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Jurnal Literasi Digital Vol 5 No 2, Juli 2025

Development of Interactive Media Based on the SETS Approach to Enhance Students' Learning Outcomes

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Abstract

The urgency of this research lies in addressing the challenges students face when learning about elements, compounds, and mixtures, which are often taught in a theoretical and abstract manner, leading to learning difficulties and low academic achievement. Abstract concepts require effective instructional strategies to support student understanding. One solution is the use of interactive instructional media, which can present material more clearly and engagingly. The SETS (Science, Environment, Technology, and Society) approach further enhances learning by connecting scientific concepts to real-life contexts. This study aims to develop interactive instructional media using Articulate Storyline software based on the SETS approach to improve students' learning outcomes. This research is a type of Research and Development (R&D) that follows the ADDIE development model. Data collection techniques include observations through a needs questionnaire and interviews, cognitive domain tests covering levels C1 to C5, and a student response questionnaire. The research was conducted through an individual trial with two students, a small group trial with eight students, and a field implementation involving 29 students. The findings revealed: (1) The validity of the SETS-based interactive media received a score of 1.00, categorized as very high; (2) There was a significant improvement in student learning outcomes, supported by a significance value of < 0.05; (3) The N-gain score reached 0.60, indicating a moderate level of improvement; and (4) Student responses to the interactive media were positive, with an average score of 81.15%, classified as good.

Keywords: *Interactive Media, Articulate Storyline, SETS Approach, Learning Outcomes,* ADDIE

Introduction

The field of education is evolving alongside the advancement of science and technology, as evidenced by changes in curriculum, media, and technological tools. In line with the development of the educational curriculum, learning media have become an essential component of the learning process. The use of learning media fosters students' desire to learn, helps them understand and master the material, and creates engaging learning experiences through a variety of activities. (Yudha, 2021). The development of science and technology has led to the creation of tools used as learning media to improve student engagement in the learning process (Agustin, 2024). Observations conducted at a junior high school in Gresik Regency revealed that science and technology-based learning media are rarely utilized during the learning process. The limited use of learning media results in poor student awareness of effective learning strategies, which affects the quality of their learning outcomes (Putra & Suniasih, 2021).

https://doi.org/10.54065/jld.5.2.2025.876

Student learning outcomes are influenced by a range of factors, including intelligence, learning styles, interests, motivation, environmental conditions, and the availability of learning media during the learning process (Astiti et al., 2021). Learning outcomes are measured through evaluation activities that demonstrate students' ability to understand the material. Elements, compounds, and mixtures are among the materials studied at the junior high school level. This material is considered difficult because it is presented theoretically, covering topics such as atomic and molecular models, types of elements and molecules, and their occurrence in nature (Firliani & Utami, 2023). Abstract and theoretical concepts are frequently challenging for students to comprehend, which can negatively impact their learning outcomes. This is supported by evidence from the results of a needs analysis of ninth-grade students at a junior high school in Gresik Regency, which showed that 86% of the students experienced difficulties in learning the material on elements, compounds, and mixtures. Efforts need to be made to overcome these difficulties by relating the learning material to everyday life, as this can foster students' active participation in the learning process.

An effective way to address students' learning difficulties is by relating learning materials to everyday life. Relating learning materials to daily life can be done through the SETS (Science, Environment, Technology, and Society) approach. The SETS approach emphasizes that students have the expertise to integrate science, technology, society, and the environment in a single unit. The presence of social issues in society and the environment poses a challenge for the development of science and technology (Wibowo & Wardhani, 2022). The integration of the SETS approach in learning aims to help students understand science and how its progress can affect the environment, technology, and society (Wulandini et al., 2024). Through the SETS approach, students can learn scientific concepts and their connection to technology by considering the benefits of technology for the environment and society. Moreover, additional efforts can be made by utilizing learning media to support the delivery of instructional content. Interactive media represent constructivist tools that involve students, media, and active learning processes (Khofifah &Handayani, 2022). The use of media in learning stimulates thinking skills, enhances the quality of learning outcomes through various scientific content, and creates a more interactive learning process. Instructional media designed to be interactive can create reciprocal relationships and provide easier access to learning (Fitra & Maksum, 2021). Interactive media fosters interaction by providing instructions that elicit feedback from students, making students more active in the learning process. In addition, the use of interactive media as an instructional tool can facilitate teachers in delivering content, support the creation of an innovative learning process, and foster an enjoyable and interactive learning experience.

