

An Inquiry-Based Collaborative Writing and Assessment (IB-CWA) Prototype Model Supported by Digital Technology: Design, Validation, and Initial Practicality

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Abstract—This study aims to develop the Inquiry-Based Collaborative Writing and Assessment (IB-CWA) prototype model supported by digital technology through a Design-Based Research (DBR) approach during the prototyping phase, which includes model design, expert validation, and initial practicality testing. The IB-CWA prototype model consists of six main phases, namely: (1) Orientation and Questioning, (2) Inquiry Exploration, (3) Collaborative Drafting, (4) Self and Peer-Assessment, (5) Revision and Publication, and (6) Reflection and Evaluation. The research involved lecturers, students, and experts who were purposively selected in accordance with the research stages. Data were collected through interviews, questionnaires, and expert validation sheets, and were subsequently analysed qualitatively and quantitatively using thematic analysis, descriptive statistics, and Aiken's V index. The research findings indicate that the prototype model possesses high levels of content and construct validity based on expert assessment, as well as high to very high levels of practicality based on the perceptions of lecturer and students. These findings indicate that the IB-CWA prototype model is suitable for use in further pilot testing and has the potential to be implemented in collaborative writing instruction in higher education. However, the model's effectiveness in improving writing and critical thinking skills still needs to be tested in subsequent assessment phases.

Index Terms—assessment for learning, collaborative assessment, collaborative writing, digital technology, inquiry-based learning

I. INTRODUCTION

Academic writing and critical thinking skills are two key competencies in 21st-century learning that play a vital role in both academic and professional contexts. These two skills form the foundation for students to analyse information in depth, construct logical arguments, and respond to various issues in a reflective and evidence-based manner (Maharani & Santosa, 2025; Akib et al., 2024). However, several studies indicate that students' writing and critical thinking skills have not yet developed optimally and do not fully meet academic demands (Nabilah et al., 2025; Syahwalya et al., 2024; Rusmin et al., 2024; Patmasari et al., 2023).

This situation is influenced by several factors. Firstly, the learning approach still tends to be oriented towards one-way knowledge transfer, and therefore does not yet optimally facilitate cognitive engagement and the development of critical thinking (Wardani et al., 2024; Kamaruddin et al., 2021). Secondly, the use of digital technology in learning has not been pedagogically integrated, as it tends to function merely as a technical tool rather than as an integral part of a systematic learning design (Ebadijalal & Moradkhani, 2025; Patmasari et al., 2024). Furthermore, students still face difficulties in organising ideas coherently, developing evidence-based arguments, and revising their writing reflectively

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(Rayhan et al., 2025; Koswara et al., 2021). Limitations in providing constructive feedback and a lack of collaborative practice also pose obstacles to the development of these skills (Chingchit, 2024; Xiao & Lee, 2024; Wu & Schunn, 2021; Kuyyogsuy, 2019).

To address these issues, a learning approach is required that focuses not only on the written product, but also on the process of knowledge construction through inquiry, collaboration, and formative assessment. One relevant approach is the development of the Inquiry-Based Collaborative Writing and Assessment (IB-CWA) model, which integrates inquiry-based learning, collaborative writing, assessment for learning, and collaborative assessment within a single integrated learning framework (Siew & Chai, 2024; Nggawu et al., 2022). Within this framework, assessment for learning is positioned as an assessment function that supports the learning process in a formative manner, whilst collaborative assessment refers to an assessment mechanism involving interaction between students through the practice of self-assessment and peer-assessment. The integration of these two aspects enables assessment to function not only as an evaluation, but also as an integral part of the learning process.

