



Development of Interactive Learning Application CHEM-OWL (Substances and Their Changes) to Increase Students' Interest in Learning

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Abstract:

This research is motivated by issues related to the low interest in learning among seventh-grade students at SMPN 1 Sekaran, caused by several factors, including monotonous teaching methods and a lack of attention in developing more engaging learning media suitable for the students' conditions. This research aims to develop an interactive learning application called CHEM-OWL and test its validity through expert assessment and its effectiveness in increasing students' interest in learning. The method in this research is Research & Development (R&D), which uses the 4D development model limited to the development stage. The results of the media validation obtained an average percentage value of 95.30% with very valid criteria. The material validation obtained a percentage of 94.37% with very valid criteria. The N-gain value of students' learning interest before and after being treated with the media was 0.57, which falls under the moderate category. Thus, the interactive learning application CHEM-OWL is suitable for use and effective in increasing students' interest in learning in science education on the topic of matter and its changes. The implications of this research indicate that using Android-based learning applications such as CHEM-OWL can be an innovative solution for teachers to support more engaging and interactive learning for students.

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Introduction

Education is one of the important and fundamental aspects of human life, especially in building a dynamic community life (Harefa *et al.*, 2023; Sharma & Ankit, 2023; Zendeli, 2017; Al-Shuaibi, 2014). In Law No. 20 of 2003, education is the creation of a learning atmosphere and a conscious and planned learning process that allows students to actively develop their potential and gain religious and spiritual strength, self-control, character, intelligence, noble morals, and skills needed for themselves, society, nation, and state (Zuhdi *et al.*, 2021). In education, there is a concept of learning, a process of interaction between students, teachers, and learning resources in a learning environment (Faizah & Kamal, 2024; Syafrin *et al.*, 2023). Interest in learning is one of the important factors in determining students' academic success.

Low learning interest can significantly decrease internal motivation and student learning outcomes (Muhammad *et al.*, 2023; Rosfiani *et al.*, 2019). Research from Harefa *et al.*, (2023) revealed a significant positive relationship between learning interest and science learning outcomes and an influence between learning interest and science learning outcomes. Students with a high learning interest can motivate themselves to understand the learning material presented by the teacher in-depth, and vice versa. Students with low learning interest have less motivation to understand the learning material in depth, which can hinder the learning process. Students will struggle to understand the material and are less active in learning activities (Mahdiyyah *et al.*, 2024). Low interest in learning and motivation are serious issues in Indonesia and globally.

Jansen *et al.*, (2022) stated that students' perceptions of their abilities significantly influence motivation and are related to learning outcomes. This is supported by the results of his research, which show that students who have strong beliefs in their own abilities (self-efficacy) will have higher motivation, which positively impacts academic achievement. The results also emphasize that low interest and motivation in learning can lead to decreased student participation, which negatively impacts learning outcomes. Intrinsic motivation, which often comes from interest in learning, is considered one of the main factors influencing student engagement. Low engagement hurts student academic performance (Valenzuela-Peñuñuri *et al.*, 2024).

Based on the PISA (Programme for International Student Assessment) report, which is an international assessment program held every three years by the OECD, this program aims to evaluate education systems in various countries by comparing the knowledge and skills of 15-year-old students based on three main areas of assessment, namely reading, mathematics, and science (Bilad *et al.*, 2024; Furnham & Cheng, 2024; AlAli & Wardat, 2024; İdil *et al.*, 2024). Since it first participated in 2001 to 2022, Indonesia's PISA ranking scores have consistently been low (Bilad *et al.*, 2024). Based on the results of the PISA in 2022, Indonesia is ranked 69th or the 12th lowest out of 80 participating countries, with a reading ability score of 359, mathematics 366, and science 383. The data reflects students' low interest, motivation, and involvement in learning even though there are several other influencing factors. The use of good learning media can attract attention and stimulate students' interest and motivation to learn; it can make the learning process more meaningful and improve student learning outcomes (Azizah *et al.*, 2024; Wulandari *et al.*, 2023; Rachmadtullah *et al.*, 2019).