One of the devices that can be used to access technology-based learning media is a smartphone. Smartphones in the context of learning also help students develop learning independence. The advanced features available on smartphones can be utilized in the field of education, such as downloading learning applications, watching videos, playing games, discussing with peers, and searching for information (Murni et al., 2023). Smartphones are among the most commonly owned devices by students due to their numerous advantages, making them a suitable alternative for delivering instructional media. Interactive media presented on smartphones serves as an effective combination for use as a learning tool. Based on the description, the efforts made to address students' learning difficulties in understanding elements, compounds, and mixtures involve relating the material to everyday life through the SETS approach, accompanied by the development of interactive media to enhance students' cognitive learning outcomes. This aligns with research conducted by

(Ristanto et al., 2024), which states that the SETS approach supports students in mastering the material by connecting it to surrounding problems, thereby improving student learning outcomes. In addition, research conducted by (Suseno et al., 2020), which found that interactive media can stimulate students' interest in learning by incorporating interactive elements, such as images, sounds, videos, animations, and interactivity, thereby creating a more effective learning process. The use of SETS-integrated interactive media in the learning process is expected to enhance students' engagement and interpretation of the material, thereby improving the quality of their learning outcomes.

The novelty of this research lies in the development of interactive instructional media using Articulate Storyline software that is integrated with the SETS (Science, Environment, Technology, and Society) approach to address students' difficulties in learning abstract science concepts, specifically elements, compounds, and mixtures. Unlike previous studies that often used conventional methods or general digital tools, this study combines an interactive platform with contextual learning to foster deeper understanding and student engagement. This integration allows learners to connect scientific material with real-life issues, thereby enhancing cognitive learning outcomes. However, the limitation of this research is that it was conducted within a limited scope involving a relatively small sample size from a single school, which may affect the generalizability of the findings. Future studies are encouraged to apply this media on a broader scale and across different educational settings to validate its effectiveness more comprehensively.

Method

This research applied the Research and Development (R&D) method with the primary goal of producing a learning product and testing its effectiveness. The research design used was a preliminary experimental design, specifically the one-group pretest-posttest design. The development process followed the ADDIE model, which includes the stages of Analyze, Design, Develop, Implement, and Evaluate. At the analysis stage, a needs analysis was conducted, including curriculum analysis, identification of student characteristics, and evaluation of existing learning media. The design stage involved creating product designs and preparing the learning materials. During the development stage, interactive media were created using Articulate Storyline 3 software and converted into APK format via a website-based APK builder. Validation tests were carried out by four expert lecturers, followed by individual trials involving two students and small group trials involving eight students. In the implementation stage, the interactive media integrated with the SETS approach were used in learning activities with 29 students. The evaluation stage involved formative evaluation, which aimed to gather feedback and make improvements throughout each phase of development. The data analysis techniques used in this study included several steps. First, the validity and reliability of the SETS-integrated interactive media were assessed. Second, the differences in students' learning outcomes before and after using the media were calculated. Third, the improvement in learning outcomes was measured using the N-Gain formula developed. Lastly, students' responses to the interactive media were analyzed to determine their level of engagement and perception of the learning tool Validity testing is used as a method to assess the feasibility of the research instrument. The validity of interactive media is calculated using a formula developed by Gregory (2000) as follows.

$$V = \frac{D}{A + B + C + D}$$

Information: V = Validity, A = Both validators disagree, B = Validator 1 agrees, validator 2 disagrees, C = Validator 1 disagrees, validator 2 agrees, and D = Both validators agree

The validity category of the research instrument is contained in Table 1 as follows.