Several previous studies have examined inquiry-based learning, collaborative writing, and collaborative assessment separately. Their findings indicate that inquiry-based learning has the potential to support the development of critical thinking and higher-order thinking skills (Kamaruddin et al., 2023; Sapriati et al., 2024; Arifin et al., 2025; Antonio & Prudente, 2024), whilst collaborative writing and collaborative assessment are reported to facilitate the process of sharing ideas, reflection, and improving the quality of writing (Taufiquilloh et al., 2024; Wonglakorn & Deerajviset, 2023; Coffin, 2020). On the other hand, research on computer-mediated collaborative learning has also explored the use of various digital platforms such as Trello, WeChat, and Google Docs to support learning interactions (Oluwajana et al., 2023; Ngai et al., 2019; Yan, 2019; Alwahoub et al., 2022). However, most of these studies still focus on partial implementation or on the effectiveness of specific technologies, without designing a learning model that systematically integrates the dimensions of inquiry, collaboration, and assessment into a single, complete learning cycle.

Considering this gap, this study offers a conceptual contribution through the development of an IB-CWA prototype model supported by digital technology that systematically integrates inquiry-based learning, collaborative writing, assessment for learning, and collaborative assessment into a coherent pedagogical design. The novelty of this study lies in: (1) the integration of these four components within a single structured learning cycle, (2) the positioning of assessment as an integrated process throughout the learning stages, and (3) the utilisation of digital technology as a pedagogical enabler that supports continuous collaboration, interaction, and reflection.

This research was conducted within the framework of Design-Based Research (DBR), which comprises three main stages: preliminary research, the prototyping phase, and the assessment phase. This article focuses specifically on the prototyping phase, which aims to produce a prototype learning model that meets the criteria of validity and practicality as a basis for further testing. Therefore, the objectives of this study are: (1) to design the IB-CWA prototype model supported by digital technology, (2) to examine the prototype model's validity through expert assessment, and (3) to evaluate the prototype model's initial practicality through limited implementation.

Theoretically, this study contributes to the development of literature regarding the integration of inquiry-based learning, collaborative writing, assessment for learning, and collaborative assessment within the context of digital technology-assisted learning. In practical terms, this study produces a validated prototype learning model with an initial level of practicality, which can serve as a basis for further testing in a broader implementation phase. Thus, the development of the IB-CWA prototype model supported by digital technology is considered relevant in supporting pedagogical transformation in the digital age, particularly in facilitating collaborative, reflective, and inquiry-based academic writing.

II. METHOD

A. Research Design

This study employed a Design-Based Research (DBR) approach, which emphasises the iterative and evidence-based design, development, validation, and refinement of learning models (Plomp, 2013). The approach aims to produce a learning model that is not only theoretically valid but also feasible for implementation in authentic learning contexts. Following Plomp's (2013) framework, the study consisted of three main phases: preliminary research, the prototyping phase, and the assessment phase. The preliminary research phase involved problem identification and needs analysis to establish the foundation for the model design. The prototyping phase focused on designing the initial prototype, conducting expert validation, and carrying out initial practicality testing with prospective users. The assessment phase, which will be conducted subsequently, aims to examine the effectiveness of the refined model in classroom practice.

The present article reports only the findings from the prototyping phase. Specifically, it presents the design of the Inquiry-Based Collaborative Writing and Assessment (IB-CWA) model supported by digital technology, the results of expert validation, and the findings of the initial practicality testing. The outcomes of this phase were directed towards producing a prototype that met the criteria of validity and practicality and could serve as the basis for effectiveness testing in the subsequent assessment phase.

B. Research Participants

The participants in this study consisted of lecturers, students, and experts who were involved in accordance with the objectives of each research stage.

During the problem identification stage, interviews were conducted with six lecturers and eight students from three universities in Palu, Central Sulawesi, namely Universitas Tadulako, Muhammadiyah University of Palu, and UIN Datokarama Palu. During the needs analysis stage, data were collected via a questionnaire involving 50 lecturers and 100 students from these three universities.

The prototype model validation stage involved five experts comprising two English writing specialists, one English assessment specialist, and two learning technology specialists. Subsequently, in the initial practicality testing stage, participants consisted of one lecturer and 15 students currently undertaking writing courses to evaluate the ease of implementing the prototype model within a learning context.

