



Development of Project Based-Flipped Classroom Textbooks in ICT-Based Learning Media Courses

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Abstract: The rapid advancement of ICT in higher education necessitates learning resources that foster students' autonomy and digital competence. However, existing materials often lack integration with constructivist models. This study aims to develop ICT-based teaching materials integrating Project-Based Learning and Flipped Classroom models to enhance students' independent learning skills. Employing a Research and Development approach with the 4-D model, the study progressed through define, design, develop, and disseminate stages. The define phase identified learning needs at Universitas Islam Negeri Mahmud Yunus Batusangkar, while the design phase constructed a textbook prototype aligning Project-Based Learning syntax—such as project planning and implementation—with Flipped Classroom pre-class activities. During development, validity and practicality were assessed by subject-matter experts, media experts, and 15 graduate students using Aiken's V analysis. Results indicated high validity, with instrument validity at 0.77, subject-matter expert validity at 0.82 (highly valid), and media expert validity at 0.75 (valid). Furthermore, student practicality reached 94.67% (highly practical). Limited dissemination confirmed the product's effectiveness in ICT-based learning media courses. It is concluded that this textbook is a valid and practical resource, effectively optimizing hybrid learning environments and supporting student-centered instruction in the digital era.

Keywords: Flipped classroom; ICT; learning media; project-based learning; textbook.

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INTRODUCTION

The rapid technological advancements characterizing the Fourth Industrial Revolution and the transition toward Society 5.0 are marked by massive digitization and the seamless integration of Information and Communication Technology across various life sectors, including education (Akram et al., 2022; Bilan et al., 2023; Kunkel & Matthess, 2020; Mourtzis et al., 2022; Wibowo, 2023). Consequently, universities are increasingly required to embed technology into their pedagogical frameworks to comprehensively develop students' cognitive capacities, critical thinking, and essential digital skills (Bizami et al., 2023; Nirahua et al., 2020; Nykyporets & Chopliak, 2023; Ulya, Sugiman, & Retnawati, 2024). Furthermore, this utilization of Information and Communication Technology unlocks new opportunities for students to access limitless knowledge, significantly enhances learning motivation, and supports educational efficiency through the provision of adaptive and relevant learning resources (Morze et al., 2021; Oviedo Ramirez et al., 2025; Taufiqurrahman, 2022; Wahid & Solihat, 2021).

In the landscape of higher education, high-quality learning resources constitute a pivotal element that lecturers must meticulously prepare to ensure effective instructional delivery and foster an academic atmosphere (Akhmadi, 2019; Ammer & Mamadjanova,

2025; Lai & Al-Maki, 2026; Li, 2024). Consequently, students are required to actively engage with these resources to independently construct knowledge and attain the prescribed learning objectives (Hristov et al., 2023; Sewagegn, 2020). Among the various types of materials available, textbooks remain the most widely used tools as they are systematically structured to align with competency standards, curriculum indicators, and essential course materials (Ali et al., 2023; Bahl et al., 2020). However, driven by rapid technological proliferation, the traditional textbook has significantly evolved into dynamic digital formats deeply integrated with Information and Communication Technology, offering interactive features that far surpass static print media (Balaban et al., 2023; Darwanto & Meilasari, 2022; Heeter, 2023; Wang et al., 2020).

Responding to these urgent educational demands, higher education institutions are compelled to curate curricula that specifically cultivate proficiency in designing and implementing technology-enhanced learning environments (Downie et al., 2021; Duterte, 2024; Goagoses et al., 2024). A pivotal component of this curricular strategy is the Information and Communication Technology-Based Learning Media course, which serves as a strategic bridge integrating pedagogical theory with the practical application of digital tools in instructional delivery. The primary objective of this course is to produce graduates who possess comprehensive skills in digital learning design and are capable of developing innovative Information and Communication Technology -based media (Fahmi & Mendrofa, 2023; Kalyani, 2024). Furthermore, the course ensures that future educators are adept at managing technology-rich classrooms, adhering to Information and Communication Technology ethics and security protocols, and remaining adaptive to the dynamic evolution of educational technology (Nofriyandi et al., 2021; Pambudi et al., 2023; Sumilat & Merentek, 2022).

