.5%) with four to six years and 6 respondents (9.2%) with one to three years. These findings indicate that the majority of participants had substantial experience in higher education as well as in teaching project-based courses.

Table 1. Participant Characteristics (N = 65)

Category	Sub-category	N	Percentage(%)
University affiliation	University A	45	69.2
	University B	4	6.3
	University C	2	3.1
	Other universities (13 institutions)	14	21.5
	Total	65	100.0
Academic discipline	Humanities and social sciences	35	53.8
	Science and engineering	28	43.1
	Others (Arts, Physical Education, and Medicine)	2	3.1
	Total	65	100.0
Teaching experience	1–3 years	6	9.2
	4–6 years	12	18.5
	7 years or more	47	72.3
	Total	65	100.0

3.2. Research instrument

To investigate faculty perceptions of and needs for AI-based team collaboration support functions, a preliminary questionnaire was developed based on a review of relevant literature and existing project-based learning practices. The initial instrument was subsequently reviewed by an educational technology expert and faculty members from both the humanities and social sciences and science and engineering disciplines to evaluate the relevance, clarity, and applicability of each item across different academic fields. Based on their feedback, the questionnaire was revised and finalized.

The final survey consisted of eight sections: (1) demographic information, (2) current status of project-based courses, (3) current use of AI, (4) importance of AI-based collaboration support functions, (5) needs for AI-based team collaboration strategies, (6) AI function needs by academic discipline, (7) concerns about AI use, and (8) open-ended questions.

The Importance of AI-Based Collaboration Support Functions scale consisted of 14 items measuring faculty perceptions of the importance of AI support for various project activities, including problem definition, information search and summarization, idea generation, facilitation of team discussions, role assignment recommendations, project schedule management, automatic meeting minute generation, collaboration monitoring, team member contribution analysis, report writing support, presentation generation, code generation and debugging, design review and feedback, and conflict diagnostic support and mediation.

The needs for AI-based team collaboration strategies scale included 10 items assessing faculty needs for AI-supported functions, including AI-based team building, role recommendation, project coaching, mentoring, collaboration monitoring, feedback, performance management, team member contribution analysis, assessment support, and learning analytics and diagnostic support.

All importance and needs items were measured using a five-point Likert scale. For the importance scale, responses ranged from 1 (Not at all important) to 5 (Very important). For the needs scale, responses ranged from 1 (Not at all necessary) to 5 (Highly necessary).

To obtain more in-depth insights into faculty expectations

Table 2. Structure of the survey instrument

Category	Content	No. of Items	Response Format
Demographic information	University affiliation, academic discipline, department, teaching experience, project course type	5	Multiple choice
Current status of project-based courses	Challenges in managing team projects, factors influencing project outcomes	2	Multiple choice (multiple responses)
Current use of AI	Recommendation of AI use, AI tools used, areas of AI application	3	Multiple choice (single or multiple responses)
Importance of AI-based collaboration support functions	Problem definition support, information search and summarization, idea generation, team discussion facilitation, role assignment recommendations, project schedule management, automatic meeting minutes, collaboration monitoring, team member contribution analysis, report writing support, presentation generation, code generation and debugging, design review and feedback, conflict diagnostic support and mediation	14	5-point Likert scale
Needs for AI-Based Team Collaboration Strategies	AI-based team building, role recommendation, project coaching, mentoring, collaboration monitoring, feedback, performance management, team member contribution analysis, assessment support, learning analytics and diagnostic support	10	5-point Likert scale
AI Function Needs by Academic Discipline	AI functions required for humanities and social sciences projects, AI functions required for engineering design and production projects	2	Multiple choice (multiple responses)
Concerns About AI Use	Concerns regarding AI-supported collaborative project courses	1	Multiple choice (multiple responses)
Open-Ended Questions	AI functions that should be most effectively supported, essential elements and recommendations for developing AI-based team collaboration strategies	2	Open-ended
Total		39	

and suggestions regarding AI-based collaboration support, the survey also included two open-ended questions. Participants were asked to describe (1) the AI functions that should most effectively support team project courses and (2) the essential features and recommendations that should be incorporated into future AI-based team collaboration strategies.

3.3. Data collection procedure

Data were collected through an online survey administered using Google Forms. The questionnaire was distributed to university faculty members who had experience teaching project-based courses or Capstone Design courses. The survey was conducted from June 23 to July 1, 2026, over a nine-day period.

Before completing the survey, participants were provided with information regarding the purpose of the study, the collection and use of personal information, the anonymous handling of survey responses, and the assurance that the collected data would be used solely for research purposes. Only those who voluntarily agreed to participate proceeded with the survey. No personally identifiable information was collected, and all responses were used exclusively for research purposes.