Following the very rapid development of science and technology, this development has affected almost all aspects of human life, including the field of education (Qorib & Afandi, 2024; Pregowska *et al.*, 2023; Wahidah & Chotibuddin, 2021). With the presence of learning media utilizing technology, learning media can be more interactive. Interactive learning media is hardware and software that contains elements of images, videos, animations, text, and sound where users can interact directly, and the media can respond to anything the user inputs in the media (Sakti *et al.*, 2024; Sahronih *et al.*, 2019). A study from Malaysia by Ramli *et al.*, (2019) shows that using interactive media in learning activities is more effective than conventional learning methods, where students who learn using interactive learning media perform better than students who learn with conventional approaches. Another study by Tarsha *et al.*, (2024) found a significant influence of the use of Android-based interactive learning media on students' learning interests, with an influence coefficient of 16.4%.

Based on observations and questionnaires conducted by researchers at SMPN 1 Sekaran with subject students of grade VII, problems were found related to the lack of teacher attention in implementing more varied learning media according to student characteristics. Teachers often use the lecture learning method, which is less focused on students, so teaching and learning activities feel monotonous, do not attract attention, and are less actively involved in learning activities. As a result, interest and motivation to learn are low and impact student learning outcomes. Conventional learning methods often used by teachers, such as lectures, tend to focus on the teacher, reducing student involvement. This study aims to develop and test the effectiveness of the CHEM-OWL application as an interactive learning media to increase the learning interest of grade VII junior high school students.

Research Method

In this study, the research method used is the Research & Development (R&D) method. This method is used to create certain products and test the feasibility and effectiveness of the product. The research and development model used is the 4D model Thiagarajan (1974) which has several stages, namely the definition stage consisting of front-end analysis, student analysis, task analysis, material analysis, learning objective analysis; the design stage consisting of media selection, format selection, and initial design; the development stage consisting of media validation, material validation, revision, and testing; the dissemination stage was not carried out due to the researcher's limited time and energy (Maydiantoro, 2021). The reason for choosing the 4D development model is that the process does not take a long time, so the work is relatively faster (Christian & Olwin, 2022) and has complete and systematic development stages, and the results in product development have been tested because before being distributed, an assessment or validation was carried out by media experts and material experts (Salsabila *et al.*, 2023). The 4D development model is also specifically designed to develop learning products.

This study uses an experimental approach to test the effectiveness of the CHEM-OWL application developed to improve the learning interest of grade VII junior high school students. The sample size is 30 students, and the research sampling uses a purposive sampling technique, taking 10 students from each class VIIA, VIIB, and

VIIC. The sample selection is based on two criteria: 1. students come from grade VII junior high school with uniform characteristics in terms of education level and curriculum, and 2. the availability of students to actively participate in all stages of the study. These criteria are chosen to ensure the suitability of the sample to the research objectives and the smoothness of the study.

The research design used a one-group pretest-posttest design, where the sample was given an initial test (pretest) to measure students' learning interest before being given media treatment and a final test (posttest) to measure students' learning interest after being given treatment using the CHEM-OWL application. The pretest and posttest data were analyzed using the N-gain test to measure and determine the effectiveness of learning media in increasing students' learning interests. This study used data collection techniques: observation, interviews, and questionnaires. The instruments used in data collection were observation sheets, interview sheets, media expert validation sheets, material expert validation sheets, and student learning interest questionnaire sheets given before treatment (pretest) and after treatment (posttest).

