JURNAL EDUSCIENCE (JES)
p-ISSN : 2303 - 355X | e-ISSN : 2685 - 2217
PUBLISHED BY : LPPM of UNIVERSITAS LABUHANBATU

Personalized Learning in the Aviation Industry: Development of Airport and Heliport Teaching Materials Based on Blended Learning

Irfan[1,*], Suhanto[2], Irwan Jaya[3]

[1,2]Human Resources Development Agency for Transportation, Makassar Aviation Polytechnic, Indonesia
[3] Barombong Maritime Polytechnic, Indonesia
*irfan@poltekbangmakassar.ac.id

ARTICLE INFO

Keywords:
Aerodrome,
Blended Learning,
Heliport,
Student competency,
Teaching materials.

ABSTRACT

Purpose – Blended Learning in the Aerodrome & Heliport course combines theory and practice flexibly and interactively. Conventional methods are less effective due to the lack of active involvement and limited access to learning materials. This study aims to develop blended learning-based learning materials to improve student competency in the Aerodrome & Heliport course at the Makassar Aviation Polytechnic. In addition, this study was conducted due to the low academic achievement of students, with 20% failing the course.

Methodology – The research used the Research and Development (R&D) model. However, only the first three stages are worked on: define, design, and develop. This research involves 24 air transport management diploma program students as respondents and two radio aids to air navigation instructor respondents. Data were collected through survey, interview, observation, and documentation. Assessments from experts on blended Learning and aviation education using qualitative and quantitative analysis methods were conducted to assess the validity of the developed teaching materials.

Findings – The study demonstrated that blended Learning considerably raised student proficiency. The methodically created instructional materials received a high validity grade from specialists who rated them as "Very Valid" (Va ≥ 0.80). Additionally, the study discovered that using interactive teaching resources—like video tutorials, simulations, and structured learning modules—helped students comprehend complex ideas.

Contribution – On a practical level, this study provides real solutions to address learning challenges in aviation vocational education by combining online and in-person Learning. The teaching materials developed can be used as a model by other similar institutions to design tech-based curricula that meet industry needs. Theoretically, the study deepens our understanding of how effective blended Learning can be in technical education, especially in aviation, by emphasizing the need for flexible instructional design that supports higher-order thinking Skills (HOTS).

Received 7 February 2025; Received in revised form 14 February 2025; Accepted 25 April 2025
Jurnal Eduscience (JES) Volume 12 No. 2 (2025)
Available online xx April 2025

INTRODUCTION

Education is changing rapidly, making it important to rethink how lessons are delivered, what materials are used, and how information is presented to meet students' evolving needs (Haleem et al., 2022; Singh et al., 2022). In the 21st century, Learning goes beyond simply passing on knowledge—it also involves developing students' literacy, communication, attitudes, skills, and insights that align with technological progress (Avdiu et al., 2025; Pérez & Montoya, 2022). Consequently, interactive and technologically based learning models have become necessary in education. Combining face-to-face and online Learning, blended Learning—which raises educational efficacy—has become very popular (Asghar et al., 2022; Gherheş et al., 2021). This approach is particularly relevant in vocational education courses, such as those offered at the Makassar Aviation Polytechnic, where a mix of theoretical knowledge and practical experience is crucial. Preliminary results from the Aerodrome & Heliport study program at the Makassar Aviation Polytechnic revealed that student competence levels fell short of projected levels. Surveys and interviews revealed that twenty percent of students had to repeat this course, suggesting difficulties grasping the content. Moreover, typical teaching strategies that are less engaging cause poor learning motivation among pupils. The non-systemically organized learning resources make it challenging for pupils to understand the taught ideas. Many studies reveal that conventional teaching approaches used in the Aerodrome & Heliport course have primarily relied on lectures and text-based instruction, with limited student participation in the learning process (Sylvia & Hutabarat, 2021; Yuniar et al., 2023). Particularly in technical disciplines requiring a more pragmatic approach, this has led to students' inadequate awareness of airport and heliport concepts.

Furthermore tricky for students to relate theory with field applications (Marougkas et al., 2023) without directly relating with real-world occurrences or pragmatic circumstances in education is their lack. Another element influencing students' poor competency levels is the scarcity of learning resources that satisfy aviation industry trends (Ng, 2022). This condition calls for creative learning strategies to raise students' enjoyment of and efficacy of their education.

Combining Learning enables one to overcome challenges in teaching in the Aerodrome & Heliport course. Combining face-to-face training with digital technology allows this method to enable students to study freely and independently. Through blended Learning, teachers may design more systematic and engaging learning materials that help their students grasp concepts (Bizami et al., 2023; Dakhi et al., 2020). Furthermore, depending on their desire, students might access the materials anytime and at any moment, so adopting digital media in the classroom can assist increase their drive (Bujang et al., 2020; Dhamayanti, 2021). Blended Learning dramatically increases students' learning outcomes and skill levels. Many studies have looked at the idea of blended Learning in many spheres. Mixed Learning combines technology-based Learning, both offline and online, with face-to-face instruction, according to Yusny et al. (2021). Peng and Fu (2021) say this approach could increase students' learning outcomes and motivation. Müller & Mildenberger (2021) also said that blended Learning permits students to choose their study environment and time, enhancing their knowledge of the content. His method is also rather pertinent to vocational education systems, where students must acquire theoretical information and gain valuable skills needed in the workforce.

This study parallels the research of Pasandín and Pérez (2021), which employed a blended learning method in airport design education. Like that study, this one also uses technology and creative learning strategies, digital resources, and case-based techniques to improve students' knowledge of aerodrome and heliport design criteria. Though the emphasis differs, MR in pilot training vs. blended Learning in the Aerodrome and heliport course, this study also corresponds with Schaffernak et al.'s (2022) study on leveraging technology to increase learning efficacy. Moreover, this study corresponds with the initiatives of Latif et al. (2024), which created digital learning tools using modules to increase the educational efficacy at the Makassar Aviation Polytechnic. Both initiatives use digital-based teaching tools to increase students' competency levels. This research treats learning differently, even if there are some parallels. While this study focuses more on blended Learning, mixing physical classrooms and e-learning to improve students' knowledge, Pasandín & Pérez (2021) used the Problem-Based Learning (PBL) approach, which stresses

addressing real-world challenges in airport architecture. The technical execution differs from Schaffernak et al.'s (2022) research. While this study used a mix of face-to-face and e-learning courses rather than mixed reality technologies, Schaffernak investigated Mixed Reality (MR) as a learning tool in pilot training. In contrast, the study of Latif et al. (2024) differs in educational tools and approaches. While this project creates more general teaching materials utilizing a blended learning approach for the Aerodrome & Heliport course at the Makassar Aviation Polytechnic, Latif created an e-module for the Aircraft Structure, Equipment, and Furnishing course.