Table 1. *Gregory's Validity Categories*

Correlation Coefficients	Category
0,80 – 1,00	Very High
0,60 – 0,79	High
0,40 – 0,59	Medium
0,20 – 0,39	Low
0,00 – 0,19	Very Low

Reliability testing is used to examine the degree of agreement among validators in assessing the research instrument. The reliability test of the research instrument was calculated using a formula proposed by (Rohimah et al., 2023) as follows.

$$R = 1 - \frac{A - B}{A + B} \times 100\%$$

Information: R = Reliability percentage, A = Maximum validator score, and B = Minimum validator score

The research instrument can be considered reliable if the R value is greater than or equal to 75%. An analysis of learning outcome differences was conducted to calculate the significant difference in students' scores before and after the learning process using interactive media. Based on the population size, the Shapiro-Wilk normality test was used, with the criterion that if the p-value is ≥ 0.05, the data are normally distributed, and if the p-value is < 0.05, the data are not normally distributed. Normally distributed data were analyzed using the paired sample t-test, a parametric statistical method; non-normally distributed data were examined using the Wilcoxon test, a non-parametric method. If the sig. (2-tailed) score is < 0.05, a variation in learning outcomes is indicated; if the sig. (2-tailed) score is $\geq$ 0,05, no significant change in learning outcomes is observed. An analysis of learning outcome improvement was conducted to measure the category of students' learning gains after the learning process using interactive media. The increase in students' cognitive learning outcomes is calculated using a formula developed by Hake (1998) as follows.

$$N - gain = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}}$$

The major category of students' learning outcome improvement, as presented in Table 2, refers to Hake (1998).

Table 2. *N-gain Value Categories*

Value	Category
$g > 0,7$	High
$0,3 \leq g \leq 0,7$	Medium
$0 < g < 0,3$	Low

Response analysis was conducted to assess the level of students' responses after using the interactive media. Students' reactions to the media were calculated using a formula developed by (Yan et al., 2024) as follows.

$$R = \frac{\sum x}{\sum i}$$

Information: R = Result of the student response questionnaire, $\sum x$ = Total student answers in all items, and $\sum i$ = Total ideal score for each item. The response formula was also used to measure students' responses in the individual and small group trials. The category of students' reactions to the media is presented in Table 3 as follows.

Table 3. *Categories of Participant Responses*

Interval (%)	Category
81,25 < R ≤ 100	Excellent
62,50 < R ≤ 81,25	Good
43,75 < R ≤ 62,50	Enough
25,00 ≤ R ≤ 43,75	Less

The table presents the interpretation of percentage scores (R) based on specific intervals and their corresponding categories. If the percentage score falls within the interval of 81.25% < R ≤ 100%, it is categorized as Excellent, indicating very high performance or response. Scores within 62.50% < R ≤ 81.25% are categorized as Good, reflecting a satisfactory level of achievement. If the percentage score lies within 43.75% < R ≤ 62.50%, it is considered Enough, showing moderate performance that may still require improvement. Lastly, scores within 25.00% ≤ R ≤ 43.75% fall into the Less category, indicating a low level of performance or response. These categories are useful for interpreting evaluation results such as student responses, media effectiveness, or learning outcomes.

Results

The development of SETS-integrated interactive media follows the ADDIE model, which consists of five systematic stages: analysis, design, development, implementation, and evaluation. In the analysis stage, a field analysis was conducted to identify existing problems. The findings revealed that students encountered difficulties in understanding the topic of elements, compounds, and mixtures, which was further exacerbated by the limited use of learning media in science classes. Therefore, SETS-integrated interactive media was developed to align with students' needs and characteristics. In the design stage, a blueprint of the interactive media was created, which involved outlining the media layout and preparing the learning materials. The development stage focused on realizing the media design through the use of *Articulate Storyline 3* and *Website 2 APK Builder* software. The content within the media was structured according to the competencies identified during the analysis stage and included components such as a competency menu, learning materials, games, discussion activities, evaluations, developer profiles, and references. This stage also included validation from both media and subject matter experts to ensure the media's quality and appropriateness. During the implementation stage, the media was tested through individual trials involving two students, followed by small group trials with eight students, and finally implemented in a class of 29 students during the learning of elements, compounds, and mixtures. Lastly, the evaluation stage served as a formative process to assess and refine the media for optimal functionality and learning effectiveness.

The validity of learning media is obtained through media validation tests and material validation tests. Media validation was conducted to assess the validity of the SETS-integrated interactive media for use in the learning process. Material validation is performed to evaluate the suitability and completeness of the material presented in the SETS-integrated interactive media. The results of media and material validation were calculated using the Gregory formula, as presented in Table 4, as follows.

