

Development of the Educational Game “Sainspedia” to Improve Science Literacy and Responsibility Among Fifth-Grade Elementary School Students

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Abstract

This study aims to create an educational game called “Sainspedia” and to test its feasibility and effectiveness in improving the science literacy skills and sense of responsibility of fifth-grade elementary school students. The method used in this study is Research and Development (R&D) based on the Borg and Gall development model. This product was designed as an interactive game based on Microsoft PowerPoint that focuses on the topic of light in science education. The feasibility of the product was evaluated through validation by subject matter experts as well as feedback from teachers and students, while its effectiveness was tested using a quasi-experimental design with an unequal control group. Data were collected through a science literacy test, a questionnaire on responsibility, an observation sheet, and a response questionnaire. The experimental group consisted of 26 students. The results showed that the assessment by subject matter experts received a total score of 82, categorized as “very good”; teacher responses reached a score of 15, categorized as “very feasible”; and student feedback showed an average score of 9.00, categorized as “very feasible.” The average science literacy score in the experimental group increased from 67.69 to 79.04, while the observed student responsibility score rose from 32.92 to 50.42. A paired-sample analysis revealed a significance value of 0.000. These findings indicate that Sainspedia is a valid and effective educational game for supporting the development of science literacy and responsibility among fifth-grade elementary school students. The integration of interactive game-based learning into science instruction can provide students with an engaging learning experience while encouraging active participation, independent learning, and responsible behavior. Therefore, Sainspedia can be considered a feasible alternative learning medium for enhancing both cognitive and affective competencies in elementary science education.

Keywords: *Educational Game, Science Literacy, Responsibility, IPAS, Light.*

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A. INTRODUCTION

Science education at the elementary school level should not only focus on mastering facts, but also on enhancing students’ ability to understand various phenomena, utilize evidence, and apply scientific knowledge in everyday life. The OECD’s science literacy framework emphasizes the importance of the ability to explain phenomena scientifically, evaluate and design investigations, and interpret data and evidence as key competencies in science literacy. This framework affirms that science literacy is related to the ability to use scientific knowledge and processes to understand issues relevant to everyday life.

In practice, the research underlying this article shows that fifth-grade students at SDN Lodoyong 02 and SDN Rapah 02 still face difficulties in understanding

abstract scientific concepts, particularly in lessons about light. Students tend to memorize information without understanding the meaning of the concepts, have difficulty explaining scientific phenomena, and do not consistently connect the concepts to everyday activities. Observations also indicate that students' engagement in literacy activities remains low; some students read merely to fulfill a requirement without demonstrating a commitment to understanding or summarizing the information. This situation points to a gap between the demands of competency- and character-focused learning and a learning experience that still requires the use of interactive media.

The use of educational games is a suitable option because it combines educational goals with play. Recent research indicates that educational games at the elementary school level can improve participation, motivation, conceptual understanding, and various cognitive skills if they are designed in accordance with learning objectives and supported by teachers. Istiq'faroh et al. found that game-based learning in elementary education influences learning outcomes and student engagement, while Sari and Rohmani reported that educational games have the potential to increase interest and understanding in science learning. The results of developing interactive games for science literacy among elementary school students also show that game-based media can be clearly targeted toward scientific competencies.

Specifically, regarding media that use PowerPoint, Levitasari et al. created PowerPoint-based educational games for science instruction at the elementary school level and highlighted the medium's ability to support the learning process. Other studies examining interactive PowerPoint media have also shown a positive impact on learning outcomes in science, while the development of PowerPoint presentations incorporating gamification for fifth-grade students demonstrates that interactive presentation formats can serve as a more dynamic option for instructional media. Therefore, the use of PowerPoint as the Sanspedia platform has a strong foundation: educators are generally already familiar with this software, and the platform can be run on computers or Chromebooks available in school settings.