Building on previous research, this study aims to fill the gap in developing blended learning teaching materials for vocational education, specifically for the Aerodrome & Heliport course at the Makassar Aviation Polytechnic. Limited research has examined how blended Learning can be applied in the context of aerodrome and heliport education. Therefore, this study aims to analyze the process of developing blended learning-based teaching materials to enhance students' competency achievement in the Aerodrome & Heliport course at the Makassar Aviation Polytechnic. This research will specifically assess how well the blended learning approach could raise learning motivation, lower course repeat rates, and enhance course content knowledge. Moreover, this study will examine how creating technologically based teaching tools might enable more methodical and participatory Learning. The synergy between in-person instruction and online Learning in creating instructional materials for the Aerodrome & Heliport course, which has not been thoroughly covered in earlier research, makes this study distinctive. This study incorporates many ways of blended Learning, resulting in a more thorough and flexible approach to suit students' requirements than previous studies focusing on problem-based Learning, mixed reality applications, or module building. Using this method, it is anticipated that this research would enhance technical education for aerodromes and heliports in academic aviation contexts. Particularly in the aviation sector, the findings of this study are anticipated to influence vocational education significantly. Other study programs at Makassar Aviation Polytechnic and other vocational education institutions may use the successful use of blended Learning as an example. Furthermore, policymakers may use this study as a guide to design curricula more accurately aligned with technological changes and industrial requirements. Graduates of Makassar Aviation Polytechnic will, therefore, be more qualified and prepared to enter the workforce.

METHODOLOGY

This study was classified as Research and Development (R&D), a systematic process used to test new goods or improve current ones. Twenty-four cadets from Class XV, the Diploma III Air Traffic Management program, and two instructors/lecturers who taught the Radio Aids to Air Navigation course from the same program served as the study's subjects. The reason for the sample choosing was the active involvement of the respondents in the radio navigation aid learning process. Using a mixed-learning approach, the 4D paradigm—which has four stages: define, design, develop, and disseminate—provided instructional materials for radio navigation aids (Putri et al., 2020).

Figure 1. Stages of 4D Model Development (Thoyibah & Hajizah, 2025)

Three main steps comprised this research: define, design, and develop. It was conducted only during the development phase, including small group testing and expert validation. Limited time caused the product not to be evaluated on a more extensive or extensively spread basis (Baihaki et al., 2021). First, on the road of research, locate and evaluate the guidelines for the evolved learning model. Regarding this level, the obligations include Developing learning goals: This is achieved by means of a needs analysis grounded on the learning objectives presented by the curriculum. This means deciding the fundamental competencies cadets should pick up during this semester. The study of learning theories pertinent to creating instructional materials based on blended Learning is known as learning analysis. This implies considering learning

opportunities like difficulties grasping the idea of radio navigation aids and evaluating the curriculum to ensure it complies with aviation education criteria. Analyzing the elements influencing the early traits of the cadets—including their motivation to study and understand—helps one to evaluate their relevant prior knowledge, spot their needs for blended learning-based instructional resources, and thus define their current traits.

A more specialized learning model is developed in the second step, design. The activities in this stage include: (1) Formulating Learning Objectives, which involves breaking general objectives into more specific, performance-based, or operational objectives. The developer translates general objectives or existing competency standards into operational goals with specific indicators. (2) Creating learning competency tools, such as assessment rubrics, to gauge cadets' proficiency and exam designs that align with operational goals. (3) Learning Strategies Development includes creating interactive learning situations and a blended learning approach that blends online and in-person instruction. (4) Creating digital and physical teaching tools like online tests, interactive modules, e-learning courses, and video lectures is part of designing teaching materials. The objects' design uses visual and acoustic aspects to improve cognitive understanding. This stage results in an initial product draft, which is then reviewed to ensure the adequacy of supporting theories and the proper application of these theories in each component of the learning model and instructional tools. By the end of this stage, an initial product is developed.

The third stage, development, involves testing, evaluating, and revising the learning model. The testing phase makes educated decisions based on rigorous considerations to assess the quality of the developed design. Data is systematically collected, processed, and examined in the evaluation process. The assessment results are used to guide changes, which are then followed by more testing and design. This feedback loop runs until the best feasible solution is discovered. This stage comprises the following actions: Professionals in blended Learning and seasoned teachers with at least five years of experience and educator certification conduct validation testing. They assess the research tools' and teaching materials' fit, readability, and viability. (2) Individual Testing: To get early input on the readability and understandability of the blended learning model and its teaching resources, a preliminary test is carried out with instructors and cadets. (3) Small-group assessment entails a team of instructors and cadets to pinpoint areas that need improvement.

Data for this study came via observation sheets, questionnaires, and interview instruments. Instrument experts approve all tools before they are used in the study to ensure general applicability, construct validity, content validity, and language clarity. Feedback surveys from teachers and cadets who engage in individual and small-group trials and interviews with instructors and cadets help to provide a more thorough understanding of the readability and efficacy of the instructional materials during testing. Part of the validity of evaluation criteria and interview tools includes elements like the nature of the questions, the clarity of the language, the relevance of the issue, and the ability of the tool to get thorough information from respondents. Throughout the educational process, observations are also taken to gauge cadet dedication.

This study includes observation, questionnaires, interviews, and documentation as a means of data-gathering. Direct observation evaluates the cadets' interactions with the produced teaching tools. Using surveys, cadets and teachers assess the materials' validity, readability, and effectiveness. Using blended learning-based instructional tools, instructors and a small number of selected cadets are interviewed to understand their experiences further. Furthermore, acquired is documentation of the learning process, including images, as the materials are being used. Using quantitative and qualitative data, the study offers insightful analysis of the feasibility and soundness of the developed integrated learning tools. The created teaching and learning resources are validated and evaluated by professionals and experts who are judged qualified to appraise the components they include. The classification criteria based on Bloom et al.'s taxonomy (1981) are used to determine the value of each aspect, or all aspects, which will be evaluated using the following approach:

Table 1. Classification Criteria

Average	Criteria
$0{,}80 < Va \leq 1{,}00$	Very Valid

Average	Criteria
0,60< Va ≤0,80	Valid
0,40< Va ≤0,60	Quite valid
0,20< Va ≤0,40	less valid
0,00< Va ≤0,20	invalid

An instrument's proper degree of validity is assessed using the Va value as a criterion. The teaching resource may be utilized for instruction if the validity value is in the Valid or Highly Valid range. However, if the result is less than 0.60, the instructional materials should be revised before being extensively used (Piyona et al., 2025). According to Aminullah et al. (2018), the instrument's dependability is evaluated using Grinnell's % of agreements approach:

$$Percentage\ of\ agreements = \frac{Agreements}{Disagreements\ (D) + Agreements}\ x\ 100\%$$

The frequency of agreement (A) and disagreement (D) calculated from two validators or observers' data helps ascertain the instrument's dependability coefficient (R). An instrument's dependability is its constant observation of a variable under change. The instrument sheet is trustworthy if the dependability coefficient (R ≥ 0.70) is 0.70 or above. This implies that the technique might provide consistent and reliable results independent of measurement frequency or varied observer frequency. Using a qualitative and quantitative descriptive method, data from observations, surveys, and interviews is also investigated to determine the success of the instructional materials for blended Learning.

