



Development and Validation of Student Worksheets Air Theme based on the RADEC Model and 4C Skill-oriented

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Abstract: 4C skills have become part of the current elementary school curriculum, which is expected to improve the quality of education so that graduates are ready to compete in the global world. Student worksheet, based on the RADEC model, is needed as a learning tool that can help participants practice 4C skills. This study aims to develop and validate the Student Worksheet based on the RADEC model on the theme of aerial skills-oriented 21st century: critical thinking, collaboration, creativity, and communication (4C). This research and development (R&D) use the ADDIE model (Analyze, Design, Develop, Implement, Evaluate). This research was carried out until the development stage or validation stage. The validity of the student worksheet is determined by an assessment of media, materials, and language on a scale of four, validated by twenty-five teachers who have attended the RADEC model workshop for three days. The data obtained were tabulated by calculating the validity of the quantitative and descriptive analysis. The development results show that the student worksheet based on the RADEC model to train 4C skills is declared valid with the calculation results $V_h > V_t$ or $V_h > 0.64$ and is suitable for use in learning. This research can be used as information on the development and validation of teaching materials, especially student worksheet, based on the RADEC model to train 4C skills in science materials in elementary schools.

Keywords: Air; RADEC; Student worksheet; Development; Validation

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Introduction

21st-century skills are skills that 21st-century humans must build; humans succeed in this century if they have 21st-century skills (Bialik & Fadel, 2015). The US-based Partnership for 21st Century Skills (P21) identifies competencies needed in the 21st century, including "The 4Cs" – communication, collaboration, critical thinking, and creativity. These essential competencies are taught to students in core subject areas and 21st-century themes. The Assessment and Teaching of 21st Century Skills (ATC21S) categorizes 21st-century

skills into four categories: ways of thinking, ways of working, tools for working, and skills for living in the world (Abidin, 2016).

Educational institutions are required to be able to innovate to facilitate students to have the skills needed in the 21st century (Bialik & Fadel, 2015; Redhana, 2019). Research-based knowledge of 21st-century skills is dynamic and evolving. In line with the increasing interest in teaching and assessing 21st-century skills, educational researchers have made significant efforts to improve the quality of learning, especially regarding cognitive processes in students who emphasize context

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in learning and assessment. These changes led to the development of various contextual learning methods in education (Erwina et al., 2015). Contextual learning and teaching are based on cognitive situations that construct students' thinking processes such as critical thinking, inquiry, and problem solving that are adapted to students' intellectual and social conditions. This contextual learning prepares students to learn to face complex problems in the future (Glynn & Winter, 2004). 21st-century skills direct students to "how to learn, how to work, work tools, and live in the world." Learners must also learn essential skills for success in today's world, such as critical thinking, problem-solving, communication, and collaboration (Kartimi et al., 2021).

4C skills have become part of the current elementary school curriculum, which is expected to improve the quality of education so that graduates are ready to compete in the global world. The current primary school curriculum aims to develop 21st-century skills, such as critical thinking, creative thinking, collaboration and communication skills (4Cs skills), and information and communication technology media competencies. The current Indonesian curriculum emphasizes student character development, literacy, higher-order thinking skills (HOTS), and 4C. Teachers need to design a learning model following the characteristics of the current curriculum, which in its implementation uses a thematic-integrative learning approach. 4C (Creativity and innovation, Critical thinking and problem solving, Communication, and Collaboration) is required to create "globally competitive learners." Therefore, education policymakers must create a system with the above needs in today's education landscape.

Research on effective pedagogical frameworks to support 21st-century skills based Van Gompel (2020) confirms that in primary education is still limited, and educators agree that primary school students should be oriented to these skills. It is not too young to instill in elementary school students the 4C learning aspects (Alghamdi & Al-Ghamdi, 2021). Creativity is needed for critical thinking and oral communication. Collaborative skills are essential for primary students to express thoughts and share ideas jointly.

