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# Development of Interactive Learning Multimedia on Atomic Model Topic to Minimize Students Misconceptions at SMAN 1 Driyorejo

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**Abstract**
This research aims to develop interactive multimedia that can minimize students' misunderstanding of atomic model materials. Media developed using Macromedia Flash which contains animations about atomic models. Feasibility is reviewed from three aspects, namely (1) validity which contains the validity of content and construct, (2) practicality which is reviewed based on the results of student observations and response questionnaires, (3) effectiveness reviewed based on pretest – posttest results which will later show a shift in student conception from initially not understanding the concept (TPK) to understanding the concept (PK). This research uses the 4D Research and Development (R&D) method with 15 research subjects in class XI Science at SMA Negeri 1 Driyorejo. The results of the research obtained show that interactive multimedia is suitable to be used as a medium in learning and minimizes the occurrence of misconceptions in atomic model material. This is evidenced based on the results obtained during the study, namely (1) the average validation obtained mode 5 so that it was categorized as very good / valid, (2) the average percentage of student response questionnaires obtained a score of 94% so that it was categorized as very practical, in observation a score of 98% was obtained so that it was categorized as very practical, (3) and the average percentage of student conception shift from not understanding the concept (TPK) to understanding the concept (PK) obtained a score of 87.23% so that it was included in the category is very effective.

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## INTRODUCTION

Science essentially consists of artifacts and processes associated with facts, concepts, principles, theories and laws. His two elements of science are contained in chemistry (Aprilia et al., 2023). Chemistry is the branch of science that studies structure, properties and changes on the fabric (Artini & Wijaya, 2020). In studying chemistry, you are always faced with problems that are related to daily activities and require systematic solutions. Sometimes the problems presented seem complicated and complex, making the impression that chemistry is a difficult science (Lathifah et al., 2023).

Chemistry learning is one of the subjects that many students complain because they have difficulty understanding the concepts in this science (Prayunisa, 2022). Chemistry as a compulsory subject for science program students is often perceived as a quite difficult subject by most high school students, causing students not to be interested in learning chemistry (Akram et al., 2017). The chemistry is abstract, so it is difficult to imagine a picture because there is no real form. This was reinforced by the preresearch that I had done as a researcher at

SMAN 1 Driyorejo, which showed that 82.85% of students said chemistry was a difficult subject.

This is in line with research conducted by Sukmawati (2019), who said that the chemicals considered by most students are abstract sciences and tend to be complex. This was also reinforced by the pre-research that I had done as a researcher, the results showed that students considered chemistry to be an abstract and complex science as much as 77.14%. students learning chemistry is caused by several factors, including students interest and motivation in learning chemistry, weak understanding of concepts, peer influence, ineffective chemistry learning time, abstract chemistry topics, and misconceptions (Hemayanti et al., 2020). Misconception is an erroneous understanding of a concept or an error occurs in interpreting some of the variables that are interrelated, this concept is not in accordance with the understanding of the concept of experts (Lestari, 2021).

Research conducted by Sukmawati (2019) shows that one source of misunderstanding is the difficulty of understanding abstract concepts from chemistry. Chemistry itself is divided into three levels, namely macroscopic, microscopic and symbolic. Through these representations, properties of the physical world of matter, phenomena and processes can be interpreted and predicted at the macroscopic level using the language that surrounds them at the microscopic level. Misconceptions in studying chemistry can be solved if the three levels of chemical representation are represented properly (Fahmi & Fikroh, 2022). In fact, students have difficulty understanding and using the three levels of multi-representation in explaining a chemical phenomenon. One of the chemical materials that requires an understanding of the submicroscopic and symbolic levels is the atomic model.

The atomic model is one of the materials studied in chemistry $10^{th}$ grade. States that the atomic model is composed of three basic particles, namely protons, electrons, and neutrons (Widiyatmoko & Shimizu, 2018). among others, developments in atomic theory, elementary atomic particles, atomic notation, terms in atoms, relative atomic masses and average atomic masses, electron configurations, and quantum numbers. This material cannot be done theoretically, but must be mediated in the form of images or symbols.