C. Data Collection Techniques and Instruments

Data were collected through semi-structured interviews and the distribution of questionnaires. The research instruments used comprised several components in line with the research stages. Firstly, interview guidelines were used in the preliminary research stage to identify issues and the experiences of lecturers and students in writing instruction. Secondly, a needs analysis questionnaire using a five-point Likert scale was used to measure the level of readiness and need for the development of the model. Thirdly, an expert validation sheet was used to assess the theoretical suitability, integration of components, and feasibility of implementing the prototype of the IB-CWA model supported by digital technology. Fourthly, a practicality questionnaire was used during the practicality testing stage to evaluate the clarity of the learning syntax, the ease of use of digital technology, and the usefulness of the model in supporting collaborative writing learning.

D. Data Analysis Techniques

Data were analysed in accordance with the stages within the Design-Based Research framework. During the preliminary research stage, interview data were analysed qualitatively using thematic analysis to identify patterns of problems and learning needs as the basis for model design development. Data from the needs analysis questionnaire were analysed descriptively and quantitatively to obtain an overview of users' readiness levels and needs regarding model development.

In the prototyping phase, data from expert validation were analysed using Aiken's V index to measure the level of agreement among evaluators regarding the relevance and consistency of the model's indicators. The validity categories refer to Aiken's V (Aiken, 1985), namely: $V < 0.40$ = low; $0.40 \leq V < 0.80$ = moderate; and $V \geq 0.80$ = high.

Furthermore, the practicality data were analysed descriptively and quantitatively using SPSS software to obtain mean values as the basis for determining the assessment categories. The criteria for interpreting mean values refer to Sugiyono (2019), namely: 1.00-1.79 = very low; 1.80-2.59 = low; 2.60-3.39 = moderate; 3.40-4.19 = high; and 4.20-5.00 = very high.

The findings from the validation and practicality testing stages were used as the basis for refining the prototype model before proceeding to the next testing stage within the DBR framework.

III. RESULTS

A. Design of the Inquiry-Based Collaborative Writing and Assessment (IB-CWA) Prototype Model Supported by Digital Technology

Based on the results of problem identification and the analysis of lecturers' and students' needs, the IB-CWA prototype model supported by digital technology was developed. This prototype model integrates inquiry-based learning, collaborative writing, assessment for learning, and collaborative assessment into a single integrated learning framework.

The IB-CWA prototype model consists of six main phases, namely: (1) Orientation and Questioning, (2) Inquiry Exploration, (3) Collaborative Drafting, (4) Self and Peer-Assessment, (5) Revision and Publication, and (6) Reflection and Evaluation. Each phase is designed with integrated components, including learning objectives, student learning activities, the lecturer's facilitative role, and digital technology support. The syntactic design of the IB-CWA prototype model supported by digital technology is presented in Table 1, while Table 2 presents its validated and refined syntax following expert review and revision.

TABLE 1
SYNTAX OF THE IB-CWA PROTOTYPE MODEL SUPPORTED BY DIGITAL TECHNOLOGY

Phase	Objective	Student Activities	Lecturer's Role	Digital Technology Support
Orientation and Questioning	Activating prior knowledge and prompting critical questions.	Watching a video on a controversial issue, noting down key ideas, asking critical questions, discussing, reading examples of argumentative essays.	Playing videos, guiding observations, selecting relevant questions, presenting text examples, clarifying concepts.	Online video
Inquiry Exploration	Exploring and gathering relevant information.	Selecting a topic, searching for sources, reading, noting down facts and arguments, discussing in groups, formulating a position or stance on the issue.	Providing a list of topics, guiding the search for sources, facilitating class discussions.	Academic search engines
Collaborative Drafting	Drafting the first draft collaboratively.	Brainstorming ideas, creating an outline, writing a draft together.	Guiding the structure of the text, providing feedback on sentences and paragraphs.	Google Docs for collaboration
Self and Peer-Assessment	Evaluating and revising the writing based on reflection and peer feedback.	Conducting self-assessment, revising, assessing other groups' drafts, and discussing feedback.	Providing assessment guidelines, facilitating the exchange of drafts.	Google Docs for comments
Revision and Publication	Finalising the final draft and publishing it.	Revising according to the lecturer's feedback, proofreading, and uploading the final version.	Providing constructive feedback.	Google Docs, Microsoft Teams
Reflection and Evaluation	Reflecting on the learning process and outcomes.	Writing personal reflections and group discussions.	Facilitating reflection, offering appreciation and guidance.	

