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ORIGINAL

# Implementing a Collaborative-Inquiry Learning Model to Foster 21st Century Critical thinking: A Validity and Practicality Study for Sustainable Human Development

## Implementación de un modelo de aprendizaje colaborativo e indagación para fomentar el pensamiento crítico del siglo XXI: un estudio de validez y practicidad para el desarrollo humano sostenible

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## ABSTRACT

**Introduction:** critical thinking skills are core competencies of the 21st century for individuals to solve complex problems, make data-based decisions, and adapt to rapid social, technological, and environmental changes. This condition indicates the need for innovative learning models to encourage active student involvement and develop critical thinking in a meaningful collaborative context. This study aims to evaluate the validity and practicality of the Collaborative-Inquiry Learning (Collin) model in developing 21st century critical thinking skills, which contribute to sustainable human development in the era of digital transformation.
**Method:** the study was conducted in stages: preliminary study, prototype design, and formative evaluation. The products developed include model books, student's book, and teacher's book designed to support collaborative inquiry learning. Validation was carried out by education experts, colleagues, and practitioners, while the practicality test was obtained from teachers and students' feedback.
**Results:** the validation results showed a very high level of validity with an average score: model book (0,85), teacher's book (0,85), and student's book (0,82). The practicality from teachers resulted in a score of 89,27 for teacher's and student's book. The practicality from students resulted a score of 94,82 for student's book. All instruments were declared feasible and relevant to be applied in 21st century learning.
**Conclusion:** the Collaborative-Inquiry learning model is declared valid and practical to be applied in learning, especially in developing students' critical thinking skills. This model supports active and reflective learning needed to form human resources that are adaptive, collaborative, and ready to face global challenges sustainably.

**Keywords:** Collaborative Learning; Inquiry Learning; Critical Thinking; Validity and Practicality; Sustainable Development.

## RESUMEN

**Introducción:** las habilidades de pensamiento crítico son competencias fundamentales del siglo XXI para que las personas resuelvan problemas complejos, tomen decisiones basadas en datos y se adapten a los rápidos cambios sociales, tecnológicos y ambientales. Esta condición indica la necesidad de modelos de aprendizaje innovadores que fomenten la participación activa de los estudiantes y desarrollen el pensamiento crítico en un contexto colaborativo significativo. Este estudio busca evaluar la validez y la viabilidad del modelo de aprendizaje de Indagación Colaborativa para el desarrollo de habilidades de pensamiento crítico del siglo

XXI, que contribuyen al desarrollo humano sostenible en la era de la transformación digital.
**Método:** el estudio se llevó a cabo en etapas: estudio preliminar, diseño de prototipos y evaluación formativa. Los productos desarrollados incluyen libros modelo, un libro del profesor y un libro del alumno, diseñados para apoyar el aprendizaje de indagación colaborativa. La validación fue realizada por expertos en educación, colegas y profesionales, mientras que la prueba de viabilidad se obtuvo a partir de la retroalimentación de profesores y estudiantes.
**Resultados:** los resultados de la validación mostraron un nivel de validez muy alto, con una puntuación promedio: libro modelo (0,85), libro del profesor (0,85) y libro del alumno (0,82). La practicidad de los docentes resultó en una puntuación de 89,27 para el libro del docente y del alumno. La practicidad de los alumnos resultó en una puntuación de 94,82 para el libro del alumno. Todos los instrumentos se declararon viables y relevantes para su aplicación en el aprendizaje del siglo XXI.
**Conclusión:** el modelo de aprendizaje de Indagación Colaborativa se considera válido y práctico para su aplicación en el aprendizaje, especialmente en el desarrollo del pensamiento crítico de los estudiantes. Este modelo promueve el aprendizaje activo y reflexivo necesario para formar recursos humanos adaptables, colaborativos y preparados para afrontar los desafíos globales de forma sostenible.

