Using Adobe Animate CC Software in Designing Interactive Multimedia Based on Cognitive Conflict in Straight Motion

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Abstract: The understanding of student concepts found in the field in straight motion materials is still relatively low and the unavailability of teaching materials or multimedia can increase students' understanding of concepts. One solution to be able to solve this problem is to design interactive multimedia based on cognitive conflicts. This study aims to design interactive multimedia based on cognitive conflicts on valid straight-motion materials. Interactive Multimedia based on cognitive conflicts as teaching material to improve understanding of student concepts based on assessments from experts. This research uses a development research method (Design Research) with a group development model. However, the research carried out is limited to the Development or Prototyping phase stage of the expert review section. The object of this study is interactive multimedia based on cognitive conflicts. The data collection instruments in this study are educator questionnaires, journal analysis sheets, and validity test sheets. The data were analyzed using the Percentage technique and the V-Aiken formula. The results of the study obtained interactive multimedia design using Adobe Animate CC software which can be used on student smartphones. This interactive multimedia is compiled based on syntactic cognitive conflict-based learning models. The validity of the product obtained from the assessment of experts obtained the average value of the product, which was 0.81 with a valid category. Interactive multimedia is proven to be valid in terms of material substance, learning design, visual communication display, and use of software.

Keywords: Interactive Multimedia; Cognitive Conflict; Understanding of Concepts; Straight Motion

Introduction

One of the objectives in learning physics contained in the 2013 curriculum is that in every physics material must achieve an understanding of concepts (Masril & Fanny, 2017). The learning found in field conditions is still relatively low due to various factors. The cause of the low understanding of students' concepts is due to the application of the learning process and the use of teaching materials. This is in line with research conducted by Mufit et al., (2020) namely students do not understand concepts because the learning provided by teachers does not directly involve students in finding concepts. And in accordance with Puspitasari et al., (2020) The low understanding of students' concepts is due to the learning process in schools which tends to be done with lecture activities. Low understanding of students' concepts can make it difficult for students to achieve cognitive abilities at a higher level. One of the learning materials that is still low in understanding the concept is straight motion. In line with research conducted by Capriconia & Mufit (2022) which states that students' understanding of concepts is still low in straight motion material. Therefore, interactive multimedia teaching materials based on cognitive conflicts are needed to be able to improve students' understanding of concepts. According to research by Mufit et al., (2020) stated that it is necessary to develop teaching materials that can improve students' understanding of concepts and integrate new literacy.

According to Smaragdina et al., (2020) interactive multimedia as teaching material has the advantage that

it can be combined with digital devices that are in great demand by the digital generation and this teaching material can provide a different learning experience. This is in line with research conducted by Supardi (2014) the use of interactive multimedia in the learning process used as teaching material can foster learning motivation and increase student interest in learning.

Interactive multimedia development will be carried out using Adobe Animate CC software. Adobe Animate CC is a software that is presented in the form of images, animations, sounds, text, and video in it. In line with Chun (2018) which states that Adobe Animate CC is widely used in the creative industry. One of the advantages of Adobe Animate CC is the development of interesting projects that combine video, audio, graphics, and animation that can be published on various platforms. Adobe Animate is the latest form developed by Flash. Adobe flash was developed so as to create the latest features known as adobe animate, such as features in animation (Enterprise, 2017). More and more and continuously updated features can facilitate and design more interesting teaching materials.

Interactive multimedia designed using Adobe Animate CC can be accessed on laptops and smartphones. Adobe Animate CC is equipped with an additional menu of Adobe AIR that can produce interesting interactive multimedia and can be accessed easily. This is in line with research conducted by Rahayu & Ratna (2020) that interactive multimedia designed with Adobe Animate is effective and worthy of use in the learning process. The advantage of the features in Adobe Animate is that it is more interesting and easy to understand by students so that it can bring out student responses in following the learning process. In line with Chun's (2017) opinion stating that Adobe Animate CC is a comprehensive software for creating advanced animations and interactive multimedia software that can be published on different platforms.