TABLE 2
VALIDATED AND REFINED SYNTAX OF THE IB-CWA PROTOTYPE MODEL SUPPORTED BY DIGITAL TECHNOLOGY

Phase	Objective	Student Activities	Lecturer's Role	Digital Technology Support
Orientation and Questioning	Activating prior knowledge and stimulating the emergence of critical questions based on authentic issues.	Watching an interactive video presenting a controversial issue, identifying key ideas, answering questions embedded in the video, posing critical questions, discussing, and analysing examples of argumentative essays.	Facilitating the viewing of interactive videos, guiding students' focus, directing the questions asked, selecting relevant issues, and presenting and clarifying the structure and characteristics of argumentative essay texts.	Using interactive videos via Edpuzzle to insert questions, provide immediate feedback, and monitor student engagement.
Inquiry Exploration	Exploring and gathering relevant information as a basis for developing arguments.	Selecting a topic, searching for relevant sources of information, reading critically, noting down facts and supporting arguments, discussing in groups, and formulating a position or stance on the issue under consideration.	Providing alternative topics, guiding the process of source research, directing the evaluation of information credibility, and facilitating group and class discussions.	Using academic search engines such as Google Scholar to access relevant and credible scholarly sources.
Collaborative Drafting	Collaboratively drafting an initial draft as a basis for developing the written work.	Brainstorming ideas, drafting an outline, and writing an initial draft collaboratively in a group by dividing up writing roles and responsibilities.	Guiding the development of the text's structure, providing feedback on sentences and paragraphs, and ensuring the text has good coherence and cohesion.	Collaboration platforms such as Google Docs to support real-time collaborative writing.
Self and Peer-Assessment	Evaluating and revising the text based on reflection and peer feedback.	Conducting self-assessment of writing drafts, revising based on personal reflection, assessing other groups' drafts using established criteria, and discussing the feedback provided.	Provide guidance and assessment rubrics, guide the self- and peer-assessment process, and facilitate exchange and discussion between groups.	A collaborative platform such as Google Docs to provide comments, suggestions, and revisions directly.
Revision and Publication	Refining the writing and publishing the result to a wider audience.	Revising the draft based on feedback received, proofreading to ensure linguistic accuracy and correct formatting, and uploading or publishing the final version.	Provide further constructive feedback, ensure the final quality of the writing, and guide the publication or dissemination process.	Collaborative platforms such as Google Docs and Microsoft Teams for final revisions and sharing published results.
Reflection and Evaluation	Reflecting on the process and evaluating learning outcomes for continuous improvement.	Writing personal reflections on the learning process and outcomes, identifying strengths and weaknesses, and discussing in groups to share experiences and learning.	Facilitate the reflection process through prompting questions, acknowledging students' achievements, and providing guidance for future improvement.	Learning platforms such as Google Classroom or Padlet for writing and sharing reflections digitally.

This prototype model positions students as active learners (student-centred), who are involved in the process of problem identification, information exploration, knowledge construction, collaborative writing, and reflective assessment. Meanwhile, the lecturer acts as a facilitator who directs the inquiry process, mediates collaborative interactions, and provides formative feedback throughout the learning process.