**Palabras clave:** Aprendizaje Colaborativo; Aprendizaje por Indagación; Pensamiento Crítico para las Habilidades del Siglo XXI; Validez y Practicidad; Desarrollo Sostenible.

## INTRODUCTION

The development of technology and information in the digital era has drastically changed. It affects the mindset, social interactions, and learning methods of the younger generation. In the modern society, there is a demand for individuals to have critical thinking skills to face the complexities of everyday life.[1] Critical thinking is also the foundation for data-based decision making, which is now an important need.[2] Therefore, education needs to design learning strategies that not only deliver content but also develop high-level thinking skills from an early age.[3,4] In other words, the synergy of technology and cutting-edge pedagogy is something that cannot be ignored.

Digital transformation and the entry of the Society 5.0 era are major challenges for the traditional education system.[5] Educational institutions have not fully adapted to the new paradigm, so many still use memorization-oriented learning methods.[6,7] This method makes students passive and less practicing critical thinking in responding to various information.[8] As a result, students' reflective and analytical abilities have not developed optimally.[9] Therefore, transformational steps are needed in learning practices to create an adaptive and critical generation.

Innovative and contextual learning models are expected to be able to answer these problems. In the ideal model, students' cognitive, affective, and social dimensions are integrated in the learning process.[3,8] The combination of collaboration and inquiry encourages students to ask critical questions, examine information, and build logical thinking.[10,11] Through the right strategy, students not only absorb the material but also understand the context and logic behind the issue.[12] This is an important means to promote competency-based and adaptable continuing education.

Collaborative learning has been studied to be effective in improving students' social interactions and academic performance.[13] This process allows students to share ideas, work on assignments together, and learn from each other.[14,15] Collaboration also plays a role in building communication skills and social responsibility.[16] In addition, this model is suitable for the needs of cross-disciplinary collaboration that is a global demand.[17,18] In other words, collaboration adds a social dimension that is much needed in the digital era.

Inquiry-based learning positions students as active agents in the search for and reflection on knowledge.[12] This method involves observation, experimentation, and analytical reflection on findings. Therefore, students are trained to formulate hypotheses, evaluate data, and build scientific conclusions. Inquiry also encourages students' mental resilience to mistakes and failures.[19] Through this process, learning becomes meaningful and contextual according to the needs of the 21st century.

Critical thinking is the foundation for filtering information, building arguments, and making rational decisions.[20] A structured learning process must continuously foster critical and reflective attitudes.[21] Studies show that the integration of collaboration and inquiry significantly improves students' analytical and synthesis skills.[11] Students who are actively involved in discussions and explorations tend to have better thinking skills.[13] Therefore, this model is important for forming an independent and responsible generation.

Education that simultaneously develops critical, collaborative, and inquiry thinking will support sustainable human development. Adaptive and solution-oriented human resources are urgently needed in facing global challenges.[8] Learning models that emphasize exploration, critical dialogue, and deep reflection touch on

sustainability values.[9] 21st-century skills, such as collaboration and critical thinking, are the main requirements for achieving the sustainable development goals.[4] Therefore, education must be directed to produce a generation that is ready to face global change inclusively.

Although many studies discuss collaboration and inquiry, most focus on improving students' writing skills or academic achievement.[22] However, the validity and practicality of tools such as model books, teacher books, and student books in real classroom contexts are still rarely evaluated. In fact, the quality of the products determines the success of implementing innovative pedagogy.[23] Several previous studies tend to be partial and have not provided a systematic overview of the topics studied.[10] Therefore, a more comprehensive evaluation is needed with an appropriate methodological approach.

In addition, the analysis of Collaborative-Inquiry learning with sustainable human development has rarely been studied in depth. In fact, in the era of Society 5.0, education is required to be able to produce graduates who are adaptive to technological and social challenges.[6] On the other hand, empirical evaluation of learning tools is also rarely carried out through trials in real classes, although this form of validation is very important so that the model can be implemented effectively.[24] This condition underlines the importance of more applicable and contextual studies according to local needs.