This interactive multimedia was created with the help of a syntactic cognitive conflict-based learning model, which consists of four syntaxes: 1) Activation of Preconceptions and Misconceptions, 2) Presentation of Cognitive Conflicts, 3) Discovery of Concepts and Equations, and 4) Reflections (Mufit, 2018). Students' new reading abilities can be enhanced by the usage of interactive multimedia that is based on cognitive conflict in learning (Arifin et al., 2021). It was discovered that interactive multimedia based on cognitive conflict can enhance students' grasp of the 4C concepts and abilities of static fluid material, which is in line with research by Dhanil & Mufit (2021).

Cognitive conflict learning models can enhance students' conceptual knowledge, correct misconceptions, enhance positive attitudes about learning, and can boost students' enthusiasm for learning (Fauzan & Mufit, 2019). This is the same as the research stated in the research of Wiranata et al., (2017) that the application of cognitive conflict-based learning in the learning process can provide an understanding of the discrepancies in cognitive structures that students have to understand concepts more precisely. The cognitive conflict learning that is applied can also provide opportunities for students to be able to play an active role during the learning process, either finding or looking for information about theories and concepts themselves and conclusions from a learning material.

The limitation of the problem in this study is that researchers create interactive multimedia products based on cognitive conflicts on straight motion material. This interactive multimedia was developed using a plomp model that is limited to the validity test stage. This study has two main objectives. First, it describes the characteristics of cognitive conflict-based interactive multimedia on straight motion material that can improve students' understanding of concepts in straight motion material. Second, knowing the validity of cognitive conflict-based interactive multimedia to improve students' understanding of concepts in straight motion materials designed using Adobe Animate CC software.

Method

This research uses development research method (Development/Design Research) with the development model is Plomp development and consists of three phases (preliminary research, development and evaluation). However, this research is limited to the development stage of the expert review section. The plomp development model was chosen because this study aims to design products in the form of interactive multimedia based on cognitive conflicts as teaching materials. According to Plomp (2013) how to overcome problems in complex research and develop knowledge requires a design to develop an intervention. The preliminary research stage is used to analyze the needs before the study is carried out. The preliminary research stage is used to analyze the needs before the study is carried out. The preliminary research stage includes two steps. First, the needs analysis is by giving a questionnaire to the physics teacher. The questionnaire provided consists of several indicators related to the learning process on straight motion material. Second, literature analysis is by analyzing misconceptions in straight motion material in several journals that have been found.

The development stage is carried out to create interactive multimedia designs. In the development stage there are two stages. First, the prototype design is

designed using adobe animate cc software with straight motion material. Multimedia designed using a cognitive conflict-based learning model consisting of 4 stages of syntax (Mufit, 2018). Second, formative evaluation and prototype revision aimed at testing the validity of prototypes that have been developed in the previous stage. In this stage two steps are performed. First, the self-assessment instrument carried out by the individual in observing then analyzes the errors that exist after carrying out design activities. Second, expert reviews conducted by experts to validate interactive multimedia designs based on cognitive conflicts that have been developed to obtain advice and input. A chart of the stages of the study is shown in Figure 1.
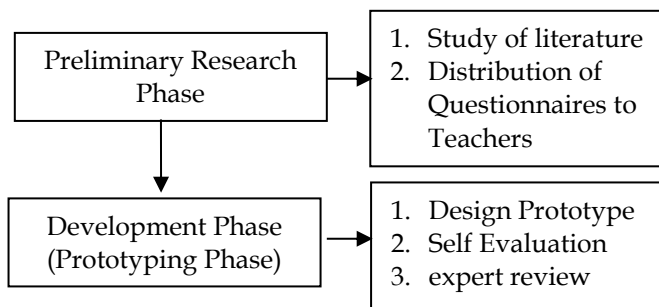

