

The Future of Cine-Education: An AI-Enhanced Project-Based Learning Model for Modern Filmmakers

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Abstract

Artificial intelligence is increasingly influencing creative media production and higher education. However, undergraduate filmmaking education still lacks a structured approach for integrating AI into project-based learning across the full production workflow. This study investigates the first phase of a broader doctoral research project and aims to identify the core components of an AI-enhanced project-based learning model for undergraduate filmmaking education in China. A mixed-methods developmental research design was employed. Data were collected through document analysis, stakeholder questionnaires, open-ended responses, and expert evaluation. A total of 350 student questionnaires were distributed, and 291 valid responses were retained for analysis. Additional data were obtained from 80 film instructors, 60 film employers or industry representatives, and 15 model review experts. The findings revealed five cross-group themes: authentic project experience, integrated filmmaking skill development, AI-supported process assistance, collaboration and role-based participation, and continuous feedback and revision. These themes were translated into design requirements and then organized into a four-layer instructional framework consisting of input, process, support, and outcome layers. Expert evaluation indicated that the preliminary model components were appropriate, relevant, and suitable for further development. The study contributes a stakeholder-informed framework for integrating AI into project-based filmmaking education and provides a foundation for subsequent classroom implementation and empirical validation.

Keywords: AI-enhanced project-based learning, filmmaking education, undergraduate education, instructional model development, thematic analysis

1. Introduction

As digital media continues to transform, Chinese universities are expected to make undergraduate filmmaking education more practice-oriented (Ren, 2024). Filmmaking combines creative decision-making, technical execution, and multi-stage coordination (Florén et al., 2025; Ling et al., 2024), yet existing teaching often separates skills such as screenwriting, filming, and editing, thereby limiting students' understanding of the full production process (Lyu & Ang, 2024). Filmmaking requires iterative feedback and reflection, but instructors often struggle to provide such support continuously (Boutellier & Raptis, 2023). Project-based learning (PBL) emphasizes process-oriented, task-driven learning and aligns with filmmaking education (Ling et al., 2024). AI increasingly supports creative fields through idea generation, process planning, and workflow optimization (Orak & Turan, 2024; Monserrat & Srnc, 2025), enhancing planning, decision-making, and reflection, taking into consideration of student's creativity. Currently, AI applications in education are diverse but remain largely tool-based (Lee et al., 2024). Developing an AI-enhanced PBL model can reorganize instructional structures and support mechanisms. This study aims to identify the model components, investigate the perceptions of students, instructors, and industry representatives, and examine expert evaluations. It addresses three questions: (1) What instructional needs and perceptions exist regarding AI-supported filmmaking education? (2) What core components should an AI-enhanced PBL model include? (3) How do experts evaluate the preliminary model's suitability and feasibility?

2. Literature Review

2.1 AI in Education and Creative Learning Contexts

Recent studies indicate that AI in higher education is reshaping teaching and learning practices, while also raising concerns about ethics, collaboration, and responsible implementation (Bond et al., 2024; Lee et al., 2024). In creative

learning contexts, AI systems have been used to support idea development, reflection, and peer feedback, particularly through multimodal and dialogue-based approaches (Orak & Turan, 2024; Yang et al., 2023).

However, existing studies remain limited in their focus on individualized tool use and often lack systematic integration across comprehensive learning processes. This limitation is particularly evident in complex creative fields such as filmmaking, which involve interconnected learning stages and long-term collaboration. As a result, the role of AI has not yet been sufficiently defined within a structured educational model.

In creative learning contexts, students have also reported both perceived benefits and challenges associated with generative AI, particularly in relation to learning support and academic practice (Chan & Hu, 2023; Yang et al., 2023).

In film production, AI can support the three major stages of filmmaking. In pre-production, AI can assist with script development, idea generation, storyboarding, scheduling, and production planning. During production, AI can support shot planning, camera assistance, scene organization, and technical decision-making. In post-production, AI can contribute to editing, visual effects, sound design, color correction, and feedback analysis. Therefore, AI should be understood as a process-supportive tool across the full filmmaking workflow.

2.2 Project-Based Learning in Filmmaking Education

Project-based learning (PBL) is widely recognized to be suitable for filmmaking education because it emphasizes task- and process-oriented learning (Ling et al., 2024). By situating learning within complete projects, PBL enables students to integrate knowledge and skills through collaborative problem-solving (Florén et al., 2025). Film education in higher education also benefits from connecting academic learning with authentic production practice, particularly when students are expected to engage with real-world creative and production contexts (Loader & Maasdorp, 2024).

Nevertheless, current implementations remain fragmented. Project activities are often treated as separate training tasks and lack continuous support throughout the entire production process (Lyu & Ang, 2024). Furthermore, the iterative and response-oriented nature of filmmaking creates challenges for instructors in providing continuous, goal-directed guidance (Boutellier & Raptis, 2023). A standalone PBL approach may therefore be insufficient to meet the demands of filmmaking education.

Project-based learning aligns naturally with the filmmaking process. In pre-production, PBL enables students to define problems, develop ideas, write scripts, and organize production tasks. During production, students collaborate in authentic roles such as directing, cinematography, lighting, acting, and production coordination. In post-production, PBL supports editing, revision, reflection, peer feedback, and the presentation of final works. Therefore, PBL provides a pedagogical structure that mirrors the actual process of film production.