3.4. Data analysis

The collected data were analyzed using Microsoft Excel and IBM SPSS Statistics. First, descriptive statistics, including frequencies and percentages, were calculated to summarize participants' demographic characteristics, the current status of project-based courses, and the use of generative AI. For multiple-response items, the frequency of each response option and the corresponding percentage based on the total sample ($N = 65$) were calculated.

Means and standard deviations were computed for the importance ratings of AI-based collaboration support functions and the need ratings for AI-based team collaboration strategies. To examine differences between the humanities and social sciences and science and engineering groups, Welch's independent-samples t-tests were conducted to account for differences in sample sizes and variances between the two groups. Statistical significance was determined at the .05 level.

For the matrix analysis, the importance and need items were grouped into seven corresponding functional areas based on the conceptual similarity of the functions they represented in the project collaboration process. The mean scores of the relevant items within each functional area were then calculated and used as the importance and need values for the matrix analysis.

An Importance–Need Matrix Analysis was conducted to identify the relative priorities of AI-based team collaboration support functions. Traditional Importance–Performance Analysis (IPA) determines improvement priorities by comparing the perceived importance of attributes with their current performance or satisfaction levels. However, the present study did not assess the current performance of existing AI support functions; rather, it examined faculty perceptions of the importance and need for AI-based team collaboration support functions to be developed or strengthened. Therefore, need was used instead of performance as the second analytical dimension to determine the relative development priorities of the functions. The overall mean scores for importance and need across the analyzed functions were used as the reference points for the matrix. This approach allowed each function to be interpreted as relatively high or low compared with the overall average and enabled an exploratory classification of development priorities. Accordingly, functions with both high importance and high need were classified as Priority Development, those with high importance but relatively low need as Continued Management, those with both low importance and low need as Low Priority, and those with relatively low importance but high need as Potential Improvement.

Responses to the open-ended questions were analyzed using qualitative content analysis. The responses were first segmented into meaningful units and then grouped into categories based on similarities in content. Through an iterative coding process, major themes were identified. The resulting categories included information retrieval and summarization support, idea generation and problem definition support, collaboration management and role assignment support, report and presentation development support, assessment and feedback support, and ethical guidelines and the appropriate scope of AI use.

4. Results

4.1. Current status of project-based courses and the use of generative AI

4.1.1. Types of project-based courses

As shown in Table 3, the most common type of project-based course taught by the participants was humanities and social sciences projects (discussion-, research-, writing-, and content creation-oriented), reported by 33 respondents (50.8%). This was followed by science and engineering design and development projects (design-, experimentation-, and prototype development-oriented), reported by 25 respondents (38.5%), and hybrid projects, reported by 17 respondents (26.2%).

Table 3. Types of project-based courses

Category	N	Percentage (%)
Humanities and Social Sciences Projects (discussion-, research-, writing-, and content creation-oriented)	33	50.8
Engineering Design and Development Projects (design-, experiment-, and prototype development-oriented)	25	38.5
Hybrid Projects	17	26.2
Others (instructional design and teaching demonstration projects)	1	1.5

4.1.2. Challenges in managing team projects

As presented in Table 4, faculty members identified project management and team collaboration as the most challenging aspect of managing project-based courses (33 respondents, 50.8%). Other frequently reported challenges included managing team member participation (27 respondents, 41.5%), conflict management (26 respondents, 40.0%), idea generation (22 respondents, 33.8%), and problem definition (21 respondents, 32.3%).

These findings suggest that the primary challenges in project-based learning are associated with collaborative processes, such as team management, participation, and conflict resolution, rather than with the development of project deliverables or report writing.

Table 4. Challenges in managing team projects

Challenge	N	Percentage (%)
Project management and collaboration	33	50.8
Managing team member participation	27	41.5
Conflict management	26	40.0
Idea generation	22	33.8
Problem definition	21	32.3
Communication	20	30.8
Role assignment	18	27.7
Deliverable development	15	23.1
Schedule management	10	15.4
Information search and data collection	9	13.8
Presentation preparation	6	9.2
Report writing	4	6.2
Others	1	1.5

4.1.3. Factors influencing team project outcomes

Communication among team members was identified as the most influential factor affecting team project outcomes (49 respondents, 75.4%). This was followed by teamwork and collaboration (45 respondents, 69.2%), team member participation (30 respondents, 46.2%), and team leadership (22 respondents, 33.8%).

In contrast, AI competency was selected by only 8 respondents (12.3%), indicating that faculty members regarded interpersonal and collaborative factors—including communication, teamwork, and participation—as substantially more important determinants of project success than students' proficiency in using generative AI.