The validation instrument was adopted from Arikunto & Rahman in Khoironi (2021) the learning interest questionnaire instrument was adopted Putra (2021). The data analysis techniques used in this study were qualitative and quantitative descriptive. Qualitative data were obtained from pre-research interviews, expert validation suggestions and input. Quantitative data were obtained from expert validation questionnaires and student learning interest questionnaires. The data was analyzed using a 4-level scale (Likert) for the media and material expert validation questionnaires. It was calculated using the following percentage formula.

$$P = \frac{\sum X}{n} \times 100\%$$

Explanation:

P = Percentage of average score

$\sum X$ = Total average score

N = Total maximum score

Table 1. Expert Validation Criteria	
Average score percentage	Criteria
85-100	Very valid
70-84	Valid
55-69	Quite valid
50-54	Less valid
>50	Not valid

(Source: Arikunto & Rahman in Khoironi, 2021)

In the student learning interest questionnaire, the differences in student learning interest before (pretest) and after (posttest) being given media treatment were analyzed using the N-gain test using the following N-gain formula:

$$\text{N-gain} = \frac{(\%posttest) - (\%pretest)}{100\% - (\%pretest)}$$

Table 2 Criteria for N-gain Value of Learning Interest

Interval	Criteria
$g > 0,7$	High
$g \geq 0,3 \geq 0,7$	Moderate
$g < 0,3$	Low

(Source: [Rahmania et al., 2023](#))

Results and Discussion

The following will describe the results of research and development in the form of the CHEM-OWL interactive learning application, testing the effectiveness of the media with the N-gain test to compare changes in student learning interest before and after using the CHEM-OWL application in learning.

Definition Stage

The initial stage of 4D development aims to determine and formulate learning requirements by analyzing and collecting information data to determine the extent to which development needs to be carried out. At the define stage, researchers carry out several activities such as front-end analysis, student analysis, concept analysis and formulating learning objectives. The front-end analysis was conducted by interviewing the science subject teacher of class VII of SMPN 1 Sekaran. Based on the interview results, the curriculum implemented in the school is the independent curriculum.

The learning methods often used by teachers are still conventional, such as lectures and giving independent assignments. In conventional learning methods, students tend to be passive or less active because learning focuses more on the teacher than on students, so student involvement in learning is low. Besides that, students will also easily feel bored and sleepy during learning, and the learning process easily becomes verbalistic or only depends on the understanding of the words conveyed by the teacher. The learning media used by teachers is also still limited to textbooks and whiteboards, although sometimes, using PowerPoint media is rarely done because of the limited availability of projectors. Lack of attention in developing learning media results in low student interest and motivation to learn. This is evidenced by the number of students scoring below the KKM.

Then, in the student analysis carried out using observation and questionnaire distribution, not a few students paid attention to the explanation given by the teacher during the learning activities. Some students are busy talking to their friends, playing with smartphones, sleeping, and even some children do not attend class. These problems' findings indicate that students' interest in learning is still low. In the results of the questionnaire distribution, on average, students think that the material of substances and their changes is one of the difficult science subject materials. This is because of the many theories and long and abstract definitions related to submicroscopic aspects such as particle form, the effect of temperature on particles, atoms, molecules, and chemical and physical change processes.

The concept formulation is adjusted to the independent curriculum's learning outcomes (CP). The learning outcomes (CP) of the material of substances and their changes in phase D of grade VII SMP are as follows: 1) Students can identify the properties and characteristics of substances; 2) Students can distinguish physical and

chemical changes.; 3) Students can separate simple mixtures. Learning objectives are analysed to determine learning objective indicators that are in accordance with learning outcomes/CP. The learning objectives for the material on substances and their changes, which are arranged in the CHEM-OWL application, are described as follows:

1. Understand the concept of substances and the differences between pure substances and mixtures.
2. Classify the forms of substances based on their physical properties (solids, liquids, gases, and plasma).
3. Explain the concept of changes in substances and the types of changes in substances.
4. Identify physical and chemical changes and examples in everyday life.
5. Analyze the properties of particles of solids, liquids, and gases and the effect of temperature on particles of substances.
6. Know how to determine the density of a substance.

