



## Pengembangan Multimedia Interaktif Articulate Storyline 3 Berbasis Problem Based Learning Pada Materi Struktur Atom Berorientasi Kemampuan Berpikir Kritis Murid

*(Development of Interactive Multimedia Articulate Storyline 3 Based on Problem Based Learning on Atomic Structure Materials Oriented to Students' Critical Thinking Skills)*

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**ABSTRACT.** This study aims to determine the process of development, feasibility, and response of teachers and students to interactive multimedia Articulate Storyline 3 based on problem-based learning on atomic structure materials oriented to students' critical thinking skills. The product development process is carried out by the Lee and Owens model stages, namely: analysis, design, development, implementation, and evaluation. The instruments used were interview sheets and questionnaires. The resulting products are validated by material experts and media experts. Furthermore, it is assessed by teachers and tested in a one-to-one and small group manner. Data analysis techniques are used for qualitative data analysis and quantitative data analysis. The results of the study that the product developed was conceptually and procedurally feasible based on subject matter experts obtained a percentage of 90%, a one-to-one test with a percentage of 90%, and from the student's response had a percentage of 91.7%. Based on the results of the study, it can be concluded that interactive multimedia Articulate Storyline 3 based on problem-based learning on atomic structure materials oriented to students' critical thinking skills has fulfilled all stages with "very good" results and contributes to improving students' critical thinking skills.

## INTRODUCTION

According to the SISDIKNAS Law No. 20 of 2003, Education is a conscious and planned effort to develop the potential of students as a whole. The Merdeka Curriculum demands student-centered learning, as well as being able to utilize digital technology to support 21st century skills [1]. The Merdeka Curriculum emphasizes active and student-focused learning, in accordance with the needs of 21st century skills such as the 6C skills, namely critical thinking, problem-solving, metacognition, communication, collaboration and creativity. In line with these demands, the development of technology-based media is an important need in the world of education, the learning process also needs to be systematically designed to be able to harmonize the diversity of student learning styles and encourage student involvement in the learning process [2]. The right learning media is expected to help students build a more meaningful understanding of concepts.

In chemistry learning, critical thinking skills are a very important competency, because students not only understand concepts but are also able to relate learning to real phenomena and can solve problems [3]. However, the chemical material that is often considered difficult by most students is the atomic structure because this material is abstract so that students still find it difficult to analyze and understand concepts [4].

The results of an interview conducted with chemistry teachers at SMA Negeri 8 Muaro Jambi, stated that the school has used the Merdeka curriculum, but in the process of learning chemistry still uses student worksheets (LKS) as the main source of teaching materials and learning is still dominated by the lecture method so that student involvement and critical thinking skills have not developed optimally. In addition, the results of the student needs questionnaire show that in chemistry learning students rarely use digital technology-based media, but students are very enthusiastic if in the learning process the material presented in the form of pictures, animations, videos and students need learning media that can be used outside the classroom. As many as 96% of students have difficulty understanding atomic structure material and state that they need interactive learning media.

One of the relevant learning models to develop students' critical thinking skills, namely the Problem Based Learning model, is an effective teaching strategy based on problems that can be overcoming these obstacles. This model encourages students to think critically, seek information, and work together to solve problems [5]. However, the implementation of Problem Based Learning in schools is still not optimal due to limited media. So that without the help of media in the learning process, it will tend to be like a lecture or passive discussion method, which



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makes it difficult for students to understand abstract concepts and lack of student involvement in the learning process. So that learning media innovation combined with the Problem Based Learning model is needed to make the learning process effective.