This study addresses this gap by evaluating a Collaborative-Inquiry Learning (Collin) model that is evaluated comprehensively and systematically. The focus on assessing the validity of the content and practicality of the tool through expert testing and classroom practice is the methodological strength of this study. Therefore, the resulting product is not only theoretical, but ready to be used in real classes. This model is also developed in accordance with the demands of digital era learning and the principles of sustainability.[4] It is hoped that this research can encourage transformative and contextual educational practices.

Based on the background above, this study aims to evaluate the validity and practicality of the Collaborative-Inquiry learning model in developing 21st century critical thinking skills. This research is expected to produce valid, practical, and applicable tools in supporting sustainable human development. The Collaborative-Inquiry model can be an effective strategy to equip students with the critical and collaborative thinking skills needed in the 21st century. The successful application of this model also has the potential to strengthen sustainable human development. In addition, this study emphasizes the urgency of learning transformation in the Society 5.0 era. Through these efforts, education not only transfers knowledge but also shapes the character and competence of future generations.

## METHOD

### Research Design

The research design in this study is research and development (R&D) in this study since R&D is a systematic method for developing and validating learning products that can be used in the learning process.[24,25] This approach is very relevant in this study, because it aims to produce a collaborative-inquiry learning model that suits students' needs and an innovative and inspiring learning orientation. The ADDIE (Analyze, Design, Develop, Implement, Evaluate) model used in this study provides a clear framework for identifying, designing, developing, implementing, and evaluating the resulting learning products.[26] This structured R&D process also ensures that the products developed not only meet validity standards, both in terms of content, construction, and language, but can also be practically applied in real learning contexts, by involving questionnaire responses from teachers and students to evaluate the effectiveness and practicality of the product.

### Participants of the Research

Participants in this study were 32 sixth-semester students from the faculty of education and vocational, *Universitas Lancang Kuning* in the 2023/2024 academic year. The selection of field trial subjects was carried out using a purposive sampling technique, selecting control and experimental classes based on the highest-class average scores. In addition to students, participants also included two expert lecturers from the English Language Education Study Program at *Universitas Negeri Padang* and *Universitas Riau* for the validation process involved in one-on-one evaluations and small group evaluations.

### Research Procedure

*Level design and develop prototype*

This stage aims to develop a collaborative-inquiry learning model along with its assessment instruments, and conduct formative evaluation using the ADDIE (Analyze, Design, Develop, Implement, Evaluate) design model. The evaluation methods used at this stage include self-evaluation, expert review, one-on-one evaluation, small group evaluation, and field testing.

*Prototype 1 (initial design stage results)*

Based on the initial research analysis, a collaborative inquiry learning model was designed, which resulted

in the creation of an initial prototype, Prototype 1. The next step is the validation of the instrument used to collect data on validity, practicality, and effectiveness through experts. After the instrument has been validated, a self-evaluation of Prototype 1 is carried out using the same questions as the validation instrument. This self-evaluation aims to identify design errors and is carried out by peer reviewers. This evaluation also aims to ensure that the product meets relevant, scientifically based, and consistent and practical criteria. After this evaluation, Prototype 1 was revised to produce Prototype 2, which was then continued to the next evaluation stage.

*Prototype 2 (result of initial design revision)*

Validation of the collaborative-inquiry learning model was carried out through an assessment of the model book, student's book, and teacher's book. Three types of validation were measured in this process, namely content validation, construction validation, and language validation. The entire validation process was carried out by experts in their respective fields, who provided feedback on all aspects of the validity of Prototype 2. Of the two experts involved in the validation, one was a lecturer from the English Language Education Study Program, *Universitas Negeri Padang*, and the other was a lecturer form English Language Education Study Program, *Universitas Riau*. Based on the opinions and suggestions from the experts, Prototype 2 was revised. Validation activities were carried out through written feedback and discussions, which continued until the experts reached a consensus on the validity of the collaborative-inquiry learning model. Prototype 3 was born as a result of this assessment.