Table 5. Factors influencing team project outcomes

Factor	N	Percentage (%)
Communication among team members	49	75.4
Teamwork and collaboration	45	69.2
Team member participation	30	46.2
Team leadership	22	33.8
Disciplinary expertise	19	29.2
Project management	17	26.2
Role assignment	17	26.2
Instructor feedback	17	26.2
AI competency	8	12.3

4.1.4. Recommendations for the use of generative AI

As presented in Table 6, the largest proportion of respondents (29 faculty members, 44.6%) strongly recommended the use of generative AI in project-based courses. In addition, 17 respondents (26.2%) recommended limited use, while another 17 respondents (26.2%) believed that students should decide independently whether to use AI. Only one respondent (1.5%) recommended restricting AI use, and one respondent (1.5%) recommended prohibiting its use altogether.

Overall, 96.9% of respondents expressed either positive or permissive attitudes toward the use of generative AI, suggesting that AI has become widely accepted as a learning support tool in project-based courses.

Table 6. Recommendations for the use of generative AI

Recommendation	N	Percentage (%)
Strongly recommend	29	44.6
Recommend limited use	17	26.2
Leave the decision to students	17	26.2
Restrict use	1	1.5
Prohibit use	1	1.5
Total	65	100.0

4.1.5. Most frequently used AI tools by students

As shown in Table 7, ChatGPT was reported by faculty as the most frequently used AI tool among students (60 respondents, 92.3%), followed by Gemini (55 respondents, 84.6%) and Claude (32 respondents, 49.2%). Canva AI was reported by 14 respondents (21.5%), while Perplexity, Notion AI, Figma AI, and Gamma were reported less frequently.

These findings suggest that, according to faculty perceptions, students primarily rely on general-purpose conversational AI systems, while specialized AI tools for design, document management, and presentation development are used less frequently.

Table 7. AI tools most frequently used by students

Category	N	Percentage (%)
ChatGPT	60	92.3
Gemini	55	84.6
Claude	32	49.2
Canva AI	14	21.5
Perplexity	7	10.8
Notion AI	5	7.7
Figma AI	5	7.7
Gamma	3	4.6
Others	3	4.6

4.1.6. Areas in which students primarily use AI

As presented in Table 8, faculty members reported that students most frequently used generative AI for information search and summarization (60 respondents, 92.3%). Other common applications included presentation preparation (38 respondents, 58.5%), idea generation (35 respondents, 53.8%), report writing (28 respondents, 43.1%), and image generation (24 respondents, 36.9%).

In contrast, AI was used far less frequently for activities directly related to team collaboration and project management, such as collaboration management (4 respondents, 6.2%), meeting minute preparation (2 respondents, 3.1%), role assignment (2 respondents, 3.1%), and schedule management (1 respondent, 1.5%).

Table 8. Areas in which students primarily use AI

Area of AI use	N	Percentage (%)
Information search and summarization	60	92.3
Presentation preparation	38	58.5
Idea generation	35	53.8
Report writing	28	43.1
Image generation	24	36.9
Brainstorming	16	24.6
Data analysis	13	20.0
Error detection and correction	8	12.3
Code generation	6	9.2
Collaboration management	4	6.2
Meeting minute preparation	2	3.1
Role assignment	2	3.1
Schedule management	1	1.5

These results suggest that generative AI is currently used primarily to support information processing and the production of project deliverables, whereas its potential to facilitate collaborative processes and team management remains largely underutilized.

4.2. Importance of AI-based team collaboration support functions

Table 9 presents faculty members' perceptions of the importance of AI-based team collaboration support functions. Among the 14 functions, AI for information search and summarization received the highest importance rating (M = 4.42, SD = 0.66). This was followed by AI for presentation preparation (M = 4.12, SD = 0.82), AI for report writing support (M = 4.09, SD = 0.77), and AI for code generation and debugging (M = 3.97, SD = 0.95).

In contrast, relatively lower importance ratings were reported for AI for conflict detection and mediation (M = 2.92, SD = 0.94), AI for team member contribution analysis (M = 3.09, SD = 0.98), and AI for role assignment recommendations (M = 3.11, SD = 0.97).

These findings indicate that faculty members place greater importance on AI functions that support information retrieval, content development, presentation preparation, and technical problem-solving than on AI functions designed to facilitate team management and interpersonal collaboration, such as conflict mediation, contribution analysis, and role assignment.