Design Stage

The design stage is the second stage in the 4D development model, where, at this stage, the design and design process of the learning application to be developed is carried out. The media chosen in this development is interactive learning media as an Android-based application. The media selection is adjusted to the environment and conditions of students where most students have smartphones, and they bring them to school to support learning. However, these conditions are underutilized in supporting learning activities, so students use smartphones more often only to play games and social media. Media selection is also based on the needs and problems related to the learning process described by researchers at the definition stage. The format chosen for the media developed is interactive audio-visual, which consists of text, images, video, audio, illustrations, symbols, and animations. The media file format is an APK (Android package kit), which can be installed and run on Android smartphones.

The initial design consists of making a flowchart and storyboard. The media display design process is carried out using Figma design software and then continued with the process of compiling and integrating each layout, interaction buttons, animations, background, and other interactivity in the CHEM-OWL application using the help of Smart Apps Creator (SAC) software. Then, the file is exported into an APK format application that can be installed and run on Android-based smartphones. The following is a design for the CHEM-OWL interactive learning application.



Figure 1. The Front Cover Display of The Application



Figure 2. The Login Menu

Figure 1. It is the front cover display of the application, consisting of images, illustrations, text, and a start button. The cover is very important because it is the first part when the application is opened, so it is made as attractive as possible so that students are interested in learning to use CHEM-OWL. **Figure 2.** The login menu is a login column that must be filled in before proceeding to the application's main menu; login is designed only for formality because student data is not stored in the application system. However, the login column is part of the interactivity of the CHEM-OWL application.



Figure 3. The Main Menu Displays Menu Buttons

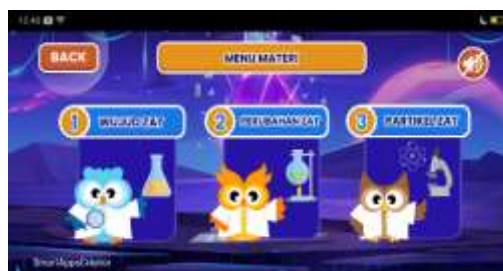


Figure 4. Three Main Material Buttons to be Studied

Figure 3. The main menu displays menu buttons consisting of the user manual, learning objectives, material menu, and final quiz. There is also a button to turn the background on and off.

Figure 4. The menu presents three main material buttons to be studied: the form of matter, changes in matter and particles of matter. There is also a back button to return to the previous page (main menu).



Figure 5. The User Manual



Figure 6. Displays The Learning Objectives

Figure 5. The user manual explains how to use the CHEM-OWL application regarding the functions and interactions of the existing buttons.

Figure 6. Displays the learning objectives that must be achieved for each sub-material on substances and their changes.



Figure 7. A Learning Map



Figure 8. The Contents of The Discussion of The Material

Figure 7. A learning map designed to break down the material into several sequential stages, from the start to the finish mark. This map aims to attract students' attention and make it easier for students to understand learning materials sequentially.

Figure 8. Presents the contents of the discussion of the material in the form of text, images, videos, illustrations, animations, charts, and symbols that make it easier for students to understand the learning material.



Figure 9. Mini Quiz Game



Figure 10. The Final Quiz

Figure 9. Mini quiz game in the form of 5 multiple choice questions that students must complete before reaching the finish. Each material has a quiz that functions as independent practice and tests their understanding after completing the learning sub-material. This section has a more interactive side where the media can respond to whether the answer is right or wrong.

Figure 10. The final quiz contains multiple-choice questions that students can work on after completing all the sub-materials of substances and their changes. The final quiz consists of 20 questions on all materials of substances and their changes.

Development Stage

After the CHEM-OWL learning application is developed, the next stage is validating the developed media to media and material experts. Aspects assessed in media validation include software appearance, illustration presentation, media interactivity, language and readability. The results of media validation are used to determine its feasibility based on its media aspects. The results of media validation are presented in Table 4 below.

