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Implementation of Student Worksheets in Chemistry Learning: A Case Study about Rare Earth Elements in Socioscientific Issue at Secondary Islamic School

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Abstract

This study aims to explore the effectiveness and efficiency of using Student Worksheets in chemistry learning at MAN 2 Kota Serang, one of public secondary Islamic school. The method in this research is R&D with a 4-D development model (define, design, develop, disseminate). The topic introduced in two days meeting (90 minutes each meeting) to students revolves around the periodic table of elements, with an emphasis on the usage and utilization of rare earth elements in daily life. Assessment is conducted through student response questionnaires regarding the use of the prepared Student Worksheets. The student's response from questionnaire were analyzed using descriptive statistic based on the percentage each item of the questionnaire (12 items of 5 Likert scale questionnaire). Analysis of the implementation results indicates that the prepared Student Worksheets is effective and efficient in teaching the topic of the Periodic Table of Elements with a Socio scientific Issue approach. The findings of this research make a significant contribution to the development of chemistry learning materials oriented towards SDGs, highlighting the importance of using Student Worksheets to enhance student understanding and participation in chemistry learning.

Keywords: Student Worksheets; Chemistry Learning; Rare Earth Elements; Sustainable Development Goals (SDGs); Socio-scientific Issue

INTRODUCTION

This study investigates the effectiveness and efficiency of implementing Student Worksheets in chemistry education at MAN 2 Kota Serang, a public Islamic secondary school in Indonesia. The unique context of this school, where students reside in a dormitory and are restricted from using mobile phones, presents a distinctive learning environment. Moreover, the students' demonstrated preference for social subjects over science subjects and the absence of specialized chemistry textbooks raise questions about their engagement with the subject matter.

Student worksheets have been shown to be effective tools in science and chemistry education. Studies have demonstrated their positive impact on student learning outcomes, with effect sizes ranging from medium to very high (Chutami & Suhartini, 2021). These worksheets can be designed to incorporate various pedagogical approaches, such as science process skills (Ardhiantari *et al*., 2015) and Science, Technology, and Society (STS) learning (Fartiwi *et al*., 2019). When developed properly, these worksheets can meet didactic, construction, and technical requirements while remaining attractive to students (Ardhiantari *et al*., 2015). Overall, the use of well-designed student worksheets in chemistry education appears to be a promising approach for enhancing student engagement and learning outcomes.

To address these challenges, the study will evaluate the impact of Student Worksheets on student learning outcomes in chemistry. The student worksheets will be introduced to two classes, comprising a total of 52 students, over two days of instruction. By examining the students' performance and understanding of chemistry concepts after using student worksheets, this research aims to determine whether this pedagogical approach can enhance their learning experience and improve their overall chemistry achievement.

METHOD

The method in this research is R&D with a 4-D development model (define, design, develop, disseminate). The topic introduced in two days meeting (90 minutes each meeting) to students revolves around the periodic table of elements, with an emphasis on the usage and utilization of rare earth elements in daily life. Assessment is conducted through student response questionnaires regarding the use of the prepared Student Worksheets. The student's response from questionnaire were analyzed using descriptive statistic based on the percentage each item of the questionnaire (12 items of 5 Likert scale questionnaire). The development steps in this research were carried out by referring to the 4D Models development model, namely in Table 1.

Table 1. Research Procedure

Steps	Implementation
Define	Initial observation
Design	Determine the concept, Arrangement of the instrument, Design the product
Develop	Validation of instrument Exploration which is focused on research interview, Observing, data collection and documentation, Record and classify the data intensively, Describing the data about the use of the worksheet
Disseminate	Disseminate the results of the product

The data collection technique in this study is by observation and distribution of questionnaires. Observations are conducted to analyze the needs in development and to analyze problems that occur in learning. The distribution of questionnaires is conducted to students to determine the efficiency and effectiveness of the products developed based on student responses.

RESULTS AND DISCUSSION

Define

The identification of problems that occurred from this study is the lack of teaching materials and also the lack of preparation of student worksheets for chemistry learning in cross-interest elective subjects in the IPS class at MAN 2 Kota Serang.

Design

This phase focuses on creating the student worksheets. It starts by setting learning goals, gathering resources, and outlining the structure of the worksheets. We'll also develop a system for organizing the content and design digital tools to support the worksheets. Additionally, we'll create instruments to evaluate the worksheets and gather feedback from students. Each draft instrument is first validated by seeking expert opinions on the developed assessment tool. Here's a preliminary look at what the worksheets might look like.