To achieve the course objectives, students need learning resources that are easily accessible and appropriate to the characteristics of the learning material (Ilic, 2021; Lomos et al., 2023). Properly designed modules and textbooks are essential, especially in Information and Communication Technology -based courses that encourage active student engagement (Handayani et al., 2023; Purwanto et al., 2019). However, various problems are still found in Information and Communication Technology learning, such as the limited ability of students to develop learning media, low motivation in producing media products (Balaban et al., 2023; Kango & Ghazi, 2019; Vedantham et al., 2022), weak digital skills (Siddiquah & Salim, 2018) and the unavailability of textbooks that are in line with the learning design, student characteristics, and learning needs (Purwanto et al., 2019; Salam, 2022; Ulya, Sugiman, Rosnawati, et al., 2024). In addition, some available textbooks do not fully support the constructivist approach, resulting in a suboptimal understanding of theory and practice among students.

Several previous studies have shown the effectiveness of the Project-Based Learning model in increasing student activity and learning effectiveness as well as constructivist project-based learning based e-modules in developing computational thinking skills (Isroani et al., 2022; Jerez et al., 2021; Purwanto et al., 2019; Handayani et al., 2023). Research by Puspitasari (2021) also found that project-based teaching materials are effective as reading resources, while other studies report that integrating flipped classrooms and Project-Based Learning can improve students' critical thinking skills (Andrini et al., 2019; Ishak et al., 2020; Zainuddin & Perera, 2018). However, there has been no research specifically developed, validated, and tested the practicality of Information

and Communication Technology-based learning media textbooks in higher education that integrate both models simultaneously.

Addressing the critical research gaps regarding the scarcity of instructional materials that effectively blend constructivist pedagogies with digital technology, this research strategically focuses on the development, rigorous validation, and comprehensive practical testing of an Information and Communication Technology-based Learning Media textbook. This instructional resource is uniquely designed to integrate two powerful pedagogical models: Project-Based Learning and the Flipped Classroom models (George & Casey, 2020; Kale et al., 2020; Luo et al., 2020). By synthesizing project-based learning emphasis on real-world problem solving with the flexible, pre-class engagement strategies of the Flipped Classroom, the proposed textbook aims to maximize student autonomy and active participation during university Learning Media courses (Adi et al., 2021; Katona et al., 2022; Lange & Costley, 2020). Consequently, this study does not only fill a specific void in current educational resources but also provides a validated framework for enhancing students' digital competencies and independent learning skills in the post-pandemic educational landscape (X. Zhao, 2025; Y. Zhao et al., 2021).

METHOD

The research method employed in this study was Research and Development (R&D) using the 4D development model. The 4D model was originally introduced by Thiagarajan, Semmel, and Semmel (1974) as a systematic framework for developing educational products, particularly learning materials and instructional media. This model consists of four sequential stages: define, design, develop, and disseminate. The *define* stage focuses on identifying learning needs, analyzing curriculum requirements, and determining relevant problems in the learning process. The *design* stage involves planning the structure, format, and components of the learning product to be developed. The *develop* stage includes product creation, expert validation, and revisions based on feedback. Finally, the *disseminate* stage aims to implement and distribute the finalized product more broadly. The development stages applied in this research follow the modification proposed by Djamas et al. (2018), as illustrated in the following chart.

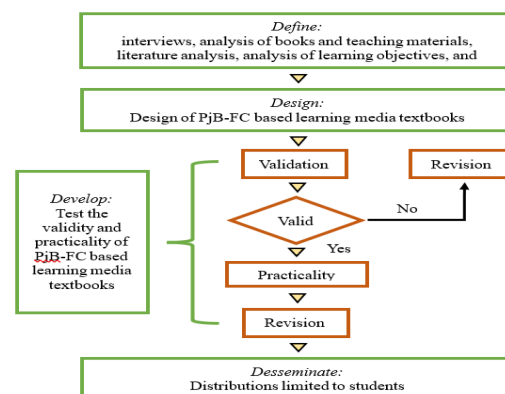


Figure 1. 4D Development Steps

Based on Figure 1, there are four stages of development as follows:

Define Stage (Definition)

At this stage, a needs analysis was conducted through interviews with lecturers who teach the Information and Communication Technology-Based Learning Media course, as

well as graduate students from the Islamic Education Study Program at UIN Mahmud Yunus Batusangkar. In addition, previously used textbooks and teaching materials were examined to evaluate their relevance and effectiveness in supporting the learning process. A comprehensive literature review was also carried out, accompanied by an analysis of learning objectives outlined in the course syllabus. This stage aims to identify actual field conditions, understand student characteristics, and determine specific learning needs within the course. The findings from the define stage serve as the fundamental basis for determining an appropriate instructional approach. Based on this analysis, the integration of Project-Based Learning and Flipped Classroom models was selected as the framework for developing the textbook.

Design Stage (Designing)

During the Design phase, the researchers constructed a comprehensive textbook prototype that systematically integrates the Project-Based Learning and Flipped Classroom models, adhering to a structured methodological framework (Effendi et al., 2023; Ma et al., 2025). Initially, learning objectives were rigorously formulated in accordance with the Semester Learning Plan to ensure strict alignment with the curriculum's competency standards (Hamidi et al., 2024; Munna & Kalam, 2021). To guarantee content validity and pedagogical relevance, the researchers curated primary references from reputable scientific journals and authoritative textbooks. Consequently, the organized to facilitate hybrid learning workflows, comprising an introduction, core material, specific "pre-class activities" for the Flipped component, "project guidelines" and student worksheets to support Project-Based Learning syntax, and concluding with summaries and comprehensive evaluations.

The instructional content was meticulously structured to mirror the syntax of the Project-Based Learning model, encompassing distinct phases such as problem orientation, project planning, scheduling, implementation, and evaluation (Ulya et al., 2024; Wibowo et al., 2023). To effectively operationalize the Flipped Classroom approach, these core phases were complemented by asynchronous digital components, including instructional videos, curated pre-reading materials, and strategic guiding questions designed to stimulate pre-class cognitive engagement. Furthermore, the prototype was significantly enriched with concrete examples, visualization, and technical instructions specifically tailored to facilitate Information and Communication Technology media development skills. Prior to the formal validation phase, this comprehensive draft underwent a rigorous internal review to ensure content feasibility, constructive alignment with the hybrid learning model, and language clarity

Develop Stage (Development)

Entering the pivotal Development stage, the constructed textbook prototype underwent a multi-tiered validation process involving subject matter experts and media specialists to rigorously assess its theoretical soundness and instructional feasibility (Agustini, 2023; Warlizasusi et al., 2023). Concurrently, to evaluate the product's functional practicality and user engagement, the research enlisted 15 graduate students from the Islamic Education Study Program at UIN Mahmud Yunus Batusangkar as representative test subjects. The data collection mechanism employed a structured Likert-scale questionnaire, meticulously designed to gauge various critical components, including content depth, linguistic clarity, visual presentation, and the effectiveness of the

embedded digital features. This comprehensive assessment strategy was essential to ensure that the final product met the high academic standards required for hybrid learning environments before wider dissemination.

Subject matter experts assessed the accuracy of the content, completeness of the material, coherence, suitability for the learning objectives, and integration of Project-Based Learning and Flipped Classroom principles. Meanwhile, media experts evaluated aspects of design appearance, readability, visual consistency, presentation structure, and technical quality of the media. Each validator provided an assessment for each indicator, and the results were analyzed using descriptive statistics and Aiken's V formula to assess content validity. The validity test uses a Linkert scale with an interval of 1-5. Student response data via questionnaires collected for practicality testing and tabulated. The validation phase spanned a rigorous two-week period, during which the constructive feedback and expert insights were utilized as the foundational basis for iteratively revising and refining the textbook prototype to ensure maximum instructional efficacy.