2.3 Filmmaking Process and Filmmaking Skills

Filmmaking competence in education involves technical, creative, and collaborative dimensions. The filmmaking process generally includes pre-production, production, and post-production. Pre-production includes concept development, scriptwriting, storyboarding, scheduling, and resource planning. Production requires directing, cinematography, lighting, sound recording, performance coordination, and on-set problem-solving. Post-production includes editing, sound design, visual effects, color grading, retouching, and final delivery. Therefore, filmmaking skills should not be viewed as separate technical tasks, but should instead be understood as integrated abilities that develop through the actual production process.

2.4 Integrating AI with Project-Based Learning: Opportunities and Gaps

Recent research has examined how AI can be integrated into PBL settings to help students manage project responsibilities, assess process-based tasks, and receive feedback within project contexts (Orak & Turan, 2024). In film production, AI can be used at numerous stages of the process, from concept development and production planning to the final editing of content and materials (Monserrat & Srnc, 2025). The increasing use of artificial intelligence in the film industry also suggests that filmmaking education needs to respond to emerging changes in production practices and professional competencies (Tsiavos & Kitsios, 2025).

However, much current AI integration remains tool-oriented rather than model-oriented. AI is often discussed as a set of isolated applications, with less attention to how it can be embedded across the full PBL lifecycle. This gap is especially important in filmmaking education, where effective learning requires the alignment of creative tasks, production workflows, collaboration, and continuous support.

The intersection between AI-supported learning and filmmaking education highlights the need for a domain-specific instructional model. More specifically, a framework is needed to support collaboration at every stage, provide continuous and timely feedback throughout the PBL project cycle, and assess learning outcomes with appropriate criteria. To address this need, this study develops an AI-enhanced project-based learning model by integrating stakeholder perspectives and evidence from the needs-analysis phase.

3. Research Methodology

3.1 Research Design and Rationale

This study used a mixed-methods developmental research design. The aim was to identify and preliminarily validate the core components of an AI-enhanced project-based learning model for undergraduate filmmaking education.

This article reports the first phase of a broader doctoral research project. This phase focused on needs analysis, component identification, and preliminary expert review. It did not test the instructional effectiveness of the model; this issue will be examined in a later implementation phase.

The mixed-methods design aligned with the objectives of this study. The research required both quantitative evidence and qualitative interpretation. Quantitative data were collected through Likert-scale questionnaires completed by undergraduate students, film instructors, film employers or industry representatives, and model review experts.

The qualitative data were derived from document analysis, open-ended questionnaire responses, and expert comments. These materials helped clarify stakeholder needs and practical concerns. They also helped translate the research findings into model components.

The research process included four stages. First, the relevant literature was reviewed. The review covered artificial intelligence in education, project-based learning methods, instructional design, film production, filmmaking processes, and filmmaking skills.

Second, stakeholder questionnaires were administered. The questionnaires collected data from students, instructors, film employers, and industry representatives. These data highlighted learning needs, pedagogical challenges, and disciplinary expectations.

Third, the findings were integrated. The quantitative results illustrated the general patterns in stakeholder views. The qualitative responses clarified the underlying meaning of these views. The combined findings were then used to develop the initial model components.

Fourth, experts reviewed the preliminary components. They assessed the suitability, completeness, relevance, and overall appropriateness of the proposed framework. Their feedback provided guidance for improving the AI-PBL model.

Figure 1 illustrates the research procedure, including document analysis, stakeholder needs analysis, component synthesis, and expert validation.

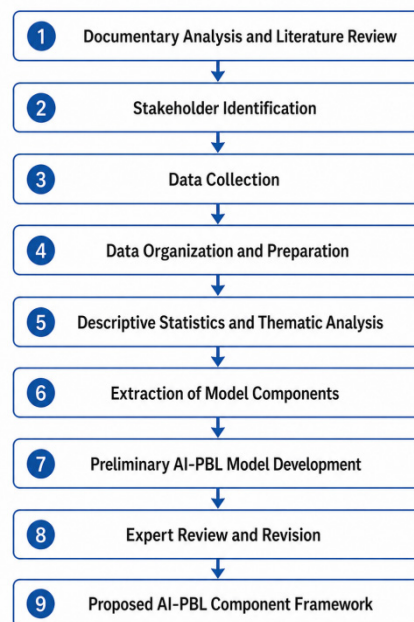


Figure 1. Research design and procedure of the study

3.2 Participants and Data Sources

This study involved four participant groups: undergraduate students, film instructors, film employers or industry representatives, and model review experts. Each group provided a different perspective on AI-supported filmmaking education.

The student group provided the learner perspective. The instructor group provided the pedagogical perspective. The

employer and industry group provided professional expectations. The expert group provided academic and practical validation.

The student population consisted of 1,200 undergraduate students in their second, third, and fourth years. Their majors included film production, digital media arts, broadcasting and directing, editing, animation, and related fields.

First-year students were not included because most of them had limited experience with professional filmmaking courses. Students from Years 2 to 4 had more relevant learning experience and were therefore more suitable for identifying learning needs and skill gaps.