*Prototype 3 (result of second stage design revision)*

Like its predecessor, Prototype 3 was further evaluated through the following methods: a) one-on-one evaluation, where one student was selected from each high, medium, and low ability group to provide feedback on the developed student book. In addition, lecturers were asked to provide opinions on the model book, student's book, and teacher's book; and b) small group evaluation, involving six students divided into two groups of three, who tested the revised model book, student's book, and teacher's book, and provided feedback on the materials. Two teachers also provided their opinions on the books. Based on feedback from students and teachers, the product was revised again. After this evaluation, further revisions were made to refine the prototype before field testing.

*Final Prototype*

The last stage of the formative evaluation was the field test. At this stage, the final prototype was implemented in a real classroom setting to assess the effectiveness of the collaborative-inquiry learning model in improving students' 21st century skills. The trial was conducted at *Universitas Lancang Kuning* which has a course description that is in accordance with academic writing. The test subjects were sixth semester students of the faculty of education and vocational studies 2023/2024.

**Data Analysis**

*Assessment Instrument of Validity and Practicality*

**Table 1.** Validation instrument

| No | Instrument | Aspect of Assessment | Sample of Item |
|---|---|---|---|
| 1 | Model book validation | Supporting concept of model book | - Concept of collaborative-inquiry learning model is written well. |
| | | Construction of model book | - The type and size of font and colours used are easy to read. |
| | | Language use of model book | - The language used in the book is communicative. |
| 2 | Teacher's book validation | Supporting concept of teacher's book | - Learning materials are based on the lesson plan, added with a model of thesis, information convention, and language use. |
| | | Construction of teacher's book | - The design of the book cover is attractive and balanced. |
| | | Language use of teacher's book | - The language use for teaching notes is communicative. |
| 3 | Student's book validation | Supporting concept of student's book | - Writing assignment are suitable to Collin Model. |
| | | Construction of student's book | - The graphic design in the book is interesting. |
| | | Language use of student's book | - The language used is communicative. |

**Source:** Adapted from Sugiyono[27]

The researchers had conducted initial validation of all materials used in this study using the validity instrument assessment sheet. The results of the validation and revisions carried out indicate that the researcher assessed the validity and practicality instruments as appropriate for the product development validation process. The

validity instrument aims to collect data on the validity of the model book, teacher's book, student's book, and 21st century skills assessment instruments. The researcher developed the validity instrument based on three main assessment indicators, namely content validity, construct validity, and language validity. The researchers summarized the instruments used for data collection in table 1.

The practicality instruments used in this study were questionnaires for teachers and students, which had the same number and aspects, but differed in the wording of the questions. This questionnaire consisted of a total of 15 items measuring four aspects, namely the useable and easy to apply, the usefulness of the collaborative-inquiry learning model, the attractiveness of the model, and its efficiency. The first and second aspects each consisted of 5 items, while the third aspect consisted of 3 items, and the fourth aspect included 2 items. The instruments were used to collect data on the practicality of implementing the developed model, both from the perspective of teachers and students. The instruments used are presented in table 2 were compiled by the authors by referring to the validity indicators developed by expert.[27]

**Table 2.** Practicality instrument

| No | Instrument | Aspect of Assessment | Sample of Item |
|---|---|---|---|
| 1 | Practicality from Teachers | Usable and easy for teachers to apply the collaborative-inquiry learning model | - Model is suitable to use in academic writing in university level. |
| | | Usefulness of the collaborative-inquiry learning model | - This model is useful in drafting of writing instruction of academic writing. |
| | | Attractiveness the collaborative-inquiry learning model | - The colour used in the model is appropriate and attractive |
| | | Efficiency of the collaborative-inquiry learning model | - The assigning task of small groups and individuals is efficient to apply. |
| 2 | Practicality from Students | Usable and easy to apply for students the collaborative-inquiry learning model | - Material contained in learning model is accordance with the needs of students of English education study program. |
| | | Usefulness of the collaborative-inquiry learning model | - The material provided in the learning model can increase students' interest. |
| | | Attractiveness the collaborative-inquiry learning model | - The writing on the learning model utilizes an appropriate font size that is easy to read. |
| | | Efficiency of the collaborative-inquiry learning model | - It is efficient to provide a good example of each unit about thesis in Collin model |

