Development and Validation of The Electronic Student Worksheet Assessment Instrument Based on The 4C Skills Oriented RADEC Lecture Model

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ABSTRACT
This study aims to develop an electronic student worksheet assessment instrument based on the RADEC model oriented to 21st-century skills: Critical thinking, Communication, Collaboration, and Creativity. This research uses a descriptive method with the research and development design of the A+2D model, namely, Analyze, Design, and Develop. The instrument was developed by considering the learning needs of 4C skills and the possibility of being taught through RADEC stages. Furthermore, the instruments that have been developed are validated by four expert lecturers for the feasibility and practicality aspects of the E-LKM instrument, which include validating the suitability of the RADEC model stages and the emergence of 4C skills learning. Data collection was carried out by filling out the E-LKM instrument assessment sheet. The assessment data were analyzed using Aikens content validity. The results showed that the content validity of the E-LKM feasibility and practicality assessment instrument was categorized as good, with an average value of 0.95. The E-LKM assessment instrument is feasible and can be used to assess E-LKM based on the 4C skills-oriented RADEC lecture model.

Keywords: *Instrument Development, E-LKM, RADEC, 4C Skills*

1. INTRODUCTION

Higher education has an essential role in preparing students to face the demands of the growing world of work [1]. In facing the digital era, students must have skills relevant to industry needs and be able to adapt quickly to technological changes. In addition, the ability to think critically, communicate, collaborate, and create (4C skills) is important in facing challenges in today's world of work [2], [3].

To optimize 4C skills, many models can be used, namely POE (Predict, Observe, Evaluate). [4], SAVI (Somatic, Auditory, Intellectual), STEAM (Science, Technology, Engineering, Art, Mathematics), SIL (Science Integrative Learning) [5], and Collaborative Inquiry. These learning models can train 21st-century skills, but these models at each stage need to be trained in 4C skills; besides that, these learning models are foreign products that are difficult to apply in the Indonesian context [6]. Among the many models, the learning model is suitable for collaboration with Student Worksheets as the basis for its preparation and can train 4C skills in the Indonesian context is the RADEC model.

One of the lecture models developed to improve 4C skills is the RADEC (Read, Answer, Discuss, Explain, Create) model [7]. This lecture model focuses on the application of teaching practices that involve students actively in the learning process, with an emphasis on the application of concepts relevant to the world of work and in practicing 4C skills. In the RADEC model, students are given worksheets as a guide to conduct learning activities that involve information gathering, investigation, problem-solving, and product or project development [8].

However, in developing and implementing the RADEC course model, there are challenges in objectively assessing student progress and achievement. A practical assessment is needed to ensure students develop the expected 4C skills.

Therefore, this study aims to develop an electronic student worksheet assessment instrument based on the RADEC lecture model and oriented toward 4C skills.

Appropriate assessment instruments can assist lecturers in evaluating student achievement and progress in developing 4C skills [9]. Electronic worksheet-based assessment instruments can provide advantages in ease of use, more objective assessment, and more structured data collection. This assessment instrument is also expected to provide students with meaningful feedback so they can improve and develop themselves more effectively [10].

Developing an electronic student worksheet assessment instrument based on the 4C skills-oriented RADEC lecture model is very important in this context. This research is expected to improve the effectiveness of teaching and learning in higher education by strengthening the assessment of 4C skills in the RADEC lecture model. The results of this study are expected to be used by lecturers and teachers in designing better assessment instruments that support the development of students' 4C skills. In addition, this study can also provide a better understanding of implementing the RADEC model in improving 4C skills and measuring student learning outcomes.

With a quality electronic student worksheet assessment instrument, lecturers can accurately evaluate students' progress in developing 4C skills. This assessment instrument can cover various aspects such as the quality of students' critical thinking, ability to communicate effectively, ability to collaborate in teams, and ability to be creative in solving problems. Electronic worksheet-based assessment instruments can facilitate systematic data collection and allow lecturers to provide specific student feedback [11].

In addition to providing benefits for lecturers, developing this assessment instrument will also benefit students. With a clear and structured assessment, students will have clear guidance on what is expected of them in developing the 4C skills. They will also receive constructive and helpful feedback, which can help them understand their strengths and weaknesses and improve their overall skills.

In the context of career preparation-oriented higher education, it is essential to ensure that students have skills relevant to industry needs and can compete in a competitive job market [12]. Therefore, developing an electronic student worksheet assessment instrument based on the 4C skills-oriented RADEC lecture model is essential in ensuring the quality of learning and preparing students for a successful future.

Thus, this research is expected to significantly contribute to the higher education assessment instrument development and strengthen the implementation of the RADEC lecture model. Through this research, it is expected that there will be an improvement in the understanding and measurement of students' 4C skills and the development of more effective evaluation methods. The results of this study can serve as a reference for higher education institutions in designing better learning strategies relevant to current and future needs.