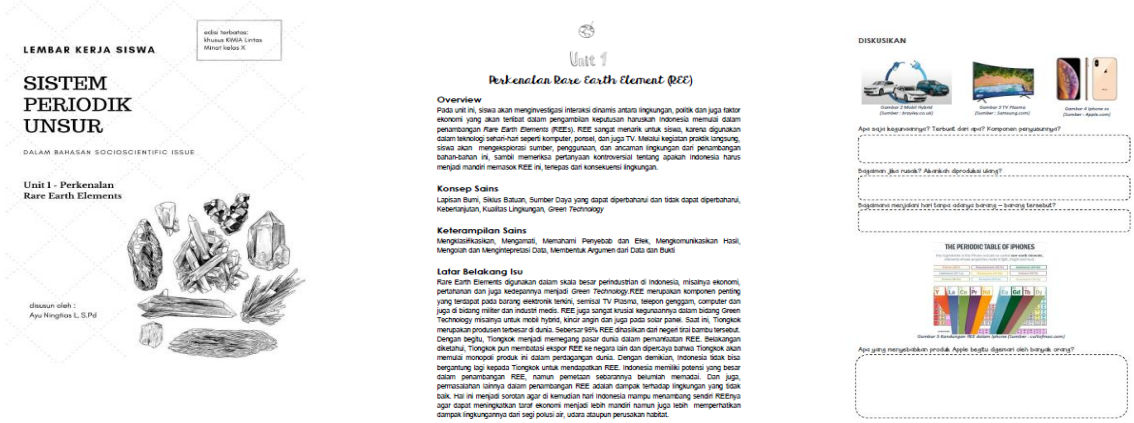


Figure 1. Initial design of the student worksheet developed

Develop

This phase focuses on creating effective and efficient research materials. To ensure the effectiveness of the final product, we conducted a validation process. Once the student worksheet draft was finished, we sought expert opinions on its design and content. Three experienced chemistry teachers evaluated the worksheets' validity. You can see the results of this validation in the image below.

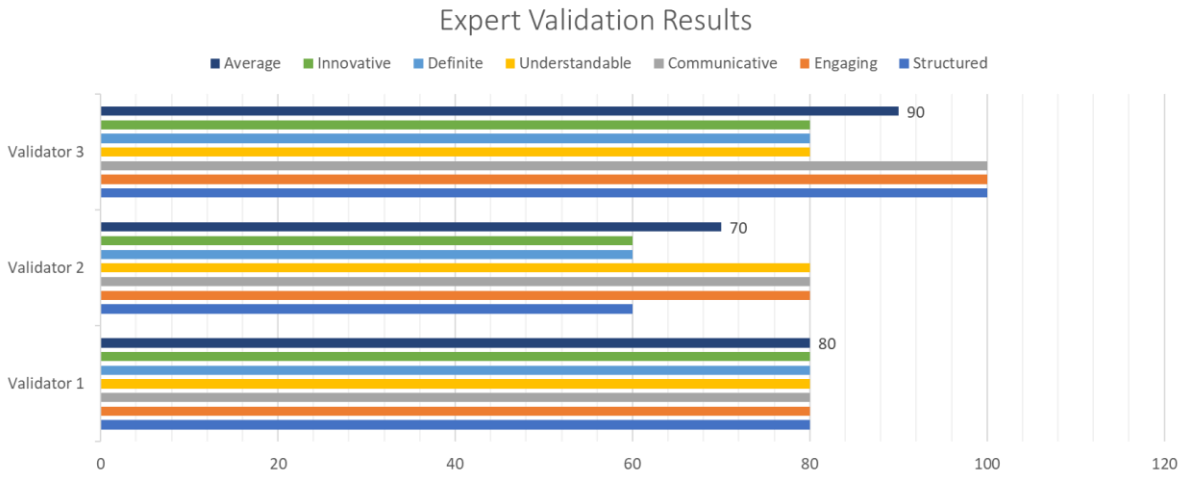
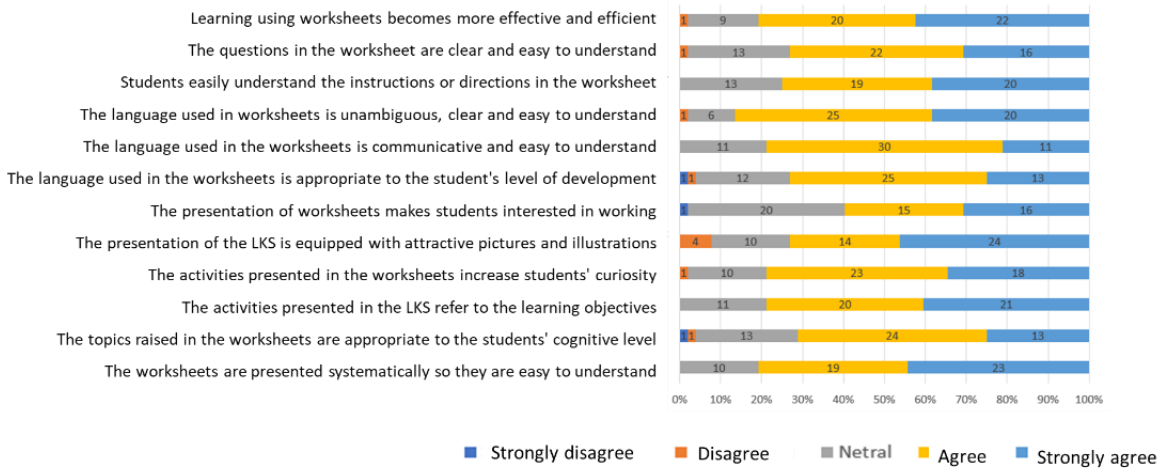