The student sampling frame consisted of 1,200 undergraduate students enrolled in film- and media-related majors across their second, third, and fourth years. Based on the sample size table by Krejcie and Morgan (1970), a minimum of 291 valid responses was required for representative analysis. To ensure sufficient data, 350 questionnaires were distributed. After screening for completeness and validity, 291 valid responses were retained for analysis, yielding a valid response rate of approximately 83%.

The sample distribution is shown in Table 1.

Table 1. Sampling Distribution of Undergraduate Students

Year Level	Population	Proportion	Sample Size
Year 2	400	33.33%	97
Year 3	400	33.33%	97
Year 4	400	33.33%	97
Total	1,200	100%	291

The instructor sampling frame included 80 eligible instructors teaching in film- and media-related disciplines. A total of 80 instructors were purposively selected based on educational qualifications and professional experience.

The employer and industry representative group comprised 80 eligible individuals from film production companies, digital media studios, creative media enterprises, AI-related media companies, and broadcasting or media organizations. Sixty representatives were purposively selected to provide professional expectations and employability perspectives.

The expert group consisted of 15 model review experts, including specialists in AI or educational technology, film education, and film production. The experts evaluated the preliminary model components regarding appropriateness, completeness, relevance, and overall suitability.

Table 2. Population, Sample Size, and Sampling Method

Participant Group	Population/Sampling Frame	Questionnaires Distributed/Invited	Valid Responses/Final Sample	Sampling Method	Role in the Study
Undergraduate students	1,200 second- to fourth-year students in film- and media-related majors	350	291	Proportional stratified sampling (Krejcie & Morgan)	Identify learning needs, skill gaps, and expectations for AI-supported filmmaking education
Film instructors	80 eligible instructors	80 invited	80	Purposive sampling	Provide pedagogical and curriculum-related perspectives
Employers/industry representatives	80 eligible representatives	60 invited	60	Purposive sampling	Provide industry expectations and employability perspectives
Model review experts	15 AI, film education, and film production specialists	15 invited	15	Expert purposive sampling	Evaluate preliminary model components

3.3 Research Instruments

The research instruments were selected in accordance with the purpose of this stage, which was to identify model components and obtain preliminary validation from model review experts. Students' learning outcomes were not assessed.

Five instruments were used in the present study: a document analysis protocol, a student questionnaire, a film instructor questionnaire, a film employer/industry representative questionnaire, and an expert evaluation form for model components.

Document analysis provided the theoretical basis for the model. The reviewed materials included AI in education, project-based learning methods, teaching approaches, filmmaking education, filmmaking processes, and filmmaking skills. This analysis helped identify the fundamental concepts of the AI-PBL model.

The student questionnaire examined students' needs and expectations. It focused on students' use of AI in the filmmaking process. It also examined their expectations regarding future applications of AI-supported learning methods, real-time feedback, creative support, and collaboration with AI tools.

The film instructor questionnaire examined instructors' views on AI integration. It covered AI-supported pre-production, production, post-production, technical problem-solving, ethical concerns, and educational value. This instrument helped identify the educational potential and feasibility of AI-supported film production curricula.

The film employer/industry representative questionnaire examined industry expectations. It focused on productivity, creative innovation, emerging areas of expertise, technological challenges, ethical concerns, and future developments. This instrument helped connect the model with real industry needs.

The expert evaluation form was used to assess the preliminary model components in terms of appropriateness, completeness, relevance, and overall suitability. Experts also provided written comments to support further refinement of the model.

Table 3. Research Instruments Used in the Present Study

No.	Research Instrument	Participants/Data Source	Purpose	Data Type
1	Document analysis	Literature and theoretical materials	To establish the theoretical foundation of the AI-PBL model	Qualitative documentary data
2	Student questionnaire	291 undergraduate students	To examine students' needs, expectations, challenges, and willingness to use AI tools	Quantitative data and open-ended responses
3	Film instructor questionnaire	80 film instructors	To examine teachers' views on AI integration and teaching feasibility	Quantitative data and open-ended responses
4	Film employer/industry representative questionnaire	60 film employers or industry representatives	To explore industry expectations and AI-related production needs	Quantitative data and open-ended responses
5	Expert evaluation form for model components	15 model review experts	To evaluate the preliminary model components	Quantitative ratings and written comments

The broader research project includes additional instruments, such as the Expert Model Quality Assessment Form, the Filmmaking Skills Assessment Tool, the Learning Achievement Test, and the Student Learning Satisfaction Questionnaire.

These instruments were not used in the current article. They are associated with later stages of the research and are used to assess model quality, teaching effectiveness, film production capabilities, student performance, and student satisfaction.

3.4 Data Collection Procedure

Data collection was conducted in four connected stages to develop the AI-enhanced PBL model.

First, document analysis was conducted. Literature on AI in education, project-based learning, instructional design, film production, filmmaking workflow, and filmmaking skills was reviewed to establish the conceptual foundation of the study.

Second, stakeholder questionnaires were administered. A total of 350 student questionnaires were distributed, and 291 valid responses were retained after screening the completeness and validity. The instructor questionnaire was completed by 80 selected film instructors. The employer questionnaire was completed by 60 selected film employers or industry representatives. All stakeholder questionnaires contained Likert-scale items and open-ended questions.