*Validity Analysis*

After the data was collected, validity analysis was carried out by involving expert validation that provide input and recommendations for improving the collaborative-inquiry learning model. The validation of the collaborative-inquiry learning model prototype was carried out by a group of experts, consisting of university lecturers. These experts were tasked with evaluating the prototype and providing suggestions for improvement so that the model met the first quality criterion, namely validity. In addition, the practicality of this model was also assessed through feedback provided by lecturers and students at *Universitas Lancang Kuning*, Indonesia.

The level of validity of the model, which includes the appropriateness of the content, the accuracy of the construction, and the clarity of the language, is the main focus in this evaluation process. The experts provide suggestions and input based on the results of their assessment, which are then used to revise the prototype to produce a more valid product. The reviewers give scores to each aspect, and the scores are analyzed using the formula, with the results of the analysis presented as follows.

The validity assessment of this model focuses on the suitability of the content, construction, and language used. Based on input from experts and reviewers in Focus Group Discussion (FGD), validity calculations were carried out and prototype revisions were made to produce a more valid product.

This process aimed to ensure that the developed model was relevant and in accordance with the expected learning objectives. Experts used scoring criteria in providing their evaluations. This validation was very important to identify parts that need to be improved in the learning model. In analyzing the validity and practicality of the Collaborative-Inquiry learning model, the instrument used refers to the assessment criteria by expert.[28] The assessment criteria for the validity questionnaire consist of four categories, namely: strongly disagree (0–24 %), disagree (25–49 %), agree (50–74 %), and strongly agree (75–100 %).

Based on the results of the assessment, the validity of a product is determined by the range of coefficient values that have been grouped into five categories: very high (0,801–1,00), high (0,601–0,800), moderate (0,401–0,600), low (0,01–0,400), and invalid (0,000).[28] This validity is the main indicator in evaluating the suitability of the content, design, and usability of the learning products that have been developed.

Furthermore, the analysis of the practicality of the model is carried out by processing data from the questionnaire given to lecturers and students as the main users. Similar to the validity questionnaire, the

practicality instrument uses an assessment scale with identical categories, namely strongly disagree (0–24 %), disagree (25–49 %), agree (50–74 %), and strongly agree (75–100 %).[28]

The final calculation and assessment of the practicality of the collaborative-inquiry learning model is carried out using a scale (0-100) through a predetermined formula:

$$Practicality = \frac{Obtained\ Score}{Maximum\ Score} \times 100\ \%$$

This final value is then classified into five practicality categories, namely impractical (0 %–20 %), less practical (21 %–40 %), quite practical (41 %–60 %), practical (61 %–80 %), and very practical (81 %–100 %).[28]

By using these procedures, the validity and ease of implementation of the model can be evaluated objectively and systematically. High validity indicates that the model has a strong substantive suitability with the objectives of 21st century learning, especially in developing students' critical thinking skills in the context of academic writing. Meanwhile, a very high level of practicality reflects that this model is not only theoretically feasible, but also easy to apply in a real learning environment. These evaluative procedures are important in the development of research-based educational products so that they can be scientifically and practically accounted for.

### Ethical aspects

The ethical aspects of this research were strictly adhered to, adhering to the principles of responsible research. All participants were fully explained the purpose, procedures, and potential implications of the study and were asked to voluntarily sign an informed consent form without any pressure. Participants' identities and personal data were kept confidential and used solely for research purposes. This research also received official permission from the relevant institutions, which serves as the legal basis for the research activities, ensuring that the entire process adhered to ethical standards for higher education research.