Table 4. *Media and Material Validations Results*

Media Validation			Material Validation		
Aspect	**Validation**	**Category**	**Aspect**	**Validation**	**Category**
Simplicity	1	Very High	Content quality and purpose	1	Very High
Alignment	1	Very High			
Shape	1	Very High			
Color	1	Very High	Quality of learning	1	Very High
Balance	1	Very High			
Average	1	Very High	Average	1	Very High

Table 4 shows that the average score for all aspects of media validation and material validation is 1, indicating a very high level. A very high category indicates that SETS integrated interactive media is feasible for use in testing and implementation. The assessment results from media and content experts for the SETS-integrated interactive media can be measured for reliability. The results obtained show a media reliability of 95% and a content reliability of 92%, indicating that both are reliable. The analysis of learning outcome differences was carried out using normality and hypothesis tests. The results of the normality test for students' pretest and posttest scores showed that the data were not normally distributed; therefore, a non-parametric test, the Wilcoxon test, was conducted. The Wilcoxon test results for the learning outcome scores are presented in Table 5 as follows.

Test Statistic

Table 5. *Wilcoxon Test Results of Students' Learning Outcomes*

	Posttest Hasil Belajar – Pretest Hasil Belajar
Sig. (2-tailed)	.000

Table 5 shows a significance value of 0.000 < 0.05, indicating a difference in students' learning outcomes before and after the learning process using SETS-integrated interactive media. Learning outcomes reflect the quality and effectiveness of students' learning efforts. The cognitive learning outcomes in this study were measured using the C2-C5 cognitive domain test, consisting of 7 questions in the form of a non-objective essay test. The validation of the test questions received a score of 1, indicating very high validity. The improvement in students' cognitive learning outcomes was calculated using the N-gain formula based on pretest and posttest scores, resulting in a value of 0,60, which falls into the medium category. The percentage increase in cognitive learning outcomes of 29 students is contained in Table 6 as follows.

Table 6. *Percentage Increase in Student Learning Outcomes*

Category N-gain	**Frequency**	**Percentage**
Low	0	0%
Medium	21	72,41%
High	8	27,59%

Table 6 shows that 72,41% of students showed a moderate level of improvement, while 25,59% showed a high level of improvement. This condition supports the calculated improvement in overall learning outcomes, which falls into the medium category with an N-gain value of 0,60. The improvement of students' outcomes after learning with the use of SETS Integrated interactive media is supported by various advantages of the media. Integrating the material with SETS (Science, Environment, Technology, and Society) aspects enables students not only to learn the material theoretically but also to connect it with real-life contexts, resulting in more meaningful learning. Examples of learning materials related to the SETS aspect are presented in the following figure.

Figure 1. *Integrating the SETS Aspect*

Abstract and theoretical material is connected to the surrounding life through the SETS aspect, aimed at facilitating the understanding and education of the material. The integration of the material with the SETS aspects encourages students to solve problems in their surrounding environment based on the subject matter studied. Through discussion activities designed to solve these issues, students can develop and apply their knowledge in ways that benefit their environment. SETS' integrated interactive media consists of a competency menu, games, discussion activities, evaluations, developer profiles, and a bibliography. The menu in the media is presented in Table 7 below.