Third, the quantitative and qualitative data were organized for analysis. Quantitative responses were prepared for descriptive statistics and reliability and validity testing. Open-ended responses were reviewed and coded to identify recurring themes related to AI-supported learning, project-based production tasks, collaboration, feedback, and instructional needs.

Fourth, expert review was conducted. The preliminary model components were presented to 15 model review experts. They evaluated the components in terms of appropriateness, completeness, relevance, and overall suitability, and they also provided written comments for model revision.

The expert feedback was used to refine the preliminary framework. The revision clarified teacher guidance, AI functions across filmmaking stages, feedback checkpoints, and the relationship among input, process, support, and outcome layers.

3.5 Data Analysis

Both quantitative and qualitative analytical methods were used. The results from both approaches shed light on different aspects of model development.

The quantitative data were derived from Likert-scale responses and were analyzed using frequency, percentage, mean, and standard deviation. The analysis summarized stakeholder views on the potential applications, challenges, and value of AI in film production. The reliability of the questionnaire constructs was assessed using Cronbach's alpha. Expert evaluations were also analyzed using means and standard deviations. These results helped assess the suitability of the initial model components.

The qualitative data were drawn from documents, open-ended questionnaire responses, expert comments, and research notes. These data were examined using thematic analysis following the approach proposed by Braun and Clarke (2006). The qualitative analysis proceeded through several stages. First, the materials were reviewed multiple times. Second, initial coding was carried out. These codes captured ideas related to filmmaking skill development, AI-supported learning methods, PBL, collaboration, feedback, and workplace expectations. Third, corresponding codes were grouped into broader categories. Fourth, the categories were compared with research findings and the literature. Finally, the content was translated into instructional design requirements.

Quantitative and qualitative findings were integrated during model development. The quantitative results revealed general trends in stakeholder views, while the qualitative findings explained the underlying concerns and implications of these views. This combination strengthened the model development process by integrating stakeholder insights with expert-informed decisions on the initial components.

3.6 Model Component Development and Preliminary Expert Validation

The AI-PBL model was developed through an evidence-informed process. The study did not adopt a ready-made model template. Instead, the framework was built from literature, stakeholder data, and expert feedback.

The first step identified recurring problems in undergraduate filmmaking education. These problems included limited authentic project experience, fragmented skill development, weak links between production stages, limited role coordination, and insufficient process-based feedback.

The second step translated these problems into design requirements. Authentic project experience supported the need for a project-based learning structure. Fragmented skill development clarified the need for a complete filmmaking workflow. The demand for timely support justified the integration of AI as a learning support mechanism. Collaboration also became a key design requirement. Film production depends on teamwork, role allocation, and shared decision-making. For this reason, team-based project work was included in the model structure. Feedback and revision formed another design requirement. Filmmaking develops through repeated adjustment. The model needed to include continuous feedback, reflection, and revision across the project cycle.

The third step organized these requirements into six core components. These components were AI integration, project-based learning structure, filmmaking process, filmmaking skills, achievement assessment, and student satisfaction.

The fourth step involved expert verification. Fifteen experts reviewed the preliminary components. They assessed their suitability, completeness, relevance, and overall appropriateness. Their ratings were analyzed quantitatively, while their written comments were reviewed qualitatively.

The expert review strengthened the model foundation. It clarified the relationships among the components and refined the practical logic of the proposed AI-PBL model.

3.7 Ethical Considerations

The entire research process strictly adhered to ethical principles. All participants were informed of the research purpose, participation requirements, and their right to withdraw from the study.

Before data collection, informed consent was obtained from all participants, and participation was voluntary. No participant was forced to complete the questionnaire or provide opinions. Personal information was kept confidential during data collection. Questionnaire responses and expert opinions were used only for academic research, and the results were reported in summarized or anonymous form.

The study also considered the responsible use of AI. AI was examined as a pedagogical support mechanism. It was not assumed as a replacement for student creativity, teacher guidance, or human decision-making in filmmaking education.

4. Results

4.1 Profiles of Participants

This study collected data from four participant groups: undergraduate students, film instructors, film employers or industry representatives, and model review experts. Each group provided evidence for identifying and validating the components of the proposed AI-enhanced PBL model.

The student sample included 291 valid responses from Year 2, Year 3 and Year 4 students. The sample included 139 male students (47.8%) and 152 female students (52.2%). Year 2 students accounted for 112 responses (38.5%), Year 3 for 103 responses (35.4%), and Year 4 for 76 responses (26.1%). The main majors were film production (26.8%), digital media arts (21.3%), broadcasting and television (18.6%), animation (15.5%), visual communication (11.0%), and new media art (6.9%). Most students had basic or moderate experience with both AI and filmmaking.

The instructor sample included 80 valid responses from film- and media-related teaching fields. The group included 42 male instructors (52.5%) and 38 female instructors (47.5%). Their teaching disciplines covered film production, digital media, post-production, animation, broadcasting, and visual design. Most instructors had at least six years of teaching experience, and 44 instructors (55.0%) had moderate or frequent AI-related teaching experience.