Figure 2**.** Expert validation results

Based on the expert reviews, the first expert rated the worksheet highly at 80%, the second rated it at 70%, and the third rated it at 90%. Overall, the average rating was 80%, which indicates a valid worksheet. The experts also provided feedback for improvement, such as refining the learning goals and using more legible fonts.

The expert feedback indicates that the worksheets are ready for the next testing phase with some minor adjustments. After implementing these changes, we conducted a trial to evaluate the worksheets' effectiveness and efficiency.



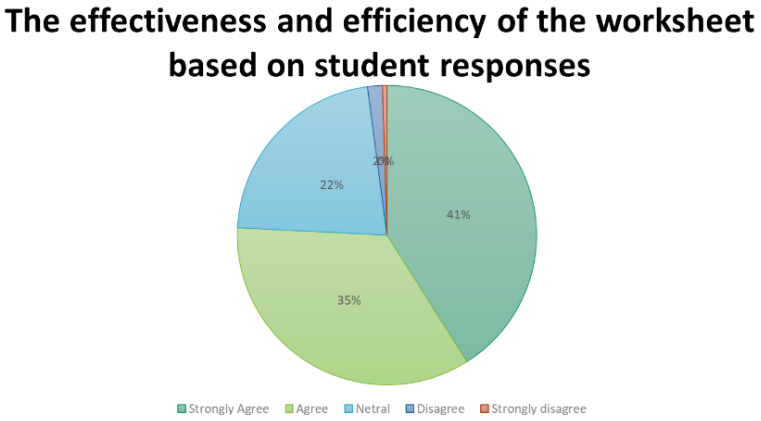


Figure 3. Students Feedback

We tested the worksheets on two classes with a total of 52 students. Students were asked to provide feedback on the worksheets' effectiveness and efficiency. The majority of students (75.9%) rated the worksheets positively, with 34.7% strongly agreeing and 41.2% agreeing. A smaller group (24%) expressed neutral or negative opinions. Based on these results and the previous expert validation, we concluded that the developed student worksheets are effective and efficient as a learning tool (Kurniawan, 2012).

Disseminate

This stage is the dissemination of the student worksheets produced. Dissemination of research results is carried out by distributing research results through discussion forums. Dissemination is also carried out by distributing student worksheets that have passed the validation and trial stages on students to MGMP teachers.

CONCLUSION

This research developed student worksheets using the 4D model. Experts rated the worksheets positively, with an average score of 80%, indicating they are suitable for learning. Students also gave positive feedback, with 75.9% approving the worksheets. Based on these results, we conclude that the worksheets are effective as a learning tool. However, further testing is needed to assess their impact on student learning outcomes and science literacy.

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