Figure 1. Research Stage

The instruments used in preliminary research are questionnaires and for product assessment using validity assessment instruments. The data analysis technique used in needs analysis uses equation 1.

$$P = \frac{\sum x}{\sum x_i} \times 100\% \qquad (1)$$

Description:
P = Percentage
x = Score Obtained on each Indicator
x_i = Number of Respondents

Furthermore, product validation data is in the form of input from experts in the form of qualitative data which is then converted into quantitative data based on the likert scale. The weight of validity with a scale of (4) Strongly Agree, (3) Agree, (2) Disagree, and (1) Strongly Disagree (Sugiyono, 2012). The validity test result data obtained were then analyzed using aiken's V validity index formulated in the following equation:

$$V = \frac{\Sigma s}{n\,(c-1)} \qquad (2)$$

$$s = r - l_o \qquad (3)$$

Description:
V   = Deal Index Rater

s   = Score
n   = Number of Raters
c   = Highest Validity Assessment Figure (= 4)
l_o = Lowest Validity Assessment Figure (= 1)
r   = Ang Figures given by the appraiser

After obtaining the results of the rater agreement index, it can be determined the category of the assessment that has been obtained using the following *Aiken's V* index in Table 1.

Table 1. Indeks *Aiken's V*

Interval	category
≤ 0.4	InValid
0.4 < V ≤ 0.8	Valid
0.8 < V	Very Valid

(Retnawati, 2016)

Result and Discussion

Based on the research that has been carried out, research products were obtained in the form of interactive multimedia teaching materials based on cognitive conflicts to improve the understanding of the concept of high school students in straight motion materials. Cognitive conflict-based learning has advantages in its use, namely it can change students' conceptual in the learning that is carried out so that it can increase students' conceptual understanding and reduce the occurrence of misunderstandings of students' concepts (Rahim et al., 2015). The results of the study were obtained based on the following stages of research:

Preliminary Research Stage
a. *Needs Analysis Results*
Preliminary research is carried out through two stages, namely by distributing questionnaires for the learning process and journal analysis. In providing questionnaires for the implementation of straight motion material learning during the learning process carried out by teachers, they apply direct learning in explaining the material provided with a percentage of 90%. The application of direct learning results in students being less active in learning because they only listen to explanations from the teacher and learning becomes less interesting. In the learning carried out, teachers did not identify students' misconceptions (40%). This can result in further learning being disrupted. During the learning process, the teacher emphasizes more to students to memorize formulas or physics equations (70%) than concept problems, emphasizes more on discussing questions (70%) and emphasizes less on experimental activities and more discussion and giving counting questions to students (90%). This can result in a lack of understanding of

students' concepts in straight motion materials. The materials used by teachers for learning are still concentrated in textbooks (100%) and the use of IT-based materials is still low (40%). According to Trianggono (2017) In learning physics, understanding concepts is necessary in order to be able to solve physics problems. The low understanding of students' concepts can cause students to find it difficult to achieve cognitive abilities at a higher level.

b. *Literature Review Results*

In the literature study stage carried out by analyzing 3 journals, from the analysis of the journal. Journal analysis revealed that the percentage of students who understood the concept was still low and the percentage of students who had misconceptions was still high.

The results of the journal analysis are shown in Table 2.

Table 2. Journal Analysis Results

Author	Undestanding Concepts on Materials	Analysis Results (%)
Triastutik et al., 2021	Distance and Displacement	32.00
	Distance and Acceleration	17.20
	Initial Velocity of free fall	28.90
	Position, Distance, and Displacement	33.30
Nasir, 2020	Speed	34.00
	Acceleration and Deceleration	40.60
	Uniform Straight Motion	40.60
	Uniform Motion in a Straight Line	27.60
	Vertical Motion	38.00
	Quantities in Straight Motion	48.00
Fauziah & Darvina, 2019	Speed	42.00
	Free Fall Motion	46.00
	Speed and Position	48.00
	Acceleration and Position	48.00

Based on the percentage of data in table 2, there are many misconceptions obtained by students in understanding the concepts of straight-motion material. It can be concluded that in learning straight-motion material there are misconceptions and students' understanding of concepts in straight-motion material is still relatively low which can be caused by various factors. Based on these problems, interactive multimedia was developed using Adobe Animate CC 2019 software to help students understand the concept of straight motion. It has the advantage of being accessible on students' smartphones and has the advantage of being easily accessible to students. The success of learning using multimedia is very dependent on the multimedia design that is applied (Gunawan et al., 2016). After being designed, testing is carried out with the prototyping phase.