FINDINGS

This project aims to improve cadet performance in Makassar Aviation Polytechnic's Aerodrome & Heliport course through mixed learning approaches. Three primary processes—define, design, and develop—help shape these teaching instruments. Every phase consists of well-thought-out exercises to ensure that the teaching materials sufficiently complement the learning objectives.

Stage 1: Define

This research seeks to define cadet traits, assess the learning process, and provide instructional goals.

Identifying Learning Objectives

Aviation industry standards define the Aerodrome & Heliport course as aiming to provide students with academic understanding and practical skills in Aerodrome and Heliport management. Over the course, Makassar Aviation Polytechnic's students have several learning objectives to satisfy. They must be conversant with the principles of heliports and aerodromes, including their technical requirements stated in ICAO Annex 14, layout, and classification. Moreover, they need analytical abilities for aerodrome operations—airport security, air traffic control, and aircraft movement procedures. Students also have to know the laws and regulations related to heliports, like those relating to their design, building, and operations, and how they are subject to national and international legislation.

Furthermore, they need to be capable of implementing aerodrome and heliport management systems, particularly in facility management, infrastructure maintenance, and aviation safety standards. Given the environmental consequences of airport operations, students should also examine the environmental implications of heliport and aerodrome operations and learn mitigating techniques to lower adverse effects. Students nowadays must know how to use digital technology for aerodrome and heliport monitoring and management, including navigation software and operational simulation tools. However, early statistics and talks with course teachers revealed that students' competency was still below the required level. Moreover, it is clear that more than twenty percent of students failed to understand the material and had to repeat the session. The education system has to be changed to satisfy better student requirements. Designing new courses employing blended learning components is one way to do this, so combining digital and conventional approaches will help to raise the efficacy of Learning. This approach aims to enable pupils to

absorb more by combining more conventional classroom education with more fascinating digital media forms.

Learning Analysis

Problems with conventional learning techniques may be resolved by considering ideas that support the mixed learning model. This study's three primary components are curriculum studies, instructional challenges, and pertinent learning concepts.

Relevant Learning Theories

The development of blended learning-based teaching materials is grounded in several learning theories. Proposed by Piaget and Vygotsky, constructivist theory holds that students must actively create knowledge using direct experience and social interaction (Huang, 2021; Wibowo et al., 2025). In this regard, by combining online conversations with in-person meetings, blended Learning may provide a more engaging and cooperative learning environment. Cognitive Learning Theory, particularly Bloom's Taxonomy, states that Learning should encompass six cognitive levels: remembering, understanding, applying, analyzing, evaluating, and creating (Benjamin S. Bloom & Krathwohl, 1956). Through blended Learning, students are expected to reach the analysis and evaluation levels using digital technology, such as simulation-based case studies and interactive e-learning. Collaborative Learning Theory also provides a reference as it emphasizes how better Learning, including debates, cooperation, and case-based projects, enhances students' knowledge (Silvano et al., 2015; Wengrowicz et al., 2018). Thus, the developing instructional resources will combine project-based coursework with online discussion forums.

Analysis of Learning Issues

Initial research revealed several issues in the Aerodrome & Heliport course. One of the biggest problems is the traditional teaching style, in which lectures still control the learning process with little active contact between teachers and students. Moreover, the present teaching resources lack a methodical organization to help pupils follow the logical flow of ideas. Another difficulty is the limited use of technology in education, as teachers seldom apply digital simulations, interactive movies, or e-learning tools that enable pupils to understand aerodrome ideas visually. Students also lack participation in self-directed Learning as they usually depend only on lecture content without further research using digital tools or industrial case studies. Lack of real-world application experience causes restricted face-to-face teaching time in vocational education, further confusing students' understanding of aerodrome and heliport principles. An initial research phase was carried out in order to handle these problems, including the definition of learning goals, learning analysis, student qualities, and difficulties in the teaching and learning process. Data utilized for this study came from surveys, interviews, and direct observation of the learning process.

Table 2. Preliminary Investigation Results

Aspects	Average	Criteria
Needs analysis in learning learners	57.20	Less
Needs analysis in learning lecturers	59.50	Less
Aerodrome & heliport learning management	72.60	Good
Lesson planning	76.40	Good
Learning Implementation	66.70	Less
Learning evaluation	74.20	Good

Based on Table 2, the questionnaire results distributed to students indicate that the analysis of learning needs among students has an average score of 57.20. In contrast, the analysis of learning needs among lecturers reaches 59.50, both of which fall into the "lower" category. Meanwhile, the aspect of learning management for Aerodrome & Heliport received a score of 72.60, and lesson planning achieved 76.40, both categorized as "good." The implementation of Learning obtained an average score of 66.70, which is still considered "lower," whereas the evaluation of Learning reached 74.20, also classified as "good."

The time allotted by instructors to discuss each learning competency in detail, the feedback that lecturers provide following independent assignments, and the availability of extensive learning resources in the form of modules and articles are just a few of the factors that are included in the further analysis of students' learning needs. One of the most important aspects of Learning is applying the information, making sure the references are accurate, and having self-accessible learning resources available. The efficacy of Learning may also be increased by making e-learning platforms available and encouraging student engagement via chat rooms, forums, and in-person encounters. Therefore, to improve the quality of Learning in Aerodromes and Heliports, innovations in teaching methods, the utilization of technology, and increased student engagement in a more active and independent learning process are necessary.