Table 9. Importance of AI-based team collaboration support functions (N=65)

Rank	AI-based team collaboration support function	Mean	SD
1	AI for information search and summarization	4.42	0.66
2	AI for presentation preparation	4.12	0.82
3	AI for report writing support	4.09	0.77
4	AI for code generation and debugging	3.97	0.95
5	AI for problem definition	3.95	0.84
6	AI for design review and feedback	3.94	0.95
7	AI for idea generation	3.82	0.81
8	AI for automatic meeting minute generation	3.57	0.94
9	AI for project schedule management	3.31	0.95
10	AI for facilitating team discussions	3.20	0.78
10	AI for collaboration analytics	3.20	0.94
12	AI for role assignment recommendations	3.11	0.97
13	AI for team member contribution analysis	3.09	0.98
14	AI for conflict detection and mediation	2.92	0.94

4.3. Needs assessment of AI-based team collaboration strategies

Table 10 presents faculty members' perceived needs for AI-based team collaboration strategies. Among the ten proposed strategies, AI-based feedback received the highest mean score (M = 4.06, SD = 0.70). This was followed by AI-based learning analytics and diagnostic support (M = 3.98, SD = 0.93), AI-based mentoring (M = 3.91, SD = 0.81), and both AI-based project coaching (M = 3.85, SD = 0.69) and AI-based performance management (M = 3.85, SD = 0.82). These findings suggest that faculty members expect generative AI to serve not merely as a tool for information retrieval or content generation but as an educational support system capable of diagnosing students' learning processes, providing timely feedback and mentoring, and continuously monitoring project performance throughout the learning process.

In contrast, relatively lower levels of need were reported for AI-based team member contribution analysis (M = 3.40, SD = 1.09) and AI-based role recommendation (M = 3.49, SD = 0.85). Notably, AI-based team member contribution analysis exhibited the largest standard deviation among the proposed strategies, indicating greater variability in faculty perceptions regarding the necessity of this function.

Table 10. Needs assessment of AI-based team collaboration design strategies

Rank	AI-based team collaboration strategy	N	Mean	SD
1	AI-based feedback	65	4.06	0.70
2	AI-based learning analytics and diagnostic support	65	3.98	0.93
3	AI-based mentoring	65	3.91	0.81
4	AI-based project coaching	65	3.85	0.69
4	AI-based performance management	65	3.85	0.82
6	AI-based assessment support	65	3.74	0.91
7	AI-based collaboration monitoring	65	3.62	0.86
8	AI-based team building	65	3.55	0.77
9	AI-based role recommendation	65	3.49	0.85
10	AI-based team member contribution analysis	65	3.40	1.09

4.4. Importance–need matrix analysis of AI-based team collaboration support functions

An Importance–Need Matrix Analysis was conducted to examine the relative positions of each functional area based on the overall mean scores of perceived importance and need. The reference values for the matrix were 3.52 for importance and 3.78 for need.

Table 11. Importance–need matrix of AI-based team collaboration support functions

Functional area	Importance (M)	Need (M)	Importance–need matrix quadrant
Information search and report writing	4.21	4.06	I. Priority Development
Performance management and learning analytics	3.94	3.92	I. Priority Development
Problem definition and idea generation	3.88	3.85	I. Priority Development
Team discussion and conflict management	3.06	3.91	IV. Potential Improvement
Project scheduling and collaboration monitoring	3.36	3.62	III. Low Priority
Contribution analysis and assessment	3.09	3.57	III. Low Priority
Role recommendation and team building	3.11	3.52	III. Low Priority

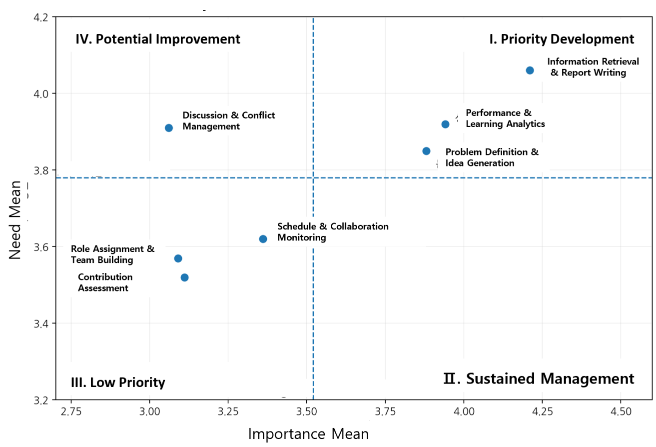

Fig. 1. Overall importance–need matrix

As shown in Table 11 and Figure 1, three functional areas—information search and report writing, performance management and learning analytics, and problem definition and idea generation—were positioned in Quadrant I (Priority Development), indicating that these functions received above-average ratings for both importance and need. These findings suggest that AI-based team collaboration systems should prioritize functions that support information retrieval and summarization, report and presentation development, problem definition, idea generation, learning analytics, and performance management.

In contrast, the team discussion and conflict management area was classified into Quadrant IV (Potential Improvement), characterized by relatively low perceived importance but high perceived need. Although faculty members did not regard discussion facilitation and conflict mediation as the primary functions of AI, they nevertheless recognized a substantial need for these capabilities when managing project-based courses. This finding suggests that AI support for team interaction and conflict resolution represents an important area for future development.