Development Phase (Prototyping Phase)
1. *Design Prototype*

The prototype developed is an interactive multimedia-based cognitive conflict to improve students' understanding of the concept of straight-motion material. The prototype developed refers to the ICT-based teaching materials development guide. This interactive multimedia is structured with guidelines on structural components (Depdiknas, 2008) which includes titles, study instructions, competencies to be achieved, supporting information, practice questions, work procedures, and evaluations. Parts from interactive multimedia designs developed by researchers include the following

a. The cover is part of the front page of interactive multimedia that contains the title, identity, class, and semester. The title on the product cover is Cognitive Conflict-Based Interactive Multimedia to Improve Understanding of High School Students' Concepts on Straight Motion Material which can be seen in Figure 2.

b. The Main menu contains buttons that will direct to the destination we will choose using interactive multimedia.

c. The question exercise consists of the activation stage of preconceptions and misconceptions as well as the presentation of cognitive conflicts.

Figure 2. Interactive Multimedia Cover Design

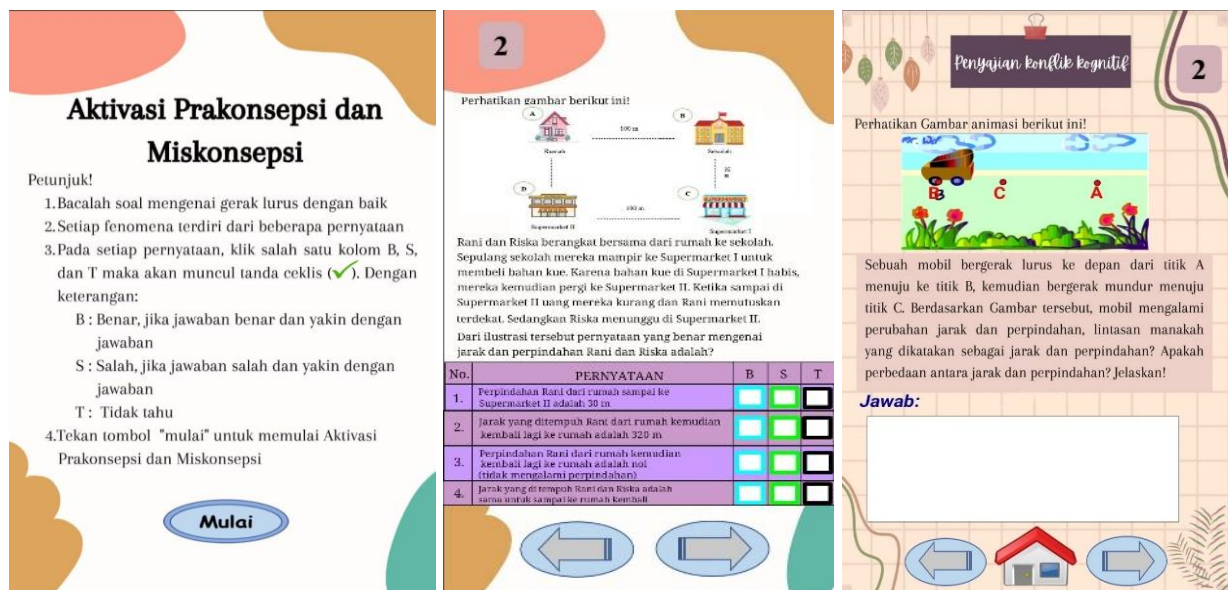**Figure 3**. Interactive Multimedia Main Menu Design