Curriculum Analysis

The Aerodrome & Heliport course, which is worth three credits, covers a broad range of topics, including the design, legislation, and operations of aerodromes and heliports, according to the curriculum evaluation. The curriculum meets the requirements of the Ministry of Transportation and the International Civil Aviation Organization (ICAO). While the implemented curriculum encompasses theoretical and practical competencies, its execution has not yet fully integrated digital technology as part of the learning strategy. Due to the lack of case studies and supporting learning media, the ICAO Annex 14-based curriculum and national aviation regulations remain difficult for students to comprehend. In order to improve student engagement in the learning process, blended learning-based teaching materials are anticipated to integrate interactive e-learning with in-person instruction. This will allow students to access resources anytime and from any location.

Cadet Characteristics Analysis

Cadet characteristics were analyzed to understand students' initial abilities, attitudes, and skills before developing the teaching materials. Based on survey results and observations, several key characteristics of the students that need to be considered in teaching material development were identified.

Attitude Competency

The first findings indicate that many students are not motivated to learn because they think the repeated teaching methods in this course make it difficult and dull. Insufficient initiative in individual studies may also lead to students relying too much on the instructor's resources without further investigation. Technical concepts may be complex for many students, especially when applying aerodrome and heliport principles in real-world settings.

Knowledge Competency

The fact that this course keeps coming up suggests that students still have trouble grasping the fundamentals of heliports and aerodromes. Furthermore, many students struggle to read and comprehend aviation legislation, particularly ICAO Annex 14, which requires further help translating the requirements into practical application. Students find it challenging to grasp technology applications in aerodrome management as they are unfamiliar with the navigation tools and aerodrome management systems used in the aviation industry.

Skill Competency

Students still struggle with analysis and problem-solving, especially with case studies on airport operations. Moreover, even though simulators and navigation tools are important in the aviation industry, they are not yet used.

Initial Characteristics of Cadets

Since most students have visual and kinesthetic learning styles, the teaching resources should include more visual media, interactive simulations, and practice-based projects to improve their knowledge correctly. By recognizing these characteristics, the blended learning-based teaching materials will be

designed to be more flexible, interactive, and technology-driven to improve the effectiveness of Aerodrome and Heliport learning at Makassar Aviation Polytechnic.

Phase 2: Design

A blended learning approach and systematic approaches for instructional material design are used throughout the design phase to develop the learning model further. This phase seeks to satisfy course requirements and provide instructional tools to enhance cadets' drive to acquire higher-order thinking Skills (HOTS). This stage consists of various crucial chores like developing instructional techniques, learning competency instruments, setting learning objectives, and organization of learning resources.

Formulating Learning Objectives

Decomposing large goals into more exact, measurable aims based on specific factors helps to generate learning objectives. Cognitive, emotional, and psychomotor are the primary learning areas considered while creating these goals. The theoretical Learning of radio aids to air navigation is based on the cognitive domain concerned with thought processes, idea understanding, and information processing. In addition to how students react to the provided content and grow to understand the significance of navigation technology in aviation, the emotional domain pertains to cadets' attitudes and desire for Learning. While this is all going on, the psychomotor domain gives practical ability in utilizing air navigation equipment top priority, ensuring cadets acquire outstanding applied skills and theoretical knowledge. The learning process may be more outcome-oriented and methodically organized by creating thorough learning goals.

Designing Learning Competency Instruments

After the learning objectives are formulated, the next step is designing learning competency instruments, which include developing assessments directly related to the operational learning objectives. These instruments serve to measure cadets' learning achievements in terms of theoretical understanding (cognitive assessment), attitudes and learning motivation (affective assessment), and the ability to apply learned concepts (psychomotor assessment). The design of these instruments is based on different levels of thinking—low, medium, and high—to ensure cadets can develop critical and analytical thinking skills by the demands of vocational education in aviation. Appropriate assessment tools allow one to continually evaluate and modify the efficacy of the learning process to fit cadets' demands.

Developing Instructional Strategies

Blended Learning—which combines online and in-person instruction—forms the basis of the teaching strategy used in this study. The fundamental elements of face-to-face instruction include discussions, content reinforcement, and exercises enhancing higher-order thinking abilities (HOTS). Cadets may access interactive tests, simulations, and other resources anytime via Online Learning. This kind of instruction aims to empower cadets and inspire them to participate more completely in Learning. Digital presentations, instructional videos accessible via online learning platforms, and printed courses are tools used in the teaching approach.

Structuring Instructional Materials

Instructional materials are structured in part by content outlines, material characteristics, media use planning, and preparation of teaching aids and instruments. Two main kinds of developed instructional resources exist: Printable and nonprintable materials. Learning modules, including theoretical information, example questions, and exercises to help cadets gain knowledge, are among printed resources. Non-printed materials include multimedia-based information, including interactive videos, operating air navigation equipment simulations, and online discussion forums, allowing cadets to conduct more flexible talks. Based on the curriculum of the Air Traffic Management study program at the Makassar Aviation Polytechnic, these resources have evolved using accepted instructional design guidelines. The generated instructional materials for this design phase should provide a more enjoyable and efficient learning environment fit for aviation vocational education. Apart from providing flexibility in the course of instruction, the blended learning

method motivates cadets to actively develop the communication, critical thinking, and practical skills needed in the aviation sector.

Stage 3: Development

At this stage of development, the study focuses on many assessment and adjustment techniques for the previously implemented blended learning-based teaching approach. Before the educational model is widely used in learning activities, its development tries to ensure it achieves high validity or practicality. Three primary phases define this stage: validation testing, individual trials, and small group trials. Every step is carried out methodically to find flaws in the teaching strategy and implement required changes before more general tests.

Validation Testing

Validation testing—done by accredited instructors with knowledge of blended learning technologies—is the initial phase of the development process. The validation ensures that the learning model meets content-based, use-based, and language-based quality criteria. Learning tools, including instructional materials, semester lesson plans, questionnaires, and interview tools analyzing cadets' responses to the learning model constituted validation for this study. Experts assigned to evaluate the feasibility of implementation in real-world learning environments, the clarity of instructions, and the consistency of information with learning objectives were provided with learning materials. The results of validation show that every learning tool has very validity. The following table presents the validation results of the learning instruments:

Table 3. Feasibility of Instructional Instruments

Instrument	Average		Index	
	Va	Criteria	PA	Criteria
Assessment of Blended Learning	0.90	Very Valid	0.74	Reliable
Instrumentation document for instruction	0.88	Very Valid	0.72	Reliable
Instrument document for the Semester Learning Plan	0.89	Very Valid	0.74	Reliable
Instrument document for the student response questionnaire about the learning model	0.78	Valid	0.70	Reliable
Cadet activity instrument sheet	0.82	Very Valid	0.72	Reliable

The results of the validation test show that the designed instrument is very valid. The average validation score ranges from 0.78 to 0.90 in Table 3 and is in the "highly valid" range. All instruments were found trustworthy when the reliability requirements were investigated using the percentage agreement index (PA ≥ 0.70). Thus, the blended learning-based instructional model has met the validation standards and is suitable for further trial implementation. Although most validators stated that this model is already highly valid, some improvements were recommended. The primary changes include improving the language in the teaching resources, including real-life examples in the learning environments, and changing the assessment tools to represent higher-order thinking Skills (HOTS) more fairly. The following step, individual trials, is built upon these validation findings.