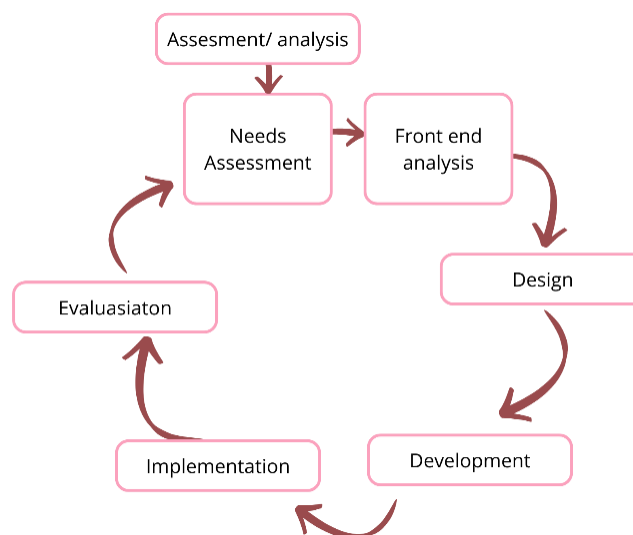
Technology is a solution for interactive learning so that the learning process becomes more interesting. Technology in the context of education is used as a tool to convey learning materials that are used to deliver teaching to students [6]. One of the uses of technology in education is the use of interactive multimedia. Interactive multimedia is a type of technology that can be used to present information interactively using laptops and smartphones, therefore the use of technology can be integrated into the learning process [7].

The use of technology through interactive multimedia can be a solution to support the implementation of problem-based learning. Multimedia components include text, graphics, audio, video, and even animation so that they are able to present more interesting and interactive material [8]. One of the software used to develop interactive multimedia is Articulate Storyline 3. This medium allows students to access online and offline through smartphones and laptops [9] [10]. Previous research has shown that the interactive multimedia based on Problem Based Learning used is able to increase students' interest in learning [11]. However, previous research focused on increasing students' interest in learning, the novelty of this research is to develop interactive multimedia using Articulate Storyline 3 which is integrated with the Problem Based Learning model oriented to students' critical thinking skills. This integration not only makes learning more interactive and contextual, but also provides a learning experience that encourages students to think in solving real-world problems, in accordance with the principles of the Merdeka curriculum and the needs of 21st century learning.

Based on this description, this study aims to develop an interactive multimedia Articulate Storyline 3 based on Problem Based Learning on atomic structure materials that are oriented towards students' critical thinking skills.

## RESEARCH METHODS

This research is a type of development research (R&D), the goal is to produce a product and test the product. In this study, the development model that will be used is Lee and Owens. In the development model of Lee and Owens there are 5 stages, namely Analysis, Design, Development, Implementation and Evaluation. The schematic of the stages of the Lee and Owens model can be seen in figure 1.



In the analysis stage, the researcher collected data used for analysis purposes at SMA Negeri 8 Muaro Jambi, some of the analyses carried out included: student needs analysis, learning objective analysis, material analysis, and technology analysis. This stage aims to understand the real conditions in the field and identify the gap between the applicable rules and the existing reality, in addition to knowing the needs in the learning process and exploring new information that is relevant to the product being developed. After the analysis is carried out and the results of the analysis stage have been obtained, it is continued with the design stage. This design stage is the process of making a design design, which is interactive multimedia on atomic structure materials. This stage includes team

building, research time, material preparation, *flowchart creation*, and interactive multimedia *storyboarding*. At this stage, an initial evaluation of the product design is also carried out before entering the development stage.

This development stage involves creating interactive learning multimedia based on the storyboard that has been created. The researcher uses articulate storyline software. The material is presented through a combination of text, images, animations, and learning videos about atomic structure materials. One of the important stages in this stage is the validation stage by material experts and validation by media experts with the aim of assessing the feasibility of the product from a conceptual and procedural perspective. The suggestions provided by the validators are used to improve the product so that the interactive multimedia is ready to be tested in learning. After that, the product will be assessed according to the input from the teacher until the product is considered suitable for use by students. Furthermore, a one-to-one trial was carried out to find out the practicality and understanding of the material presented in the learning media. After that, small group trials are carried out to see the level of practicality and comprehension of the product that has been developed.