Figure 4. Design of Preconception and Misconception Activation Stage and Cognitive Conflict Presentation Stage

In the first syntactic, namely the Preconception and Misconception Activation Stage which aims to find out the students' initial knowledge of straight motion material before learning. At this stage it contains about the concepts of the material to be studied. This design at the stage of Activation of Preconceptions and Misconceptions is given questions regarding the phenomenon of straight motion that students often encounter in everyday life, one of which is about distance and displacement. At this stage students can click on one of the answers with confidence which is between B (true), S (false), and T (do not know). Based on these answers, both teachers and students can know that there is a wrong concept and must be corrected.

In the second syntac, namely the Cognitive Conflict Presentation Stage which aims to bring out cognitive conflicts or conflicts in students' minds so as to trigger students to think deeply by answering hypotheses about concepts in straight motion matter. The design at the Presentation stage of Cognitive Conflict is given an essay question about straight motion events that occur in everyday life, one of which is distance and displacement, namely students observe the event of an animated car moving forward on a straight track and then moving backwards. In each question, students give their answers or hypotheses in the available answer columns. At the end of the stage of presenting cognitive conflicts are presented the correct answers to each of its

questions. Based on these answers, teachers and students can make the necessary concept changes to change student preconceptions that do not conform to scientific concepts (misconceptions).

Discovery of concepts and equations containing learning materials found independently by students through student interaction with interactive multimedia which can be seen in Figure 5.
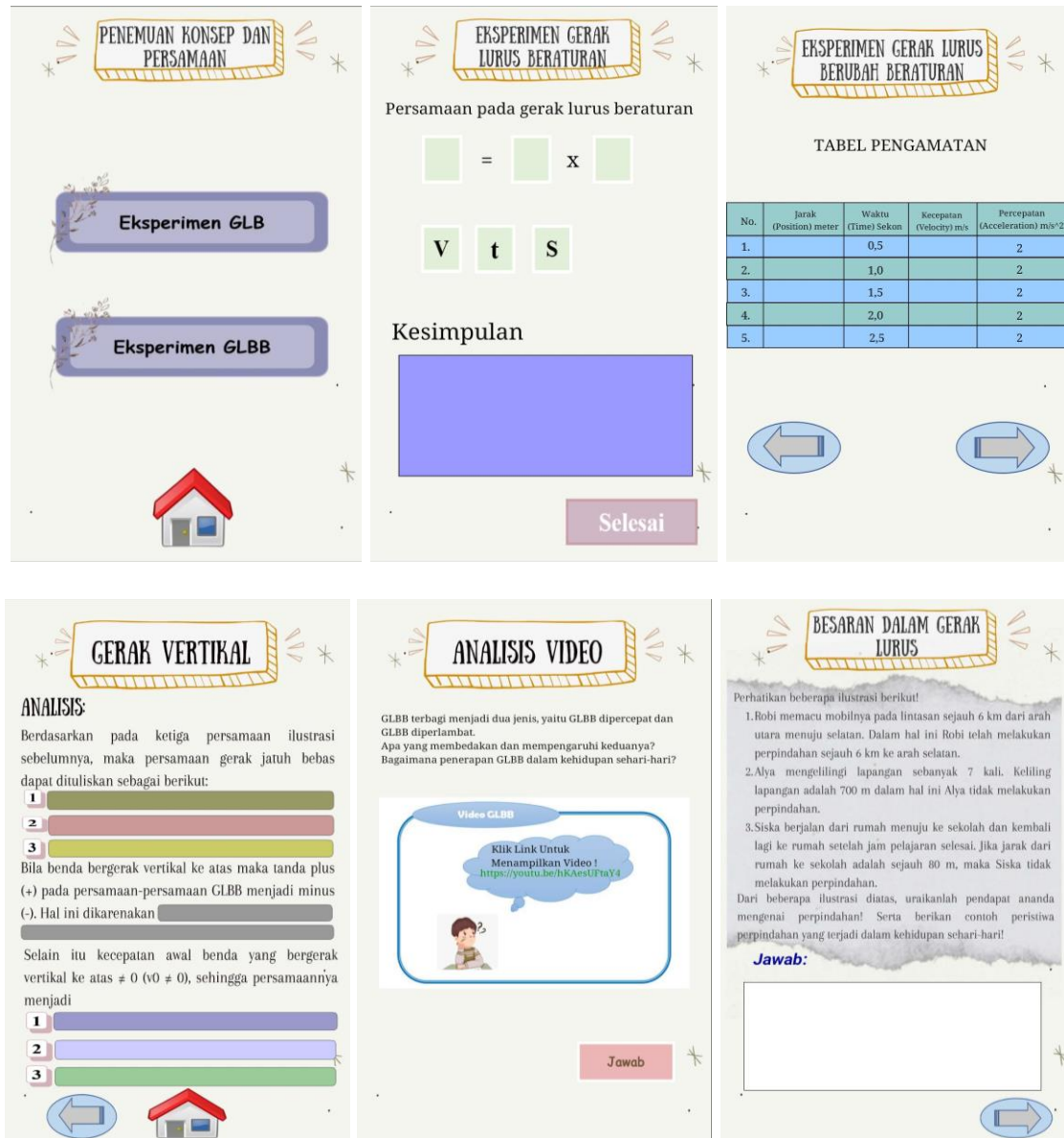