Individual Trial

The individual trial follows the completion of the validation phase. This research involves several instructors and cadets to assess the effectiveness of the learning model's instructions and the instructional materials' readability and clarity. The experiment is conducted individually by providing the teaching materials in both digital and paper formats. Both cadets and instructors are asked to provide input about the training materials' subject grasp, language clarity, and structure. Their opinions on how the developed model combines virtual and in-person education are also requested. The individual trial findings show that most cadets and instructors believe the instructional materials are clear and methodically organized. However, some educators recommend improving how online resources are presented, especially by

including extra resources like interactive learning videos and activities that may be done via apps. In order to make it more transparent how theories are used in practical settings, we suggest adding additional case studies to the instructional materials. Teachers also advise changing the use of the e-learning platform as some cadets find it challenging to download and access the course materials. The various studies' findings were used to enhance the interactive elements of Online Learning, include more varied case studies in the course, and simplify the instructional resources.

Small Group Trial

The small group testing phase is a crucial step in creating the instructional model based on blended Learning. Finding elements that need further work before the model is widely used is the main objective of this phase. 24 cadets and two instructors who primarily utilize printed instructional materials as their learning resource are involved in this small-scale study. Additionally, the materials are supplemented with e-learning-based content that can be accessed online. The two primary learning sessions in the small group trial's execution are in-person and virtual. In-person meetings explore important ideas, lead conversations, and provide activities based on Higher Order Thinking Skills (HOTS). Printed teaching materials are the primary resource used by teachers to deliver lessons during this session. Using these materials helps cadets understand concepts systematically, especially since the content is arranged logically, supporting progressive comprehension. Although most cadets find printed teaching materials helpful, some suggest including more real-life case examples and detailed illustrations to clarify complex concepts. Consequently, one of the main revisions based on this trial was the addition of diagrams, navigation tool schematics, and photographs of aviation navigation devices in the teaching materials to make them more engaging and easier to understand.

The online session in the small group trial serves as a complement to face-to-face learning. Cadets can obtain digital instructional resources via the e-learning platform. Additionally, cadets may evaluate their comprehension using online tasks based on HOTS. However, several technological problems arose, especially with the e-learning platform's interoperability with the mobile devices of the cadets. Some cadets had trouble accessing digital documents because of formatting problems that prevented them from being seen on mobile devices. Two changes addressed this: enhancing platform compatibility and offering a lighter PDF version of the instructional materials for quicker access. Questionnaires and interviews were conducted after the learning sessions to gauge the effectiveness of the learning model and get feedback from instructors and cadets. This experiment's main result was that in-person and online schooling together worked well. Most cadets felt comfortable combining many techniques as each one provided its benefits. While in-person meetings were demonstrated to be more helpful for talks and HOTS problem-solving exercises, online Learning allowed cadets the freedom to review materials whenever they needed to. Still, there are some challenges in implementing blended Learning. Although most cadets said in-person sessions should focus more on interactions and problem-solving, online Learning may be the primary way to teach theoretical information. Teachers also said that while the blended learning approach requires more time to create digital resources, it offers more freedom in presenting the content. The instructional paradigm was changed to handle these problems using teaching tactics that increased face-to-face sessions' interactive and discussion-based nature. One of the biggest challenges in online Learning is how educators can effectively monitor cadets' learning progress. A monitoring system was created to manage this so instructors could track cadets' e-learning platform activities, like access frequency, task completion rates, and exam scores. Depending on the needs of every trainee, instructors might provide more precise and timely comments utilizing this approach.

To employ printed teaching materials as the primary learning component, many notable improvements were made to the blended learning-based instructional model in response to the results of the small group experiment. Additional diagrams, illustrations, and real-world case studies helped to make the instructional resources more appealing and intelligible. Moreover, cadets had easier access to smaller information formats, and the e-learning platform was changed to fit cell devices. Teaching strategies were also changed to maximize learning time by prioritizing talks in in-person meetings and online presentations of theoretical

materials. Monitoring and evaluation features on the e-learning platform also let teachers follow cadets' development and provide quick comments. The results of the small group study show that even if e-learning aids with learning flexibility, printed instructional resources remain a great primary instrument for education. Using the changes, the blended learning-based instructional approach is projected to be more realistic and successful in enhancing cadets' critical thinking abilities and learning results. The next stage is a more thorough study to evaluate this paradigm's performance in a more all-encompassing classroom.

Figure 2. Small Group Trial

DISCUSSION

This project aims to improve students' competency attainment in the Aerodrome & Heliport course of Makassar Aviation Polytechnic by developing blended learning-based instructional resources. Students have greater freedom in understanding aerodrome and heliport topics thanks to blended Learning—which combines online and in-person instruction. In several vocational education disciplines, this approach has been shown to increase student involvement and learning efficacy (Esichaikul & Jayalath, 2020; Radovan & Radovan, 2024). Define, create, and develop (Thoyibah & Hajizah, 2025) these training materials using a methodical methodology spanning three primary phases of the 4D development model. Because it provides a systematic approach targeted at the needs of the students, this model is well-liked in producing educational tools (Mutia et al., 2020). We closely review learner profiles, needs, and learning objectives during the Define phase. The investigation results show that students struggle with several aerodrome and heliport subjects, including a lack of interactive learning tools and limited teaching methodologies still primarily dependent on lectures. Previous research indicates that vocational education, mainly dependent on lectures, is less successful in raising students' capabilities, particularly in professions requiring technical and practical skills (Akounjom et al., 2024; Okolie et al., 2021). As a result, a more flexible and participatory blended learning strategy is selected as a solution, combining in-person and online instruction.

The instructional strategy that is based on blended Learning is intended to increase students' active participation in the learning process throughout the design phase. The constructivist approach, which stresses active Learning via interaction with materials, teachers, and other students, forms the basis of the instructional design (Istiana et al., 2024; Siddiqi & Ahmad, 2021). Following the revised Bloom's taxonomy, learning objectives are formulated operationally based on cognitive, affective, and psychomotor domains (Qasrawi & Beniabdelrahman, 2020). The applied learning strategies involve a combination of in-class direct instruction, group discussions, and e-learning platforms to provide supplementary materials, operational simulations, and assessments. Teaching materials are designed in two main formats: printed teaching materials in the form of modules and digital teaching materials, including instructional videos, interactive simulations, and case study-based exercises. Incorporating educational videos and technology-based

simulations may improve students' technical proficiency in engineering and aviation, according to recent research (Assad et al., 2020; Wang, 2024).