According to research from A'yun & Nuswowati (2018) states that the level of attainment of students' conceptions in the atomic model material is as much as 37.03% of students in the group understand the concept, 28.91% of students in the group do not understand the concept, and 34, 06% of students in the misconception group. The percentage of students' misconception level groups in the atomic model material is spread over each sub-concept. However, most misconceptions were found in Rutherford's theory. This is also in line with the initial research conducted by the researchers, namely the results of the group understanding the concept were 17.62%, the group not understanding the concept was 36.67%, and the group with misconceptions was 45.71%.

Students lack of understanding of the atomic model material can result in the formation of misunderstandings for subsequent chemical material, because the atomic model is a basic chemical material that must be understood for the next understanding of chemistry. One of the studies of chemistry that is closely related to the atomic model is chemical bonding, because chemical bonding requires theory to study the structure and properties of matter (Mellyzar et al., 2022). One method that is suitable for measuring the level of understanding of students is a diagnostic test (Widiyatmoko & Shimizu, 2018). Diagnostic tests are tests that can be used to identify difficulties experienced by students in certain materials. From the results of these tests, the teacher can find the right solution to overcome the difficulties experienced by students (Ayu Rahmi et al., 2021). The instrument used is four tier multiple choice. The four tier multiple choice diagnostic test is a type of test that is suitable for identifying and measuring the difficulties experienced by students.

This is what makes students hope that there will be media that can make them interested so they don't get bored and sleepy and can make them more active in class (Aprilyani et al., 2021). Learning media has an important role in achieving student learning success. Learning by using learning media will attract more students attention so that it can improve learning outcomes. The learning media used in the learning process will affect the activities of students while participating in learning. The use of learning media for students will become more active, enthusiastic, and critical because they use their five senses in learning so that learning will become more meaningful (Putri et al., 2020). One of the multimedia that is often used is macromedia flash.

Stated that macromedia flash is a multimedia that can create interactive media in the form of videos, animations, images, and sounds in an easy and effective way (Ayu Rahmi et al., 2021). The use of interactive media is to attract students learning interest through the various forms of animation that are presented, as well as abstract things that can be concreted (Fakhri et al., 2018). The use of computers can explain concepts that are abstract or symbolic in nature because they are able to use dynamic displays that allow students to manipulate atomic models, see atoms that are small in size, and see interactions between molecules.

This interactive learning media is expected to make it easier for students to learn in understanding atomic model material and engage in the use of interesting technology. The media can later be used as a variation of teaching materials so that learning becomes more effective and efficient. Therefore, it is necessary to test the feasibility of a learning media in order to know the validity, practicality, and effectiveness of the media.

This Macromedia Flash multimedia contains animations that can move on atomic model material, such as electrons that can rotate, the origin of the atomic model is found, the experiments that underlie the formation of the atomic model theory (Handayani, 2018).

## METHOD

This research is a type of development research using the research and development (R&D) research method of Thiagarajan (1974). This is because this research is developing teaching materials in the form of interactive learning media for atomic model materials. The research and development method by Thiagarajan (1974) consists of his four steps of (1) definition, (2) design, (3) development, and (4) dissemination. However, as shown in Figure 1, only the third stage of development is performed in this study, as the researchers only consider product feasibility.

The feasibility of developing interactive multimedia is reviewed based on validity in the form of content and construct validity, practicality, and effectiveness. Data collection methods in this study included questionnaires (validation questionnaire, student activity observation questionnaire, student response questionnaire) and test questionnaires (pre-test and post-test). Validation questionnaires are completed by experts (validators), such as chemistry lecturers and chemistry teachers. The student response survey is for students who have used animated interactive media in their tests. The student activity observation Sheet is an observation sheet used to observe student activity in learning activities using interactive multimedia development. Observation forms are completed by observers according to the instructions provided. The effectiveness of interactive multimedia content is determined using a four-level pretest post-test questionnaire. This test is designed to measure students' cognitive performance before and after delivery of interactive multimedia content and to determine if there is a change in concepts afterward.