2. METHOD

This study aims to develop a 4C skills-oriented Electronic Student Worksheet (E-LKM) (Critical thinking, Communication, Collaboration, and Creative thinking). The research method used is descriptive with a research and development design. Gall & Borg (1998) stated that the process used to validate and develop products is research and development. The model used in this research and development is the A+2D model, which stands for the Analyze, Design, and Develop stages derived from the adaptation of the development model found by Dick and Carry (1996), which uses the term ADDIE [14]. Four experts validated the feasibility and practicality of assessment sheet instruments.

The validation sheet data was analyzed using Aiken's validity index (1985) [15]. The validity assessment scale in the content validation instrument uses a 4 scale (1,2,3,4), symbolizing the highest alternative score value of the scale as hi, the lowest score value as lo, and the score of the rater or validator as r, so that the value is transformed into s = r - lo if lo < hi and s = lo - r if lo> hi. The sum of the s values from all raters (or items) is then added to the number of items (n) or the number of raters (m) to produce S. The alternative form of "attitude" choice for the statement used in this study is "good", so the rating scale is determined to be Very Good (SB), Good (B), Fairly Good (CB), and Less Good (KB).

Data processing on the validation sheet through giving a check mark (√) in the alternative answer column with a positive four-scale statement as in Table 1.

Table 1. Instrument Validation Sheet Data Scoring Guidelines

No.	Alternative Answer	Score Weight
1	Strongly Agree (SS)	4
2	Agree (S)	3
3	Disagree (KS)	2
4	Disagree (TS)	1

The validity of the components on the validation sheet was calculated and processed using the content validity test from Aiken (1985), determining the validity of the statement items in the content validation instrument by comparing with the minimum validity value in the Aiken index V table. The validity value of items in this validation instrument is calculated by the formula:

$$V = \frac{\sum S}{[n(c-1)]} \quad (1)$$

Description:

V = content validity l_0 = minimum assessment number r = the score given by the rater
S = r - l_0 n = number of raters c = maximum assessment number

In this study, validators were involved to assess the E-LKM developed with an answer scale of four, and an error rate of 0.05. If the value of $V_{count} \geq V_{table}$ then the item is declared valid [15].

3. RESULT AND DISCUSSION

Analysis Stage

The analysis stage involved analyzing the assessment indicators of each aspect, namely content, language, presentation, graphics, and 4C skills in the RADEC model. In this analysis, an in-depth evaluation of each assessment indicator was conducted to assess the suitability and quality of the electronic student worksheets developed based on the 4C skills-oriented RADEC lecture model. The description of the flow of the analysis stage of each aspect is as follows:

Content Assessment Indicator Analysis Stage: 1) Identification of assessment indicators related to the content aspects of student worksheets; 2) Evaluate the suitability and relevance of worksheet content to lecture material and learning objectives; 3) Review the quality of information, understanding of concepts, clarity, and usefulness of worksheet content. Then, Language Assessment Indicator Analysis Stage: 1) Identify assessment indicators related to language aspects in student worksheets; 2) Evaluate the clarity, accuracy, fluency, and effectiveness of language use in the worksheet; 3) Review the use of appropriate terminology, completeness of sentences, and suitability of language style to the purpose of communication.

Presentation Assessment Indicator Analysis Stage: 1) Identification of assessment indicators related to the presentation aspect of student worksheets; 2) Evaluate the layout, use of blank space, formatting, and organization of information in the worksheet; 3) Review regularity, visual clarity, use of relevant graphs or tables, and consistency of presentation. Stage of Analysis of Graphics Assessment Indicators: 1) Identification of assessment indicators related to the graphical aspects of student worksheets; 2) Evaluate the design, font selection, size, color, and visual elements in the worksheet; 3) Review the suitability of the graphics with communication objectives, readability, and emphasis of important information.

4C Skills Assessment Indicator Analysis Stage: 1) Identification of assessment indicators related to 4C skills in student worksheets; 2) Evaluate students' ability to think critically, communicate, collaborate, and create in the context of worksheets; 3) Review the ability of analysis, argumentation, presentation, and the ability to innovate in problem solving. Each stage of the analysis will involve an in-depth evaluation process of the relevant assessment indicators. This analysis will assist in comprehensively evaluating the quality of the RADEC lecture model-based electronic student worksheets.

Design Stage

After going through the assessment indicator analysis stage, the next step is the design stage. At this stage, planning will be carried out in developing an electronic student worksheet assessment instrument based on the 4C skills-oriented RADEC lecture model.

