Developing Team-Based Project Model Combined with Flipped Classroom for Scientific Writing in Higher Education

Noni Febriana*, Ermanto, and Abdurahman

Language Pedagogy Program, Faculty Language and Arts, State University of Padang, Padang, Indonesia
Email: NoniFebriana6@gmail.com (N.F.); ermanto@fbs.unp.ac.id (E.); abdurahman.ind@fbs.unp.ac.id (A.)
*Corresponding author

Manuscript received January 20, 2025; revised February 25, 2025; accepted April 18, 2025; published October 24, 2025

***Abstract*—This study investigates the development of a Team-Based Project (TBP) model combined with Flipped Classroom (FC) to enhance scientific writing skills in a multidisciplinary classroom setting. Addressing challenges identified in preliminary research at UPI YPTK Padang and theoretical gaps, this study integrates students from Counseling, English Education, Informatics Education, Visual Communication Design (DeCafe), Civil Engineering, and Industrial Engineering within a single collaborative learning environment. Unlike previous research that applied TBP and FC in homogeneous academic settings, this study adopts an interdisciplinary approach, fostering both discipline-specific expertise and cross-disciplinary collaboration. The research employs the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) framework to accommodate multidisciplinary learning contexts. Participants were divided into an experimental group (n = 30), taught using the TBP-FC model, and a control group (n = 30), which followed conventional instruction. Validation results demonstrated high reliability (α = 0.88) for the TBP-FC model book. Practicality tests indicated strong usability, with average scores of 0.865 from lecturers and 0.86 from students. Effectiveness tests showed significant improvements in the experimental group's pretest (M = 60.83, SD = 7.12) and posttest (M = 81.16, SD = 6.45) scores (t (29) = 12.87, p < 0.001), whereas the control group exhibited minimal gains. These findings confirm that TBP-FC is a valid, practical, and effective model for enhancing scientific writing skills in multidisciplinary higher education environments. This study expands TBP-FC applications beyond single-discipline contexts, offering a scalable and adaptable instructional framework for fostering interdisciplinary academic writing.**

***Keywords*—team-based project, flipped classroom, writing scientific papers, higher education**

I. Introduction

The ability to write productive scientific papers requires critical thinking skills and a solid understanding of the subject matter [1]. In higher education, enhancing students' scientific writing skills can be achieved through the application of team-based project model. This method aligns with the process of scientific writing, as both require careful planning, in-depth research, and structured execution [2]. Scientific writing is defined as a process where students receive guidance, encouragement, and feedback from instructors, enabling them to express their thoughts effectively and improve their writing over time [3, 4]. While project-based learning has been shown to be effective in developing scientific writing skills, collaborative frameworks like the Team-Based Project (TBP) model have enhanced learning outcomes in various disciplines [5, 6], significant challenges remain.

One notable issue in Fig. 1 is the limited mastery of the systematic structure of scientific writing. Many students struggle to produce well-organized papers that adhere to the conventional structure, which typically includes sections such as the introduction, literature review, methodology, results, discussion, and conclusion [7]. For instance, a student attempting to write a research paper may present an unclear research question in the introduction or fail to connect findings to relevant literature in the discussion. Such disorganization reduces the clarity and coherence of their work, ultimately hindering their ability to communicate research effectively. This gap highlights the need for targeted strategies to help students understand and implement proper scientific writing structures.

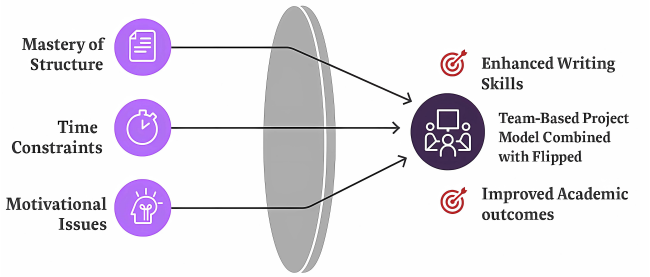

Fig. 1. Significant gaps in scientific writing.

A second gap arises from time constraints and motivational issues, which significantly hinder students' writing processes. Empirical data from the 2021/2022 academic year at Universitas Putra Indonesia YPTK Padang revealed that many students lacked sufficient time to complete their tasks and struggled with low motivation and limited understanding of effective writing techniques [8]. For example, students tasked with writing a research article in two weeks often felt overwhelmed, leading to incomplete drafts or low-quality work. This problem is exacerbated by the fact that some students view writing as a tedious requirement rather than a valuable skill to master. Addressing these motivational and time-related challenges is critical to fostering a more supportive and productive writing environment [6].

A third gap involves the unrealistic time pressures often imposed on students, which make it challenging for them to engage in extended and in-depth writing. Time constraints frequently prevent students from revising and refining their work, a critical step in producing high-quality scientific papers [9]. For instance, students assigned to write a detailed analysis on a complex topic, such as the impact of artificial intelligence on education, may not have adequate time to conduct thorough research, draft multiple iterations, or incorporate feedback effectively. These constraints not only

compromise the quality of their work but also limit their opportunities to develop essential academic writing skills [3].

A fourth gap relates to the underexplored potential of the Team-Based Project (TBP) model in addressing the challenges specific to scientific writing. While the TBP model has demonstrated success in other contexts, such as training medical students to write clinical reports in South Africa or guiding Indonesian students in developing research proposals [10] its application to scientific writing remains limited. Exploring this potential could provide innovative solutions to the challenges students face, such as understanding structure, managing time effectively, and maintaining motivation throughout the writing process [11].

Addressing these gaps is crucial to improving the overall competence of students in scientific writing. Enhancing their ability to structure and articulate ideas effectively not only leads to better academic performance but also contributes to more impactful research outputs [2]. The TBP model offers the additional benefit of fostering essential collaborative skills, such as teamwork, communication, and leadership, which are indispensable for academic and professional success [6]. Furthermore, Previous studies on Team-Based Project (TBP) and Flipped Classroom (FC) have primarily focused on homogeneous student groups within a single discipline [12]. However, this study addresses a gap by implementing a TBP-FC model in a multidisciplinary classroom setting, encompassing students from Counseling, English Education, Informatics Education, Visual Communication Design, Civil Engineering, and Industrial Engineering. By allowing students to work on scientific writing projects aligned with their respective disciplines, this model enhances both subject-specific learning and interdisciplinary collaboration. This research, therefore, contributes to the existing body of knowledge by exploring how TBP-FC can be adapted for large, diverse classrooms and how structured collaboration across fields impacts scientific writing development [13]. Based on the above explanation, the research questions for this study can be formulated as follows:

1) What is the process of developing the Team-Based Project model combined with the Flipped Classroom for scientific writing in higher education?
2) What is the validity of the Team-Based Project model combined with the Flipped Classroom for scientific writing in higher education?
3) What is the practicality of the Team-Based Project model combined with the Flipped Classroom for scientific writing in higher education?
4) What is the effectiveness of the Team-Based Project model combined with the Flipped Classroom approach for scientific writing in higher education?