Finally, project scheduling and collaboration monitoring, contribution analysis and assessment, and role recommendation and team building were positioned in Quadrant III (Low Priority), with both importance and need falling below the overall averages. These findings suggest that these functions may be introduced incrementally after the development of higher-priority functions or implemented selectively according to the characteristics of specific project contexts and instructional needs.

4.5. Comparison of importance ratings between humanities and social sciences and engineering faculty

Table 12 presents the comparison of faculty perceptions regarding the importance of AI-based team collaboration support functions between the humanities and social sciences and science and engineering groups. Overall, no statistically significant differences were observed between the two groups for most AI support functions.

However, a significant difference was found for AI for code generation and debugging, with faculty in the science and engineering group (M = 4.36) assigning significantly higher importance to this function than those in the humanities and social sciences group (M = 3.63; t = −3.30, p = .002). This finding is likely attributable to the nature of science and engineering projects, which more frequently involve programming, system design, experimentation, debugging, and other technically oriented problem-solving activities.

Although AI for design review and feedback was also rated higher by science and engineering faculty (M = 4.18) than by humanities and social sciences faculty (M = 3.71), the difference narrowly failed to reach statistical significance (t = −1.99, p = .051). Similarly, AI for presentation preparation received higher ratings from science and engineering faculty (M = 4.32) than from humanities and social sciences faculty (M = 3.94), although the difference was not statistically significant (t = −1.88, p = .064).

Overall, these findings indicate that faculty perceptions of the importance of AI-based collaboration support functions were largely similar across disciplines, with the notable exception of code generation and debugging, which was considered substantially more important in science and engineering education.

4.6. Comparison of needs for AI-based team collaboration strategies between humanities and social sciences and engineering faculty

As shown in Table 13, no statistically significant difference was observed between the humanities and social sciences and the natural sciences and engineering in terms of the perceived need for AI-based team collaboration strategies. Based on mean scores, engineering faculty identified the highest needs for AI-based feedback (M=4.04), AI-based learning analytics and diagnostic support (M=4.04), and AI-based project coaching (M=4.00).

Similarly, humanities and social sciences faculty reported the highest need for AI-based feedback (M = 4.06), followed by AI-based mentoring (M = 3.89) and AI-based learning analytics and diagnostic support (M = 3.89).

Table 12. Comparison of importance ratings between humanities and social sciences and engineering faculty

AI-based support function	Humanities and social sciences (M)	Sciences and engineering (M)	t	p
AI for problem definition	3.91	3.96	-0.23	.818
AI for information search and summarization	4.31	4.50	-1.12	.268
AI for idea generation	3.77	3.86	-0.42	.675
AI for facilitating team discussions	3.20	3.18	0.11	.913
AI for role assignment recommendations	3.14	3.00	0.59	.557
AI for project schedule management	3.26	3.29	-0.12	.904
AI for automatic meeting minute generation	3.37	3.75	-1.61	.113
AI for collaboration analytics	3.11	3.25	-0.58	.563
AI for team member contribution analysis	3.00	3.11	-0.45	.651
AI for report writing support	3.94	4.25	-1.64	.106
AI for presentation preparation	3.94	4.32	-1.88	.064
AI for code generation and debugging	3.63	4.36	-3.30	.002
AI for design review and feedback	3.71	4.18	-1.99	.051
AI for conflict detection and mediation	2.91	2.89	0.09	.928

p<.01

Table 13. Comparison of needs for AI-based team collaboration strategies between humanities and social sciences and engineering faculty

AI-based team collaboration strategy	Humanities and social sciences (M)	Sciences and engineering (M)	t	p
AI-based team building	3.49	3.61	-0.62	.538
AI-based role recommendation	3.34	3.64	-1.41	.163
AI-based project coaching	3.71	4.00	-1.70	.095
AI-based mentoring	3.89	3.93	-0.21	.838
AI-based collaboration monitoring	3.63	3.57	0.26	.798
AI-based feedback	4.06	4.04	0.12	.907
AI-based performance management	3.80	3.82	-0.10	.918
AI-based team member contribution analysis	3.23	3.50	-0.99	.329
AI-based assessment support	3.66	3.79	-0.55	.587
AI-based learning analytics and diagnostic support	3.89	4.04	-0.63	.529

Although AI-based project coaching received a higher mean rating from science and engineering faculty ($M = 4.00$) than from humanities and social sciences faculty ($M = 3.71$), the difference was not statistically significant ($t = -1.70$, $p = .095$). Overall, these findings indicate that both disciplinary groups share similar needs for AI-based team collaboration support, particularly for feedback, learning analytics and diagnostic support, mentoring, and project coaching.