To guarantee that instructional materials are helpful before they are widely used, the Development stage consists of validation testing, individual trials, and small group trials. Professionals carry out validation studies to evaluate the efficiency of the mixed-learning delivery methods, the material's fit, and the instructions' clarity. When suggestions to enhance the learning materials with additional case studies and pictures are implemented, the validation findings show high validity. Students and teachers do individual tests to evaluate the readability and applicability of the teaching instruments. Small group testing helps determine which elements should be changed before significant implementation. Recent studies show that this approach effectively enhances hybrid learning environments' educational experiences for students (Raes, 2022). According to the research findings, students' competence accomplishment is much raised by the created blended learning model. Through digital simulations and examinations, the combination of face-to-face and online Learning helps students be more flexible in grasping aerodrome and heliport ideas, promotes participation in discussions and project-based assignments, and develops conceptual knowledge. Other studies confirm these results by showing that blended Learning improves students' ability for analysis and problem-solving through techniques grounded on higher-order thinking Skills (HOTS) (Dewi & Fatkhiyani, 2021; Saefullah et al., 2020). Using e-learning tools allows students to access learning resources anywhere and at any time, enabling them to study at their own speed and in line with their particular requirements.

This study offers benefits over earlier studies, mainly in creating instructional resources based on blended Learning that combines online Learning with face-to-face instruction. Technology also improves students' competency in studying aerodromes and heliports, including digital simulations and assessment. This study is more thorough than Pasandín & Pérez's (2021) research, which merely used problem-based Learning in airport design via workshops. This is because it makes use of flexible, interactive instructional tools. Meanwhile, the study by Schaffernak et al. (2022) focused on the use of mixed reality technology in pilot training.

In contrast, this research is more relevant to vocational education in aerodrome and heliport studies, where students' technical skills are improved through blended Learning. The effectiveness of e-modules for the Makassar Aviation Polytechnic's Aircraft Structure, Equipment, and Furnishings course was also shown by the study by Latif et al. (2024), which supported this research on incorporating technology into education. Previous studies demonstrating the successful development of student's abilities by using digital-based technologies, interactive techniques, and creative learning strategies increase the quality and relevance of the study in the framework of occupational aviation education. Furthermore, this paper underlines individual trials, small-group research, and validation testing requirements to guarantee their durability and early efficacy even before training resources are usually used. Using interactive media, including instructional videos, digital simulations, and evaluations, blended Learning has improved students' grasp of complex ideas. The main advantage of this research is its systematic approach to developing instructional materials, which begins with expert validation and proceeds with individual and small-group assessment to identify areas requiring development prior to general use. This technique helps create more flexible and responsive teaching tools for students' requirements and criteria for vocational aviation. Moreover stressed in this research are the individual, small-group, and validation testing procedures to guarantee the initial viability and efficacy of the instructional materials before their wider use. Blended Learning was shown to be pretty beneficial for students grasping challenging concepts using interactive media, including digital simulations, instructional videos, and exams. Beginning with expert validation and working through individual and small group testing, these instructional resources were created, planned, and methodically. This approach helped identify elements that need development prior to mass publication.

The methodical approach of this research on material development and more complete integration of digital technologies help to promote blended Learning in aviation education. Unlike previous studies that primarily focused on problem-based Learning or specific technologies like mixed reality, this study uses a comprehensive strategy combining several elements of technology-based Learning, theories of occupational

education, and teaching strategies based on HOTS. This approach enhances technical knowledge and provides a framework that other aviation education institutions may use to design innovative courses reflecting industry developments. Therefore, the findings of this study might form the foundation of policy in vocational education to promote the use of blended Learning in a range of courses requiring a balance of theory and technology-based hands-on Learning.

The practical outcomes of the study reveal in aerodrome and heliport courses that the blended learning method may significantly increase students' active participation and knowledge of theoretical and practical conceptions. The created learning model shows that combining face-to-face and online Learning gives students more freedom to access resources at any moment, actively engage in conversations, and do project-based tasks more efficiently. Additionally, continuous evaluation and revision are essential in ensuring that the developed teaching materials meet vocational aviation education standards. In line with the trend of digital technology adoption in aviation sector operations, technology, such as digital simulations and assessment, has also been shown to improve students' technical abilities and conceptual understanding. As a result, this research advances vocational education. It provides a learning model that can be used in other courses that call for a blend of applied technology- and theory-based Learning. Therefore, the findings of this study can serve as a foundation for vocational education institutions in designing innovative curricula that align with industry demands and support educational policies that encourage the implementation of blended Learning in technical and professional education.

CONCLUSION

This research has developed blended learning-based teaching materials for the Aerodrome & Heliport course at the Makassar Aviation Polytechnic using the 4D development model, which focuses on three main stages: define, design, and develop. This approach was born from a needs analysis that showed that traditional teaching methods have not been able to optimally improve students' technical abilities in understanding concepts and practices in airports and heliports. Through online and face-to-face Learning, teaching materials were developed by integrating simulations, interactive videos, digital modules, and technology-based evaluations. Expert validation and individual and small-group trials were part of this development process, and the results demonstrated that the learning products were deemed highly valid, dependable, and capable of enhancing students' comprehension, motivation, and active participation. Although the results are promising, challenges remain—from time constraints in compiling materials and technical constraints of online learning platforms to optimal technology integration compatible with students' devices. In addition, infrastructure readiness, lecturer training in managing digital Learning, and the need for a data-based monitoring system are important aspects that need to be prepared carefully. Practically, this approach raises the effectiveness of training and provides aviation vocational education institutions with chances to use technology-based Learning in other technical courses. Further developments like using augmented reality (AR) and virtual reality (VR) might improve students' practical knowledge and educational experiences. Therefore, further research is recommended to expand the implementation of this model in various similar study programs while examining more flexible and sustainable technology integration strategies in the context of aviation vocational education.