II. Review

A. Team-Based Project (TBP)

The Team-Based Project (TBP) refers to an inquiry-based instructional method that engages learners in constructing knowledge by requiring them to complete meaningful projects and develop real-world products. TBP is distinguished by six key features: driving questions, a focus on learning objectives, participation in educational activities, collaboration among students, the use of scaffolding technologies, and the creation of tangible artifacts. Among these, the creation of artifacts that address authentic problems is the most significant characteristic, setting TBP apart from other student-centered pedagogies, such as problem-based learning [14]. In addition, TBP enhances students' responsibility, punctuality in submitting assignments, independence in completing tasks and exercises, and ability to follow instructions during the learning process [15]. Furthermore, TBP reduces the need for intensive guidance from instructors during both the learning process and task completion. The TBP method also emphasizes the principle that working in small groups or teams toward a common goal facilitates the development of language skills, particularly writing [16].

Additionally, TBP is a learning model that constructs educational activities by presenting real-world problems for students to solve collaboratively. This model creates a dynamic learning environment, enabling students not only to comprehend knowledge content but also to apply it directly in solving problems collectively. TBP supports learners in reconstructing information provided by instructors and in completing assignments, fostering greater autonomy in the learning process [17]. Meanwhile, TBP as complex activities requiring analysis, planning, and management. These projects may introduce new subjects, involve intricate tasks, and adhere to a specified timeline [18]. While smaller projects are confined to a single scientific scope, larger ones can be multidisciplinary, involving diverse disciplines, professionals, and teams. In the Team-Based Learning (TBL) approach, instructors provide ample opportunities for students to develop collaboration skills, emphasizing discussion and individual learning over traditional lecture-based teaching methods [19]. The implementing TBP includes the formation and management of student groups, transparency of processes to students, integration of group-based learning in courses, and structured feedback [20]. Furthermore, the TBP process includes dual evaluation phases, ensuring a comprehensive assessment of both individual and group learning outcomes.

In the Team-Based Learning (TBL) approach, instructors provide ample opportunities for students to develop collaboration skills, emphasizing discussion and individual learning over traditional lecture-based teaching methods [19]. The implementing TBP includes the formation and management of student groups, transparency of processes to students, integration of group-based learning in courses, and structured feedback [20]. Furthermore, the TBP process includes dual evaluation phases, ensuring a comprehensive assessment of both individual and group learning outcomes.

B. Flipped Classroom

The Flipped Classroom emerged as a solution to address the diminishing effectiveness of traditional classroom instruction [1]. Initially applied in remote areas with millennial students, the method involved recording lecture videos for students to study at home, followed by in-class problem-solving and guided exercises with teachers. It also demonstrates significant improvement when integrated with peer review, guided writing, and scaffolding [21–24]. Furthermore, it describes this student-centered approach as combining individual computer-based learning outside class

with interactive activities during lessons [25]. Flipped classroom emphasizes its core principle: tasks traditionally done at school are completed at home, while homework is tackled in class, with teachers acting as facilitators [9]. This model allows students to access foundational materials, such as video lectures, before class and engage in discussions, brainstorming, or problem-solving during class time [26].

The Flipped Classroom minimizes direct instruction, encouraging students to explore course materials independently, thus dedicating classroom sessions to collaborative and interactive activities [27]. Videos, often used as pre-class resources, offer flexibility, enabling students to pause and revisit content as needed, fostering self-paced learning and active engagement both inside and outside the classroom. This approach not only supports individual learning but also enhances peer collaboration and inventive research opportunities [28]. Its philosophy is rooted in maximizing teacher-student interaction during class, allowing teachers to address students' specific needs and promote cooperative problem-solving [29]. By restructuring instructional time and integrating technology, the Flipped Classroom shifts the focus from traditional lectures to dynamic, interactive group learning environments [30]. This paradigm prepares learners for deeper classroom engagement by frontloading instructional content through e-learning and dedicating classroom sessions to higher-order cognitive processes, such as analysis and synthesis, with immediate feedback from teachers [31, 32].

The Flipped Classroom represents a shift from teacher-centered to student-centered learning, transforming lecture-based classes into activity-based environments that promote active and interactive discussions among students [33]. This approach involves pre-class exposure through resources such as textbook readings, micro lectures, or online videos from platforms like YouTube or Coursera, while in-class sessions emphasize the teacher's role as a "guide on the side" rather than the primary source of information [34]. It is particularly effective for teaching both in and out of the classroom when teachers have limited time to interact directly with students, as it allows materials and assignments to be provided in advance, encouraging students to prepare beforehand [35]. This approach fosters deeper in-class discussions, collaboration, and individualized teacher support, thereby enhancing student understanding, engagement, and the overall learning experience. identify distinctive characteristics of the Flipped Classroom, including the reallocation of in-class and out-of-class time, active learning, peer collaboration, problem-solving, and the integration of pre- and post-class activities [36]. Technology, particularly videos, plays a central role, enabling students to revisit archived content and participate in personalized, flexible learning. the Flipped Classroom enhances teacher-student interaction, encourages student responsibility for learning, combines direct instruction with constructivist practices, and ensures no student lags due to absences, as content remains accessible for review and improvement [37]. These features collectively create an inclusive and effective educational environment tailored to the diverse needs of learners.

Comparing TBP-FC with other teaching methods like peer review, guided writing, or scaffolding helps to show its unique strengths. While peer review focuses on students giving feedback to each other and guided writing offers more step-by-step support, TBP-FC stands out by encouraging students to work together on real-world problems. This approach not only builds collaboration but also helps students take more responsibility for their learning. Guided writing improves writing skills, but TBP-FC also develops teamwork and communication abilities. Scaffolding offers help through structured steps, but TBP-FC gives students a chance to solve complex problems together, preparing them for real-life situations [38]. Similarly, Flipped Classroom (FC) also promotes active learning by having students review content outside of class and engage in discussions or problem-solving activities during class time. However, unlike traditional flipped classrooms, TBP-FC emphasizes even more on collaborative group work and real-world applications, giving students a more hands-on learning experience that integrates individual and group learning in solving real-life challenges.

C. Scientific Paper

Scientific writing, as a factual and structured form of communication, plays a pivotal role in addressing specific issues and disseminating ideas through various mediums like newspapers, magazines, and bulletins. Its objectives include persuading, educating, solving problems, or entertaining, with articles often reflecting the author's perspectives, ideas, and evaluations [39]. Writing is a fundamental skill in language acquisition, fostering critical competencies such as analysis, argumentation, and critical thinking. It requires mastery of linguistic components, including morphology, syntax, semantics, grammar, diction, punctuation, and spelling, to present structured and coherent ideas in written form, making it essential in language education [40]. Despite its importance, writing is often perceived as challenging due to its complexity and the demand for clarity and precision in conveying meaning [41–43]. It serves as a medium for expressing thoughts and emotions through language, enhancing cognitive and linguistic skills [44, 45].

