Validation of an Interactive e-Worksheet with Solar System Scope Assistance

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Abstract *- The use of e-worksheets is important in 21st-century learning. The purpose of this study is to assess the validity of an interactive e-worksheet based on a scientific approach with the help of Solar System Scope designed for junior high school students and focusing on solar system materials. This is crucially important because a number of challenges students face in grasping the understanding of the abstract scientific concepts, such as the solar system, which is difficult to be understood through normal teaching practices. The way this is being undertaken is through construct validity in which product evaluations are obtained from validators by researchers' developed instruments. This instrument was created using the e-worksheet feasibility indicator as the foundation. The indicators were evaluated and then grouped into five categories. The findings of the study show that the e-worksheet made is very valid. The presentation component has an average validity percentage of 94.42%, the linguistic aspect has an average validity percentage of 90%, the content element has a validity percentage of 93.75%, and the design aspect of e-worksheet also has a validity percentage of 91.67%. This shows that e-worksheet has extraordinary quality in terms of presentation, language, content, and design. The findings of this study can be used to improve the efficiency of the process of acquiring the concept of the solar system in the framework of 21st-century education.*

Keywords*: e-Worksheet; Solar System Scope; Solar System; Scientific Approach*

INTRODUCTION

The infusion of technology within education has gained leverage in the teaching-learning process due to the interactive platform that it has been able to construct for students. One way to validate the Scientific Approach-based Interactive e-worksheet (Electronic Student Worksheet) supported by Solar System Coverage material concerning is as a solution to the limitations which are brought by traditional approaches of teaching, since they lack interactivity and may not fully engage the student in learning. Teachers hope to bridge the gap that digital tools provide and ensure the right effects of pedagogical practices in combination with scientific methods (Galkienė & Monkevičienė, 2021).

Though research suggests the positive impact that interactive, science-based learning experiences may present, in practical teaching, there remains a significant gap or discrepancy between the vast theoretical benefits that technology-based education provides and the practical application in a classroom setting. Even though findings from research point out some of the benefits associated with such interactive, science-based learning experiences, their actual inclusion within the teaching practice is riddled with various challenges related to the application of pedagogies and technological constraints (Zhang, 2023). This gap must be addressed with an understanding of current theories and research findings that support interactive e-worksheet in conjunction with a Scientific Approach to improve student learning outcomes. (Muhammad et al., 2022).

The value of these recent studies lies in the possibility of enriching traditional pedagogical strategies and further enhancing student engagement and understanding. The justification for using interactive e-

worksheets, supported by Solar System Scope and based on the Scientific Approach, can help facilitators enhance the quality of learning and support students in actively participating in an inquiry-based process to better understand complex scientific concepts (Mahmudah, 2023). This not only advances educational technology but also marks a continued shift toward an evidence-based approach in shaping contemporary pedagogical strategies (Alves, 2023).

Merging frontier science literacy research with interactive learning tools, such as e-worksheet, will transform how students can interact with complex scientific ideas. Adhering to Scientific Approach principles and applying them through the use of interactive platforms like the Solar System Scope makes it possible for educators to immerse learners in experiences that are very effective in the learning process, enabling students to think critically and inquire effectively (Beniermann et al., 2021). This novel approach is innovative not only in facilitating the student-friendly understanding of the solar system but also for inducing fundamental skills such as problem-solving, and data interpretation (Adri et al., 2020).

The validation of the interactive e-worksheet is aimed at broader objectives, including supporting inclusive education and transforming the learning environment through the Scientific Approach with Solar System Scope materials. The use of technology to create interactive and accessible learning resources would ensure that diverse needs were met and that equally quality education was accessible to all. This is made possible by employing technology in developing interactive and accessible learning resources (Zamiralova et al., 2019). This research has added great weight to the ongoing debate on policies for inclusion within education, focusing on the potential for digital tools to create an inclusive and engaging learning environment (Jedemark, 2019).

This research aims to find out the validity of e-worksheet based on a scientific approach, assisted by materials from solar systems for junior high school students. This validation is necessary because abstract science topics, like the solar system, face challenges in developing conceptual understanding through traditional learning methods. The use of interactive, technology-based e-worksheets can help students overcome difficulties in visualizing concepts related to the solar system, hence promoting better understanding and enhancing the overall science learning experience.

RESEARCH METHODS

This research is part of research and development (R&D). The main focus of this study is to determine the validity of the PBL-Assisted Interactive e-worksheet Virtual Lab developed, which is included in the design and development stage of the 4D development model (Thiagarajan & Sivasailam, 1974). Validation was carried out by three validators. The instrument used to collect validation data employed a 1-4 scale. Validation was conducted by three independent validators who were graduate students in science education, each with a background in science education and curriculum development. The product validation utilized a 1-4 rating scale, with validators assessing based on the quality of content, the relevance of the material to the curriculum, interactivity, and ease in the use of material. The validation results were analyzed using descriptive statistics and are shown according to the instrument category in Table 1.