Figure 5. Design of the Concept and Equation Discovery Stage

In the third syntactic, namely the Concept and Equation Discovery Stage which aims to achieve an understanding of concepts that last a long time in students' memories and is designed so that students find themselves concepts and equations through real or virtual experiments. In line with the research conducted by Mufit et al., (2019) in bringing up and developing understanding of concepts students can be connected with equations and conducting real experimental video analysis. In this product to find concepts through the analysis of an illustration and video analysis while to

find equations through virtual experiments PhET Simulation moving-man (regular straight motion and regularly changing straight motion). At each stage in this third syntactic the misconceptions that students experience towards the concept of straight motion can be overcome and students can understand the meaning of the physics equations and the concepts they write.

d. The reflection stage consists of material reinforcement of previous stages of the cognitive conflict model and competency tests that can be seen in Figure 6.

Figure 6. Reflection Stage Design

In the fourth stage, namely the Reflection Stage, which aims to allow the teacher to assess the extent of understanding the concept of straight motion students after carrying out the stage of discovering concepts and equations. At this stage, an evaluation of straight motion material is presented that requires understanding concepts as well as understanding the relationships between concepts through mathematical equations. At the end of the reflection stage, the scores obtained by students will be displayed in answering questions from the evaluation questions given. Based on the answers and scores obtained, students and teachers can find out the level of understanding and misconceptions that still occur after the learning process is completed.

The results of working on evaluation questions can be used as a benchmark to see the level of understanding of concepts and misconceptions that still exist after learning is carried out. According to Pratama et al., (2021) at this stage it is carried out so that after finding the concept and its similarities, students can be assessed to what extent the ability to understand existing concepts.

Formative Evaluation and Revision of the Prototype
a. *Self Evaluation*

Self evaluation is carried out by the researcher himself to re-examine the results of the interactive multimedia product created, before the product is validated by a team of experts. At this stage, the researcher made several improvements, namely repairing and adding several navigation buttons, checking the completeness of the prototype, correcting writing errors, and adding things that were felt to be lacking in the prototype in accordance with the ICT-based teaching material development guidelines. According to Fadhilah et al., (2020) in a self-evaluation the researcher fixes and adds parts that feel the need to be corrected or added by re-examining products that have been made before.