The employer and industry representative sample included 60 valid responses. Participants came from film production companies, digital media studios, advertising and commercial media companies, short video platforms, and post-production or VFX organizations. Most respondents had more than five years of industry experience, and 43 representatives (71.7%) had moderate or frequent AI application experience.

The expert group included 15 model review experts. The panel represented five areas: AI and educational technology, film education, film production, PBL curriculum design, and digital media technology. This structure allowed the model components to be reviewed from technological, pedagogical, curricular, and professional perspectives.

Table 4. Profile of Participants

Participant Group	Sample Size	Key Profile Information
Undergraduate students	291	Year 2–4 students from film- and media-related majors. Most had filmmaking course experience and prior exposure to AI tools.
Film instructors	80	Participants from film production, digital media arts, broadcasting and directing, editing, animation, creative media, and related disciplines.
Film employers/industry representatives	60	Representatives from film production companies, digital media studios, creative media enterprises, AI-related media companies, and broadcasting organizations.
Model review experts	15	Experts in AI and educational technology, film education, and film production.

The participant profiles indicate that the data were collected from relevant educational, professional, and expert sources. This provided an appropriate basis for identifying instructional needs, validating preliminary model components, and refining the AI-PBL framework.

4.2 Stakeholder Perceptions of AI-Supported Filmmaking Education

Descriptive statistics were used to examine stakeholder perceptions of AI-supported filmmaking education. Overall, the three stakeholder groups reported positive perceptions of AI integration, although their priorities differed across learning, teaching, and industry contexts.

Students reported the highest mean score for AI Expectations ($M = 4.53$, $SD = 0.50$), suggesting strong interest in AI-supported feedback, idea generation, and learning support during filmmaking projects. AI Application also received a high score ($M = 4.41$, $SD = 0.54$), and Overall Evaluation was positive ($M = 4.36$, $SD = 0.59$). The lower score for AI Challenges ($M = 3.92$, $SD = 0.63$) indicates that students recognized both the potential and complexity of AI-supported learning.

Film instructors also showed positive perceptions. AI Application received a high mean score ($M = 4.33$, $SD = 0.65$), while Overall Evaluation was also positive ($M = 4.26$, $SD = 0.55$). Challenges and Future Outlook produced a slightly lower but still high score ($M = 4.10$, $SD = 0.65$), indicating that instructors recognized the educational value of AI but also considered implementation barriers, learning demands, and ethical concerns.

Employers and industry representatives showed strong support for AI use in film production. AI Application received the highest score in this group ($M = 4.43$, $SD = 0.56$), followed by Overall Evaluation ($M = 4.38$, $SD = 0.63$). Challenges and Future Outlook received a moderate-to-high score ($M = 3.81$, $SD = 0.67$), suggesting that industry participants valued AI-related production competence while remaining aware of practical constraints.

Table 5. Descriptive Statistics of Stakeholder Perceptions

Group	Construct	Mean	SD
Students	AI Application	4.41	0.54
Students	AI Expectations	4.53	0.50
Students	AI Challenges	3.92	0.63
Students	Overall Evaluation	4.36	0.59
Film Instructors	AI Application	4.33	0.65
Film Instructors	Challenges & Future Outlook	4.10	0.65
Film Instructors	Overall Evaluation	4.26	0.55
Employers	AI Application	4.43	0.56
Employers	Challenges & Future Outlook	3.81	0.67
Employers	Overall Evaluation	4.38	0.63

Taken together, the results show that all three stakeholder groups recognized the value of AI in filmmaking education and

production. Students emphasized AI-supported learning and feedback, instructors emphasized teaching feasibility and guided integration, and employers emphasized production efficiency and employability. These findings support the need to integrate AI systematically within a project-based learning structure rather than treating AI as a standalone technical tool.

4.3 Reliability and Validity of the Stakeholder Questionnaires

Reliability and validity analyses were conducted for the student, instructor, and employer questionnaires. Internal consistency was examined using Cronbach's alpha, and construct validity was assessed through KMO values, Bartlett's test, and total variance explained.

The student questionnaire demonstrated good reliability and validity. The overall Cronbach's alpha was 0.876, the KMO value was 0.893, Bartlett's test was significant ($p < .001$), and the total variance explained was 68.6%. These results indicate that the student questionnaire was suitable for examining learners' needs and expectations regarding AI-supported filmmaking education.

The instructor and employer questionnaires also showed acceptable psychometric quality. The instructor questionnaire obtained an alpha value of 0.885, a KMO value of 0.839, and 72.95% total variance explained. The employer questionnaire obtained an alpha value of 0.870, a KMO value of 0.799, and 69.23% total variance explained. Bartlett's tests were significant for both instruments ($p < .001$), supporting their use in the needs-analysis stage.

Table 6. Reliability and Validity Indicators of Stakeholder Questionnaires

Group	Cronbach α	KMO	Bartlett's Test	Total Variance Explained
Students	0.876	0.893	<0.001	68.6%
Film Instructors	0.885	0.839	<0.001	72.95%
Employers	0.870	0.799	<0.001	69.23%

These results support the internal consistency and structural suitability of the three stakeholder questionnaires. Since the instructor and employer samples were smaller than the student sample, their factor analysis results were treated as supplementary validity evidence rather than as definitive measurement validation.