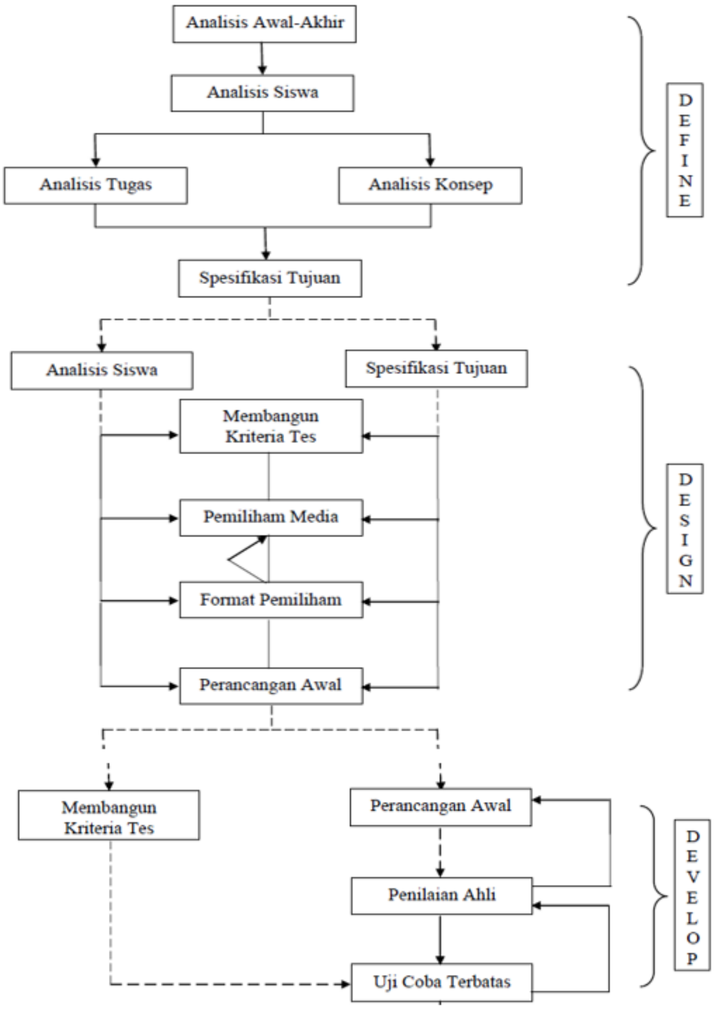



Figure 1. 4D (3D) Research Design Model

This study was conducted at SMAN 1 Driyorejo with 11th grade high school physiology first-year students in the even-numbered semester of the 2022/2023 school year. The data sources used are surveys in the form of research and validity, pretest results, posttest results, answer sheets, and student activity observation sheets. The measurement results are based on changing the misconceptions of students who initially did not understand the concept and understanding the concept that the student has acquired from the perspective of cognitive knowledge. The data analysis method used in the validation sheet uses the Likert scale. Since the data obtained are ordinal, analysis of the validated data is done by determining the mode at each validated point. A point is declared valid if the validity score and mode obtained is 3 or higher. Validity score obtained and mode 3 declared invalid (Lutfi, 2021).

Table. 1 Likert Scale (Riduwan, 2018)

| **Valuation** | **Score** |
|---|---|
| Very bad | 1 |
| Bad | 2 |
| Enough | 3 |
| good | 4 |
| Excellent | 5 |

Analysis of student activity observation data and response questionnaires using the Guttman scale, then calculated the average using the following formula.

$$P\ (\%) = \frac{\sum Score\ obtained}{\sum Maximum\ Score}\ x\ 100\%$$

This interactive multimedia is considered useful if you achieve an average point rate of ≥ 61%. Student observation assessment scale and student response questionnaire can be seen in Tables 2 and 3.

Table 2. Guttman Scale (Riduwan, 2018)

| Answer | Positive Statement Score | Negative Statement Score |
|---|---|---|
| Yes | 1 | 0 |
| No | 0 | 1 |

Table 3. Interpretation of Practicality Criteria

| Percentage (%) | Category |
|---|---|
| 0 -20 | Impractice |
| 21 – 40 | Less practice |
| 41 – 60 | Quite practice |
| 61 – 80 | Practice |
| 81 – 100 | Very practice |

Pre-test and post-test sheets are created to divide students into 3 parts: "concept understood", "concept not understood" and "misunderstood". Upon receipt of pretest results, multimedia content designed to take students from non-conceptual understanding to conceptual understanding is provided. After treatment and posttest, there will be a shift in students understanding of concepts. This interactive learning multimedia is said to be effective if the percentage shift in concept understanding is ≥ 61% (Riduwan, 2018). Interpretation of the results four tier diagnostic test can be seen in the Table 4.