Table 1. Product Validity Criteria

No	Percentage	Criteria
1	0-20	Invalid
2	21-40	Less valid
3	41-60	Moderately valid
4	61-80	Valid
5	81-100	Very valid

Validation was conducted by considering various aspects that reflect the quality and effectiveness of the interactive e-worksheet in supporting the learning process of junior high school students on solar system material. The validation results were then categorized to determine the overall level of product validity.

RESULTS AND DISCUSSION

This research mainly focuses on the material of the solar system as stated in the e-worksheet material. Figure 1 and Figure 2 present the display of the e-worksheet which includes an overview of the cover and examples of the use of solar system scope with a scientific approach. The steps of the scientific approach learning activities include questioning, collecting data, analyzing and communicating. Students are asked to make relevant questions related to the solar system (Pertiwi et al., 2023; Plummer et al., 2015; Saputro & Subekti, 2023). Students collected data from the results of analysis of the use of solar system scope related to the classification of planets (Plummer et al., 2015; Prima et al., 2018; Rustaman et al., 2018). Students collect data in tables that have been provided on the e-worksheet. Students analyze and answer essay questions and finally students present the results of group work in creating works that can be uploaded on social media (Pertiwi et al., 2023; Plummer et al., 2015; Saputro & Subekti, 2023).

Figure 1. Cover e-worksheet Solar System

Figure 2. Web Solar System Scope

After the e-worksheet is prepared, experts carry out the validation procedure. Validation is a crucial stage in the development of educational tools, such as e-worksheet. Validation studies assess the reliability of an instrument in accurately measuring the intended target (Margaretha, 2024). E-worksheet based on the Solar System Scope Assisted Scientific Approach on Solar System material received high assessments from experts during the validation process. This e-worksheet shows that it is valid to be used from the assessment in terms of content, layout, and conformity with the Scientific approach.

The superiority of e-worksheet is in its integration with the Scientific Approach, providing students with real problem situations related to the solar system. According to research by Safitri and Rahayu (Safitri & Rahayu, 2022). e-worksheet guided by inquiries into membrane transport material trains students' critical thinking skills. Moreover, (Fitriani et al., 2021) shows that e-worksheet based on the ecosystem concept can improve students' critical thinking skills. In this context, e-

worksheet not only facilitates theoretical understanding of concepts, but also enriches students' ability to think critically and solve problems, in accordance with the findings of Puriasih and Rati (Puriasih & Rati, 2022).

It is in this significance to middle school students that e-worksheet (Electronic Student Worksheet) will be measured for its relevance to middle school students. From these results, it was determined that the teaching and learning materials are fit for middle school students. The contents given are within their cognitive capacity and make it possible for the students to access and use the e-worksheet effectively. This finding parallels preceding research which has emphasized that a relevance of educational media is required for effective learning.

The validation results show that the e-worksheet is in accordance with the Independent Curriculum for junior high school students. The material about the solar system is delivered in an easy-to-understand and sequential way so that students can understand the concept of solar system matter, its components, and the phenomena that occur. The curriculum has also been adapted to a Scientific Approach that encourages students to solve real-life problems related to solar system materials.

The e-worksheet design is considered very effective in supporting the learning process. The intuitive design increases the ease of student engagement with the subject. The Solar System Scope that comes with the simulation provides a comprehensive understanding of the concept of the solar system through visual means. Table 2 presents the aspects and indicators used for the validation of e-worksheet (Huda et al., n.d.; Puspita Sari et al., 2022; Setiawan & Fikri, 2022).

Table 1. Validation Indicators e-worksheet

No	Aspects	Indicator
1	Presentation	Accuracy of information presentation
		Settings for illustrations and images
		Configuration options for structuring and displaying elements
2	Language	Compatibility of the language used with EYD
		Simplicity of sentence structure
		Clarity of indications and instructions
		Question sentences do not contain double meanings
		Communicative nature of the language used
3	Content	Conformity with indicators of learning outcomes
		The truth of the content/material supports the clarity of the material
		Suitability of e-worksheet with the needs of students
		Feasibility as a learning tool
4	e-worksheet *Design*	The appearance of the layout on the cover of the e-worksheet (title, illustration, logo, etc.) is arranged harmoniously
		The letters used are attractive and easy to read
		Consistent layout placement (title, illustration) of each page
		Doesn't use a lot of typefaces
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		Doesn't use a lot of typefaces
		Colors and layouts match and clarify the function
		The images presented are attractive and support the clarity of the material

The evaluation of e-worksheet validation includes four main areas consisting of various aspects and indicators. The presentation factors include the firmness of the content delivery, the arrangement of illustrations/pictures, and the arrangement of the layout, all of which strive to ensure the presentation of the content in a clear and structured manner. Linguistic aspects include language compatibility with EYD (Indonesian Style Guide), communicative language, clear sentence structure, language does not have double meanings and clear directions.