4.4 Cross-Group Themes and Model Component Identification

Following the reliability and validity analyses, the qualitative responses, open-ended comments, and expert feedback were subjected to thematic analysis. The purpose of this analysis was not only to identify recurring stakeholder concerns but also to translate these concerns into instructional design requirements for the development of the AI-enhanced PBL model.

The coding process revealed five recurring shared themes that appeared consistently across students, instructors, employers, and experts. These themes represented shared expectations regarding the future direction of filmmaking education and the role of AI-supported learning environments.

Rather than being treated as isolated findings, the themes were interpreted as design requirements. Each requirement was subsequently translated into one or more model components. This process enabled the transformation of stakeholder perceptions into a structured instructional framework.

The first theme was authentic project experience. Participants believed that filmmaking should be learned through engagement in complete production tasks rather than through isolated short activities.

The second theme was integrated filmmaking skill development. Script development, planning and shooting, and post-production were viewed as interconnected stages of a continuous workflow. This finding supports the need for workflow-based learning in filmmaking education.

The third theme was AI as a process-supporting mechanism. Participants indicated that AI should not replace students' creative thinking, but should support ideation, planning, shooting, post-production, feedback, and reflection.

The fourth theme was collaboration and role-based participation. Communication was viewed as a central component of filmmaking, and participants emphasized the importance of collaborative decision-making and role assignment.

The fifth theme was continuous feedback and revision. Participants believed that sustained feedback was needed throughout the project cycle. This finding revealed the need for instructor feedback, peer participation, and AI-supported feedback mechanisms.

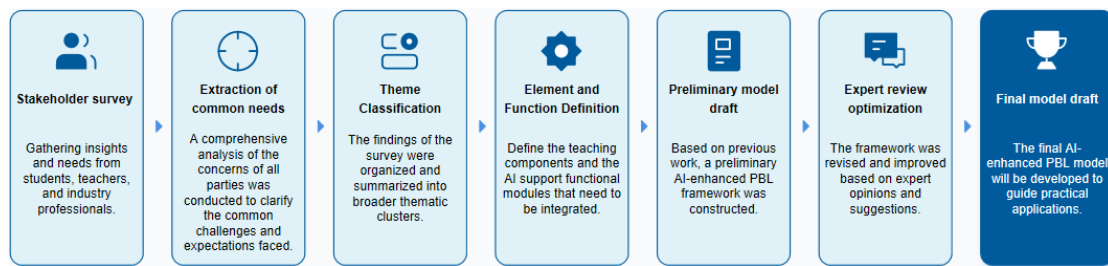


Figure 3. Development path of the AI-enhanced PBL model

Table 7. Cross-Group Themes, Design Requirements, and Model Components

Cross-Group Theme	Design Requirement	Related Model Component	Model Layer
Authentic project experience	Learning should be organized around authentic production tasks	Project-Based Learning Structure	Process Layer
Integrated filmmaking skill development	Learning should follow a complete filmmaking workflow	Filmmaking Process; Filmmaking Skills	Process Layer
AI as a process-supporting mechanism	AI should support ideation, planning, production, editing, and feedback	AI Integration	Support Layer
Collaboration and role-based participation	Students should engage in team-based production roles and shared decision-making	Project-Based Learning Structure	Process Layer
Continuous feedback and revision	Feedback should occur throughout the project lifecycle	Achievement Assessment; Student Satisfaction	Outcome Layer

The translation of stakeholder themes into design requirements provided the conceptual bridge between empirical findings and model construction. Instead of directly converting stakeholder perceptions into model components, the study first identified the instructional implications of each theme and then incorporated these implications into the overall framework. This process strengthened the theoretical coherence of the proposed model and ensured that each component was grounded in stakeholder evidence rather than researcher assumptions.

4.5 Expert Evaluation of Preliminary Model Components

Fifteen experts evaluated the preliminary AI-PBL model components across four dimensions: appropriateness, completeness, relevance, and suitability.

The expert ratings were positive across all four dimensions. Relevance received the highest mean score ($M = 4.53$, $SD = 0.48$), indicating that the proposed components were strongly aligned with AI-supported filmmaking education. Completeness also received a high score ($M = 4.45$, $SD = 0.51$), showing that the model included the main elements required for further development.

Appropriateness and suitability received the same mean score ($M = 4.43$), with SD values of 0.49 and 0.55, respectively. The relatively small standard deviations indicate a consistent level of agreement among the experts. The overall expert evaluation was very high ($M = 4.46$, $SD = 0.41$), providing preliminary support for the coherence and practical value of the model components.

Table 8. Expert Evaluation of Preliminary Model Components

Dimension	Mean	SD
Appropriateness	4.43	0.49
Completeness	4.45	0.51
Relevance	4.53	0.48
Suitability	4.43	0.55
Overall Expert Evaluation	4.46	0.41

These findings support the preliminary suitability of the AI-PBL model components. The expert evaluation indicates that the components were appropriate, relevant, and suitable for further model development. However, the expert review should be understood as preliminary validation of the component framework, not as evidence of classroom effectiveness.