Effective academic writing is influenced by grammatical proficiency and understanding of structural and stylistic conventions, which necessitate clear guidance for students [46]. Collaborative writing initiatives, such as Team-Based Projects (TBP), not only mirror real-world practices but also foster communication, engagement, and retention in online learning contexts [47]. Writing, as a reflective process, enables individuals to systematically organize their ideas and better comprehend themselves and their environment, highlighting its significance as both a practical and introspective tool [48].

Scientific writing is characterized by specific features that distinguish it from other types of writing, emphasizing the importance of understanding these markers to produce high-quality scholarly works [49]. Good scientific writing is clear, accurate, concise, reproducible, impersonal, and adheres to standardized language and notation while explicitly including essential publication details [50]. According to Yulietri and Mulyoto [51] synthesizing these perspectives, conclude that scientific writing must be objective, neutral, systematic, logical, fact-based, devoid of pleonasm, and written in a formal style, avoiding persuasion, argumentation, or exaggeration, while solely presenting

verifiable truths.

III. Materials and Methods

A. Participants

This study involved students from six disciplines, Counseling, English Education, Informatics Education, Visual Communication Design (Decafe), Civil Engineering, and Industrial Engineering, at Universitas Putra Indonesia YPTK Padang. A total of 60 students participated, divided into an experimental group (n = 30), which received instruction using the Team-Based Project (TBP) model combined with Flipped Classroom (FC), and a control group (n = 30), which followed conventional instruction. Data collection was conducted before and after the intervention to evaluate the model's effectiveness.

B. Research Methodology

This study employed Research and Development/R and D with the ADDIE design—Analysis, Design, Development, Implementation, and Evaluation (Fig. 2). The ADDIE model was effectively adapted to the TBP-FC approach to enhance scientific writing skills through a structured yet flexible process. In addition, the ADDIE model is more suitable for the development of instructional materials because it provides a systematic and structured approach, with evaluation integrated into every step. This ensures continuous feedback and refinement, allowing for instructional content that is aligned with learning objectives and tailored to learners' needs. Its thoroughness and evaluation-driven process make it ideal for creating high-quality, effective educational resources. The Analysis phase identified the specific needs and objectives for scientific writing, while the Design phase developed tailored activities such as collaborative writing workshops and peer reviews aligned with TBP-FC principles. The Development phase focused on creating resources and tools to support both individual and group work, and the Implementation phase saw these strategies put into practice in real classroom settings with active student engagement. Finally, the Evaluation phase assessed the effectiveness of the model through ongoing feedback and assessment, leading to continual improvement. This customized approach within the ADDIE framework ensured that scientific writing was taught collaboratively and actively, addressing the unique challenges of students while preparing them for real-world academic writing tasks. It was chosen because it was more flexible and structured, with each step containing activities that could be adapted to the characteristics of the research [45, 46].

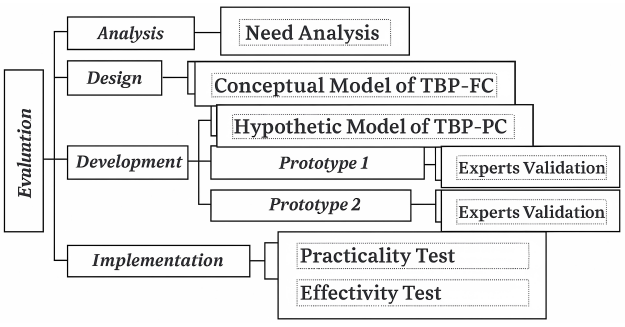

Fig. 2. Procedure of the research.

C. Data Collection Technique

The data collection process in this study utilized multiple instruments to assess the validity, practicality, and effectiveness of the Team-Based Project (TBP) model combined with the Flipped Classroom (FC) approach. Validity was evaluated through expert validation questionnaires, assessing the learning model book, instructor's guidebook, student's guidebook, and teaching materials, ensuring alignment with interdisciplinary learning needs. To measure effectiveness, pre-tests and post-tests were administered to both the experimental group (TBP-FC) and control group (conventional instruction), allowing for a comparative analysis of scientific writing skill development. Additionally, lecturer interviews provided qualitative insights into the practical application of the model and its impact on teaching strategies. Finally, practicality questionnaires were used to evaluate the usability of the learning materials, including the learning model book, instructor's guidebook, and student's guidebook. These data collection methods helped ensure a comprehensive assessment of the learning model's design and implementation.

D. Data Analysis Technique

The data analysis techniques employed in this study involved several methods to assess the validity, practicality, and effectiveness of the Team-Based Project-Flipped Classroom (TBP-FC) model. To analyze the validity of the TBP-FC model, expert validation was conducted using a Likert scale ranging from 1 to 5 [52, 53]. This approach allowed for the evaluation of the learning model's feasibility and its alignment with the intended goals of the TBP-FC framework. The practicality of the model was assessed by examining the responses from both instructors and students. If the model required minimal revisions or no revisions, it was considered practically applicable. The responses from both groups were collected through questionnaires and analyzed using quantitative data to evaluate the usability of the TBP-FC model. These data were then tabulated for further analysis [54, 55]. To analyze effectiveness, this study employed a quasi-experimental research design using a pretest-posttest control group approach. Participants were divided into an experimental group (n = 30), which received instruction using the TBP-FC model, and a control group (n = 30), which followed conventional instruction. The effectiveness of the TBP-FC model was assessed through pretest and posttest knowledge tests, measuring students' scientific writing skill development [56]. Through these rigorous data analysis techniques, the study was able to assess the validity, practicality, and effectiveness of the TBP-FC model comprehensively.

IV. Result and Discussion

A. The Process of Developing the TBP-FC for Scientific Writing in Higher Education

On the Fig. 3 the development of the Team-Based Project (TBP) learning model assisted by Flipped Classroom (FC) for writing scientific papers follows a structured sequence that logically aligns with educational goals and the collaborative nature of the model. The process begins with

the learning orientation phase based on the Fig. 4. Hypothetic Model of TBP-FC, where the learning objectives, expectations, and structure of the TBP-FC model are explained to the students. This phase ensures that students understand the pedagogical framework, the importance of the project-based approach, and how the flipped classroom elements, such as self-directed learning outside the classroom, complement the teamwork aspect of the project [20]. Next, students move to the designing project planning stage, where they define the scope, objectives, methodology, and timelines of their research project. This phase integrates structured learning with creativity as students select resources and tools for their research, encouraging independent problem-solving and research skills [14].

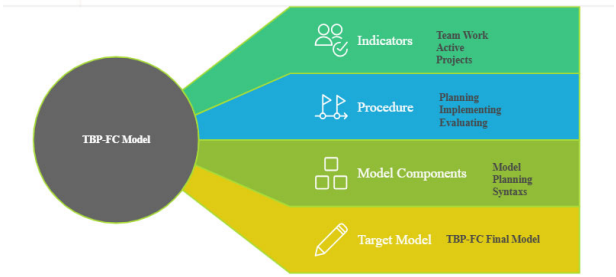

Fig. 3. Conceptual model of TBP-FC.