4.7. Comparison of the importance–need matrix by academic discipline

4.7.1. Importance–need matrix analysis for humanities and social sciences faculty

Table 14 and Figure 2 present the Importance–Need Matrix Analysis for humanities and social sciences faculty. Information search and report writing, performance management and learning analytics, and problem definition and idea generation were classified as Priority Development areas. Team discussion and conflict management was identified as a Potential Improvement area, while the other functional areas were classified as Low Priority. Based on the mean scores, faculty members in the science and engineering group reported the greatest needs for AI-based feedback ($M = 4.04$), AI-based learning analytics and diagnostic support ($M = 4.04$), and AI-based project coaching ($M = 4.00$). Faculty members in the humanities and social sciences group reported the highest need for AI-based feedback ($M = 4.06$), followed by AI-based mentoring ($M = 3.89$) and AI-based learning analytics and diagnostic support ($M = 3.89$). Although AI-based project coaching received a higher mean rating from science and engineering faculty ($M = 4.00$) than from humanities and social sciences faculty ($M = 3.71$), the difference was not statistically significant ($t = -1.70$, $p = .095$).

Table 14. Importance-need matrix for humanities and social sciences faculty

Functional area	Importance (M)	Need (M)	Importance–need matrix quadrant
Information search and report writing	4.07	4.06	I. Priority development
Performance management and learning analytics	3.71	3.84	I. Priority development
Problem definition and idea generation	3.84	3.71	I. Priority development
Team discussion and conflict management	3.06	3.89	IV. Potential improvement
Project scheduling and collaboration monitoring	3.25	3.63	III. Low priority
Contribution analysis and assessment	3.00	3.44	III. Low priority
Role recommendation and team building	3.14	3.41	III. Low priority

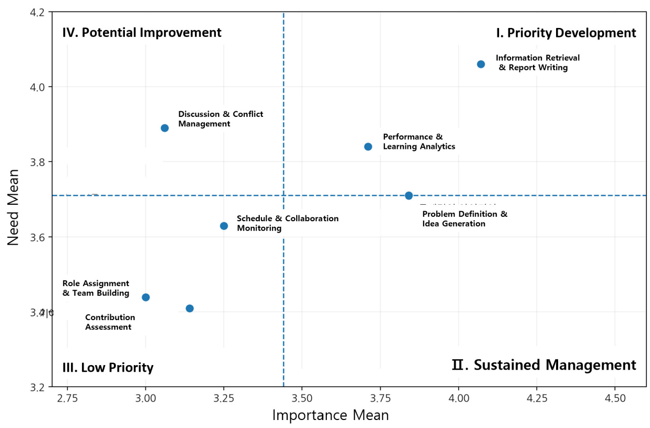

Fig. 2. Importance–need matrix for the humanities and social sciences

Overall, the findings indicate that both disciplinary groups shared similar needs for AI-supported feedback, learning analytics and diagnostic support, mentoring, and project coaching, suggesting common expectations regarding the educational role of AI in supporting collaborative project-based learning.

4.7.2. Importance–need matrix analysis for science and engineering faculty

Table 15 and Figure 3 present the results of the Importance–Need Matrix Analysis for faculty members in the science and engineering disciplines. Three functional areas —information search and report writing, performance management and learning analytics, and problem definition and idea generation—were positioned in Quadrant I (Priority Development), indicating above-average ratings for both importance and need. Among these, information search and report writing received the highest importance rating (M = 4.36), followed by performance management and learning analytics (M = 4.18). These findings suggest that science and engineering faculty place particular value on AI functions that support technical information retrieval, documentation, analysis of design outcomes, learning analytics, and performance feedback throughout project implementation.

Table 15. Importance–need matrix for engineering faculty

Functional area	Importance (M)	Need (M)	Importance–need matrix quadrant
Information search and report writing	4.36	4.04	I. Priority development
Performance management and learning analytics	4.18	3.93	I. Priority development
Problem definition and idea generation	3.91	4.00	I. Priority development
Team discussion and conflict management	3.04	3.93	IV. Potential improvement
Project scheduling and collaboration monitoring	3.43	3.57	III. Low priority
Contribution analysis and assessment	3.11	3.64	III. Low priority
Role recommendation and team building	3.00	3.63	III. Low priority

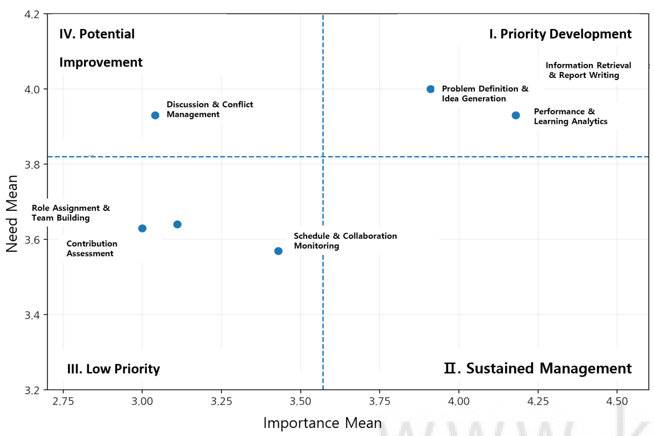

Fig. 3. Importance–need matrix for science and engineering

The problem definition and idea generation area also demonstrated a high level of need (M = 4.00), indicating strong demand for AI support during the early stages of engineering projects, particularly for defining complex technical problems, exploring alternative design solutions, and refining innovative ideas.