## RESULTS

Result of the validity of collaborative-inquiry learning model by reviewers can be seen in the table 3.

**Table 3.** Result of validation by reviewers (peers) of the research products

| Product | Aspect | Score (Validation) | Description |
|---|---|---|---|
| Model book | Content: | | |
| | 1. Rational of the learning model | 0,84 | Very high |
| | 2. Theoretical basis of the learning model | 0,81 | Very high |
| | 3. Syntax of learning model | 0,88 | Very high |
| | 4. Social system | 0,88 | Very high |
| | 5. Principle of reaction | 0,94 | Very high |
| | 6. Support system | 0,88 | Very high |
| | 7. instructional and accompaniment effect | 0,83 | Very high |
| | Language | 0,88 | Very high |
| | Construct: | | |
| | 1. Serving | 0,81 | Very high |
| | 2. Graphic | 0,84 | Very high |
| | Average | 0,85 | Very high |
| Teacher's book | Content: | | |
| | 1. General instruction | 0,88 | Very high |
| | 2. Specific instruction | 0,88 | Very high |
| | Language | 0,81 | Very high |
| | Construct: | | |
| | 1. Serving | 0,94 | Very high |
| | 2. Graphic | 0,75 | High |
| | Average | 0,85 | Very high |
| Student's book | Content: | | |
| | 1. General instruction | 0,91 | Very high |
| | 2. Specific instruction | 0,90 | Very high |
| | Language | 0,84 | Very high |
| | Construct: | | |
| | 1. Serving | 0,75 | High |
| | 2. Graphic | 0,78 | High |
| | Average | 0,82 | Very high |

**Source:** Adapted from Sugiyono[27]

The validation results presented in table 3 show that the collaborative-inquiry learning model, which was developed in the form of a complete learning model book with a teacher's book, student's book, and 21st century skills assessment instrument, is included in the "Very High Validity" category. In more detail, the model book and teacher's book obtained an average validity score of 0,85 which is included in the "Very High" category, while the student's book obtained an average validity score of 0,82 which is also in the same category.

**Result of the validity of collaborative-inquiry learning model by experts**

Experts are the main parties who carry out the validation process by following previously established procedures. In this activity, they assess the learning model book, teacher's book, student's book, and assessment guidelines based on specific criteria that have been designed previously. The assessment result is presented in table 4.

**Table 4.** Result of validation by experts (lecturers) of the research products

| Product | Aspect | Score (Validation) | Description |
|---|---|---|---|
| Model book | Content: | | |
| | 1. Rational of the learning model | 0,92 | Very high |
| | 2. Theoretical basis of the learning model | 0,79 | High |
| | 3. Syntax of learning model | 1,00 | Very high |
| | 4. Social system | 0,87 | Very high |
| | 5. Principle of reaction | 0,96 | Very high |
| | 6. Support system | 0,83 | Very high |
| | 7. instructional and accompaniment effect | 0,88 | Very high |
| | Language | 0,83 | Very high |
| | Construct: | | |
| | 1. Serving | 0,83 | Very high |
| | 2. Graphic | 0,73 | High |
| | Average | 0,86 | Very high |
| Teacher's book | Content: | | |
| | 1. General instruction | 0,92 | Very high |
| | 2. Specific instruction | 0,90 | Very high |
| | Language | 0,83 | Very high |
| | Construct: | | |
| | 1. Serving | 0,92 | Very high |
| | 2. Graphic | 0,71 | High |
| | Average | 0,86 | Very high |
| Student's book | Content: | | |
| | 1. General instruction | 0,94 | Very high |
| | 2. Specific instruction | 0,94 | Very high |
| | Language | 0,81 | Very high |
| | Construct: | | |
| | 1. Serving | 0,75 | High |
| | 2. Graphic | 0,68 | High |
| | Average | 0,80 | Very high |

**Source:** Adapted from Sugiyono[27]

The experts gave an average score of 0,86 for the learning model book and teacher's book, and 0,80 for the student's book, all of which are included in the "very high validity" category. Therefore, the experts assessed that the prototype of this collaborative inquiry learning model is very valid and feasible to be applied in thesis writing instruction for EFL learners at the university level.