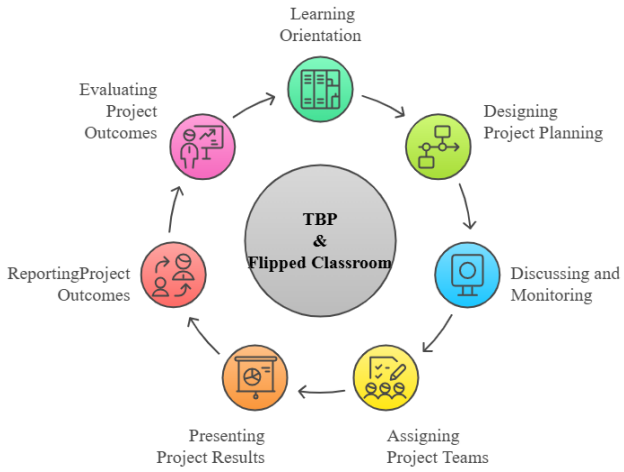

Fig. 4. Hypothetic model of TBP-FC.

The discussing and monitoring phase follows, where students engage in regular discussions with peers and instructors to refine their plans, exchange feedback, and address emerging challenges. This stage ensures that students are on track with their project goals and that any difficulties are addressed early, promoting critical thinking and collaboration. Collaboration is further emphasized in the assigning project teams' stage, where students are grouped according to a diversity of skills and knowledge [17]. This stage also aligns with the flipped classroom model, as students are expected to bring their pre-learned knowledge from outside the classroom into the collaborative project work. Effective team composition promotes the development of communication, problem-solving, and negotiation skills.

The presenting project results stage provides an opportunity for students to demonstrate their findings, defend their arguments, and engage in peer review. This phase is integral to building public speaking skills, enhancing critical thinking, and providing a platform for constructive feedback [14, 16]. It allows students to synthesize individual and group learning, reinforcing the educational objectives of the project. Afterward, students move to the reporting project outcomes phase, where they formalize their findings in a written report following academic standards for scientific papers. Writing the report helps students refine their research skills and academic writing techniques, as well as organizing information logically and coherently, while developing formal communication skills necessary for publishing in scholarly contexts.

In addition, the evaluating project outcomes phase involves evaluating both the outcomes of the project and the process itself. Students engage in self-assessment and peer review, reflecting on their contributions, team dynamics, and overall learning experience. Instructors also provide feedback on the quality of the research and its presentation. This phase promotes continuous improvement by helping students identify their strengths and areas for growth. Through these stages, the TBP-FC model encourages active engagement, collaboration, and critical reflection, offering students a holistic learning experience that develops both technical and soft skills necessary for academic success [19, 21].

The process of developing the Task-Based Pedagogical Framework for Scientific Writing in Higher Education (TBP-FC) demonstrates significant improvement when integrated with peer review, guided writing, and scaffolding [22–25]. These three pedagogical strategies collectively enhance students' critical thinking, linguistic accuracy, and structural coherence. Peer review encourages collaborative learning and reflective practice, allowing learners to engage critically with both peer and self-produced texts. Guided writing, on the other hand, offers targeted support through structured feedback and exemplars, ensuring learners internalize genre-specific conventions of scientific discourse. Scaffolding provides a gradual release of responsibility, enabling learners to build confidence and competence as they progress through increasingly complex writing tasks. Together, these strategies align seamlessly with the TBP-FC model, leading to more effective and sustainable scientific writing development in higher education.

B. The Validity of the TBP-FC for Scientific Writing in Higher Education

According to the validation results of the developed instructional materials provide compelling evidence of their high reliability and suitability for use in educational settings. The average reliability scores for the materials were notably high, demonstrating the consistency and robustness of the resources. Specifically, the Fig. 5 is model book achieved an impressive reliability score of 0.88, underscoring its effectiveness in guiding the overall instructional framework. This score reflects the model book's comprehensive design, which ensures that it can serve as a dependable tool for instructors and students alike.

Furthermore, Fig. 6 above, the validation results of the developed instructional materials demonstrated high reliability across all components. The average reliability scores for the materials were impressive, indicating their robustness and consistency. Specifically, the model book achieved a reliability score of 0.88, reflecting its suitability for guiding the overall instructional framework. These results

collectively highlight the strong reliability of the instructional materials, making them well-suited for practical application in educational settings.

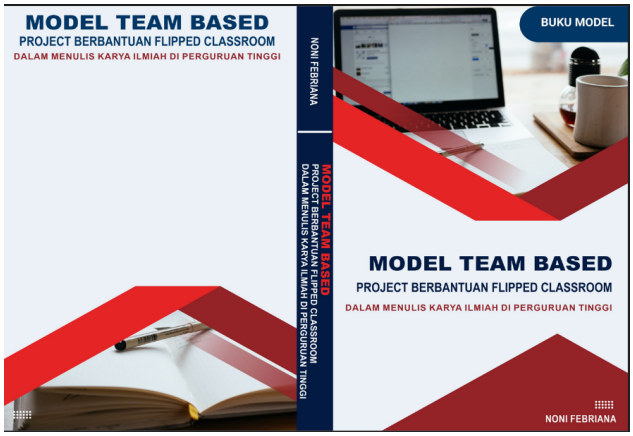

Fig. 5. Conceptual model of TBP-FC.

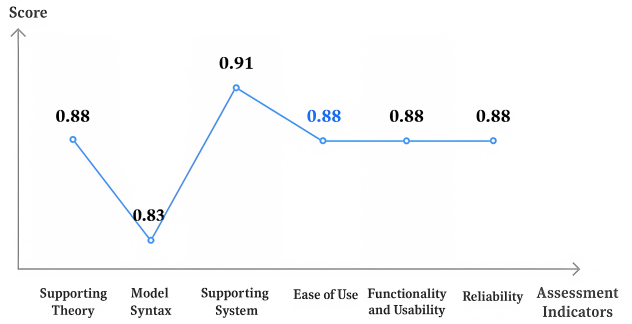

Fig. 6. Validity of TBP-FC.

High reliability indicates that the materials can be trusted to function effectively across various contexts, reducing the likelihood of variation or inconsistency in learning experiences [32, 36]. As such, the strong reliability of these materials suggests they are well-suited for practical application in educational settings, providing educators with a solid foundation for delivering effective instruction [39].

In conclusion, the validation results highlight the robustness of the developed instructional materials, making them a reliable resource for educational practice. Given their high reliability scores, these materials are poised to enhance teaching effectiveness and support student learning in a wide range of academic contexts.

C. The Practicality of the TBP-FC for Scientific Writing in Higher Education

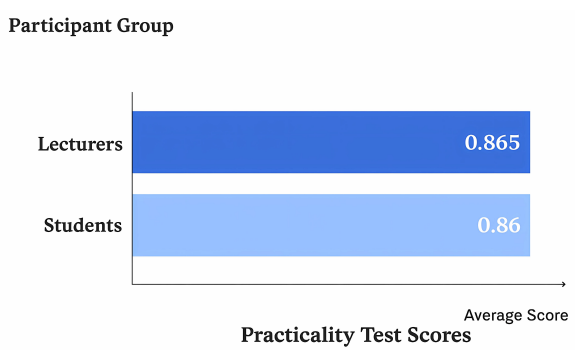

Fig. 7. Practicality of TBP-FC.