The team discussion and conflict management area was classified into Quadrant IV (Potential Improvement), reflecting relatively low perceived importance but high perceived need. Although faculty members did not consider conflict management to be a primary AI function, they recognized the potential value of AI in supporting engineering team discussions by organizing technical issues, comparing alternative solutions, summarizing meeting outcomes, and facilitating consensus-building during collaborative decision-making.

Finally, role recommendation and team building, project scheduling and collaboration monitoring, and contribution analysis and assessment were positioned in Quadrant III (Low Priority). These findings suggest that such functions should be regarded as supplementary features that reduce instructors' and students' management burdens rather than replace the core educational activities involved in project-based learning.

5. Discussion

This study examined faculty perceptions of the importance of and need for AI-based team collaboration support functions in project-based courses and Capstone Design and compared these perceptions between the humanities and social sciences and science and engineering disciplines.

First, faculty members perceived generative AI as more than a content generation tool; they viewed it as an educational tool that could support project implementation and collaborative processes. Although students currently use AI primarily for information search and summarization, presentation preparation, and idea generation, faculty members identified project management and collaboration, team member participation, and conflict management as major challenges in project-based instruction. Communication and collaboration among team members were also perceived as major factors influencing project outcomes. These findings suggest that generative AI should evolve beyond supporting information retrieval and deliverable production toward facilitating collaborative processes. This interpretation is consistent with previous studies demonstrating the potential of generative AI to support brainstorming, integration of team members' ideas, collaborative writing, interaction, collaborative knowledge construction, and collaborative problem-solving [13–17].

Second, the Importance–Need Matrix Analysis identified information search and report writing, problem definition and idea generation, and performance management and learning analytics as Priority Development areas. This finding suggests that AI-based team collaboration support should encompass the overall project process, from problem definition and idea generation to information exploration, deliverable development, feedback, and learning analytics. The relatively high needs for AI-supported feedback, learning analytics and diagnosis, mentoring, and project coaching further indicate that faculty members expect AI to function as an educational partner that supports the learning process rather than merely as a content generation tool. This finding is consistent with previous research emphasizing the potential of generative AI to support learning, feedback, problem-solving, and learners' cognitive processes [3,10,11].

Third, most AI support functions did not show statistically significant differences between the two disciplinary groups. Code generation and debugging was the only function rated significantly higher by science and engineering faculty. Therefore, rather than developing entirely different AI collaboration strategies for each discipline, a more appropriate approach would be to establish common core functions while selectively strengthening discipline-specific support. For science and engineering projects, for example, technical functions such as code generation and debugging may be selectively enhanced to support programming, design, experimentation, and technical problem-solving.

Finally, team discussion and conflict management was classified as a Potential Improvement area, showing relatively low importance but high need. This pattern suggests that although faculty members may be cautious about allowing AI to directly judge or mediate interpersonal conflicts, they recognize the need for support in managing discussion and conflict during project activities. AI should therefore support rather than replace human interaction by organizing team perspectives, identifying key issues, comparing alternatives, summarizing discussions, and facilitating consensus building.

6. Conclusions, Limitations, and Future Research

This study analyzed the importance of and need for AI-based team collaboration support functions among 65 faculty members with experience in project-based courses or Capstone Design. Information search and report writing, problem definition and idea generation, and performance management and learning analytics were identified as Priority Development areas, whereas team discussion and conflict management was identified as a Potential Improvement area. Most functions showed no significant disciplinary differences, except for code generation and debugging, which was rated significantly higher by science and engineering faculty. These findings suggest that AI-based team collaboration support should be built around common core functions, with selected functions strengthened according to disciplinary characteristics.

This study contributes to extending the educational role of generative AI from supporting individual task performance and content generation to facilitating project implementation and collaborative processes. It also provides practical priorities for AI-supported collaboration based on faculty needs and the Importance–Need Matrix Analysis. However, the proposed strategies should be regarded as preliminary design directions derived from the findings rather than an empirically validated model.
Several limitations should be acknowledged. The study employed a cross-sectional survey design, which limits causal interpretation. Although participants were recruited from 16 universities, a substantial proportion were affiliated with a single institution, limiting the representativeness and generalizability of the findings. In addition, although the questionnaire items were developed based on previous studies and expert review, separate assessments of content validity, construct validity, and internal consistency reliability were not conducted. The study also focused on faculty perceptions and did not empirically validate the proposed AI-based team collaboration strategies in actual instructional settings. Future research should validate the instrument using larger and more diverse samples and examine the effects of the proposed strategies on collaborative competence, problem-solving ability, team efficacy, and learning outcomes in authentic project-based learning environments.