Table 4 Media Expert Validation Results

No.	Aspect	Percentage	Criteria
1	App View	95,30%	Very valid
2	Presentation of illustrations (pictures & animations)	95%	Very valid
3	Media interactivity	93,75%	Very valid
4	Language and readability	97,5%	Very valid
Average Score Percentage		95,30%	Very valid

Based on Table 4, the results of media validation on the application display aspect obtained a score percentage of 95.30% with the criteria of "very valid". The illustration presentation aspect obtained a score percentage of 95%, included in the criteria of "very valid"; the media interactivity aspect obtained the criteria of "very valid" with a score percentage of 93.75, then the last aspect, namely language and readability, entered the criteria of "very valid" getting the highest score among other aspects of 97.5%. Then, the average score percentage of all aspects was obtained at 95.30%, included in the criteria of "very valid" to conclude that the CHEM-OWL application is declared suitable for use for learning without revision.

Then, the material aspects assessed were validated as suitability with learning achievements, similarity with learning objectives, suitability of the material order, the concept of substances and their changes, mini quiz games, and final quizzes. The results of the material validation are used to determine the feasibility of the learning application based on the assessment of the material discussed. The results of the material validation are presented in Table 5 as follows.

Table 5 Material Expert Validation Result

No.	Aspect	Percentage	Criteria
1	Compliance with learning outcomes	100%	Very valid
2	Similarity with learning objectives	87,5%	Very valid
3	Compliance with the sequence of materials	100%	Very valid
4	Concept of matter and its changes	90,62%	Very valid
5	Mini game quiz and final quiz	93,75%	Very valid
Average score percentage		94,37%	Very valid

Based on Table 5, the results of the material validation on the aspect of the suitability of the material sequence obtained the highest percentage score of all existing aspects, namely 100% with the criteria of "very valid", the aspect of the concept of substances and their changes obtained a percentage value of 90.62% included in the criteria of "very valid", and the last aspect, namely the mini-game quiz and final quiz obtained a percentage score of 94.37% included in the criteria of "very valid". So, the average percentage score of all aspects of the material assessment obtained a score of 94.37%, where this percentage is included in the criteria of "very valid". So, the CHEM-OWL application is very suitable for use in learning based on the assessment of material experts without revision.

After the validation of the media and materials is complete, the next step is the product trial stage to implement the learning media and test its effectiveness by comparing changes before and after using the CHEM-OWL interactive learning application to increase students' interest in learning science on the material of

substances and their changes. The results of the N-gain measurement of students' interest in learning before being treated (pretest) and after being treated (posttest) will be described in Table 6 below.

Table 6. Results of the N-gain Test of Students' Learning Interest

No.	Aspect	Pretest	Posttest	Posttest Percentage	Max score.	N-gain	Criteria
1	Feelings of joy	10,9	16,5	82,5%	20	0,61	Medium
2	Student involvement	10,6	16,4	82%	20	0,61	Medium
3	Student interest	11,7	16,33	81,6%	20	0,55	Medium
4	Student attention	12,4	16,27	81,3%	20	0,50	Medium
	Average	57	82	82%	80	0,57	Medium

Based on Table 6, the results of the N-gain test of learning interest in the aspect of feelings of pleasure obtained an N-gain of 0.61 with the criteria of "moderate"; the aspect of student involvement obtained the same N-gain, namely 0.61 included in the criteria of "moderate", the aspect of student interest obtained an N-gain of 0.55 with the criteria of "moderate", in the aspect of student attention obtained an N-gain of 0.50 which was included in the criteria of "moderate". Furthermore, the total average N-gain from all aspects measured was 0.57 with the criteria of "moderate".

The findings in this study indicate that the use of the CHEM-OWL interactive learning application is quite effective in increasing students' interest in learning, as evidenced by the average N-gain of 0.57, which falls into the "moderate" criteria so that there is a change in students' interest in learning before and after being treated. In line with research from Khotimah *et al.*, (2023) which found a positive effect of the use of Android-based learning media (SAC) on the learning interest of students at SMPN 2 Bontomarannu, with the results of the ANOVA test, the sig value obtained was 0.084 greater than >0.05 so that there is an influence of media on students' interest in learning. Another similar study Ramli *et al.*, (2019) using the independent t-test, concluded that the experimental class score after the learning intervention using the interactive multimedia module was significantly higher than the control class score, thus indicating that the use of the interactive multimedia module is very effective compared to conventional learning methods. The N-gain results for each aspect of learning interest will be described in more depth.