Referring to the Fig. 7 above, the practicality tests revealed high usability of the developed instructional materials, as evidenced by the scores obtained from both lecturers and students. The lecturers provided an average score of 0.865, indicating that the materials were well-structured, accessible, and supportive of their teaching practices. Similarly, students rated the materials with an average score of 0.86, highlighting their ease of use and alignment with learning needs. These results suggest that the instructional materials are not only functional but also effective in fostering an engaging and user-friendly learning experience for all stakeholders.

The results from the practicality tests clearly demonstrate the high usability of the developed instructional materials, with both lecturers and students providing positive feedback. The lecturers, who scored the materials with an average of 0.865, indicated that the resources were well-structured, accessible, and effectively supported their teaching practices. This score reflects the materials' alignment with the needs of instructors, offering tools that enhance their ability to deliver lessons. Students also expressed favorable opinions, giving the materials an average score of 0.86, which signifies that the materials were user-friendly and catered to their learning requirements.

From a broader perspective, these findings underscore the practical value of instructional materials [40]. As experts in the field of education often highlight, usability is a key factor in the success of instructional resources, as materials that are difficult to use can hinder both teaching and learning [44, 45]. The positive feedback from both groups suggests that the materials not only serve their intended function but also contribute to creating a more engaging and effective learning environment.

The findings of this study underscore the significance of effective instructional materials in supporting learning, as emphasized by educational experts who highlight that usability is a key factor in the success of teaching resources [40]. Although the study primarily focuses on quantitative data, the qualitative feedback from both students and instructors provides deeper context for understanding the results. Overall, the positive feedback suggests that the TBP-FC model's instructional materials not only served their intended purpose but also contributed to creating a more engaging and effective learning environment. Students reported that the collaborative project-based approach increased their involvement in the learning process and helped them grasp scientific writing concepts more deeply. Instructors, on the other hand, noted that the TBP-FC model facilitated more active discussions and provided opportunities for offering constructive feedback to students. This indicates that the usability and engagement factors within the TBP-FC model were key contributors to the positive outcomes observed in this study. The findings suggest that easy-to-use materials that promote active learning can significantly enhance teaching and learning processes, aligning with the results that demonstrate the effectiveness of the TBP-FC model in improving students' scientific writing skills across various disciplines.

In conclusion, the high usability scores from both lecturers and students indicate that the instructional materials are practical and effective. These results point to the materials' potential for fostering an accessible and engaging educational experience, reinforcing their suitability for widespread implementation in diverse learning contexts.

D. The Effectiveness of the TBP-FC for Scientific Writing in Higher Education

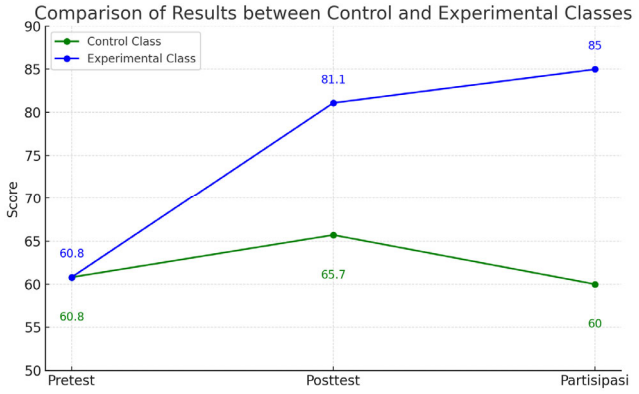

Fig. 8. Result of Pretest and Posttest in experiments and control class.

The overall effectiveness of the TBP-FC model is further validated by the comparative analysis between the experimental and control groups. The Fig. 8 in line graph illustrates that the experimental group, which received TBP-FC instruction, experienced a significant increase in posttest scores (M = 81.1) compared to their pretest performance (M = 60.18). In contrast, the control group, which followed conventional learning methods, showed only a marginal improvement, with posttest scores averaging 65.7 from an initial pretest mean of 60. Additionally, the participation rate in the experimental group continued to rise, reaching 85, while the control group exhibited a slight decline to 60. These results suggest that the TBP-FC model not only enhances scientific writing skills but also fosters greater engagement and active participation among students.

The effectiveness in this study encompasses both cognitive and behavioral dimensions of learning outcomes. The significant improvement in posttest scores among the experimental group (M = 81.1) compared to their pretest performance (M = 60.18) indicates a substantial cognitive gain, demonstrating that the TBP-FC model effectively enhances students' scientific writing proficiency. Furthermore, the increased participation rate in the experimental group (85) compared to the control group (60) highlights the model's impact on student engagement, an essential component of active learning. By considering both academic performance and learner engagement, the study provides a comprehensive assessment of effectiveness, ensuring that the TBP-FC model is not only beneficial for skill development but also for fostering a more interactive and participatory learning environment [44, 45].

The effectiveness of the Team-Based Project (TBP) learning model combined with the Flipped Classroom (FC) approach in improving scientific writing skills in higher education was evaluated using a pretest-posttest experimental design. The study involved students from multiple disciplines, including Counseling, English Education, Informatics Education, Visual Communication Design (Decafe), Civil Engineering, and Industrial Engineering. The findings indicate significant improvements in students' learning outcomes, as demonstrated by the comparative analysis between the experimental and control groups.

On the Fig. 9 the pretest and posttest results for each discipline reveal a substantial increase in students' performance after the implementation of the TBP-FC model. Each discipline exhibited a marked improvement from the pretest to the posttest, as indicated by the filled grid charts. The most significant learning gains were observed in students from Decafe, Civil Engineering, and Industrial Engineering, where posttest scores showed a higher percentage of completion compared to their pretest scores.

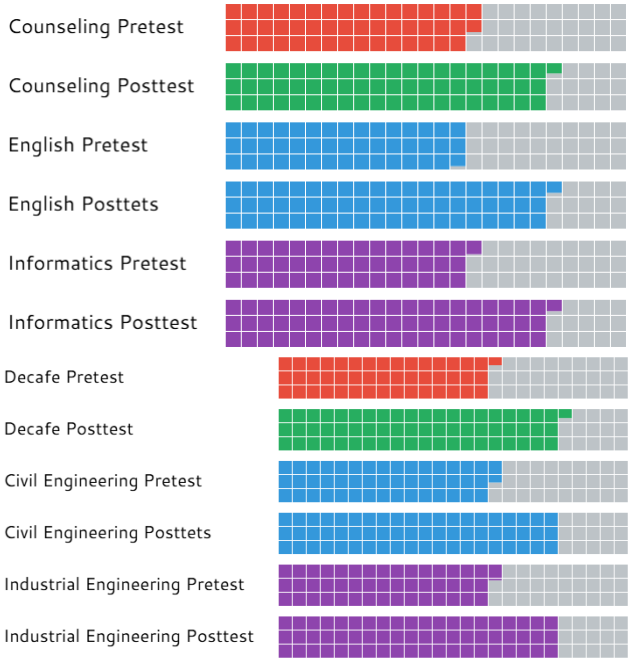

Fig. 9. Result of pretest and posttest in each specific discipline.