Interactive multimedia created is in accordance with the syntactic of cognitive conflict-based learning, specifically the activation of preconceptions and misconceptions, the presentation of cognitive conflicts, the discovery of concepts and equations, and reflection. Completeness of the product according to Depdiknas 2010, interactive multimedia in accordance with the syntax of the cognitive conflict-based learning model, interactive multimedia integrating virtual laboratory, linguistic and graphic compatibility.

However, some errors in the prototype have been corrected, namely in the typing of letters and punctuation, the use of language, and the neatness of writing. Illustrations, images, and equations are already visible in interactive multimedia. Figure 7 depicts the results of the plot of the value data of each self-evaluation indicator.
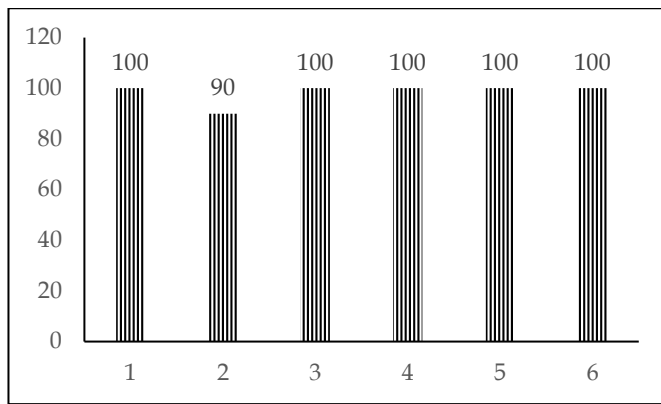
Figure 7. Self-Evaluation Results

Based on Figure 7, it can be seen that the indicator values in self-evaluation are classified as all indicators of excellent value with values ranging from 90 to 100. The average value on the self-evaluation indicator is 98.3. Thus the value of ¬self-evaluation belongs to the category of very valid

b. *Expert Review*

The *expert review* stage is carried out after the interactive multimedia product created has been validated by the validator. Interactive multimedia product validation is carried out by three experts. The interactive multimedia assessment instrument used for validation of this interactive multimedia product is already valid. The interactive multimedia assessment instrument consists of 4 assessment indicators.

The first is the material substance component which consists of five indicators: 1) The suitability of the material with the 2013 curriculum, 2) The suitability of the material with basic competencies (KD), and 3) The suitability of indicators with KD, 4) Language compatibility with EYD, and 5) clarity language. In accordance with research which states that the substance of the material must be designed according to the standard of learning objectives applied by Ilahi et al., (2021). Reinforced by research conducted by Khairunnisa (2018) that the teaching materials developed must be in accordance with the curriculum used and in accordance with educational goals. Figure 8 shows the results of plotting the value data for each chart indicator.

Based on Figure 8, the indicator value on the substance of the material ranges from 0.78 to 0.89. Four of the five indicators are classified as moderate, with a value of 0.78, and one is classified as valid, with a value of 0.89. The average validation value on the indicator of the material's substance is 0.80. As a result, the validation value of the material's substance is classified as a valid category.
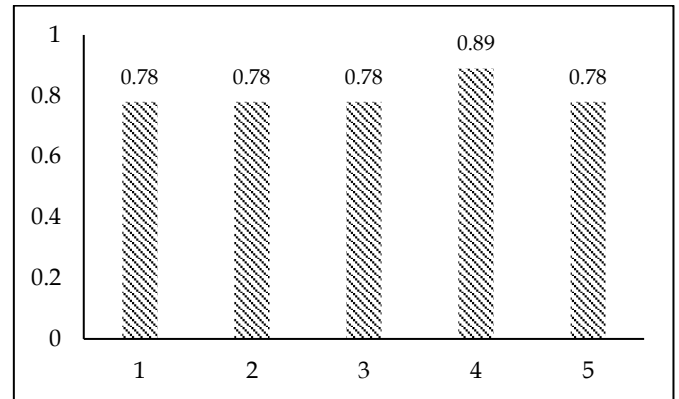