The next stage is the implementation, the process of implementing *Articulate Storyline 3 interactive multimedia* based on *Problem Based Learning* which has previously been developed but has not yet been specific. At this stage, the researcher prepares a learning tool in the form of an Independent Curriculum RPP that will be used by teachers. The lesson plan made is appropriate and the product that has been revised and declared feasible by validators and teachers can be applied in the learning process to students of class X E3 SMA Negeri 8 Muaro Jambi. Furthermore, the last stage is Evaluation, this stage aims to assess the success and suitability of interactive multimedia created with initial expectations. In this study, evaluation is formative where evaluation is carried out at every stage starting from the stage of analysis, design, development to implementation. The evaluation carried out refers to the Lee and Owens development model, which is at level 1 of evaluation, namely reaction. Evaluation is urgently needed as a guideline for revision or improvement to obtain products that are suitable for use.

The test subjects in this study were students of class X E3 of SMA Negeri 8 Muaro Jambi and were only limited to a one-to-one trial of 3 students with different cognitive levels (Low, Medium, and High) and a small group trial of 10 students with different cognitive levels (Low, Medium, and High). Product trials were conducted to obtain data on how students responded to the interactive multimedia developed. The data obtained will be used for the improvement and improvement of interactive multimedia which is the final product of this study.

In this development research, the types of data taken are quantitative and qualitative data. Quantitative data was obtained from student needs analysis questionnaires, validation questionnaires for material experts and media experts, as well as from teacher assessment questionnaires and student responses expressed in the form of scores. Meanwhile, qualitative data was obtained from the results of interviews with teachers as well as validation questionnaires of media experts and material experts which were equipped with suggestions and improvements related to the media products developed.

The data that has been collected is then analyzed based on assessments on student needs instruments, media expert validation instruments, materials, teachers, and student responses. To analyze the data from the needs questionnaire, a rating scale assessment scale was used with the following formula:

$$\% \text{ score} = \frac{\text{number of scores obtained}}{\text{total score}} \times 100\%$$

The data obtained from the analysis of the validation sheets of material experts, media, and teachers is quantitative. The classification of validation by experts and teachers is also based on the average answer score, using the formula:

$$\text{Avarage} = \frac{\text{number of scores obtained}}{\text{number of question}}$$

Furthermore, the collected data will be analyzed and converted into interval data descriptively using the Likert scale. According to Widoyoko (2012), it is stated that the scale of five has higher variability and is better or more complete than the scale of four. The five scale criteria used are as follows:

**Table 1.** Categories of Assessment Validation and Teacher Assessment.

No	Average score	Criteria
1.	>4,2 – 5,0	Excellent (SB)
2.	>3,4 – 4,2	Good (B)
3.	>2,6 – 3,4	Lees Good (KB)
4.	>1,8 – 2,6	Not Good (TB)
5.	1,0 – 1,8	Very Bad (STB)

[12]

After getting the teacher's assessment, the interactive multimedia product was then tested on students through one to one and small group trials. Instrument data from the student responses that have been collected are analyzed to calculate the percentage that gave responses according to certain criteria. The formula used to calculate the eligibility percentage is:

$$\text{percentage \%} = \frac{\text{total score of data collection result (F)}}{\text{maximum score} \times \text{number of questions} \times \text{number of respondents}} \times 100\%$$

The interpretation of the Score can be stated as follows:

**Table 2.** Questionnaire Level Assessment Criteria.

No	Average score	Criteria
1.	81% - 100%	Excellent (SB)
2.	61% - 80%	Good (B)
3.	41% - 60%	Lees Good (KB)
4.	21% - 40%	Not Good (TB)
5.	1% - 20%	Very Bad (STB)

[13]

## RESULTS AND DISCUSSION

In this section, the result and discussion of the development of interactive multimedia Articulate Storyline3 based on Problem Based Learning on atomic structure materials oriented to students' critical thinking skills are presented. The results of the research were obtained through the validation of material experts, validation of media expert, teacher assessments, as well as one to one and small group trials.