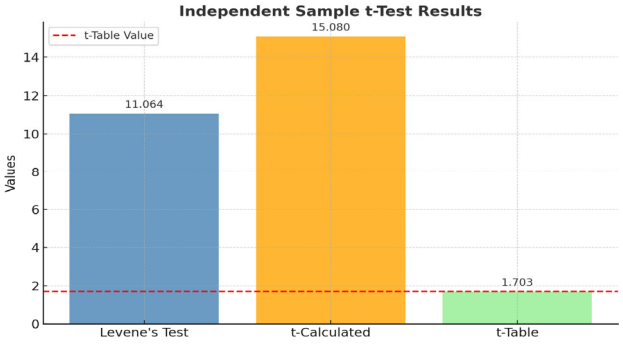

Fig. 10. Result of independent sample t-test.

The results in the Fig. 10 of the independent sample t-test show Levene's test value of 11.064 with a probability of 0.000, which is less than 0.05, indicating that the variances are equal. Furthermore, the calculated t-value (t-calculated) under the assumption of equal variance is 15.080, with a significance probability (two-tailed) of 0.000. Comparing the t-calculated value to the t-table value (t-table = 1.703), it is evident that t-calculated (15.080) > t-table (1.703). Therefore, the alternative hypothesis (Ha) is accepted, and the null hypothesis (Ho) is rejected.

The results of the independent sample t-test provide strong evidence supporting the statistical significance of the findings. Levene's test value of 11.064, with a probability of 0.000, indicates that the variances between the groups are equal, which is a necessary condition for conducting the t-test. The t-calculated value of 15.080, which is much higher than the t-table value of 1.703, further reinforces this conclusion. With a significant probability of 0.000, which is well below the conventional alpha level of 0.05, the results clearly

demonstrate that there is a statistically significant difference between the two groups being compared.

In this case, the comparison of t-calculated and t-table values leads to the acceptance of the alternative hypothesis (Ha) and the rejection of the null hypothesis (Ho), suggesting that there is a meaningful difference between the groups. This outcome not only supports the hypothesis being tested but also validates the robustness of research design and methodology.

To strengthen the study's findings, it is important to critically discuss how the TBP-FC model compares to other instructional strategies, such as peer review, guided writing, and scaffolding [57]. While the statistical results from the t-test indicate significant differences between the groups, a deeper comparison with these alternative methods would clarify why TBP-FC stands out in terms of fostering collaboration and real-world problem-solving. For instance, comparing TBP-FC with guided writing could show that while both approaches aim to improve writing skills, TBP-FC encourages collaborative learning and group interaction, whereas guided writing focuses on individual development through structured steps. Providing a stronger justification for TBP-FC's integration would help educators understand its advantages, such as its potential for enhancing teamwork and communication. Furthermore, improving methodological controls, such as randomization, blinding, and standardized grading rubrics, would address potential biases and enhance the overall reliability and validity of the findings. Incorporating these elements into the study would provide a more comprehensive understanding of the effectiveness of TBP-FC and its applicability across various educational contexts. In line with that, there is no research has been found that applies the ADDIE model specifically to interdisciplinary classrooms [22–25]. Existing studies have primarily utilized the ADDIE model in the context of writing instruction for English Foreign Language (EFL) students or in the development of writing modules tailored for low-achieving students, but not within the interdisciplinary framework addressed in this research.

In conclusion, the statistical analysis through the independent sample t-test strongly supports the research findings, confirming that the observed differences between the groups are significant and not due to random chance. This reinforces the reliability of the conclusions drawn from the study and suggests that the factors under investigation have a meaningful impact.

V. Limitation

The limitations of this research are primarily centered around the scope of the study, which focuses exclusively on the development of the TBP-FC model in the context of writing scientific papers, specifically scientific articles, at the higher education level. One key limitation is that the study only addresses this aspect of academic writing and its findings may not be directly applicable to other types of writing or disciplines. Therefore, the model's effectiveness and applicability may vary when applied to different fields or types of scholarly work beyond scientific articles.

Another limitation is the context in which the research was conducted. The study was carried out at a single institution with 60 students participated, divided into an experimental group (n = 30), which received instruction using the Team-Based Project (TBP) model combined with Flipped Classroom (FC), and a control group (n = 30), which followed conventional instruction. This limited number of institutions, which may impact the generalizability of the results. Variations in institutional settings, resources, and student demographics could influence how effectively the TBP-FC model is implemented in different environments. Furthermore, while the research focused on a specific pedagogical approach, other external factors, such as students' prior knowledge, motivation, and learning styles, was not deeply examined in relation to their influence on the success of the model. Lastly, the study relied on specific assessment tools to measure the effectiveness of the TBP-FC model, which may have limitations in capturing all dimensions of students' learning experiences and outcomes. To make the TBP-FC model more applicable in different educational settings, educators should adjust it based on the needs of their students and the resources available at their institutions. Implementing the model across various disciplines can help understand its effectiveness in different academic areas. Educators should also consider students' prior knowledge and motivation, offering personalized support. It is recommended to include collaborative activities, peer feedback, and real-world projects to promote engagement and critical thinking. Additionally, monitoring the long-term effects of the model on students' writing, teamwork, and communication skills will help improve its overall impact.

Future research should address these limitations by increasing the sample size to improve the generalizability of the findings. It should also include multiple institutions or settings to better understand how the TBP-FC model performs in different contexts. Finally, the limitation of this study lies in its exclusive use of the TBP-FC model, which may limit the generalizability of the findings to other pedagogical approaches. While the TBP-FC model offers valuable insights into the development of students' writing skills, it is important to recognize that different teaching methods, such as guided writing and scaffolding, may provide alternative or complementary strategies for enhancing student learning. By incorporating a variety of pedagogical approaches, future research could offer a more comprehensive understanding of how different models impact writing outcomes, thus expanding the applicability of the findings to diverse learning environments and student needs.

VI. Conclusion

In conclusion, this study presents the development and evaluation of a Team-Based Project (TBP) combined with a flipped classroom to address key challenges in scientific writing at UPI YPTK Padang. By focusing on issues such as insufficient argumentation, limited understanding of writing structures, and inaccuracies in assignment submissions, the research successfully developed, validated, and evaluated a practical and effective model for enhancing students' scientific writing skills. The application of the ADDIE framework provided a structured methodology, ensuring a thorough and systematic approach to the model's design and implementation. The validation results demonstrated high

reliability, while practicality tests highlighted the model's usability, with positive feedback from both lecturers and students. Moreover, the effectiveness tests revealed significant improvements in students' writing skills, confirming the model's impact. These findings suggest that the TBP-FC model is not only valid and practical but also highly effective in improving scientific writing in higher education.