B. Validity

Validity is a crucial stage in the development of a learning model to ensure the alignment of design, content, and instruments with academic and pedagogical standards. The validity of the IB-CWA prototype model supported by digital technology, along with the learning tools and assessment instruments, was assessed by five experts. The assessment focused on the alignment between the model's components, learning objectives, the principles of inquiry-based learning, and the characteristics of collaborative learning. The self-assessment rubric, peer-assessment rubric, and argumentative writing scoring rubric were adapted from the validated instruments developed by Thamrin (2023). Therefore, they did not require further validation. The results of the analysis using Aiken's V index indicate that all components fall within the high validity category, as presented in Table 3.

TABLE 3
THE RESULTS OF VALIDITY ANALYSIS (AIKEN'S V)

Validated Aspects	V Value	Category
Prototype Model	0.926	High
Lesson Plan	0.920	High
Student Worksheets	0.951	High
Assessment Instrument	0.973	High
Overall Average	0.943	High

These findings indicate that the prototype model exhibits a high level of content and construct fit at the initial design stage, making it suitable for progression to the limited pilot phase. Nevertheless, the experts recommended several improvements, particularly regarding the clarity of the learning syntax, the operationalisation of inquiry steps, the alignment of objectives, activities and assessment, as well as guidelines for the use of digital technology to support collaborative writing and assessment. Based on this feedback, revisions were made by clarifying the syntax of the IB-CWA prototype model, strengthening the implementation of inquiry-based collaborative learning, aligning learning constructs and assessment, and simplifying the digital technology guidelines to make them more operational. Following the revisions, the prototype model was deemed to meet content and construct validity and is ready for use in a pilot study.

C. Practicality

Practicality aims to assess the ease of implementing the IB-CWA prototype model supported by digital technology from the users' perspective, including both lecturer and students. The aspects measured include ease of use, clarity of guidance, time efficiency, and the accessibility of features in supporting the learning process. The measurement of practicality covers not only the prototype model but also the learning tools and assessment instruments to obtain a comprehensive picture of feasibility.

Assessment was conducted via a Likert scale questionnaire (1-5) administered to 15 students and one lecturer. The results of the student practicality questionnaire analysis are presented in Table 4, whilst the results of the lecturer practicality questionnaire analysis are presented in Table 5.

TABLE 4
RESULTS OF THE STUDENT PRACTICALITY QUESTIONNAIRE ANALYSIS

Aspects Assessed	Average	Category
Prototype Model	3.70	High
Lesson Plan	4.13	High
Student Worksheets	4.09	High
Assessment Instrument	4.02	High
Overall Average	3.94	High

TABLE 5
RESULTS OF THE LECTURER PRACTICALITY QUESTIONNAIRE ANALYSIS

Aspects Assessed	Average	Category
Prototype Model	4.40	Very High
Lesson Plan	4.55	Very High
Student Worksheets	4.72	Very High
Assessment Instrument	4.67	Very High
Overall Average	4.59	Very High

Overall, the findings indicate that the IB-CWA prototype model supported by digital technology has a level of practicality falling within the high to very high category. From the lecturer's perspective, the prototype model is viewed as systematic and relatively easy to implement in a learning context, whilst from the students' perspective, this prototype model facilitates collaborative learning and enables the integration of digital-based writing and assessment processes. These findings indicate that the prototype model has an adequate level of feasibility for use in further pilot testing.

IV. DISCUSSION

A. Design of the Inquiry-Based Collaborative Writing and Assessment (IB-CWA) Prototype Model Supported by Digital Technology

The IB-CWA prototype model supported by digital technology is designed to facilitate the development of students' academic writing and critical thinking skills through the integration of inquiry-based learning, collaborative writing, assessment for learning, and collaborative assessment. This model positions students as active researchers who explore authentic issues, write collaboratively, and conduct self- and peer-assessment using validated rubrics. The use of digital technology serves as a tool to support collaboration, communication, and the publication of written work, thereby creating a learning process that is constructive, reflective, and aligned with the demands of 21st-century skills.