Table 4. Interpretation of the results four tier diagnostic test (Sheftyawan et al., 2018)

| Answer | Answer Confidence Level | Reason | Reason Confidence Level | Category |
|---|---|---|---|---|
| **True** | Yes | True | Yes | Understand |
| **True** | No | True | No | Don't understand |
| **True** | Yes | True | No | |
| **True** | No | True | Yes | |
| **True** | No | False | No | |
| **False** | No | True | No | |
| **False** | No | False | No | |
| **True** | Yes | False | No | |
| **False** | No | True | Yes | |
| **True** | No | False | Yes | Misconceptions 1 (M1) |
| **True** | Yes | False | Yes | Misconceptions 2 (M2) |
| **False** | Yes | True | No | Misconceptions 3 (M3) |
| **False** | Yes | True | Yes | Misconceptions 4 (M4) |
| **False** | Yes | False | No | Misconceptions 5 (M5) |
| **False** | No | False | Yes | Misconceptions 6 (M6) |
| **False** | Yes | False | Yes | Misconceptions 7 (M7) |

## RESULTS AND DISCUSSION

In this study, the results obtained were Macromedia Flash which was used as interactive multimedia which could prevent or minimize student errors in the atomic model material. The aims of this research are 1.) Explanation of the effectiveness of interactive learning media on atomic model materials to minimize student misunderstandings at SMAN 1 Doryorejo. 2.) To minimize student misunderstandings in SMAN 1 Driyorejo, we describe the practicality of interactive learning multimedia on atomic model teaching materials. 3.) Describes the effectiveness of interactive learning media on atomic model teaching materials to minimize student misunderstandings in SMAN 1 Driyorejo. This multimedia development refers to research and development (R&D) design with Thiagarajan's 4D model and consists of four steps: (1) definition, (2) design, (3) development, and (4) dissemination. However, in this study, it only made it to the development stage, providing data from the development of Macromedia Flash, student reactions, and a description of students' transition from misconceptions to conceptual understanding (Dwi L.W et.al., 2019)

### Define

#### *Front-end analysis*

Researchers made observations at the destination school (namely SMAN 1 Driyorejo). The first step is to conduct an interview with the chemistry teacher about the conditions of chemistry learning when in class, and how the methods / media used when teaching students. The results of the interview obtained that when chemistry learning took place, most of the students did not pay attention to the teacher in front of the class. While the method used is still conventional, namely only with the lecture method. This is the possibility that students do not pay attention or feel bored when learning chemistry (Sumarni, 2019).

#### *Learner analysis*

After that, researchers conducted preresearch in 1 class at $11^{th}$ grade Mathematics and Sciences (MIPA) 2, and it was found that students who did not understand the concept as much as 36.67% and students who misunderstood as much as 45.71% in atomic model material, the rest were understanding concepts. Based on the results of the preresearch conducted, students feel difficult and bored during chemistry lessons because chemistry learning is not interesting.

#### *Destination specification*

Based on the results of interviews and pre-research conducted, the researchers decided to develop interactive flash multimedia on atomic model material. This is expected to make students interested in learning chemistry and to minimize the occurrence of misconceptions, especially in atomic model materials.

### Design

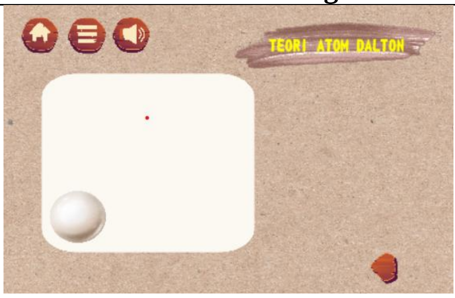
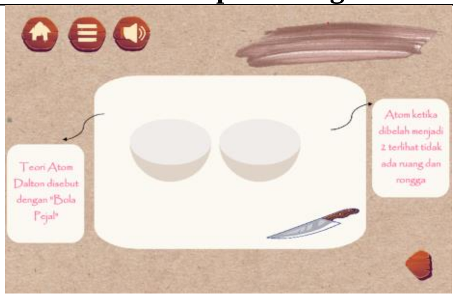
At the product design stage, the development of interactive flash multimedia begins with making storyboards related to interactive multimedia on atomic model material which aims to minimize misconceptions in students. Then create pretest and posttest questions with a four tier diagnostic test consisting of 10 questions, namely there are questions with a level of confidence, as well as reasons with a level of confidence as well.