The Student Worksheet is a learning aid that provides a smooth learning experience. Student Worksheet must not only contain information and questions but also teach students in 21st-century abilities (Rahmawati & Yonata, 2019). Student Worksheet is teaching resources and facilities that allow the implementation of learning plans in the form of activity sheets containing instructions, content summaries, and steps to complete questions that refer to basic skills that must be achieved by students (Hamdani, 2011). Titles, learning guidelines, learning indicators, supporting

materials, work processes, and assessments are all included in the Student Worksheet (Prastowo, 2015).

Learning models assist good learning, and teachers must create alternative learning models that reflect the Indonesian context when they find it difficult to organize information with the needs of the times. RADEC is a learning paradigm adapted to Indonesian students' specificity. Sopandi (2019) presented this approach at an international conference in Kuala Lumpur, Malaysia. The syntax of this model is Read, Answer, Discussion, Explain, and Create (RADEC), which can improve the quality and learning outcomes in Indonesian contexts and scenarios. This approach is a paradigm shift in education that aims to develop 21st-century competence, character, and literacy while at the same time preparing students for school or university exams. Learning outcomes, both conceptual knowledge and creative thinking skills, are positively influenced by the procedures used to study content (Pratama et al., 2020). The RADEC learning model has developed into a cutting-edge learning paradigm to develop 21st-century characteristics and abilities (Sopandi, 2019).

Based on research by Maulana & Sopandi (2022), the existing student worksheets in the field do not fully meet the standards, do not support specific learning models, and do not train 21st-century skills. Sari & Wulanda (2019) have developed project-based student worksheets but only train thinking skills (Febriani, 2016) developed student worksheet to train student activities, but the completed student worksheet has not trained 4C skills. Development of POE-based student worksheet measures critical thinking skills to respond positively to products and the necessary thinking skills (Saputra et al., 2020). However, the student worksheet developed only trains critical thinking skills. From this discussion, there is no student worksheet as a learning medium based on the RADEC model and for 21st-century skills, namely critical thinking and problem solving (Julian, 2019), creativity and innovation (Umriani, 2019), communication (Sapto et al., 2015), and collaboration (Fitriyani et al., 2019) or called 4Cs can be trained. Therefore, this article develops student worksheet based on the RADEC model to practice 4C skills on the Air Theme. This study aims to develop and validate the Student Worksheet based on the RADEC model on the theme of aerial skills-oriented 21st century: critical thinking, collaboration, creativity, and communication (4C).

Method

This research is in the form of research and development (R&D) of Student Worksheets with the ADDIE development model with the stages by Tegeh & Kirna (2013), namely Analyze: needs analysis stage, content analysis, Competence analysis; Design: The

stage of designing the contents of the student worksheet; Develop: The student worksheet development stage is validation and revision test; Implement: limited trial to students; and Evaluate: evaluation of each stage in all stages, but in this study only up to the development and validation stage. The validation instrument contains an assessment of the student worksheet, which includes an assessment of the material, media, and language.

The 4C indicator assessment is added to the RADEC model in the material assessment. The student worksheet was validated by 25 teachers who attended the Workshop on critical and creative thinking through the RADEC model in Purwakarta on Wednesday-Saturday 25-28 May 2022. The data obtained were tabulated, and the validity value was calculated and then analyzed quantitatively descriptively. The validity of the components on the validation sheet is 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 them with the minimum validity values in the Aiken V index table (Aiken, 1985). The formula calculates the value of the validity of the items in this validation instrument:

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

Information:

V = Content validity

S = reduction of the rater's score (r) with a minimum score (I₀)

n = number of raters

c = maximum rating score

The calculated value is compared to the minimum threshold value in the V table in deciding validity. If the V count (V_n) is more significant than the V table (V_t), then the item on the assessment aspect is declared valid.

In this study, there were 25 validators with a rating scale of 4, and the degree of error was 0.05, so the V table used was 0.64 so that the aspect items were declared valid if the V count value was more significant than 0.64.

Result and Discussion

Student Worksheet based on RADEC Learning and 4C Skills Indicators

This development research begins by analyzing the needs according to the literature study, then analyzing the essential competencies of air material in the elementary school curriculum. Air material is a material that, according to researchers, is important to be taught as a prerequisite material because students need to know the concept of air before studying the material on these section two in thematic learning, namely clean air for health in class V (Five) in the first semester.