The results of the development indicate that this prototype model comprises six mutually integrated learning phases, namely: (1) Orientation and Questioning, (2) Inquiry Exploration, (3) Collaborative Drafting, (4) Self and Peer-Assessment, (5) Revision and Publication, and (6) Reflection and Evaluation. These six phases form a systematic sequence designed to facilitate academic writing and critical thinking through a collaborative, inquiry-based approach supported by digital technology.

The first phase, Orientation and Questioning, aims to establish a meaningful learning context and foster students' curiosity regarding authentic issues. Students engage in activities such as watching videos, reading sample texts, and discussing to identify problems relevant to both academic and social contexts. Through this process, students develop the ability to ask critical questions and formulate the focus of their inquiry. The lecturer acts as a facilitator by providing learning stimuli, guiding discussions, and helping students formulate questions. This phase facilitates cognitive engagement and problem ownership as the foundation for critical thinking. The use of multimedia stimuli in this phase is supported by previous research indicating that the use of multimedia in the early stages of inquiry can support student motivation and engagement (Hinostroza et al., 2024).

The second phase, Inquiry Exploration, aims to guide students in conducting an in-depth investigation into the problem that has been formulated. Students collect, analyse, and evaluate information from various sources to obtain relevant data and arguments. This activity contributes to strengthening digital literacy and facilitates the process of critical thinking. The lecturer guides source searches, directs credibility assessments, and facilitates discussions. The emphasis on digital inquiry and evidence evaluation in this phase supports previous research, which also reported that the use of digital sources enables more effective and efficient exploration and contributes to the development of evidence-based reasoning and higher-order thinking skills (Deng et al., 2019; Dehghanzadeh et al., 2024).

The third phase, Collaborative Drafting, aims to produce an initial draft of an academic paper collaboratively. Students brainstorm, outline, and write the draft together in groups. This collaboration facilitates academic communication, enables the exchange of ideas, and supports shared responsibility for the quality of the writing. The lecturers guide the structure of the writing, provide feedback, and ensure coherence and cohesion. The use of platforms such as Google Docs enables real-time shared authorship. The integration of collaborative technologies in this phase is consistent with previous studies showing that technology-based collaboration can support writing awareness and learning motivation (Alsahil, 2024; Alharbi, 2019).

The fourth phase, Self and Peer-Assessment, aims to develop the quality of writing through self-assessment and peer-assessment. Students carry out self-assessment, evaluate other groups' work using a rubric, and discuss feedback constructively. This activity facilitates metacognitive awareness and supports collective responsibility. The lecturer provides rubric guidelines and facilitates the assessment process. This phase is in line with previous research indicating that peer assessment using clear rubrics can support reflective skills and the quality of written revisions (Ortega-Ruipérez & Correa-Gorospe-José, 2024).

The fifth phase, Revision and Publication, aims to refine and publish the final written work. Students revise their drafts based on feedback and carry out proofreading prior to publication. The lecturer provides further feedback and guides the dissemination process. The use of technology such as Google Docs and Microsoft Teams enables the revision and publication process to proceed more effectively. The emphasis on revision through feedback and rubric-guided evaluation in this phase is supported by previous research indicating that the integration of feedback and the use of rubrics can contribute to the quality of writing (Panadero et al., 2024; Taufiqulloh et al., 2024; Panadero et al., 2023).

The sixth phase, Reflection and Evaluation, aims to reflect on the process and evaluate the learning outcomes. Students review all stages of the learning process to identify developments in their writing and critical thinking skills through individual reflection and group discussions, whilst the lecturer facilitates this reflection and provides guidance for continuous improvement. This activity fosters metacognitive awareness and helps students understand the interconnection between inquiry, collaboration, and assessment as an integrated learning process. Previous research indicates that structured reflection through group discussions and reflective journals can contribute to students' self-awareness and critical thinking skills, whilst reflection within a collaborative context supports shared responsibility and a culture of reflective learning in academic settings (Chen & Chen, 2025a; Yang et al., 2024). Consequently, this phase is positioned as the culmination of a constructive learning cycle.