### Development

#### *Review*

The interactive multimedia that will be developed will later go through the design validation stage which is carried out by the validator, before that it must first go through the review stage which is carried out by the thesis supervisor. The study sheet contains additions as well as input or suggestions for interactive multimedia so that when validating the scores obtained it is feasible to use learning media on atomic model material. The following are the results of the study contained in Table 5.

Table 5. Results of Interactive Multimedia Study

| No | Initial Design | Repair Design |
|---|---|---|
| 1. |   A solid ball bounces zigzag with the intention that atoms are the smallest particles |   Reviewer suggestion: should be animated on the atomic model (solid ball) split into 2 for more detail. |
| 2. |   Music cannot be controlled by the user |   Reviewer suggestion: added on and off buttons for music, to make it more interesting and comfortable users |

The results of content validation get a mode of 5 which is included in the very good category, so that this interactive multimedia can be said to be feasible and can be used to minimize the occurrence of misconceptions.

### *Construct Validity*

The criteria listed in the construct validity are interactive multimedia display, quality of use of interactive multimedia, use of language in material, quality of animation in interactive multimedia, quality of layout in interactive multimedia, and use of language in *quizzes*. The results obtained on construct validity can be shown as follows.

Table 6. Results of Interactive Multimedia Construct Validation

| PURPOSE | NO | ASSESSED ASPECTS | MODE / CATEGORY |
|---|---|---|---|
| Know the interactive multimedia display | 1. | Attractive interactive multimedia cover dan sesuai dengan judul | 5 / Excellent |
| | 2. | Suitability of background selection, type, size, and color of writing | 5 / Excellent |
| Know the quality of using interactive multimedia | 1. | Ease of use of interactive multimedia | 5 / Excellent |
| | 2. | Suitability in the use of control buttons (*previous*, *next*, *home*, etc.) | 5 / Excellent |
| | 3. | Moving from one page to the next is easy | 5 / Excellent |
| | 4. | The instructions for use present in multimedia are not confusing | 5 / Excellent |

| PURPOSE | NO | ASSESSED ASPECTS | MODE / CATEGORY |
|---|---|---|---|
| Know the use of language in the material | 1. | Language used according to PUEBI | 5 / Excellent |
| | 2. | The discussion of the material does not use words that can have double or ambiguous meanings | 5 / Excellent |
| Know the quality of animation in interactive multimedia | 1. | Animations developed according to existing concepts | 5 / Excellent |
| | 2. | The selection of colors, shapes, and sizes is appropriate | 5 / Excellent |
| | 3. | Animations are not hampered when running | 5 / Excellent |
| | 4. | The animation display is not confusing | 5 / Excellent |
| Know the quality of layouts in interactive multimedia | 1. | Suitability of layout selection of text, images, and videos | 5 /Excellent |
| | 2. | Easy to read text | 5 / Excellent |
| | 3. | Each page is designed as attractively as possible | 5 / Excellent |
| Know the use of language in quizzes | 1. | The words used in the quiz are easy to understand | 5 / Excellent |
| | 2. | The language on the question does not have double meaning, causing misunderstanding | 4 / good |
| | 3. | *Quiz* using good and correct language in accordance with PUEBI | 5 / Excellent |

***Content Validity***

Criteria for content validity include the conceptual accuracy of the material and the relevance of the supporting material, as well as the requirements for interactive multimedia as a medium to minimize misconceptions in students. The results obtained on content validity can be shown as follows.