REFERENCES

Akounjom, B. J., Babatunde, O., & Aiguobarueghian, O. M. (2024). The Future of Vocational Education Trends and Innovations in Blended Teaching Methodologies in Nigeria. *International Journal of Sub-Saharan African Research*, *2*(3), 267–277. https://www.ijssar.com/uploads/135546_1727727249.pdf

Aminullah, Jumiaty, S., & Permatasari. (2018). Model Pembelajaran Terpadu Tipe Jaring Laba-Laba untuk Meningkatkan Perkembangan Kognitif Anak Usia 5-6 Tahun di Taman Kanak-Kanak. *Jurnal Andragogi*, *12*(1), 9–14. https://core.ac.uk/download/pdf/323564512.pdf#page=13

Asghar, M. Z., Afzaal, M. N., Iqbal, J., & Sadia, H. A. (2022). Analyzing an Appropriate Blend of Face-to-Face, Offline, and Online Learning Approaches for the In-Service Vocational Teacher's Training Program. *International Journal of Environmental Research and Public Health*, *19*(17), 1–17.

https://doi.org/10.3390/ijerph191710668

Assad, G. D., Hinojosa-Olivares, J. M., & Colomer-Farrarnos, J. (2020). Study of the effectiveness of interactive videos in applied electronics courses. *International Journal on Interactive Design and Manufacturing*, *14*(3), 983–1001. https://doi.org/10.1007/s12008-020-00689-2

Avdiu, E., Bekteshi, E., & Gollopeni, B. (2025). Learning skills for the future – implementing the 21st-century Learning. *Multidisciplinary Science Journal*, *7*(1), 1–8. https://doi.org/10.31893/multiscience.2025011

Baihaki, B., Danaryanti, A., & Kamaliyah, K. (2021). Pengembangan LKPD Elektronik Berbasis HOTS Menggunakan Quizizz. *Journal of Mathematics Science and Computer Education*, *1*(1), 36. https://doi.org/10.20527/jmscedu.v1i1.3352

Bizami, N. A., Tasir, Z., & Kew, S. N. (2023). Innovative pedagogical principles and technological tools capabilities for immersive, blended Learning: a systematic literature review. In *Education and Information Technologies* (Vol. 28, Issue 2). Springer US. https://doi.org/10.1007/s10639-022-11243-w

Bloom, Benjamin S., & Krathwohl, D. R. (1956). Taxonomy of educational objectives: The classification of educational goals by a college and university examiners committee. In *Handbook 1: Cognitive domain* (p. 10). https://www.d41.org/cms/lib/IL01904672/Centricity/Domain/422/BloomsTaxonomy.pdf

Bloom, Benjamin Samuel, Madaus, G. F., & Hastings, J. T. (1981). *Evaluation to Improve Learning*. McGraw Hill.

Bujang, S. D. A., Selamat, A., Krejcar, O., Maresova, P., & Nguyen, N. T. (2020). Digital learning demand for future education 4.0-case studies at Malaysia education institutions. *Informatics*, *7*(2), 1–11. https://doi.org/10.3390/informatics7020013

Dakhi, O., Jama, J., & Irfan, D. (2020). Blended Learning: a 21St Century Learning Model At College. *International Journal of Multi-Science*, *1*(7), 50–65. https://multisciencejournal.com/index.php/ijm/article/view/92/72

Dewi, R. A. K., & Fatkhiyani, K. (2021). Blended Learning: Can It Be a Solution to Improve Digital Literacy and HOTS for PGSD Students in a Pandemic Situation? *International Journal of Elementary Education*, *5*(4), 601–611. https://doi.org/10.23887/ijee.v5i4.39411

Dhamayanti, F. I. (2021). EFL Students' Perception and Motivation Toward Quizizz as E-Learning Media in English E-Classroom. *Foreign Language Journal (EDUCAFL)*, *2021*(2), 75–82. https://scholar.archive.org/work/tbsjlp3tt5b7nmoyvan4y55pnu/access/wayback/https://educafl.ub.ac.id/index.php/educafl/article/download/200/174

Esichaikul, V., & Jayalath, J. (2020). Gamification to Enhance Motivation and Engagement in Blended eLearning for Technical and Vocational Education and Training. *Technology, Knowledge and Learning*, *1*(1), 1–28. https://search.ebscohost.com/login.aspx?direct=true&db=conedsqd6&AN=edsair.doi.....845cd7a5bc0800d63632b8531f05e397&authtype=sso&custid=s5243931&site=eds-live&scope=site&authtype=shib&custid=70180632

Gherheș, V., Stoian, C. E., Fărcașiu, M. A., & Stanici, M. (2021). E-learning vs. Face-to-face learning: Analyzing students' preferences and behaviors. *Sustainability (Switzerland)*, *13*(8), 1–15. https://doi.org/10.3390/su13084381

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers*, *3*(2), 275–285. https://doi.org/10.1016/j.susoc.2022.05.004

Hilvano, N. T., Mathis, K. M., & Schauer, D. P. (2015). Collaborative Learning utilizing case-based problems. *Bioscene*, *40*(2), 22–30. https://files.eric.ed.gov/fulltext/EJ1069979.pdf

Huang, Y.-C. (2021). Comparison and Contrast of Piaget and Vygotsky's Theories. *Proceedings of the 7th International Conference on Humanities and Social Science Research (ICHSSR 2021)*, *554*(1), 28–32. https://doi.org/10.2991/assehr.k.210519.007

Istiana, Y., Dhieni, N., & Supena, A. (2024). Assessing Kindergarten Teachers ' Competence in Integrating Character Education into Lesson Plans : A Conceptual Framework and Preliminary Instrument Design. *International Conference for Research in Early Childhood Education (ICRECE)*, 310–324. http://icrece.com/paper/index.php/cf/article/view/13/26

Latif, H. L., Nur, M., & Octavianie, A. (2024). Pengembangan Bahan Ajar Mata Kuliah Aircraft Structure, Equipment and Furnishing Di Politeknik Penerbangan Makassar. *Seminar Nasional Inovasi Teknologi Penerbangan (SNITP) Tahun 2024*, *9*, 9–23.

https://ejournal.poltekbangsby.ac.id/index.php/SNITP/article/view/1945

Marougkas, A., Troussas, C., Krouska, A., & Sgouropoulou, C. (2023). Virtual Reality in Education: A Review of Learning Theories, Approaches and Methodologies for the Last Decade. *Electronics (Switzerland)*, *12*(13), 1–21. https://doi.org/10.3390/electronics12132832

Müller, C., & Mildenberger, T. (2021). Facilitating flexible Learning by replacing classroom time with an online learning environment: A systematic review of blended Learning in higher education. *Educational Research Review*, *34*(1), 1–16. https://doi.org/10.1016/j.edurev.2021.100394

Mutia, L., Gimin, & Mahdum. (2020). Development of Blog-Based Audio Visual Learning Media to Improve Student Learning Interests in Money and Banking Topic. *Journal of Educational Sciences*, *4*(2), 436–448. https://jes.ejournal.unri.ac.id/index.php/JES/article/view/160