After determining the material and competence, the competency achievement indicators (ICK) are determined. Researchers develop indicators according to learning in RADEC. In addition to having to know the concept of the material in it, there is also a creation stage where students have to investigate or solve problems or create works as follows: Explain the meaning of air; Describe the properties of air; Designing investigations, problem-solving, or outcomes related to air properties; Making investigations, problem-solving, or works related to air properties.

After determining the indicators, the learning objectives are arranged according to these indicators. The next stage is to make pre-learning questions according to the indicators.

In analyzing the 4C skills in RADEC learning, researchers determine the indicators of each skill. The analysis of 4C skills in RADEC learning can be seen in Table 1.

Table 1. Analysis of 4C Skills in RADEC learning

Syntax	Trainable 4C Skills	Trainable Skills Indicator
Read	Critical thinking	Collect and compile the necessary information
	Communication	Understand the essence of the message from the information read
Answer	Critical thinking	Give a simple explanation
	Communication	The ability to answer questions in writing and build arguments
Discuss	Critical thinking	Ability to interact and exchange information with others
	Communication	Have the ability to express arguments and ideas
	Collaboration	Have the ability to work in groups
Explain	Critical thinking	Presentation; interact with other people
	Communication	Explain the results of group discussion
Create	Critical thinking	Using their abilities to try to solve problems
	Communication	Using the ability to express ideas, both during discussions, inside and outside the classroom, as well as in writing
	Collaboration	Adapt to various roles and responsibilities, work productively with others
	Creativity	Able to express creative ideas

The next stage is the design stage: planning the student worksheet design by compiling a storyboard containing points and what materials need to be

included in the student worksheet. The results of this stage can be seen in Figure 1, which is the cover display. Figure 2 contains student worksheet information,

including instructions for use, indicators, and learning objectives. Figure 3 contains student worksheet content. An overview of student activities in at each stage of RADEC can be seen in Table 2.



Figure 1. Cover of Student Worksheet

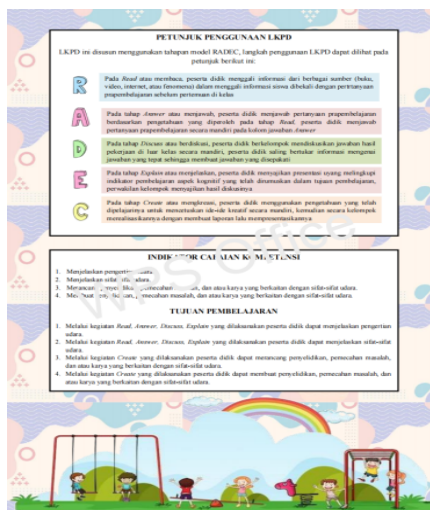


Figure 2. Information of Student Worksheet



Figure 3. Content of Student Worksheet

Table 2. Student Worksheet Seen from RADEC Syntax and Student Activities

Syntax and Display	Activity
<p>Read</p>	<p>Students explore information from various sources (books, video, internet, or phenomena) in extracting information students are equipped with pre-learning questions before meeting in class</p>
<p>Answer</p>	<p>Students answer pre-learning questions based on the knowledge gained at the Read stage, students answer pre-study questions independently in the answer column</p>
<p>Discuss</p>	<p>Students in groups discuss the answers work outside the classroom independently, students exchange information about the right answer to make the agreed answer</p>
<p>Explain</p>	<p>Students present presentations that cover indicators of cognitive aspects of learning that have been formulated in the learning objectives, group representatives present the results of their discussions</p>
<p>Create</p>	<p>Students use the knowledge that has been learned to come up with creative ideas independently, then in groups make it happen by making a report and then presenting it</p>

Formative Evaluation Test

The next stage is the development of student worksheet, in addition to making and assembling student worksheet, which includes writing text, adding images, adding video links, adding characters according to the storyboard also a formative evaluation was

carried out, namely material and media validation by material and media experts, to determine whether the media was feasible to be applied or tested in classroom learning. So that later suggestions will be obtained to

improve the student worksheet before it is implemented or tested in the field. The validation results can be seen in Table 3.