Table 7. Results of Interactive Multimedia Content Validation

| PURPOSE | NO | ASSESSED ASPECTS | MODE / CATEGORY |
|---|---|---|---|
| Knowing the truth of the concept of a material | 1. | The suitability of the atomic model material with the revised 2013 curriculum | 5 / Excellent |
| | 2. | The suitability of the atomic model material with basic competencies (KD) and learning indicators. | 5 / Excellent |
| | 3. | The sequence of material in multimedia is arranged systematically | 5 / Excellent |
| | 4. | There are no errors in writing symbols or formulas. | 5 / Excellent |
| Knowing the suitability of supporting material | 1. | Conformity of facts, concepts, and images with the material | 5 / Excellent |
| | 2. | Quiz used are appropriate and use clear and easy-to-understand language | 5 / Excellent |
| Interactive multimedia requirements as media to minimize students misconceptions | 1. | There are components that aim to minimize the occurrence of misconceptions | 5 / Excellent |
| | 2. | There are animations for each sub-concept to help minimize students conceptual errors | 5 / Excellent |
| | 3. | The questions used in the "quiz" section are in accordance with the material and can train students' knowledge to understand the concept | 5 / Excellent |

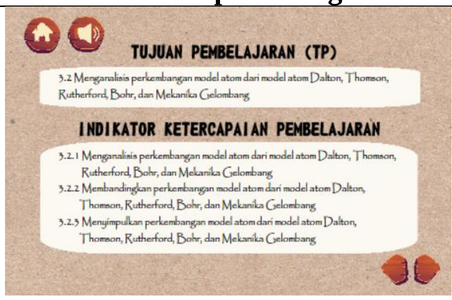
### *Design Validation*

If the review stage has been completed, then the next step is the interactive multimedia validation stage and its device instruments which will be assessed by 3 validators, namely 2 chemistry lecturers and 1 chemistry teacher. This validation is carried out to assess feasibility in the form of validity which will later be tested on class $11^{th}$ grade students of atomic model material. The validator's task is to assess the feasibility of each aspect that has been listed on the validation sheet, which consists of content validity and construct validity. The assessment of this validation sheet is based on a Likert scale consisting of scores 1-5, then the scores obtained from the 3 validators will be calculated using the mode. If the score obtained from the results of the mode assessment is $\geq 3$, then the score is declared valid. Meanwhile, if the validity score is obtained and the mode is $< 3$, then it is declared invalid. In addition, suggestions can also be added by the validator if needed. The following details the content and construct validity of the interactive multimedia that i have developed (Lutfi, 2021).

### *Design Revision*

If the result of the validation is suggestions or comments provided by the validator, it is necessary to validate the design. Here are more details regarding the design revision.

Table 8. Multimedia design revision

| No | Initial Design | Repair Design |
|---|---|---|
| 1. | <br>Still using the revised 13 curriculum | <br>Validator advice: should use an independent curriculum so that it can be used in the long term |
| 2. | <br>There is a double meaningful explanation for the fear of causing misconceptions | <br>Validator suggestion: corrected sentences that cause double meanings and misconceptions |
| 3. |  |  |

| No | Initial Design | Repair Design |
|---|---|---|
| | The animation of Thomson's atomic model, electrons (raisins) are still seen spreading on the bread / surface only. | Validator suggestion: given an explanatory image, if the electrons are evenly distributed throughout the bread, not just on the surface. |

***Limited Trial***

This development stage is carried out after the interactive multimedia and its instruments have obtained the results of review and validation and are included in the valid category. This limited trial was tested on 15 students at 11th grade SMA Negeri 1 Driyorejo who had previously carried out the pretest and selected students who were in the group who did not understand the concept of atomic structure material. Students use computers at school simultaneously to try out this interactive multimedia. This trial is expected to shift students' understanding from those who initially did not understand the concept to understand the concept.

Interactive multimedia is said to be practical if the results obtained from the student response questionnaire are ≥ 61%. The average obtained from the student response questionnaire is 94% and is included in the very practical category. The average obtained from these observations is 98% and is included in the very practical category. Based on this, it can be concluded that interactive multimedia developed by researchers is very practical for students to use in order to minimize misconceptions.