### 3.1. Material Expert Validation Results

Validation of material experts is carried out to assess the suitability of multimedia content with learning outcomes, the correctness of concepts, systematics of presentation, and the integration of the material with the syntax of Problem Based Learning. Validation was carried out in two stages. The results of the validation of the subject matter experts are presented in table 3.

**Table 3.** Material Expert Validation Results.

Validation Stage	Average score	Percentage (%)	Criteria
Phase I	3,0	60	Less good
Stage II	4,5	90	Excellent

Based on table 3, the results of the first phase of validation show a feasibility percentage of 60% with the criterion of "Not Good". Therefore, revisions were made, especially to the adjustment of CP, TP, and ATP with the Problem Based Learning model, the addition of tapping questions, and the strengthening of the indicators of students' critical thinking skills. This revision is in line with the theory of constructivism which views learning as an active process of students in building knowledge based on meaningful learning experiences. In addition, these improvements are also in line with the principle of *Problem Based Learning* which emphasizes the active involvement of students in the problem-solving process so that learning becomes more meaningful [14].

After revision, the results of the validation of the second stage of material experts increased to 90% with the criterion of "Excellent". This improvement shows that the material is in accordance with the learning objectives and is able to support the development of students' critical thinking skills, in line with the findings of previous

research. This is in line with research [15], which states that interactive multimedia assisted by *Articulate Storyline 3* based on *Problem Based Learning* is considered feasible because it is able to present material in a systematic, contextual manner, and encourage student involvement. In line with that [16], it was also revealed that interactive multimedia based on *Problem Based Learning* is effective in increasing students' involvement and critical thinking skills through the presentation of real problems. Thus, the increase in results at the validation stage in the second stage shows that what is done is appropriate and worthy of being tested in terms of material.

### 3.2. Media Expert Validation Results

Media expert validation aims to assess the quality of visual display, readability of text, navigation, interactivity, and ease of use of multimedia. Validation was carried out in two stages. The results of the validation of media experts are presented in table 3.

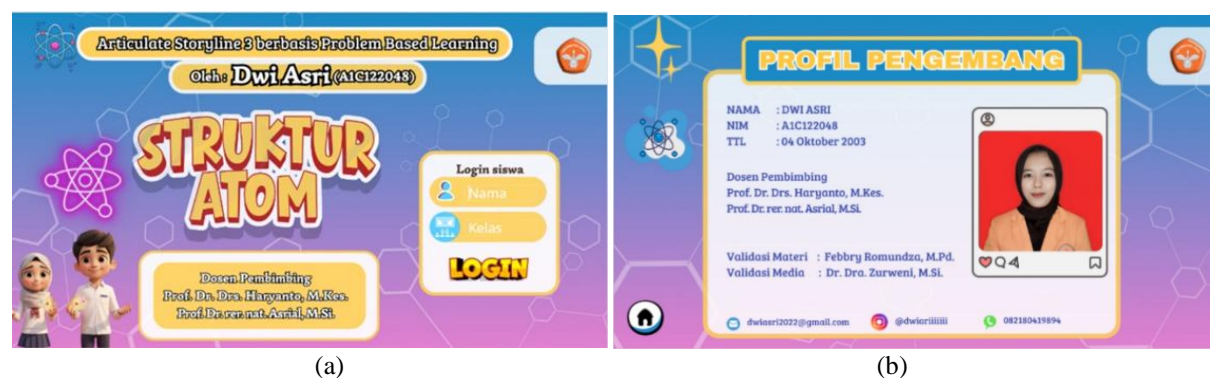
**Table 4.** Media Expert Validation Results.

Validation Stage	Avarage score	Percentage (%)	Criteria
Phase I	3,06	61,3	Kurang baik
Stage II	4,4	88	Sangat Baik

In the first stage of validation, a feasibility percentage of 61.3% was obtained with the criterion of "Not Good". Some aspects that need to be improved include color selection, font size, layout, icon clarity, and QR code size. This is in line with behaviorism theory which emphasizes that stimuli in the form of clear visual displays, harmonious colors, and easy-to-use navigation will give rise to response, comfort, and activeness of students in using interactive multimedia. This revision is in line with multimedia design principles that emphasize readability, visual clarity, and ease of navigation so that users can learn well [17].