4.6 Model Revision Based on Expert Feedback

After the expert evaluation, written comments were analyzed to guide model refinement. Fifteen model review experts provided comments on the clarity, applicability, and coherence of the proposed framework. Their feedback was translated into concrete revisions, as shown in Table 9 and Figure 4.

- 1) Clarification of Teacher Guidance: Several experts indicated that instructor scaffolding should be more visible throughout project initiation, process monitoring, feedback, and revision. In response, teacher guidance was emphasized within the human support mechanism and linked to the core PBL-filmmaking process.
- 2) Alignment of AI Functions with Filmmaking Stages: Experts suggested that the AI integration component should be aligned more closely with the actual filmmaking workflow. The revised framework therefore presents AI support through ideation support, planning support, production and editing support, and feedback and revision support.
- 3) Enhancement of Feedback Mechanisms: Experts recommended clearer feedback checkpoints across the project cycle. The revised framework highlights continuous scaffolding and connects revision activities with project completion, learning achievement, and student satisfaction.

The revised model reflects a clearer interaction among the process, support, and outcome layers. Each modification was grounded in expert recommendations and strengthened the practical applicability of the AI-enhanced PBL framework.

Table 9. Model Revisions Based on Expert Feedback

Expert Feedback Theme	Model Revision
Clarify teacher guidance	Teacher scaffolding was added across project initiation, process monitoring, feedback, and revision.
Clarify AI functions across stages	AI support was aligned with ideation, planning, production, editing, and feedback.
Strengthen feedback checkpoints	Stage-based feedback checkpoints were added across the project cycle.
Improve model coherence	The relationship among input, process, support, and outcome layers was refined.
Allow flexible application	The framework was adjusted for different project emphases, such as scripting, shooting, editing, and post-production.

The expert comments improved the model structure without changing its core logic. The revised framework retained the four-layer structure while making teacher guidance, AI functions, and feedback mechanisms more explicit. Based on this feedback, the revised framework was organized as follows:

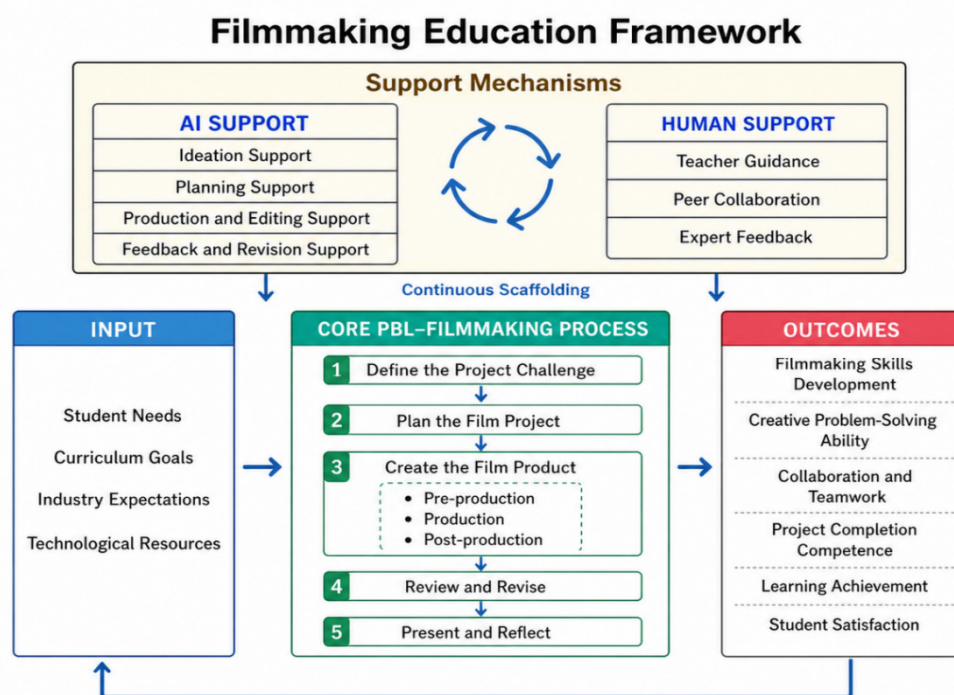


Figure 4. Revised AI-Enhanced Project-Based Learning Framework for Filmmaking Education

4.7 Summary of Findings

When the findings were consolidated, six components of the AI-PBL model were identified: AI integration, project-based learning structure, filmmaking process, filmmaking skills, achievement assessment, and student satisfaction. The framework consolidated learning conditions, production processes, scaffolding mechanisms, and outcomes. It also provides a basis for subsequent classroom implementation and empirical validation.

5. Discussion

5.1 From Stakeholder Evidence to Model Structure

The findings indicate that a process-oriented, AI-enhanced project-based learning model is suitable for undergraduate filmmaking education. Table 5 shows that students, instructors, and employers all reported positive perceptions of AI-supported filmmaking education, but their priorities differed. Students emphasized learning expectations and feedback support, instructors emphasized instructional feasibility, and employers emphasized AI-related production competence.

This pattern supports the stakeholder-informed logic of the model. The quantitative results identified the strength of stakeholder needs, while the qualitative themes explained how those needs could be translated into design requirements. The model therefore connects educational theory with practical expectations from learners, teachers, and industry representatives.