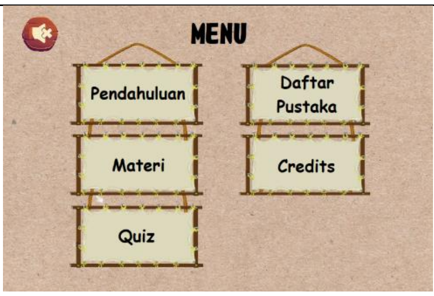
The results of shifting misconceptions in these students were obtained through pretest and posttest sheets using the four tier diagnostic test method. These pretest and posttest sheets are used to determine the effectiveness of interactive multimedia in terms of the results of a shift from not understanding the concept (TPK) to understanding the concept (PK). The pretest sheet is used to find out the initial conceptions of students and will later be grouped into 3 groups namely, not understanding the concept (TPK), understanding the concept (PK), and misconceptions (MK). The posttest sheet is used to find out the shift in student misconceptions after being given interactive multimedia, which will later be seen whether students who initially did not understand the concept (TPK) understand the concept (PK) or still don't understand the concept (TPK) or even become misconceptions (MK).

Table 9. Results of Shifting Conceptions of Learners

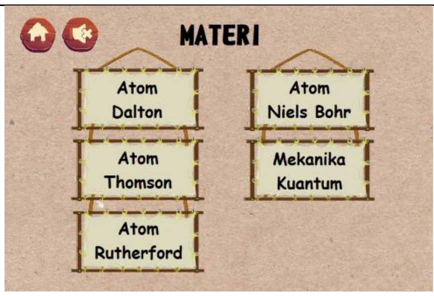
| Shifting Concept Understanding | Atom Dalton | | Atom Thomson | | Atom Rutherford | | Atom Bohr | | Atom Mekanika Kuantum | | Sum |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Question | | Question | | Question | | Question | | Question | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| TPK-PK | 11 | 8 | 8 | 5 | 8 | 8 | 10 | 7 | 9 | 8 | 82 |
| TPK-MK | 0 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 4 |
| TPK-TPK | 0 | 1 | 1 | 0 | 1 | 2 | 1 | 1 | 0 | 1 | 8 |

The shift in the conception of students who initially did not understand the concept (TPK) to understand the concept (PK), misconception (MK), or still do not understand the concept (TPK). The shift from TPK to PK was 87.23%. The shift from TPK to misconception was 4.25%, while those that did not experience a shift (still TPK) were 8.51%. So that the results of the shifting conception obtained show that this interactive multimedia is very effective and feasible to be used in minimizing the occurrence of misconceptions (Sheftyawan et al., 2018).

The final multimedia design used in this trial is as follows.



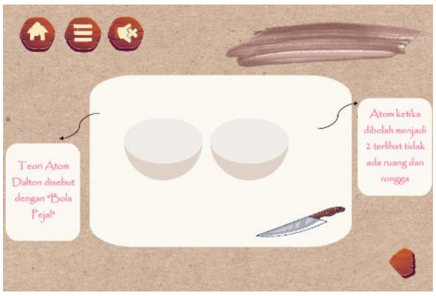

There are menu options that students can choose from




Students can choose the material to be learned first

Figure 2. Menu and material options

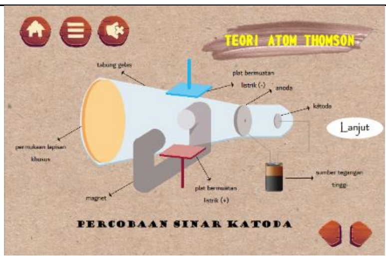

Contains an explanation of Dalton's atomic theory so that students do not experience misconceptions



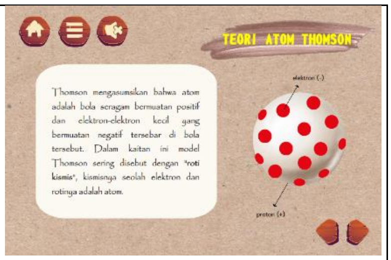
Dalton's theoretical animation is a solid ball, if it is split then there is no space and cavity in it