These aspects aim to ensure that the language used is appropriate and communicative so that students can understand it well. The content aspect includes a set of indicators of the content of the material in the e-worksheet with the adjustment of the independent curriculum. Aspects in the design of e-worksheet are some aspects of design that are to do with aesthetics of the LKPD design, which shall help ensure that the learning content will effectively represent the learning objectives and also attractive and relevant to the students. Elements in e-worksheet design could embrace the visual presentation of cover layout, attractive use of typography with a consistent layout on each page of e-worksheet, the use of a few pieces of typographies applied, cohesive color schemes, and layout. As well as visually appealing images that increase the clarity of the content. Together, these aspects ensure that the e-worksheet has an attractive and functional appearance.

Table 2. Results of e-worksheet validation

No	Aspects	Average Percentage %
1	Presentation	94.42
2	Language	90
3	Content	93.75
4	e-worksheet Design	91.67

The results of the validation of the e-worksheet instrument based on the Solar System Scope Assisted Scientific Approach show that the aspects of presentation, language, content, and design have been well evaluated by three validators. The average percentage for the presentation aspect was 94.42%, which shows that in general the material is presented quite clearly, although there is still room for improvement in the setting of illustrations and layouts. The language aspect obtained an average percentage of 90%, reflecting that the use of language in the e-worksheet is in accordance with the EYD and is quite communicative, but there needs to be an improvement in avoiding the use of sentences that can cause double meanings (Siregar, 2023; Wahyuni & Yurnetti, 2023).

The research findings present that the developed e-worksheet comes at a high level of validity; this can be seen from the percentage indicated to, among others, the aspect of presentation at 94.42%, language at 90%, and design at 91.67%. The strength of this e-worksheet lies in the embedding of the Scientific Approach for the student when given real-world problem scenarios dealing with the solar system. This is in accordance with research by Safitri and Rahayu (Safitri & Rahayu, 2022), who found out that e-worksheets, based on the inquiry method, develop students' ability to think critically. Still, its application in classrooms faces several serious challenges: technology limitations in some schools and teachers being ill-equipped in the use of some digital tools. As reported by Fitriani et al.

This study supports the fact that the use of an e-worksheet in Scientific Approach has a great influence on students' understanding, helping them improve their understanding of abstract concepts, such as the solar system, which is often difficult to explain through conventional ways. Moreover, Solar System Scope is a visual resource, which contains interactive simulations helpful for gaining general knowledge on solar system concepts. However, the space could still have been developed better in terms of the illustration and layout arrangement (Siregar, 2023). In the language respect, some of the validators pointed out that ambiguous sentences need to be avoided within the material (Wahyuni & Yurnetti, 2023). This study also underlines that the design of the e-worksheet may be considered attractive and supports the clarity of the material, but it still requires further training for teachers to have it implemented to the fullest.

In general, the validation is good to confirm that the e-worksheet could be an effective learning tool but need to consider many technical as well as pedagogical challenges in its implementations which will be a subject of future research. These findings are in line with prior literature that accentuates the use of appropriate educational media to assist in improving students' learning results.

In terms of content, the e-worksheet instrument received an average percentage of 93.75%, showing that the material was in accordance with the learning objectives and achievements. The validator also assessed that the content of the material was correct and supported the clarity of the material. The design aspect of e-worksheet obtained the highest average score of 91.67%, which shows that the layout, use of letters, and color combinations are attractive and consistent, and support the clarity of the material. Overall, the validation shows that e-worksheet can be used well as a learning tool although there are still several points that need to be improved.

CONCLUSION

The results of the validation of e-worksheet based on the Scientific Approach Assisted by Solar System Scope on the Solar System material of junior high school students showed excellent validity. Based on the assessment of three validators on the aspects of presentation, language, content, and design, this e-worksheet obtained an average percentage that was included in the very valid category according to the product validity criteria. The clarity of the material, the suitability of the language with the EYD, the simplicity of the sentence structure, the clarity of the instructions, the relevance of the content, and the attractive and functional design all support this e-worksheet as an effective learning tool.

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