The description of the design stage is 1) Identify the types of assessment instruments that are in accordance with the research objectives and the aspects being evaluated, such as assessment rubrics, rating scales, or assessment checklists; 2) Based on the results of the previous analysis, design specific assessment indicators for each aspect such as content, language, presentation, graphics, and 4C skills in student worksheets; 3) Select and design the right assessment instrument format, either in the form of an assessment scale, rubric, or checklist, according to the needs and characteristics of electronic student worksheets.

This design stage will ensure that the assessment instrument developed can measure exactly the specified aspects and provide clear guidance in evaluating the quality of electronic student worksheets based on the 4C skills-oriented RADEC lecture model.

Development Stage

After the design stage of the assessment instrument, the next step is the development stage. At this stage, the development of electronic student worksheets based on the 4C skills-oriented RADEC lecture model will be carried out. The description of the flow of this development stage is: Conducting validity tests of the assessment instrument to ensure that the instrument actually measures the desired criteria and has sufficient reliability; then testing the assessment instrument on a sample of electronic student worksheets based on the RADEC lecture model to evaluate the feasibility, clarity, and consistency of the instrument in producing accurate and relevant data.

In this section, a validation instrument sheet is produced as a formative evaluation tool by a team of experts. The validation sheet will be used to validate the feasibility aspects and validate the practicality aspects of the E-LKM. The E-LKM Instrument Sheet was validated by 4 validators. Aspects of instrument validation are aspects of content feasibility, language feasibility, presentation feasibility, graphic feasibility, and feasibility of E-LKM based on the 4C-oriented RADEC model. The validation of the instrument produced validity data calculated using Aiken's validity formula (1985).

The validity data for each aspect of the E-LKM component or each statement item is shown in Table 2.

Table 2. Validity on All Aspects E-LKM Assessment Instrument

Aspects	Value $\bar{X}$ V_{hitung}	Value V_{tabel}	α	Criteria	Decision
Contents	0.94	0.92	0.05	$V_{count} \geq V_{table}$	Valid
Language	0.96	0.92	0.05	$V_{count} \geq V_{table}$	Valid
Presentation	0.92	0.92	0.05	$V_{count} \geq V_{table}$	Valid
Graphics	0.96	0.92	0.05	$V_{count} \geq V_{table}$	Valid
4C Skills in RADEC	0.97	0.92	0.05	$V_{count} \geq V_{table}$	Valid
$\bar{X}$	0.95	0.92	0.05	$V_{count} \geq V_{table}$	Valid

Based on the table, it can be seen that the Vcount ≥ Vtable all aspects is greater than the Vtable value, namely the Vcount value in the content aspect of 0.94, the language aspect of 0.96, the presentation aspect of 0.92, the graphic aspect of 0.96, and the 4C skills aspect in RADEC 0.97 with an average value of 0.95 greater than the Vtabel so that it can be stated that all aspects of the assessment in the instrument are valid.

This development stage aims to produce electronic student worksheets that are in accordance with the RADEC lecture model and have a 4C skills orientation. The worksheets are expected to help prospective elementary school teachers develop the skills and understanding needed in the context of science learning. At this stage, evaluation and improvement of the 4C skills-oriented RADEC lecture model-based electronic student worksheets were carried out based on the input and suggestions provided by the experts. Table 3 shows the results of expert suggestions and the follow-up conducted by researchers.

Table 3. Revised E-LKM Validation Instrument

Aspects	Validator Revision Suggestions	Follow-up
Presentation	In the indicator of the suitability of E-LKM with the needs of student teaching materials can be divided into 2: • Suitability of E-LKM with student needs • Suitability of E-LKM with the needs of teaching materials	In the content feasibility indicator, point 4 is divided into 2 according to the suggestions, so that in the aspect of content feasibility there are 5 points
Contents	It is better to add the objectives of the student activities that will be carried out before writing the E-LKM instructions.	In the presentation feasibility indicator point 1, a sentence is added according to the suggestion
Graphics	Focused on the design and layout in question	In indicator points 2 and 3 corrected as suggested, the layout is a layout while the display design is a display
Language	Typo and formatting corrections	Typos and errors in writing and formatting were corrected as suggested.
Presentation	The rating points which were originally a scale of 4 (Strongly agree, Agree, Disagree, Disagree) were changed to a scale of 2 (Yes and No) so that there is affirmation.	The E-LKM rating scale was changed to a Yes and No scale as suggested.

After the E-LKM validation instrument sheet has been validated and revised according to the suggestions of the validator, then the instrument can be used for the assessment of the 4C skills-oriented RADEC-based E-LKM.

4. CONCLUSION

The E-LKM assessment instrument was developed and validated using Aikens content validity to get a score of 0.95 with a valid category. Based on these results, the E-LKM assessment instrument can be used to assess the feasibility and practicality of the 4C skills-oriented RADEC model-based E-LKM. This worksheet assessment instrument can be implemented to assess 4C-oriented RADEC-based E-LKMs developed by other researchers.

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