Ng, D. T. K. (2022). Online aviation learning experience during the COVID-19 pandemic in Hong Kong and Mainland China. *British Journal of Educational Technology*, *53*(3), 443–474. https://doi.org/10.1111/bjet.13185

Okolie, U. C., Elom, E. N., Igwe, P. A., Binuomote, M. O., Nwajiuba, C. A., & Igu, N. C. N. (2021). Improving graduate outcomes : Implementation of problem-based Learning in TVET systems of Nigerian higher education. *Higher Education, Skills and Work-Based Learning*, *11*(1), 92–110. https://doi.org/10.1108/HESWBL-12-2018-0140

Pasandín, A. M. R., & Pérez, I. P. (2021). Developing theory from practice: A case study in civil engineering airport design problem-based Learning. *Computer Applications in Engineering Education*, *29*(5), 1112–1131. https://doi.org/10.1002/cae.22364

Peng, R., & Fu, R. (2021). The effect of Chinese EFL students' learning motivation on learning outcomes within a blended learning environment. *Australasian Journal of Educational Technology*, *37*(6), 61–74. https://doi.org/10.14742/ajet.6235

Pérez, L. I. G., & Montoya, M. S. R. (2022). Components of Education 4.0 in 21st Century Skills Frameworks: Systematic Review. *Sustainability (Switzerland)*, *14*(3), 1–31. https://www.mdpi.com/2071-1050/14/3/1493

Piyona, Maria, H. T., & Hamdani. (2025). Pengembangan Multimedia Interaktif Berbantuan ISpring Suite dengan Model PBL untuk Meningkatkan Hasil Belajar Fisika Peserta Didik di SMA. *Jurnal Pendidikan*, *15*(1), 241–249. https://doi.org/10.37630/jpm.v15i1.2431

Putri, A., Roza, Y., & Maimunah, M. (2020). Development of Learning Tools with the Discovery Learning Model to Improve the Critical Thinking Ability of Mathematics. *Journal of Educational Sciences*, *4*(1), 83. https://doi.org/10.31258/jes.4.1.p.83-92

Qasrawi, R., & Beniabdelrahman, A. (2020). The Higher And Lower-Order Thinking Skills (HOTS and LOTS) In Unlock English Textbooks (1st And 2nd Editions) Based On Bloom's Taxonomy: An Analysis Study. *International Online Journal of Education and Teaching (IOJET*, *7*(3), 744–758. https://iojet.org/index.php/IOJET/article/view/866

Radovan, M., & Radovan, D. M. (2024). Harmonizing Pedagogy and Technology: Insights into Teaching Approaches That Foster Sustainable Motivation and Efficiency in Blended Learning. *Sustainability (Switzerland)*, *16*(7), 1–19. https://doi.org/10.3390/su16072704

Raes, A. (2022). Exploring Student and Teacher Experiences in Hybrid Learning Environments: Does Presence Matter? *Postdigital Science and Education*, *4*(1), 138–159. https://doi.org/10.1007/s42438-021-00274-0

Saefullah, A., Fitriyani, A., Ruhiyat, Y., & Rostikawati, D. A. (2020). Blended Learning: The Effect on Higher Order Thinking Skills (HOTS) in Thermodynamics. *Indonesian Journal of Science and Mathematics Education*, *3*(3), 262–271. https://doi.org/10.24042/ijsme.v3i3.6666

Schaffernak, H., Moesl, B., Vorraber, W., Holy, M., Herzog, E. M., Novak, R., & Koglbauer, I. V. (2022). Novel Mixed Reality Use Cases for Pilot Training. *Education Sciences*, *12*(5), 1–18. https://doi.org/10.3390/educsci12050345

Siddiqi, M. M., & Ahmad, S. (2021). Embracing Change: Active Learning in the Era of Digital Education. *Confluence of Knowledge (COK)*, *08*(01), 59–74. http://cok.pratibha-spandan.org

Singh, J., Evans, E., Reed, A., Karch, L., Qualey, K., Singh, L., & Wiersma, H. (2022). Online, Hybrid, and Face-to-Face Learning Through the Eyes of Faculty, Students, Administrators, and Instructional Designers: Lessons Learned and Directions for the Post-Vaccine and Post-Pandemic/COVID-19 World. *Journal of Educational Technology Systems*, *50*(3), 301–326. https://doi.org/10.1177/00472395211063754

Sylvia, T., & Hutabarat, L. T. (2021). A Development of E-Learning-Based Instructional Media for English At Medan Civil Aviation Academy. *Data Science: Journal of Computing and Applied Informatics*, *5*(1), 1–10. https://doi.org/10.32734/jocai.v5.i1-4350

Thoyibah, F. A., & Hajizah. (2025). Pembelajaran dengan Aplikasi Canva pada Materi Perkembangan Pesantren dan Peranannya dalam Dakwah Islam di Indonesia. *Jurnal Keislaman Dan Ilmu Pendidikan*, *7*(1), 141–155. https://ejournal.stitpn.ac.id/index.php/islamika/article/view/5505

Wang, B. (2024). Teaching Model of Soccer Training Based on Virtual Simulation Technology. *Journal of Electrical Systems*, *20*(3s), 610–619. https://doi.org/10.52783/jes.1338

Wengrowicz, N., Swart, W., Paul, R., Macleod, K., Dori, D., & Dori, Y. J. (2018). Students' Collaborative Learning Attitudes and Their Satisfaction with Online Collaborative Case-Based Courses. *American Journal of Distance Education*, *32*(4), 283–300. https://doi.org/10.1080/08923647.2018.1511509

Wibowo, S., Wangid, M. N., & Firdaus, F. M. (2025). The relevance of Vygotsky's constructivism learning theory with the differentiated learning primary schools. *Journal of Education and Learning*, *19*(1), 431–440. https://doi.org/10.11591/edulearn.v19i1.21197

Yuniar, D. C., Febiyanti, H., Ramadhani, S., & Wulandari, R. R. R. S. (2023). Development of problem-based learning practicum modules for the dangerous goods course. *JPPI (Jurnal Penelitian Pendidikan Indonesia)*, *9*(4), 679. https://doi.org/10.29210/020233339

Yusny, R., Rizki, F., Trisnawati, I. K., & Mulia, M. (2021). Offline or online?: EFL students' perceptions on working in face-to-face and virtual learning modes. *English: Journal of Language, Education, and Humanities*, *9*(1), 145. https://doi.org/10.22373/ej.v9i1.10492