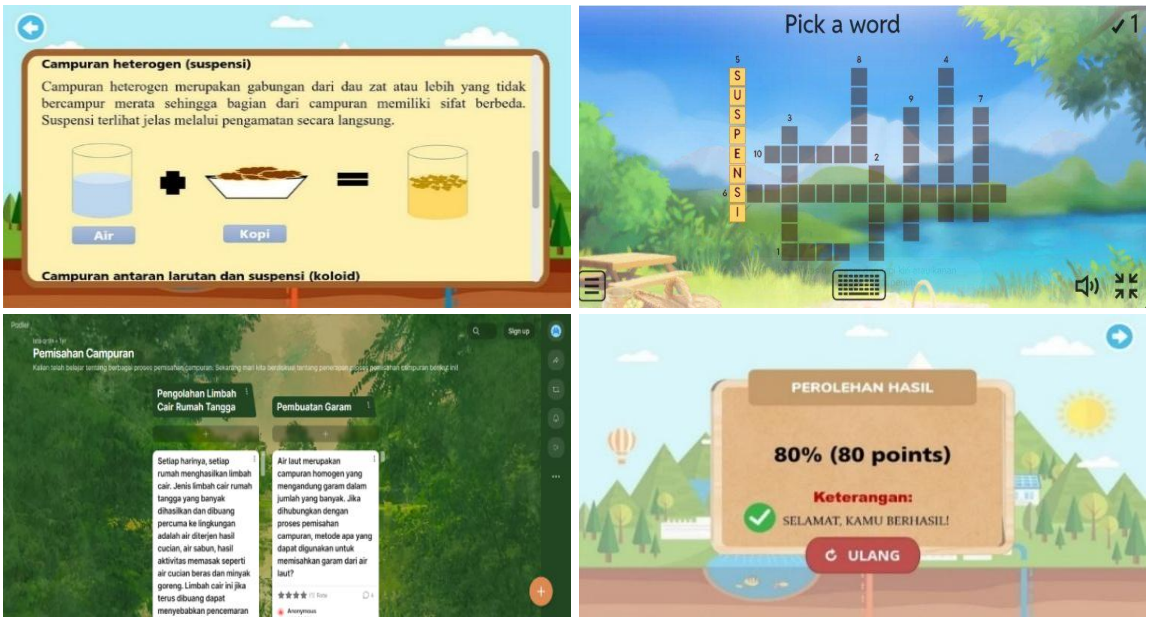

Figure 2. *Menu in Interactive Media*

Student response data were obtained through individual trials involving two students, small group trials involving eight students, and media implementation in learning for 29 students. The results of the students' responses are presented in Table 8 below.

Table 8. *Students' Responses to the Media*

Aspect	Individual Trials		Small Group Trials		Student Response	
	Value	Category	Value	Category	Value	Category
Media display	79,68%	Good	81,64%	Excellent	79,74%	Good
Material	87,50%	Excellent	84,38%	Excellent	82,33%	Excellent
Learning	77,50%	Good	76,88%	Good	81,55%	Excellent
Average	80,73%	Good	80,34%	Good	81,15%	Good

Increase in average response from the trial stage to the implementation stage. The acquisition of responses showed that at the development stage, namely during the trial, SETS integrated interactive media had received good responses from students without any revision notes, so that the media could be used at the next stage, namely, implementation.

Discussion

The SETS-integrated interactive media was created by applying the ADDIE development model, which consists of four main stages in this study. The first stage, analysis, was conducted through various observation activities, including the distribution of a needs questionnaire, interviews with science teachers, and literature review to identify the characteristics and requirements of the media to be developed. The second stage, design, involved planning the structure of the instructional media, which included creating a storyboard and organizing the content to align with the principles of the SETS approach. The third stage, development, was implemented using *Articulate Storyline 3* and *Website 2 APK Builder* to produce a smartphone-compatible interactive media application integrated with SETS elements. Finally, the fourth stage was assessment, which took the form of a formative evaluation conducted throughout each phase of the ADDIE model to collect data for ongoing improvements and refinements of the media product. The validity test for the instructional media was based on evaluations by media and content experts. The validity of the media and content of the developed interactive media falls into the very high category. This indicates that the developed interactive media aligns with the characteristics and needs of the students. This SETS-integrated interactive media effectively abstracts concepts related to elements, compounds, and mixtures through an engaging and communicative presentation.

According to Mayer's learning theory, media that incorporate audiovisual components are more effective in the learning process, as they present material through text, images, audio, video, animation, and engaging interactions that enhance student understanding (Khairani et al., 2024). Interactive media visualizes more complex elements, compounds, and mixtures, facilitates learning activities through the presentation of menus and buttons, and provides students with new learning experiences (Kusumawati & Mustadi, 2021). Abstract and theoretical material is connected to the surrounding life through the SETS aspect, aimed at facilitating the understanding and education of the material. The integration of the material with SETS aspects encourages students to solve real-world problems based on the content they have learned. The learning process using SETS-integrated interactive media enables students to connect the theoretical concepts of elements, compounds, and mixtures to broader contexts by relating science to technology for societal benefit and its implications for the environment. Through discussion activities focused on problem-solving, students can develop and apply their knowledge in ways that benefit their environment.