Regarding the feeling of happiness, the N-gain obtained was 0.61 with the criteria of "moderate". Students feel happy with the learning situation using the CHEM-OWL application; they are very enthusiastic because the learning media they use is different from what is usually used by teachers; namely, learning is limited to lecture methods, which tend to be monotonous and boring. Students are happy because learning media can be used on personal smartphones, which they usually use daily to play games and social media. According to Prasetyo, interest is a tendency that is inherent in the student's personality itself, which is evidenced by feelings of happiness and interest when carrying out learning activities (Dalimunthe, 2020). This aligns with research from Az-Zahra *et al.*, (2023) which shows that using interactive learning media can give rise to feelings of happiness so that students are interested and pay more attention during learning.

Regarding student engagement, the N-gain was 0.61 with the criteria of "moderate". Students learning using the CHEM-OWL application seemed actively involved in learning activities. This is because the CHEM-OWL media was made with an interactive design so that students have more involvement in learning and learning activities do not feel monotonous and boring. According to [Mulyani et al., \(2023\)](#), learning designs based on student learning characteristics can help increase student engagement in activities and interactivity during the learning process. Innovation in developing interactive learning media is important to increase effectiveness in the digital era. Using interactive learning media can allow students to participate actively in the learning process ([Fitriya et al., 2024](#), [Utomo, 2023](#)).

In terms of student interest, they get an N-gain of 0.55 with a "moderate" criterion. Students are very interested in learning to use the CHEM-OWL application, as evidenced by the fact that after the application is installed on their smartphone, they immediately open it and try it. The CHEM-OWL application has advantages regarding illustrations and animations, which can interest students. In line with this, according to Mayer, multimedia learning features such as images, animations, illustrations, and videos and their interactivity can make learning more interesting and enjoyable and, at the same time, clarify the presentation of the material ([Kristanti & Dantes, 2024](#); [Raehang & Karim, 2024](#)).

Furthermore, in terms of student attention, they get an N-gain of 0.50 with a "moderate" criterion. Students' attention is indeed quite high when learning to use CHEM-OWL. They pay attention when the researcher instructs them how to install and use it. Students are also enthusiastic and learn with focus using CHEM-OWL. This is supported by research from [Akbar & Hadi \(2023\)](#) which found a significant difference in learning interest between the experimental class and the control class, such as in student attention, where the experimental class obtained a higher percentage than the control class. According to [Sharma \(2023\)](#) to obtain good learning outcomes, students must pay high attention to learning materials or media. If the media cannot attract attention, students will easily get bored, so interest in learning decreases.

Additional testing should be conducted in various educational settings to understand better the effectiveness of the CHEM-OWL or similar interactive learning application. Experiments could be conducted in different school settings or educational levels (e.g., elementary, secondary, and tertiary) to determine how the application can support individual learning needs in each school or educational level. The results of this broader testing project provide useful information to improve implementation and ensure its relevance in various educational applications.

Conclusion

The interactive learning application CHEM-OWL developed received an assessment with very valid criteria and is suitable for supporting the learning process. The use of the CHEM-OWL application is also quite effective in helping to increase the learning interest of class VII students of SMPN 1 Sekaran, with the N-gain obtained of 0.57, which is included in the "moderate" criteria. Because in learning interest, apart from being influenced by learning media, it is also influenced by other factors such as the learning environment, teacher quality, and the different learning styles of each

student. To increase its impact, developers can add other necessary features, adjust to students' learning styles, and test in various educational environments or different levels of education to perfect its use in the future.

Suggestions for further similar research include reducing the file size of the developed learning application so that the application does not take up much internal storage. Then, refine the media features in storing login information and history so that usage activities can be stored and students can continue studying the learning material. Wider testing with a larger sample is needed to find more accurate and representative results related to the effectiveness of the CHEM-OWL application or similar learning media in various educational environments and student backgrounds.

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