Overall, the IB-CWA prototype model forms a constructive, collaborative, and reflective learning cycle supported by digital technology. Each phase is designed to complement one another in facilitating the development of academic writing and critical thinking skills as 21st-century competencies.

Although various previous studies have examined inquiry-based learning, collaborative writing, and assessment for learning, the majority of studies still focus on the partial implementation of each approach (Kamaruddin et al., 2023; Taufiqulloh et al., 2024; Wonglakorn & Deerajiset, 2023). Several studies have also integrated digital technology into writing instruction, but tend to treat it as a tool rather than an integral part of the pedagogical design (Oluwajana et al., 2023; Yan, 2019; Alwahoub et al., 2022). Furthermore, research on peer assessment generally emphasises the evaluative aspect, without explicitly linking it to the inquiry cycle and the collaborative writing process as a whole.

In contrast to these studies, the IB-CWA prototype model in this research was designed to systematically integrate the four main components, inquiry-based learning, collaborative writing, assessment for learning, and collaborative assessment, into a single, holistic and interrelated learning cycle. This integration positions assessment not merely as a

final stage, but as a process distributed across every phase of learning, particularly through structured self- and peer-assessment mechanisms.

Furthermore, the novelty of this model lies in the role of digital technology, positioned as a learning enabler, which facilitates continuous collaboration, interaction, and publication at every stage. Thus, the IB-CWA prototype model offers a more comprehensive and integrated pedagogical framework compared to previous approaches, particularly within the context of collaborative and inquiry-based academic writing in higher education.

B. Validity

Validation results indicate that the IB-CWA prototype model supported by digital technology has met the feasibility criteria from pedagogical, assessment, and technological perspectives. These findings suggest that all components of the model possess a high level of validity, meaning the developed design aligns with the principles of inquiry-based learning and collaborative learning, whilst meeting the criteria for content and construct validity at the initial development stage.

The high validity scores of the assessment instruments demonstrate consistency between the assessment approach and the learning objectives focused on the collaborative writing process. Furthermore, the coherence between the lesson plans, student worksheets, and assessment instruments indicates adequate pedagogical integration, particularly in linking learning activities, the inquiry process, and authentic assessment practices within a coherent learning framework.

The integration of digital technology into this prototype model serves not only as technical support but is also positioned as an element that facilitates the implementation of collaborative learning and assessment in a more systematic manner. Thus, the IB-CWA prototype model can be seen as having the potential for use in the context of structured, digital technology-assisted collaborative writing instruction. However, these findings are still limited to the expert validation stage.

Overall, the validation results provide an initial basis suggesting that the IB-CWA prototype model is worthy of further testing in a limited implementation phase to examine its practicality and potential feasibility in a real-world learning context. These findings align with previous research indicating that technology-assisted inquiry-based collaborative learning has the potential to support the development of scientific skills and argumentative abilities, whilst collaborative assessment can contribute to the quality of students' writing performance (Chen & Chen, 2025b; Taufiqulloh et al., 2024). Furthermore, the collaborative process writing approach is reported to facilitate the development of writing skills, whilst collaborative writing practices are considered important from both the lecturers' and students' perspectives (Wonglakorn & Deeraajiset, 2023). This alignment indicates that the integration of inquiry, collaboration, and digital technology within the IB-CWA prototype model is situated within a relevant theoretical and empirical framework.

Furthermore, the validity of the learning materials and assessment instruments indicates that the lesson plans, student worksheets, and assessment instruments have met the criteria for validity and are suitable for use in the limited pilot phase. These tools are designed to support the structured implementation of inquiry-based and collaborative learning, and are consistent with previous research findings that emphasise the importance of validated learning tools and assessment instruments in supporting the quality of technology-based learning processes (Oluwajana et al., 2023; Ngai et al., 2019; Yan, 2019; Alwahoub et al., 2022).