5.2 Interaction Among Model Components

The six core components of the AI-enhanced PBL model are not independent. They interact dynamically across the input, process, support, and outcome layers. The project-based learning structure organizes authentic tasks and team roles. The filmmaking process provides the domain-specific workflow. AI integration supports ideation, planning, production, editing, feedback, and reflection. Achievement assessment and student satisfaction provide outcome indicators and feedback loops for improvement.

This interaction is important because filmmaking education depends on continuous movement between creative decisions, technical execution, collaboration, and revision. AI-assisted feedback can strengthen student reflection, while teacher guidance and peer collaboration help students make responsible creative decisions. The model therefore supports a coherent learning experience rather than a set of disconnected AI tools or isolated filmmaking tasks.

5.3 Theoretical Contribution

This study advances the literature by integrating AI-supported learning, project-based pedagogy, and the filmmaking workflow into one domain-specific instructional framework. Previous studies have examined AI in higher education or PBL in creative learning contexts, but fewer studies have examined how AI can be embedded across the filmmaking process without replacing human guidance or student agency. The present model contributes a structured way to position AI as process-based support for creativity, collaboration, and reflective practice.

5.4 Contributions of the Proposed Model

This study offers three main contributions to AI-supported filmmaking education.

First, the study provides a stakeholder-informed approach to instructional model development. The model was not built from theoretical assumptions alone. It was developed from student needs, instructor perspectives, industry expectations, and expert evaluation. This strengthens its relevance for higher education and creative media training.

Second, the study clarifies the role of AI in filmmaking education. AI is positioned as a process-supporting mechanism for ideation, planning, editing, feedback, and revision. It is not presented as a replacement for students' creativity, teacher guidance, or peer collaboration. The integration of generative AI also requires attention to its potential influence on student creativity, suggesting that AI should support rather than replace students' creative decision-making (Habib et al., 2024). This distinction is important for responsible AI integration in creative disciplines.

Third, the study connects project-based learning with the actual workflow of filmmaking. The model organizes creative practice, technical production, human support, and AI-assisted feedback within one instructional structure. This responds to the common problem of fragmented skills training in film production courses.

For instructors, the model offers practical guidance for designing authentic film projects, embedding AI tools at appropriate stages, and maintaining continuous feedback throughout the project cycle. For industry stakeholders, it provides a pathway for aligning university training with emerging AI-related production competencies.

5.5 Limitations

This study has several limitations. First, it reports the model development phase of a broader doctoral project; therefore, classroom implementation and direct measurement of student learning outcomes were not included. Second, the sample was drawn from the context of Chinese higher education and creative media industries, which may limit generalizability to other cultural or institutional settings. Third, expert validation was conducted at one stage of model development rather than through longitudinal implementation. Future research should apply the model in real courses and examine its effects on filmmaking skills, learning achievement, creativity, collaboration, and student satisfaction.

6. Conclusions and Implications

This study reported the first phase of a broader doctoral research project on the development of an AI-enhanced project-based learning model for undergraduate filmmaking education. The purpose of this phase was not to test classroom effectiveness, but to identify instructional needs, develop preliminary model components, and obtain expert validation.

The findings showed that undergraduate filmmaking education requires a more integrated and process-oriented instructional structure. Stakeholders emphasized authentic project experience, workflow-based skill development, AI-supported learning assistance, collaboration, and continuous feedback. These findings indicate that film production courses should move beyond fragmented technical training and provide students with opportunities to engage in complete production tasks.

Based on the stakeholder evidence and expert evaluation, the proposed model was organized into input, process, support, and outcome layers. This structure positions AI as a process-supporting mechanism rather than a replacement for teacher guidance, peer collaboration, or student creativity. AI can assist students in ideation, planning, production organization, editing, feedback, and reflection when it is embedded within a carefully designed project-based learning environment.

The expert review provided preliminary support for the suitability and coherence of the model. Expert comments also helped refine teacher scaffolding, AI functions, feedback checkpoints, and the relationship among model layers. These revisions strengthened the practical applicability of the framework for filmmaking education.

This study offers practical implications for film production courses in higher education. Instructors may use the framework to organize authentic project tasks, align AI-supported activities with filmmaking stages, and provide structured feedback throughout the project cycle. Future research should implement the model in real classroom settings and examine its effects on filmmaking skills, learning achievement, creativity, collaboration, and student satisfaction.

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Author contributions

Xin Zhang and Assistant Professor Dr. Khachakrit Liamthaisong initiated the research problem, contributed to the conceptual development of the study, designed the study, collected and analyzed the data, drafted the manuscript, and revised it critically for important intellectual content. Dr. Worawith Sangkatip reviewed the quality of the research tools and verified the AI components to support the reliability of the testing procedures. All authors read and approved the final manuscript. Xin Zhang and Assistant Professor Dr. Khachakrit Liamthaisong contributed equally to this study.

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Competing interests

The authors declare that they have no competing interests related to this study. The research was conducted without any legal, financial, professional, or personal relationships that could be perceived as influencing the research process, analysis, interpretation of data, or conclusions. The study received ethical approval from the Ethics Committee for Research Involving Human Subjects, Mahasarakham University, Thailand. Review method: Expedited review. Approval number: 177-489/2026.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Redfame Publishing.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

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Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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