Author Contributions

Conceptualization: Yunja Hwang; Data collection, Formal analysis: Sanghyun Song, Yunja Hwang; Writing-original draft: Yunja Hwang, Sanghyun Song; Writing review&editing: Sanghyun Song

ORCID

Yunja Hwang: https://orcid.org/0009-0006-8625-4037
Sanghyun Song: https://orcid.org/0009-0000-8562-4960

Conflict of Interest

The authors declare no conflict of interest.

References

1. Brown TB, Mann B, Ryder N, Subbiah M, Kaplan J, Dhariwal P, et al. Language models are few-shot learners. Adv Neural Inf Process Syst. 2020;33:1877-1901.
2. OpenAI. GPT-4 technical report. arXiv [Preprint]. 2023. doi:10.48550/arXiv.2303.08774.
3. Kasneci E, Sessler K, Küchemann S, Bannert M, Dementieva D, Fischer F, et al. ChatGPT for good? On opportunities and challenges of large language models for education. Learn Individ Differ. 2023;103:102274. doi:10.1016/j.lindif.2023.102274.
4. Tlili A, Shehata B, Adarkwah MA, Bozkurt A, Hickey DT, Huang R, et al. What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education. Smart Learn Environ. 2023;10:15. doi:10.1186/s40561-023-00237-x.
5. Chang K. Development of project based learning taxonomy and project taxonomy. The Korean Journal of Educational Methodology Studies. 2022;34(2):427-455.
6. Hwang Y. Case study: Industry-inclusive capstone design in intelligent robotics using design thinking. Journal of Digital Contents Society. 2024;25(8):2291-2299.
7. Lo CK. What is the impact of ChatGPT on education? A rapid review of the literature. Educ Sci. 2023;13(4):410. doi:10.3390/educsci13040410.
8. Kim WS. Analysis of the educational effects regarding the use of ChatGPT in compulsory basic coding subjects. Korean Journal of General Education. 2023;17(5):113-123.
9. Ko GI. A study on the effectiveness of generative AI utilization in programming education: Focusing on ChatGPT and Scratch programming. Journal of Convergence Security. 2024;24(3):33-39.
10. Urban M, Děchtěrenko F, Lukavský J, Hrabalová V, Svacha F, Brom C, et al. ChatGPT improves creative problem-solving performance in university students: An experimental study. Comput Educ. 2024;215:105031. doi:10.1016/j.compedu.2024.105031.
11. Qadir J. Engineering education in the era of ChatGPT: Promise and pitfalls of generative AI for education. In: Proceedings of the 2023 IEEE Global Engineering Education Conference (EDUCON); 2023 May 1-4; Kuwait. Piscataway (NJ): IEEE; 2023. p.1-9. doi:10.1109/EDUCON54358.2023.10125121.
12. Hwang Y. Development of a ChatGPT-based AIoT extracurricular program for engineering students: A case study. Journal of Practical Engineering Education. 2026;18(1):1-10.
13. Kwon SA, Kwon SJ. Analysis of the role of conversation-generating AI and student experience in a human-AI collaborative learning environment. The Journal of Educational Research. 2024;22(2):97-122.
14. Kang C. Der Einsatz von ChatGPT im Seminar zur deutschen Literatur. Deutsche Sprach- und Literaturwissenschaft. 2023;31(4):45-80. doi:10.24830/kgd.31.4.3.
15. Park H. Comparison of the interaction patterns in collaborative learning using generative AI. The Journal of Korean Association of Computer Education. 2024;27(5):27-34. doi:10.32431/kace.2024.27.5.003.
16. An S, Zhang S, Guo T, Lu S, Zhang W, Cai Z. Impacts of generative AI on student teachers' task performance and collaborative knowledge construction process in mind mapping-based collaborative environment. Comput Educ. 2025;227:105227. doi:10.1016/j.compedu.2024.105227.
17. Wei X, Wang L, Lee LK, Liu R. The effects of generative AI on collaborative problem-solving and team creativity performance in digital story creation: An experimental study. Int J Educ Technol High Educ. 2025;22(1):23. doi:10.1186/s41239-025-00526-0
18. Thomas JW. A review of research on project-based learning. San Rafael (CA): Autodesk Foundation; 2000.
19. Bell S. Project-based learning for the 21st century: Skills for the future. Clearing House. 2010;83(2):39-43. doi:10.1080/00098650903505415.
20. Kokotsaki D, Menzies V, Wiggins A. Project-based learning: A review of the literature. Improv Sch. 2016;19(3):267-277. doi:10.1177/1365480216659733.