**Result of the practicality of the collaborative-inquiry learning model**

The aspects assessed include usable and easy to apply, usefulness, attractiveness, and time efficiency according to course allocation. The results of this assessment can be seen in table 5.

Based on table 5, it can be seen that the collaborative-inquiry learning model, which is implemented through the teacher's book and student's book, is proven to be very practical and facilitates teaching for EFL students in writing a thesis as an academic writing. The average rating of the teacher's evaluation is in the range of 80-100 %, with an overall average score of 89,27, which places it in the "Very Practical" category. The respondents stated that the collaborative-inquiry learning model increases the practicality of learning activities for both teachers and students. Student evaluations of this model also show similar results in table 6.

**Table 5.** Result of practicality of the research products from teachers

| Aspect of assessment | Teacher 1 | Teacher 2 |
|---|---|---|
| Usable and easy to apply | 3,60 | 3,60 |
| Usefulness | 3,40 | 3,80 |
| Attractiveness | 3,33 | 3,33 |
| Efficiency | 4,00 | 3,50 |
| Average | 89,58 | 88,96 |
| Overall average | 89,27 | |
| Category | Very practical | |

**Table 6.** Result of practicality of the research products from students

| Aspect of assessment | Score (Practicality) |
|---|---|
| Usable and easy to apply | 3,70 |
| Usefulness | 3,89 |
| Attractiveness | 3,83 |
| Efficiency | 3,75 |
| Overall average | 94,82 |
| Category | Very practical |

Table 6 shows that the collaborative-inquiry learning model effectively supports and facilitates students in the learning process. The overall average score reached 94,82, with the percentage of assessment ranging from 80 % to 100 %, which places it in the "Very Practical" category. Respondents also stated that the collaborative-inquiry learning model makes learning activities more practical and effective for students.

**Focus group discussion of the result of the collaborative-inquiry learning models**

Based on input from experts and FGD participants, the implementation of the collaborative-inquiry learning model to foster 21st-century critical thinking skills in the context of sustainable human development needs to consider the interrelationships between topics, specific learning objectives, relevant theoretical foundations, systematic learning syntax, and integration of psychomotor domains and academic and linguistic conventions. The teacher's book as a supporting tool must contain complete learning procedures and assessment rubrics that are in accordance with the indicators of 21st-century critical thinking skills. In addition, experts also emphasize the importance of using standardised English with proper grammatical structure, so it is advisable to involve a proof-reader or grammar checker to ensure the quality of academic writing. In terms of appearance, the layout needs to be improved by eliminating unnecessary blank pages, improving the cover design, and choosing an appropriate background so that this learning model appears more attractive and professional, while supporting the achievement of sustainability-based learning objectives.

## DISCUSSION

These findings strengthen the conclusion that the prototype of the collaborative-inquiry learning model has meet the criteria of high validity and is suitable to be applied in thesis writing instruction for English as a Foreign Language (EFL) learners at the university level, at least based on the assessment of the reviewers involved in this process. The results of validation conducted by experts, as shown in table 4, show that the collaborative-inquiry learning model developed in the form of a learning model book and completed with a teacher's book and a student's book, has a very high level of validity. Teachers and students are the parties who make assessments based on their direct practical experiences, with reference to the criteria that have been determined in the model book, student's book, and teacher's book. In addition, both teachers and students also assessed various aspects of the collaborative-inquiry learning model to determine the extent to which the model can be applied in thesis writing instruction for EFL students.