Following these crucial revisions, the optimized prototype underwent a comprehensive practicality test employing a student response questionnaire designed to assess key dimensions such as usability, clarity of instructional content, visual aesthetics, and the pedagogical utility of the integrated Project-Based Learning and Flipped Classroom components. This stage was pivotal to confirm that the material not only conveyed information effectively but also actively engaged students in the hybrid learning process. Subsequently, the quantitative data obtained were analyzed using a standard practicality percentage formula to rigorously determine the product's feasibility category, ensuring it met the requisite academic standards before advancing to the final dissemination stage (Ulya et al., 2024; Wibowo et al., 2023).

Disseminate Stage (Dissemination)

At the Disseminate stage, textbooks that have been declared valid and practical are reproduced in print and digital formats for limited use in Information and Communication Technology-Based Learning Media courses in the Postgraduate Program at UIN Mahmud Yunus Batusangkar. Dissemination was carried out for one semester in one class of students as part of the initial adoption. Activities at this stage include socializing with lecturers, distributing textbooks to students, and monitoring textbook use throughout the lecture process. Dissemination is limited because the research focuses only on validation and practicality testing among postgraduate students. Wider dissemination and development are recommended for further research involving other study programs or education levels.

RESULT AND DISCUSSION

The define stage comprises five primary steps: conducting interviews with postgraduate student Mahmud Yunus Batusangkar, doing literature analysis, analyzing learning objectives, conducting idea analysis, and executing model analysis. Evaluating student character is also crucial during the definition phase. At this step, a mix of learning models was identified based on the outcomes of the conducted investigation, specifically Flipped Classroom and Project-based Learning. The integration of the Flipped Classroom and Project-based Learning paradigms in textbook development yields five phases or syntax. The syntax of the project-based flipped classroom is illustrated in the subsequent chart:

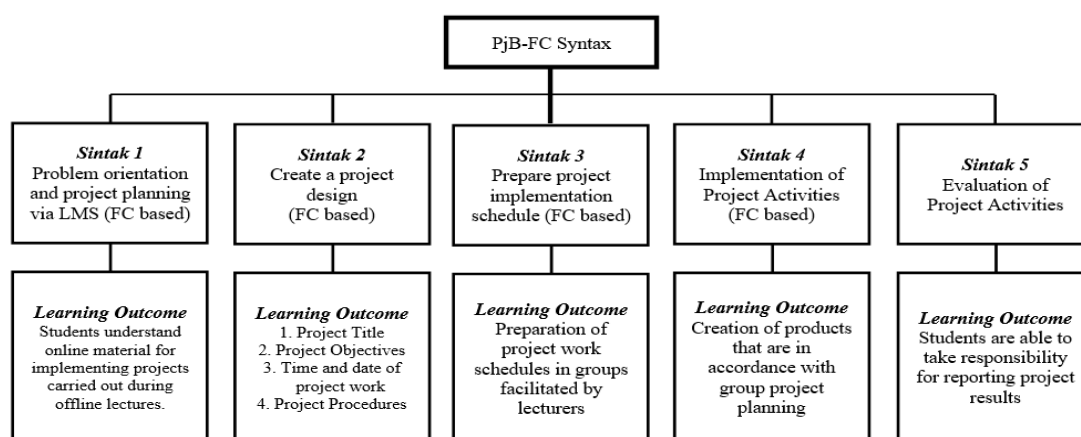


Figure 2. Project Based-Flipped Classroom Model Syntax Chart

According to Figure 2, the integration of the Flipped Classroom and Project-Based Learning models in textbook development yields five phases or syntactic elements: 1) Carrying out problem orientation through media sent in the Learning Management System, 2) Designing a project plan in groups with educators, 3) Preparing a schedule of project activities, 4) Implementation of projects in groups (monitored by educators), 5) Evaluation/test of student learning experiences and projects. At the design stage, a learning media textbook is produced, supported by a project-based flipped classroom model. The design requires much time so that it can be prepared systematically per the Semester Learning Plan determined in the previous stage. At the development stage, the results of media and material validation provided by experts can be described as follows:

Questionnaire Validity Test Results

Table 3. Questionnaire Validity Results

No	Aspect	V	Category
1	Charging instructions	0.75	Valid
2	Assessment aspect	0.75	Valid
3	Language	0.75	Valid
4	Sentences are easy to understand	0.75	Valid
5	Effective sentence	0.83	Highly Valid

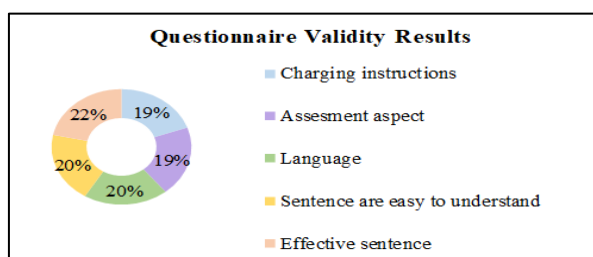


Figure 3. Questionnaire Validity Graph

The validity test results of the learning media questionnaire, as indicated in Table 3 and Figure 3, demonstrate validity with an Aiken's V value of 0.77, which is classified as valid. Aiken's V values vary from 0 to 1, with a value of 0.60 indicating a moderately high coefficient within the 0.61 to 0.80 range, which is deemed adequate for use (valid).

Material Validity Test Results

Table 4. Material Expert Validity Results

No	Aspect	V	Category
1	Self-Instruction	0.81	Highly Valid
2	Self-Contained	0.83	Highly Valid
3	Stand Alone	0.83	Highly Valid
4	Adaptive	0.75	Valid
5	User Friendly	0.85	Highly Valid

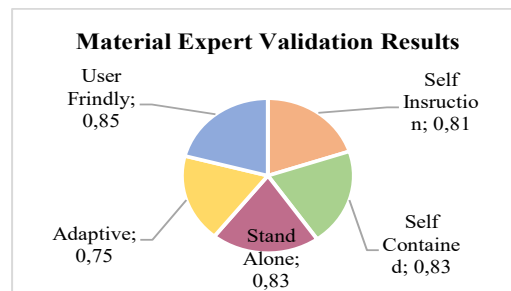


Figure 4. Material Expert Validity Graph

The validity assessment results of Islamic education learning media textbooks, as shown in Table 4 and Figure 4, reveal a substantial level of validity, with an Aiken's V value of 0.83, as evaluated by subject matter experts. The material expert validity assessment produced a score of 0.81 for the Self Instruction component, classifying it as very valid. Self-Contained attained a score of 0.83, categorized as extremely valid. Stand Alone obtained a score of 0.83, categorized as very valid; Adaptive attained a score of 0.75, categorized as valid; and User Friendly achieved a score of 0.85, categorized as extremely valid. As a result, an average Aiken's V value of 0.82 was obtained. Aiken's V values range from 0 to 1, with a value of 0.60 signifying a rather high coefficient. Values between 0.81 and 1.00 are deemed extremely valid; so, the value 0.82, above 0.60, is included in this classification.

Media Validity Test Results

Table 5. Media Expert Validity Results

No	Aspect	V	Category
1	Book Size	0.75	Valid
2	Book Cover Design	0.75	Valid
3	Textbook Content Design	0.75	Valid

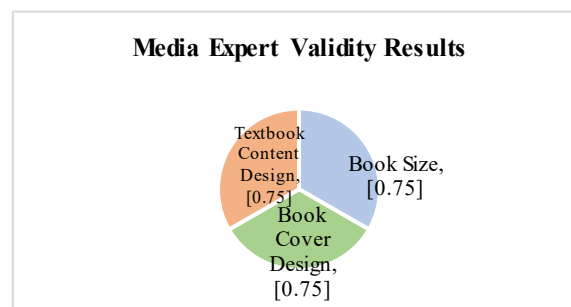


Figure 5. Media Expert Validity Graph

The validity assessment results of Islamic education learning media textbooks, as presented in Table 5 and Figure 5, reveal validity as per media professionals, with an Aiken's V value of 0.75. The validity test results for the media expert produced an Aiken's V score of 0.75. Aiken's V values range from 0 to 1, with a value of 0.60 signifying a rather high coefficient. Values between 0.60 and 0.80 are deemed valid; thus, values beyond 0.60, like 0.75, are included inside the extremely valid group. After validation testing, development continues with practicality testing. The results of the practicality test were obtained as follows:

Table 6. Practicality Test Results

No	R	Σ	Textbook Practicality	
			D.P	Category
1	R1	97	97.00%	Highly Practical
2	R2	90	90.00%	Highly Practical
3	R3	96	96.00%	Highly Practical
4	R4	95	95.00%	Highly Practical
5	R5	98	98.00%	Highly Practical
6	R6	95	95.00%	Highly Practical
7	R7	97	97.00%	Highly Practical
8	R8	93	93.00%	Highly Practical
9	R9	91	91.00%	Highly Practical
10	R10	94	94.00%	Highly Practical
11	R11	94	94.00%	Highly Practical
12	R12	92	92.00%	Highly Practical
13	R13	98	98.00%	Highly Practical
14	R14	95	95.00%	Highly Practical
15	R15	95	95.00%	Highly Practical
Average			94.67%	Highly Practical

From the standpoint of the students, Table 6 shows the practicality evaluation of the Flipped Classroom-Based Islamic Religious Education Learning Media textbook using the Project-Based Learning Model. The average percentage attained was 94.67% according to Highly Practical criterion. The practical outcomes of students concerning textbooks within the Flipped Classroom utilizing the Project-Based Learning model are evaluated through the dimensions of the textbook's utility, user-friendliness, the presentation of the Flipped Classroom-based learning media textbook with the Project-Based Learning model, and the appeal of the learning media textbook, all of which are classified as highly practical. The percentage range of 86–100 is classified as highly practical. The results indicate that the Flipped Classroom-based textbook utilizing the Project-Based Learning model is highly practical, and students exhibit exceptionally high expectations for this textbook in the Learning Media course.

According to Dantas & Cunha (2020); Ni'matussyahara et al., (2023), define stage that each individual's learning style is different when interacting according to the content or learning material presented. To maximize learning activities amidst these differences, a learning model is needed that helps learning run constructivist, including project-based learning and the flipped classroom. In line with Ahmad & Yustinaningrum (2022); Thio et al., (2025), Project-based e-learning can increase creativity, which is one of the important aspects of the 4C skills that must be mastered in learning activities. At the design stage, according to Puspitasari (2021); Sumarmi et al., (2021), textbook development will be better if it is developed by educators who teach in class because educators already know a lot

about the problems that arise during the learning process. After creating a textbook, the content, material content, design, and other elements must be checked to ensure that the book is appropriate.

The development of an interesting and effective textbook requires a systematic and scientific process so that it can be properly assessed by relevant stakeholders. According to Achuba (2025); Khachaturyan & Ghalachyan (2023) writing a scientific textbook involves several important stages, including pre-writing, preparation, expert responses, revision, and evaluation. Based on the analysis of expert validation using questionnaires, the results show that the content expert evaluation reached 82.3%, the design expert evaluation reached 80.5%, and the media expert evaluation reached 85.5%. These findings indicate that the textbook meets the required feasibility standards. The textbook development integrates Project-Based Learning and the Flipped Classroom model. As explained by Hwang et al., (2024); Xu et al., (2021) the Flipped Classroom approach enhances peer interaction and encourages independent learning.

CONCLUSION

This research resulted in the development of Information and Communication Technology-based teaching materials that integrate the Project-Based Learning and Flipped Classroom models. The development process followed the 4-D model. In the define stage, data were collected through interviews, needs analysis, and literature review to identify student characteristics and learning needs. In the design stage, learning objectives, textbook structure, and material compilation were developed using the Project-Based Learning–Flipped Classroom syntax. The development stage involved expert validation and practical testing. Instrument validation obtained an Aiken's V value of 0.77 (valid). Material expert validation yielded an average score of 0.82 (highly valid), while media expert validation yielded a score of 0.75 (valid). Practicality testing by 15 graduate students showed an average percentage of 94.67%, categorized as highly practical. In the dissemination stage, the revised textbook was implemented on a limited basis in the Information and Communication Technology-Based Learning Media course.

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