Table 3. Recapitulation Student Worksheet Validation

No	Aspect	Score of Validation			Decision
		$\sum S$	V_h	V_t	
Media Expert Validation					
1	Display quality	62	0.83	0.64	$V_h > V_t$
2	Layout quality	65	0.87	0.64	
3	Attractiveness	68	0.91	0.64	
4	Learning objectives	68	0.91	0.64	
5	Motivation and religion text	65	0.87	0.64	
6	Illustration and image Quality	70	0.93	0.64	
Category Mode					
Valid					
Material and 4C Expert Validation					
7	Contekstual material	68	0.91	0.64	$V_h > V_t$
8	Easy to understand material	69	0.92	0.64	
9	Read stage train critical thinking and communication	69	0.92	0.64	
10	Answer stage train critical thinking and communication	67	0.89	0.64	
11	Discuss stage train collaboration, critical thinking, and communication	68	0.91	0.64	
12	Explain stage train communication and critical thinking	66	0.88	0.64	
13	Create stage train creative thinking, critical thinking, collaboration, and communication	69	0.92	0.64	
Category Mode					
Valid					
Language Expert Validation					
14	Sentences and paragraphs quality	63	0.84	0.64	$V_h > V_t$
15	Easy to understand language	66	0.88	0.64	
16	Simple dan easy to understand letters	68	0.91	0.64	
Category Mode					
Valid					

Based on the validation results, which can be seen in table 3. The student worksheet developed was considered valid with the calculation value V count (V_h) greater than V table (V_t) or the minimum Aikens validity limit. This shows that the student worksheet developed is requirements and suitable for learning.

In the media aspect, the quality of illustrations and images gets the highest V_h , which is 0.93. This is because the student worksheet is equipped with the characters Jaja, Jeje, and Jojo as a guide for students in working on the student worksheet and making the student worksheet more interactive. The pictures and colors of the worksheets are also adjusted to the psychology of elementary school children who like bright colors.

The average V_h is high on the material and skill aspects of 4C. This follows the contextual content of the student worksheet, and the material is easy to understand. Pre-learning questions that are arranged according to indicators and related to everyday life, students can understand the phenomena that occur in their environment (Pratama et al., 2019).

On the material and skill aspects of 4C, the average V_h result is relatively high, which is between 0.88 until 0.92. This is inseparable from the content and material analysis stage and the RADEC learning syntax, which is suitable for practicing 4C skills which is compiled according to the 4C indicators. This is supported by

statements from some literature that RADEC can train 4C skills (Pohan et al., 2020; Ramadini et al., 2021).

The low aspect of other aspects is in the display quality points with a V_h of 0.83. This is because the student worksheet design uses Microsoft Office to produce a less smooth appearance. The student worksheet display still needs to be developed using software such as Corel Draw, the Canva website, or applications that have a smooth appearance. The quality of the appearance of images and backgrounds in student worksheet can increase the interest of the reader (Rahlinda et al., 2022).

Based on comments from validators stated that "The developed worksheets are good and easy to understand." This is appropriate because the student worksheet is developed through several analyzes, namely curriculum analysis, concept analysis, student analysis, and task analysis, and is accompanied by revisions or improvements. Based on Fatmawati (2016) statement that gradual and continuous development can produce quality products.

Overall, it can be concluded that the RADEC-based Student Worksheet on air material to train 4C skills is very valid and feasible to use to help lessons in class so that learning can be more effective and optimal.

Conclusion

Student Worksheet based on RADEC model in air material is very valid based on the V_h and V_t of appropriateness criteria based validation content from Aikens. The aspect validation assessment are media, material and the compatibility to 4C indicators, and language get value $V_h > V_t$ with category mode is valid. In addition, the student worksheet is very practical based on teachers' responses as practitioners. student worksheet based on the RADEC model, is interesting for students to teach them 4C Skills. This research can be used as information on the development and validation of teaching materials, especially student worksheet, based on the RADEC model to train 4C skills in science materials in elementary schools. Further research is expected able to implement this student worksheet-based RADEC in students.

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