Moving forward, future research could explore the application of this model in different academic contexts or disciplines to assess its broader applicability. Additionally, further studies could investigate the long-term effects of the TBP-FC model on students' academic performance and writing abilities. Exploring how different variables such as students' motivation, prior knowledge, and learning styles influence the model's effectiveness could offer valuable insights for refining and optimizing the approach

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

N.F. conceptualized the manuscript, designed the study, developed the TBP-FC model, and analyzed the data. E. contributed to the methodology, particularly in applying the ADDIE framework, and assisted with the validation process. A. oversaw the implementation of the model in the classroom and managed the student assessments. All authors contributed to the final manuscript, ensuring the accuracy and integrity of the research. All authors had approved the final version.

ACKNOWLEDGMENT

We would like to express our sincere gratitude to the participants of this research for their valuable contributions, without which this study would not have been possible. Their involvement and cooperation were essential to the success of the project, and we deeply appreciate their time and effort.

REFERENCES

[1] R. Nuriyanti *et al.*, "The effect of experiential learning models toward writing skills of narration primary school student," *International Journal of Science and Applied Science: Conference Series*, vol. 3, no. 1, pp. 109–117, 2019.

[2] N. Authar *et al.*, "Utilizing webinars to improve scientific article writing skills: An empowerment program for elementary school teachers," *Indonesia Berdaya: Journal of Community Engagement*, vol. 3, no. 4, pp. 861–870, 2020.

[3] Haryanto. (2008). Scientific writing. *STKIP Siliwangi Bandung*. [Online]. pp. 1–47. Available: https://dosen.ikipsiliwangi.ac.id/wp-content/uploads/sites/6/2018/03/modul-penulisan-karya-tulis-ilmiah-baru.pdf (in Indonesian)

[4] C. Aschliman, "Write to work: The use and importance of writing as perceived by business leaders," Ph.D. dissertation, Virginia Commonwealth University, Richmond, VA, 2016. https://scholarscompass.vcu.edu/etd/4601

[5] P. Angu, "Students' experiences of teamwork: Dealing with conflicting identities during a team-based academic writing project in a clinical medical practice programme," *International Journal of Diversity in Education*, vol. 19, no. 1, pp. 11–25, 2019.

[6] S. Deepa and M. Seth, "Do soft skills matter?—Implications for educators based on recruiters' perspective," *IUP Journal of Soft Skills*, vol. 7, no. 1, pp. 7–20, Mar. 2013.

[7] S. N. G. Ling and T. Nengfu, "Developing and assessing teamwork with enhanced team-based learning approach," in *Proc. the 17th International CDIO Conf.*, 2021, pp. 304–313.

[8] J. Bergmann and A. Sams, *Flip Your Classroom: Reach Every Student in Every Class Every Day*, Washington: ISTE, 2012, ch. 1.

[9] A. Wilkins, "Diversity in education: Emerging accounts of school choice in ethnically diverse localities," *The International Journal of Diversity in Organizations, Communities, and Nations: Annual Review*, vol. 7, no. 3, pp. 37–46, 2007.

[10] S. R. I. Utami, "The effect of the peer instruction flipped classroom model on students' mathematical problem-solving skills," Bachelors dissertation, Universitas Islam Negeri Syarif Hidayatullah Jakarta, Banten, Indonesia, 2017.

[11] W. Darmalaksana. (2020). Writing articles quickly even if you don't like writing. *Jurnal Kelas Menulis*. [Online]. Available: https://digilib.uinsgd.ac.id/32665/1/MENULIS%20SUPER%20CEPAT.pdf

[12] U. V. Wardina, N. Jalinus, and L. Asnur, "Vocational education curriculum in the era of industrial revolution 4.0," *Jurnal Pendidikan*, vol. 20, no. 1, pp. 82–90, 2019.

[13] W. Wati. (2014). A review of research structure, scientific writing, and academic writing techniques. [Online]. 3(1). Available: https://ejournal.radenintan.ac.id/index.php/al-biruni/article/view/66 (in Indonesian)

[14] Z. Unal and A. Unal, "Comparison of student performance, student perception, and teacher satisfaction with traditional versus flipped classroom models," *International Journal of Instruction*, vol. 10, no. 4, pp. 145–164, 2017.

[15] M. A. Stapa and N. Mohammad, "The use of addie model for designing blended learning application at vocational colleges in Malaysia," *Asia-Pacific Journal of Information Technology & Multimedia*, vol. 8, no. 1, pp. 49–62, June 2019.

[16] K. Y. Susana and A. A .G. R. W. Brahma, "The effectiveness of flipped learning during the pandemic to improve the writing competence of STMIK STIKOM Indonesia students," *RETORIKA: Jurnal Ilmu Bahasa*, vol. 7, no. 1, pp. 75–84, April 2021.

[17] L. Simons and B. Cleary, "The influence of service learning on students' personal and social development," *College Teaching*, vol. 54, no. 4, pp. 307–319, Aug. 2010. http://dx.doi.org/10.3200/CTCH.54.4.307-319

[18] M. Saleh, "Improving the ability to write complex explanation texts through the STAD model among senior high school students," *Briliant: Jurnal Riset Dan Konseptual*, vol. 1, no. 1, pp. 95–101, Nov. 2016.

[19] E. F. Ramadhani and R. Lestiono, "The use of diary writing to improve eight grade students' writing skill at smpn 3 malang," *Erudio (Journal of Educational Innovation)*, vol. 3, no. 1, pp. 24–31, 2015.

[20] D. Purnamasari, D. N. Hidayat, and L. Kurniawati, "An analysis of students' writing skill on English descriptive text," *English Education: Jurnal Tadris Bahasa Inggris*, vol. 14, no. 1, pp. 101–114, 2021.

[21] H. Sundari and R. H. Febriyanti, "Collective scaffolding in virtual collaborative writing: A study during emergency remote teaching in Indonesia," *Studies in English Language and Education*, vol. 10, no. 1, pp. 16–40, 2023.

[22] Supeno *et al.*, "The effect of scaffolding prompting questions on scientific writing skills in the inquiry classroom," *JPI (Jurnal Pendidikan Indonesia)*, vol. 12, no. 1, pp. 30–38, Mar. 2023.

[23] D. G. Hendricks, A. C. Taylor, and S. Pulford, "Implementation of peer review to enhance written and visual communication learning in bioengineering capstone reports," in *Proc. 2017 ASEE Annual Conf. and Exposition*, 2017, 19434.

[24] Y. Wu, "Cultivating technical writing skills through a scaffold peer review-approach of lab reports in a junior-level laboratory course," in *Proc. 2023 ASEE Annual Conf. and Exposition*, 2023, 36849.

[25] M. Nursi, "Implementation of the Independent campus policy of policy on the main performance indicators (IKU) of higher education" *Jurnal CERDAS Proklamator*, vol. 11, no. 1, pp. 120–126, 2023.