After being corrected according to the validator's suggestion, the results of the second stage of validation showed an increase in the percentage of eligibility to 88% with the criterion of "Excellent". These results show that interactive multimedia has met the principles of multimedia design that are effective and feasible to use in the learning process. This is in line with the opinion [18], which states that the feasibility of learning media can be determined through a validity test by meeting the feasibility aspects of content, language, presentation, graphics, and media use.

The *interactive multimedia display of Articulate Storyline 3* based on *Problem Based Learning* on atomic structure materials oriented to students' critical thinking skills that have been validated by material experts and media experts is presented in figure 2.



**Figure 2.** (a) Home Page Articulate Storyline 3 (b) Developer Profile Page Interactive Multimedia.

Interactive multimedia products in figure 2. It can be accessed through the following website link:  
Links:

<https://multimedaiinteraktifdwasri.netlify.app/>

### 3.3. Teacher Assessment Results

The assessment by the chemistry teacher as a practitioner validator obtained a score of 4.5 with a feasibility percentage of 90% of the "Very Good" criteria. The teacher stated that interactive multimedia is easy to use,

interesting, and able to encourage active involvement and critical thinking skills of students. In summary, the results of teacher assessments are presented in table 5.

**Table 5.** Teacher Assessment Results.

Validation Stage	Average score	Percentage (%)	Criteria
Phase I	4,5	90%	Excellent

### 3.4. Results of One to One Trial

The one-to-one test was conducted on three students with different cognitive levels to determine the clarity of the material, ease of use, and the appeal of interactive multimedia. The results of the one-to-one trial showed a student response percentage of 90% with the criterion of "Very Good". Students stated that the multimedia display was attractive, navigation was easy to understand, and the atomic structure material became easier to learn. In summary, the results of the one-to-one test are presented in table 6.

**Table 6.** Results of One to One Trial.

Trial Type	Number of Pupils	Percentage (%)	Criteria
One to One	3	90%	Excellent

### 3.5. Small Group Trial Results

The group trial was carried out on 10 students of class X Phase E3 of SMA Negeri 8 Muaro Jambi with different cognitive levels. The results showed a student response percentage of 91.07% with the criterion of "Very Good". In addition, the average score of the learning evaluation results reached 90 out of a maximum score of 100, which indicates that students were able to understand the material of atomic structures well after using interactive multimedia. In summary, the results of the small group trials are presented in table 7.

**Table 7.** Small Group Test Results.

Trial Type	Number of Pupils	Percentage (%)	Criteria
Small groups	10	91,07%	Excellent

Based on the results of the validation of material experts, validation of media experts, and tests on students through one-to-one trials and small group tests, it can be concluded that the *interactive multimedia Articulate Storyline 3* based on *Problem Based Learning* on atomic structure materials is declared feasible and obtained a very good category, so that it can be used as a learning medium to support the improvement of critical thinking skills.

## CONCLUSION

Based on the results of the development research, *the interactive multimedia Articulate Storyline 3* based on *Problem Based Learning* on atomic structure materials oriented to students' critical thinking skills using the Lee and Owens model which includes the stages of analysis, design, development, implementation, and evaluation. The validation results showed that it was conceptually and procedurally feasible based on material experts obtaining a percentage of 90%, media experts with a percentage of 88%, teacher assessments of 90%, one-to-one trials with a percentage of 90%, and student responses with a percentage of 91.7%. So that *the Articulate Storyline 3* interactive multimedia based on *Problem Based Learning* on atomic structure materials oriented to students' critical thinking skills has fulfilled all stages up to the small group trial stage with "Very Good" results So that *Problem Based Learning*-based interactive multimedia is suitable for use as a chemistry learning medium and contributes to improving students' critical thinking skills.

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