The difference in learning outcomes before and after the learning process using interactive media indicates an increase in students' interest during the learning process. The interaction between students and the interactive learning tools occurs during discussions, gameplay, and completion of evaluation tasks. This fosters students' interest in learning, thereby supporting their understanding of the material. A learning process that involves interaction in the form of stimuli and responses can lead to understanding (Hidayat & Malihah, 2023). SETS' integrated interactive media consists of a competency menu, games, discussion activities, evaluations, developer profiles, and a bibliography. Through the presentation of this menu, more interactive learning is created. The interaction between the media and students is

facilitated through discussion activities, game-based learning, and the completion of evaluation tasks. The interaction that occurs through the use of interactive media involves stimuli provided by the media and students' responses during the learning process. The responses given by students during learning indicate the growth of students' knowledge. Engaging learning activities will be implemented regularly to enhance students' knowledge (Maryani et al., 2022).

The improvement of student learning outcomes after learning with the use of *SETS* integrated interactive media is supported by various advantages of the media. Integrating the material with SETS (Science, Environment, Technology, and Society) aspects enables students not only to learn the material theoretically but also to connect it with real-life contexts, resulting in more meaningful learning. The SETS approach has a significant impact on the cognitive development of students (Wati et al., 2022). The SETS-integrated interactive media can visualize the material, making it easier for students to receive and understand the information, thereby enhancing their cognitive abilities. The responses given by the students showed improvement at each stage. The responses in the small group trial were higher than those in the individual trial. The responses in the implementation stage were higher than those in the small group trial stage. The increase in student responses at the implementation stage indicated that the media was well received by students who had used the *SETS* integrated interactive media in learning. Student responses consist of aspects of media display, materials, and learning. The good response from students indicates that innovation in the form of interactive media integrated with SETS on elemental, compound, and mixed materials supports students in mastering the material and fostering their interest in learning. Interactive media developed according to students' needs can provide an engaging learning experience and create an enjoyable learning environment.

The analysis of student learning outcomes and responses indicates that the SETS integrated interactive media is effective and engaging in supporting science education. This media helps students understand complex concepts such as elements, compounds, and mixtures through interactive features including games, discussion activities, and evaluations. These features promote active student participation and contribute to a deeper understanding of the material. By connecting the learning content to real life situations through the Science, Environment, Technology, and Society approach, the media encourages students to develop critical thinking skills and apply their knowledge in practical ways, which supports the goals of modern education. In addition, the gradual improvement in student responses from individual trials to small group sessions and full classroom implementation shows that the interactive media is well received and adaptable to different learning settings. Students responded positively to the clarity of the content, the attractiveness of the media display, and the engaging learning activities. These responses reflect the media's ability to meet students' academic needs and learning preferences. The SETS integrated interactive media not only delivers instructional material effectively but also provides a meaningful and enjoyable learning experience that fosters motivation, interest, and cognitive development in science learning.

Conclusion

This study aimed to develop SETS-integrated interactive media on the topic of elements, compounds, and mixtures to support students' understanding and improve learning outcomes. The development process followed the ADDIE model, resulting in an interactive application that presents abstract scientific material through engaging and contextual features such as games, discussion activities, and evaluations. The validity test by media and content experts placed the product in the very high category, indicating its feasibility for classroom use. The

findings showed a significant improvement in students' learning outcomes before and after using the media. Student responses also increased from individual trials to group implementation, reflecting the media's effectiveness and acceptance. The use of smartphones to deliver this media helped make the learning experience more accessible and meaningful, allowing students to visualize abstract scientific content through audiovisual interaction. This study implies that SETS-integrated interactive media can be a valuable tool in science education, particularly in making complex concepts more relatable and engaging. However, one limitation of the research is that the application is only compatible with smartphones, and some features, like games and discussions, still depend on external websites. Future research is recommended to expand compatibility to other devices such as laptops and develop fully integrated features that do not rely on third-party platforms. Further studies may also explore the long-term impact of such media on students' critical thinking and problem-solving skills.

Acknowledgment

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