From the findings, digital transformation in education demands the integration of learning models that are able to foster 21st-century skills, especially critical thinking. The Collaborative-Inquiry (Collin) learning model has proven to be valid and practical to support the development of these abilities, especially in the context of academic writing in higher education. This is in line with the findings stated that education in the Society

5.0 era needs to encourage students to become technology-based and collaborative problem solvers.[5] Collin's syntax, which emphasizes exploration, discussion, and in-depth argumentation, reflects an adaptive response to global challenges. Therefore, this model is not only theoretically relevant but also applicable to support the transformation of digital education.

Digitalization of education is often interpreted as merely the use of digital devices, without considering the effectiveness of the underlying pedagogical approach. Collin's model actually places the pedagogical aspect as the main foundation, by emphasizing the process of inquiry and meaningful collaboration in academic activities. This is in line with the criticism of findings emphasized that misinterpretation of technology can obscure the true purpose of education.[6] With Collin's model, students are not only users of technology, but also active reasoners in building knowledge. Therefore, the digitalization of education should be directed to strengthen the thinking process, not just speed up the delivery of content.

Inclusive education requires a learning model that is flexible and adaptive to the diversity of learners. Collin's model provides a wide space for participation through group discussions and exploration of ideas, which can be applied in various social conditions and technological infrastructures. This is in line with the findings emphasised the importance of inclusive and community-empowering ICT-based learning design.[8] In addition, students from different economic and geographical backgrounds can still actively contribute to the learning process. Therefore, Collin's model can support justice in higher education while strengthening collaborative values in sustainable human development.[29,30]

The inequality of digital skills of students in Indonesia is a challenge in implementing digital learning. Research by previous study revealed that many students still have low levels of digital self-efficacy.[31] This is in line with Collin's model approach which provides a safe space to learn and work collectively, so that learners can build confidence in using technology.[32,33] With a structured writing and discussion process, students are helped to practice digital skills while honing their critical thinking.[34,35] This model can be a practical solution in reducing the digital competency gap in higher education.

The digitalization of education also requires a change in learning culture to be more collaborative and reflective. Collin's model encourages a dialogic writing process, based on discussion and revision, not just individual assignments. This is in line with the research results of previous studies stated that collaborative writing can improve the quality of writing and student engagement. On the other hand, this is contrary to the traditional approach that is still dominant in academic writing classes which tends to be passive and teacher-centered. Therefore, Collin presents a model that is able to change the learning paradigm to be more active, critical, and participatory.

The integration of 21st century skills in learning needs to start from the design of a concrete and applicable learning model. This is in line with the findings stated that the development of teaching materials must accommodate character building, digital literacy, and critical thinking.[4] Collin's model has met these indicators through a measurable and flexible collaborative-inquiry approach. With proven validity and practicality, this model is worthy of being implemented widely to improve the quality of higher education in the digital era. Therefore, Collin can be an integral part of the strategy to continuously strengthen students' soft skills and hard skills.

## CONCLUSIONS

The collaborative-inquiry learning model is a representation of a pedagogical strategy that integrates critical thinking, collaboration, and inquiry in the context of 21st century academic learning. This model offers an adaptive learning framework to face digital transformation and supports the sustainable development of students' intellectual capacity. As a learning concept, collaborative inquiry fosters a reflective, participatory, and problem-solving-oriented academic culture, making it relevant for supporting academic literacy and student readiness to face the dynamics of the digital era. The application of this model can be interpreted as a strategic step towards building inclusive, high-quality, and sustainable higher education. The implications of this study suggest that collaborative and inquisitorial learning designs can be a solution to global challenges in developing 21st-century skills, particularly critical thinking, digital literacy, and teamwork. Broader application of this model has the potential to improve the quality of learning in various subject contexts, especially those related to academic skills and scientific writing. For further research, it is suggested to test this model in more diverse contexts, such as in various study programs, educational levels, or in the use of different technologies. Further research can also explore the model's effectiveness in improving other aspects, such as communication abilities, cross-cultural collaboration, and metacognitive skills. In addition, the development of a digital version of this model based on an interactive learning platform needs to be considered to improve the accessibility and applicability of the model.

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