Figure 3. Dalton's Atomic Model


Contains an explanation of the inventor of atomic theory Thomson



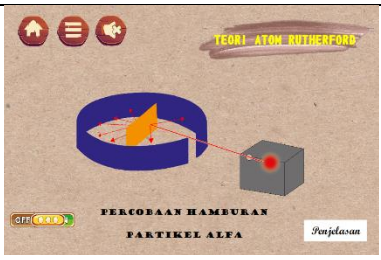

Animation of the cathode ray experiment that led to the discovery of Thomson's atomic model



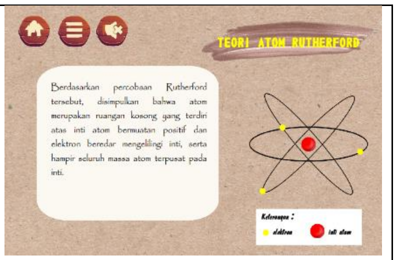

An animated form of Thomson's model of the atom in which electrons can spread across parts of raisin bread

Figure 4. Thomson's Atomic Model


Contains an explanation of the inventor of the atomic theory Rutherford



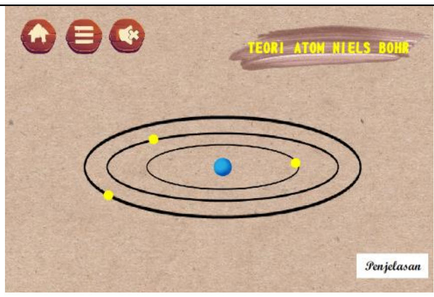

The animation of the movable alpha particle scattering experiment led to the discovery of Rutherford's atomic model




An animated form of Rutherford's model of the atom in which electrons can revolve around the nucleus according to their orbits

Figure 5. Rutherford's Atomic Model


Contains an explanation of the discoverer of the atomic theory Bohr and his postulates




Bohr's animated form is called the mini solar system. Electrons can move around the nucleus according to their cross-lines

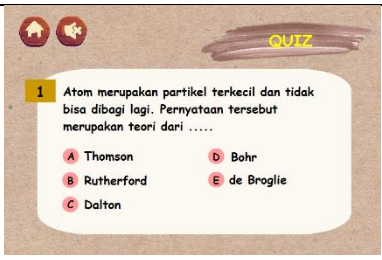
Figure 6. Bohr's Atomic Model


Contains an explanation of the inventor of atomic theory of Quantum Mechanics


Postulates presented by the three figures as well as pictures of electron probability

Figure 7. Quantum Mechanical Atomic Model


Contains quizzes that can be filled in students' names and absence numbers




Can do 5 questions of quizzes as practice questions


There is a score of the results of the quiz being done, if you want to repeat then click the "repeat" button

Figure 8. Interactive Quiz

## CONCLUSION

Based on the researcher's discussion and data analysis results, the following conclusions can be drawn. Interactive Flash multimedia content is verified. This means that it falls into the "very good" category and is very likely to be used, as it is based on obtaining content validity results in average mode 5. Construct validity similarly falls into the "very good" category with a mean mode of 5. This means that it is very suitable for learning and minimizes the occurrence of misunderstandings in the atomic model material. Flash interactive multimedia is declared to be practical. It is based on collecting the results of student response questionnaires and the results of student observations.

In the response questionnaire, students achieved an average of 94% and were assigned to the "very practical" category. Observations showed that the students achieved an average grade of 98% and fell into the "very practical" category. Therefore, Flash interactive multimedia minimizes the occurrence of misunderstandings in atomic model material and is a very practical multimedia to use for learning. Interactive Flash multimedia content is declared valid. This is due to the change in students' attitudes towards pretest and posttest results. The results obtained as a result of the change in student perception from those who do not understand concepts (TPK) to those who understand concepts (PC) have an average score of 87.23%, which is "very good." Based on this, it can be said that this interactive multimedia has been used very effectively to minimize or avoid misjudgment by students and is suitable for regular learning applications.

## RECOMMENDATIONS

Based on the research that has been done, the weakness of multimedia that I developed using Macromedia Flash is that access is limited, can only be used on PCs and laptops, cannot use smartphones. The advantage is that animations can be made easily and there is interactive value between users and media. This can be used as an improvement for further research on interactive multimedia development. Further research is expected to lead to the development of interactive multimedia content that can be accessed on any kind of device.

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