Previous research has also indicated that educational games have been widely used to improve science literacy skills; however, some studies have focused more on cognitive outcomes or motivation. On the other hand, fostering responsible character is generally achieved through assignments, habits, problem-based learning, or classroom teaching strategies. This gap serves as the background for the innovation in this study, namely the creation of an educational game that simultaneously incorporates science literacy activities on the topic of light and observable behaviors reflecting student responsibility during the learning process. This article not only evaluates the feasibility of this medium but also analyzes differences in student learning outcomes between classes using Sanspedia and those using the instructional media typically employed by teachers. Based on these differences, the objectives of this study are: (1) to develop the Sanspedia educational game suitable for use in science education on the topic of light for fifth-grade elementary school students;

and (2) to evaluate how effective Sanspedia is in improving the science literacy skills and sense of responsibility among fifth-grade elementary school students.

B. METHOD

This study is a research and development (R&D) project. This thesis utilizes the Borg and Gall model, which includes data collection, planning, initial product development, preliminary testing, refinement, main testing, refinement, operational testing, final product refinement, and deployment. In this article, these steps are summarized into the following activities: needs analysis, planning and design, development and validation, field testing, operational testing, and effectiveness assessment.

The preliminary study was conducted through observation, interviews, and the distribution of questionnaires to fifth-grade students and teachers at SDN Lodoyong 02 and SDN Rapah 02. The resulting product is an educational game designed for teaching science (IPAS) on the topic of light. This resource includes a guide, learning objectives, content, games, assessment tools, and information about the developer. The game is designed to be accessible both individually and in groups via a computer or Chromebook.

Product feasibility was evaluated through validation by experts in materials and media, which was then supported by feedback from teachers and students during the experiments. Research tools included science literacy tests, responsibility questionnaires, observation sheets on responsibility, and response questionnaires from teachers and students. Science literacy indicators include the ability to explain phenomena scientifically, evaluate and design scientific investigations, and interpret scientific information and evidence. Responsibility indicators include task completion, following instructions, time management, diligence, concentration and consistency, honesty, perseverance, collaboration, respect for others, and support for peers. The effectiveness was tested using a quasi-experimental design with unequal control groups. The control group received instruction using media commonly used by teachers, while the experimental group received instruction using the Sanspedia method. The operational trial involved 26 students in the experimental group and 26 students in the control group. The data were analyzed using descriptive and inferential approaches. The Shapiro-Wilk test was used to assess normality, while the homogeneity test was applied as a prerequisite. Differences in results between the groups were analyzed using an independent samples t-test, and pretest-posttest changes in the same subjects were analyzed using a paired samples t-test with a significance level of 0.05. This thesis notes that statistical decisions were based on a Sig. (2-tailed) value of less than 0.05.

C. RESULTS AND DISCUSSION

The development of Sanspedia began with a needs assessment. A survey of students revealed that 90% of them enjoy reading, 75% are able to use multimedia, 75% use multimedia to learn to read, 75% are interested in interactive multimedia,

90% feel that interactive multimedia makes the learning process more enjoyable, and 95% want interactive multimedia that supports science literacy and responsibility. This information underscores the importance of developing media that not only conveys content but also provides an interactive learning experience.

The product was then developed through the following stages: design, content creation, game interaction programming, validation, and revision. Revisions by media experts included refining the media's objectives to improve understanding and application, simplifying the homepage layout, and adding and adjusting background music to suit the students' characteristics. These revisions demonstrate that the effectiveness of the media is influenced not only by its content but also by the clarity of navigation, visual elements, and the user experience.

Table 1. Results of the Sanspedia Media Feasibility Assessment

Assessment Criteria	Score	Category
Subject Matter Expert	82	A / Very good
Teacher response – operational trial	15	A / Well worth it
Student responses – operational trial	9,00	A / Well worth it

The evaluation results showed that the content in the media was considered appropriate, comprehensive, clear, well-organized, and relevant to learning needs. Teacher feedback during the operational trial phase received a score of 15, classified as "highly suitable." Teachers assessed that the media was able to capture students' attention, provide new learning experiences, support the delivery of material, and help students understand the material through play-based activities. Student feedback also fell into the "highly suitable" category. These findings align with research on the development of PowerPoint-based games in science lessons, which indicates that media using PowerPoint can serve as a more interactive learning alternative.