Thus, these validation results can be positioned as an initial conceptual and empirical foundation for the development of the IB-CWA prototype model, whilst also opening up scope for further testing at the implementation stage to obtain evidence of its practicality and potential contribution within a broader learning context. However, these validation results are still limited to expert validation and do not yet reflect the dynamics of implementation in real classrooms. Furthermore, the relatively limited number of validators may affect the generalisability of the findings, necessitating further testing in more diverse contexts.

C. Practicality

The practicality results indicate that the IB-CWA prototype model supported by digital technology is perceived as practical by users, both lecturer and students. These findings suggest that the prototype model's design has taken into account aspects of usability, procedural clarity, and implementation efficiency within a technology-based learning context.

The high level of practicality in the students' assessments suggests that the prototype model is relatively easy to follow and facilitates engagement in collaborative writing activities. The clarity of the lesson plans and student worksheets indicates support for the smooth implementation of inquiry stages and the collaborative process among students. These findings align with the principle of instructional clarity in instructional design, which plays a role in reducing potential confusion and supporting the effectiveness of the learning process (Morrison et al., 2019).

Furthermore, the IB-CWA prototype model also demonstrates efforts to maintain a balance between task complexity and the achievement of learning objectives. This is relevant to the principle of cognitive load management, which emphasises the importance of managing cognitive load so that students can focus their attention on critical thinking and academic writing without experiencing excessive strain (Sweller, 2020).

From the lecturer's perspective, the very high level of practicality indicates that the prototype model is relatively easy to implement and supports efficiency in the management of learning and assessment. The integration of digital

technology helps organise the writing and assessment processes more systematically, potentially reducing the operational burden in collaborative learning.

Nevertheless, some adjustments are still required to make the prototype model more adaptable to varying classroom conditions and potential technical constraints. This aligns with the findings of previous research emphasising the importance of flexibility in the application of digital-based learning models to ensure they can still be implemented in diverse contexts (Afonso et al., 2025).

Overall, these findings regarding usability indicate that the IB-CWA prototype model supported by digital technology has an adequate level of feasibility from the users' perspective. The usability identified from the perspective of students and lecturer provides an initial indication of the prototype model's potential for implementation in collaborative writing instruction. These findings are consistent with the principles of Design-Based Research, which prioritise practicality and applicability as key indicators before a model is tested further in a broader context (Kirchner, 2025). However, these findings regarding practicality are still based on a limited number of respondents and an initial implementation context, so they must be interpreted with caution. Therefore, further testing on a larger scale is required to obtain a more comprehensive picture of practicality.

V. CONCLUSION

The research findings indicate that the IB-CWA prototype model has met the criteria for content and construct validity based on expert assessment, and demonstrates a level of practicality ranging from high to very high from the perspective of lecturer and students. These findings suggest that the prototype model design possesses theoretical soundness and initial feasibility in the context of collaborative writing-based learning.

Furthermore, the IB-CWA prototype model offers a conceptual contribution through the integration of the four main components into a single, complete learning cycle, with assessment positioned as a distributed element across each phase of learning. The role of digital technology in this model is also positioned as an enabler that supports collaboration, interaction, and continuous reflective processes.

Nevertheless, the findings of this study are still limited to the expert validation and initial practicality testing stages, and therefore do not yet reflect the model's effectiveness in improving writing and critical thinking skills empirically. Consequently, further research is required to test the model's effectiveness through implementation on a larger scale and within diverse learning contexts.

Theoretically, this study contributes to strengthening an integrative framework between inquiry-based learning, collaborative writing, and collaborative assessment within the context of digital technology-assisted learning. Practically, the IB-CWA prototype model has the potential to serve as a guide for lecturers in designing more structured, collaborative, and reflective writing instruction. These findings also provide a basis for the development of more adaptive and contextual technology-based pedagogical interventions in higher education.

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