[26] L. K. Michaelsen *et al.*, *Team-Based Learning: A Transformative Use of Small Groups in College Teaching*, London: Routledge, 2004, ch. 1.

[27] L. K. Michaelsen, N. Davidson, and C. H. Major, "Team-based learning practices and principles in comparison with cooperative learning and problem-based learning," *Journal on Excellence in College Teaching*, vol. 25, pp. 57–84 ,2024.

[28] P., Mishra and R. Mehta, "What we educators get wrong about 21st-century learning: Results of a survey," *Journal of Digital Learning in Teacher Education*, vol. 33, no. 1, pp. 6–19, 2016.

[29] R. Jasiyah *et al.*, "Training for authors of scopus-indexed scientific articles" *Community Development Journal: Jurnal Pengabdian Masyarakat*, vol. 4, no. 4, pp. 7687–7692, Sep. 2023.

[30] M. Javed, W. X. Juan, and S. Nazli, "A study of students' assessment in writing skills of the English language," *International Journal of Instruction*, vol. 6, no. 2, pp. 129–144, 2013.

[31] R. Indriyanti and Z. K. Prasetyo, "Improving the experiment report writing skills of fifth graders through the discovery learning method," *Jurnal Prima Edukasia*, vol. 6, no. 1, pp. 102–110, 2018.
[32] S. A. Indrowaty and N. Faizah, "The implementation of project-team based learning method on sakubun online learning," *EDUCATIO: Journal of Education*, vol. 6, no. 2, pp. 191–202, 2021.
[33] N. K. Hixson, J. Ravitz, and A. Whisman. Extended professional development in project-based learning: Impacts on 21st century skills teaching and student achievement. *West Virginia Department of Education*. [Online]. Available: https://files.eric.ed.gov/fulltext/ED565466.pdf
[34] T. Hutchinson and A Waters. (1991). *English for Specific Purposes: A Learning-Centred Approach*. Cambridge University Press. [Online]. Available: https://assets.cambridge.org/97805213/18372/excerpt/9780521318372_excerpt.pd
[35] K. A. Imania and S. H. Bariah, "The development of a flipped classroom model in mobile learning for the learning strategies course," *Jurnal Petik*, vol. 6, no. 2, pp. 122–127, 2024.
[36] N. Indrilla and D. S. Ciptaningrum, "An approach in teaching writing skills: Does it offer a new insight in enhancing students writing ability," *LLT Journal: A Journal on Language and Language Teaching*, vol. 21, no. 2, pp. 124–133, 2018.
[37] Y. Hanafi *et al.*, "Reinforcing public university student's worship education by developing and implementing mobile-learning management system in the ADDIE instructional design model," *International Journal of Interactive Mobile Technologies*, vol. 14, no. 2, pp. 215–241, 2020.
[38] G. Durak and M. Ataizi, "The ABC's of online course design according to addie model," *Universal Journal of Educational Research*, vol. 4, no. 9, pp. 2084–2091, 2016.
[39] P. A. Facione. (1990). The California critical thinking skills test-college level. Technical report #2. Factors predictive of CT skills, [Online]. Available: https://files.eric.ed.gov/fulltext/ED327550.pdf
[40] R. Farida *et al.*, "The development of a flipped classroom model incorporating bloom's taxonomy in the Indonesian political system course," *Kwangsan: Jurnal Teknologi Pendidikan*, vol. 7, no. 2, pp. 104–122, 2019.
[41] B.Ayçiçek and T. Y. Yelken, "The effect of flipped classroom model on students' classroom engagement in teaching English," *International Journal of Instruction*, vol. 1, no. 2, pp. 385–398, 2018.
[42] A. Bandura, "Self-efficacy: Toward a unifying theory of behavioral change," *Advances in Behaviour Research and Therapy*, vol. 1, no. 4, pp. 139–161, 1978.
[43] J. Bergmann and A. Sams. (2012). Flip your classroom: Reach every student in every class every day. *International Society for Technology in Education*, [Online]. pp. 120–190. Available: https://www.scirp.org/reference/referencespapers?referenceid=1791200
[44] J. L. Bishop and M. A. Verleger, "The flipped classroom: A survey of the research," in *Proc. 2013 ASEE Annual Conf. and Exposition*, 2013.
[45] R. M. Branch, *Instructional Design: The ADDIE Approach*, New York: Springer, ch. 1, 2009.
[46] R. Haniefa and M. Samsudin, "Applying the TPACK framework in the instruction of Arabic language skills," *Ta'limi|Journal of Arabic Education and Arabic Studies*, vol. 2, no. 1, pp. 61–72, 2023.
[47] U. B. Harun, "Project-based learning integrated to STEM (Stem-Pjbl) to enhance Arabic learning hots-based," *Al-Bidayah: Jurnal Pendidikan Dasar Islam*, vol. 12, no. 1, pp. 139–150, 2020.
[48] Y. C. Isgiarno *et al.*, "Increasing EFL students' writing skill using jigsaw and online searching strategy," *Indonesian Journal of English Education*, vol. 7, pp. 97–110, 2020.
[49] D. Istiyani and A. Rakhmawati, "Critical thinking skills in solving problems constructing flat side spaces from a cognitive style," in *Proc. Universitas Muhammadiyah Yogyakarta Graduate Conf.*, 2022.
[50] F. Yulietri and M. Mulyoto, "The influence of flipped classroom and discovery learning models on mathematics learning achievement in terms of learning independence," *Teknodika*, vol. 13, no. 2, pp. 5–17, 2015.
[51] E. Yuniarsi and J. Sapri, "The implementation of the problem-based learning model to improve critical thinking and learning achievement," *Diadik: Jurnal Ilmiah Teknologi Pendidikan*, vol. 12, no. 1, pp. 124–137, 2022.
[52] R. Zain, Z. A. Ahmad, and Nurhadi, *E-Learning-Based Course Management in Higher Education*, Yogyakarta: Institutional Repository UIN of Sunan Kalijaga Yogyakarta, ch. 3, 2017.
[53] L. R. Aiken, "Content validity and reliability of single items or questionnaires," *Educational and Psychological Measurement*, vol. 40, no. 4, pp. 955–959, Dec. 1980.
[54] H. Al-Samarraie, A. Shamsuddin, and A. I. Alzahrani, "A flipped classroom model in higher education: A review of the evidence across disciplines," *Educational Technology Research and Development*, vol. 68, pp. 1017–1051, Oct. 2019.
[55] T. A. Barrios *et al.*, "Characterization of flipped classroom model in higher education: A perception from educational resilience during Covid-19 pandemic," *Procedia Computer Science*, vol. 203, pp. 575–582, 2022.
[56] L. P. Galway *et al.*, "A novel integration of online and flipped classroom instructional models in public health higher education," *BMC Medical Education*, vol. 14, 181, Aug. 2014.
[57] T. Long, J. Cummins, and M. Waugh, "Use of the flipped classroom instructional model in higher education: Instructors' perspectives," *Journal of Computing in Higher Education*, vol. 29, no. 2, pp. 179–200, 2017.