Sanspedia's effectiveness is also consistent with research findings on educational games at the elementary school level. A systematic review shows that games can increase engagement and learning outcomes when game objectives, learning activities, and teacher guidance are planned in an integrated manner. Thus, Sanspedia's strengths lie not only in its game format but also in the integration of content on light, science literacy exercises, assessments, and activities that encourage students to follow instructions and complete tasks responsibly.

Table 2. Average Science Literacy Skills

Group	Science Literacy Pretest	Science Literacy Posttest	Description
Control	65,00	67,69	A slight increase
Experiment	67,69	79,04	A greater increase

In the experiment, the average science literacy score for the experimental group increased from 67.69 on the pretest to 79.04 on the posttest. In contrast, the control group showed an increase from 65.00 to 67.69. This difference in improvement indicates that the progress made by the group using Sanspedia was

more significant. The results of the independent samples t-test on the posttest science literacy scores showed a significance value of 0.001, while the pretest yielded a value of 0.502. A pretest value exceeding 0.05 indicates that there was no significant difference at the beginning, whereas a posttest value below 0.05 indicates a clear difference in results between the two groups.

These findings support the role of educational games as tools that transform the approach to learning from merely conveying information to activities focused on understanding and applying concepts. In teaching about light, students not only receive explanations but are also encouraged to relate the properties of light to everyday events, select tools and materials for experiments, make predictions, record their observations, and draw conclusions. This approach aligns with science literacy skills that emphasize explaining phenomena, exploration, and analyzing evidence. Research on the use of educational games to improve science literacy among elementary school students also shows that interactive media can be specifically designed to strengthen scientific competencies.

Table 3. Results of Student Responsibility in the Operational Trial

Indicator	Control	Experiment
Responsibility categories on the pretest	Pretty good & not so good	Pretty good & not so good
Responsibility categories on the posttest	8 is fairly good; 18 is not so good	20 excellent; 6 good
Average pretest score		32,92
Posttest observation mean		50,42

Changes in responsibility were more evident in the experimental group. In the pretest phase, 19 of the 26 students were in the “fairly good” category, while the other 7 were in the “less than good” category. After the learning process using Sainspedia, 20 students are now in the “very good” category and 6 students in the “good” category. Data from observations also support these findings, with the average responsibility score for the experimental group increasing from 32.92 to 50.42. In the inferential analysis, the significance value for responsibility in the experimental group was recorded at 0.000, while the control group showed no significant improvement.

This increase in responsibility can be understood through the characteristics of game-based activities, which require students to follow rules, complete challenges, manage their time, collaborate, and complete tasks. In this study, responsibility is not treated as a separate concept but as a behavior that manifests when students engage in learning activities. This approach aligns with research on the development of responsible character at the elementary school level, which emphasizes the importance of active learning strategies, assignments, habit formation, and the teacher’s role in shaping responsible behavior.

Overall, the findings of this study indicate that Sainspedia successfully met the two main criteria in development research: a usable product and a product that

demonstrated effectiveness in testing. The novelty of this study lies in the integration of science literacy and responsible behavior into a single PowerPoint-based game for fifth-grade light-related material. Previous studies generally presented games as tools to improve learning outcomes, motivation, or science literacy; Sainspedia expands this role by adding responsible behavior as one of the assessed outcomes. The significance of these findings is that game-based media in science education can be designed not only to achieve cognitive objectives but also to foster more responsible learning habits.

D. CONCLUSION

The Sanspedia educational game, designed for teaching science specifically the topic of light to fifth-grade elementary school students, was deemed appropriate following an evaluation by subject matter experts, feedback from teachers, and student responses. This product received a score of 82 from subject matter experts in the “very good” category, teacher feedback reached 15 in the “very satisfactory” category, and student responses recorded a score of 9.00 in the “very satisfactory” category. In terms of effectiveness, the use of Sanspedia increased the average science literacy score in the experimental group from 67.69 to 79.04 and improved the observed responsibility scores from 32.92 to 50.42. Statistical tests showed a significant difference in learning outcomes following the implementation of this educational media. Therefore, Sainspedia can be used as a science learning medium that combines the development of science literacy with a sense of responsibility among fifth-grade elementary school students.

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