Figure 8. Material Substance Validation Results

The second component is the learning design which consists of 13 indicator namely 1) The title presented in MI is in accordance with the material, 2) Lists KI and KD, 3) Conformity of Learning Objectives with KD, 4) Material in interactive multimedia in accordance with learning objectives, 5) Learning objectives in MI are in accordance with indicators, 6) There is a stage of presenting cognitive conflicts in interactive multimedia, 7) There is a stage of understanding concepts and equations in interactive multimedia, 8) There is a reflection stage in interactive multimedia according to the material, 9) There is data literacy in interactive multimedia, 10) There is technological literacy in interactive multimedia, 11) There is human literacy in interactive multimedia, 12) There is a constituent identity in interactive multimedia, 13) Writing citations of other people's works as references. The results of the plot of the value data of each graphic indicator can be seen in Figure 9.
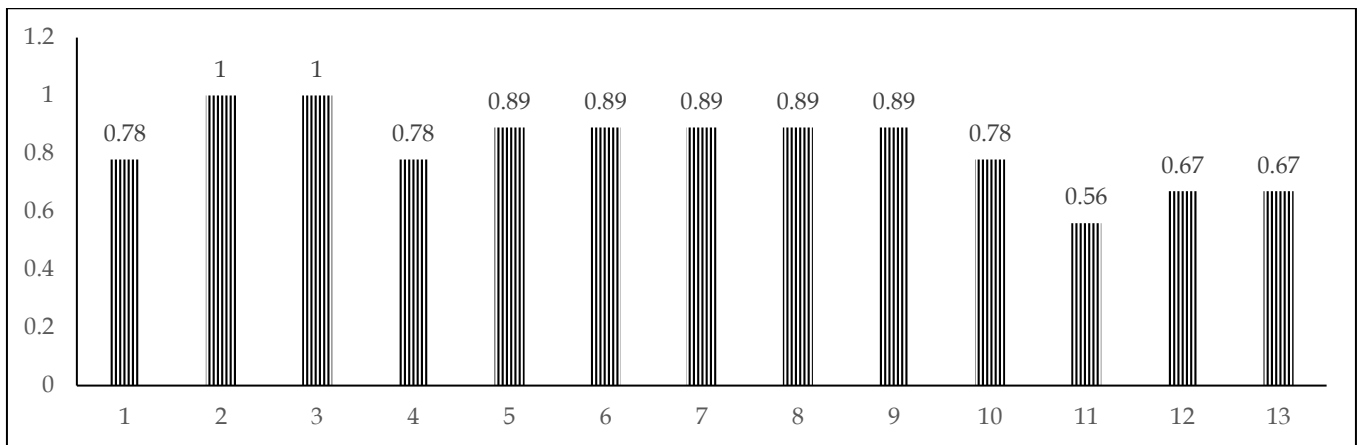
Figure 9. Validation Results of Learning Design Indicators

Figure 9 shows that the value of the instructional design indicator ranges from 0.56 to 1. Of the 13 metrics, 6 are rated moderate, i.e., between 0.56 and 0.78, and 7 are considered valid, ranging from 0.89 to 1 The average validation value for the instructional design index is 0.82. Therefore, the value of learning design validation is in the valid category.

Third, the visual communication display component includes six indicators: 1) Interactive multimedia with basic navigation and hyperlinks that function properly, 2) Interactive multimedia fonts are legible, proportional, and appealing, 3) Interactive multimedia employs images, animations, and sounds, 4) The color combination on the cover and each slide is harmonious and appealing, 5) The design layout is proportional and appealing, and 6) The instructions for use in interactive multimedia are clear and precise.

Making interactive multimedia based on cognitive conflict needs to be designed as attractive as possible in order to motivate and attract students to use interactive multimedia based on cognitive conflict in learning. This is reinforced by the opinion of Fadhilah et al., (2020) which states that the appearance, use of fonts, layouts, and illustrations in teaching materials will make users attractive to use them. The results of the plot data on the value of each indicator of visual communication display can be seen in Figure 10.
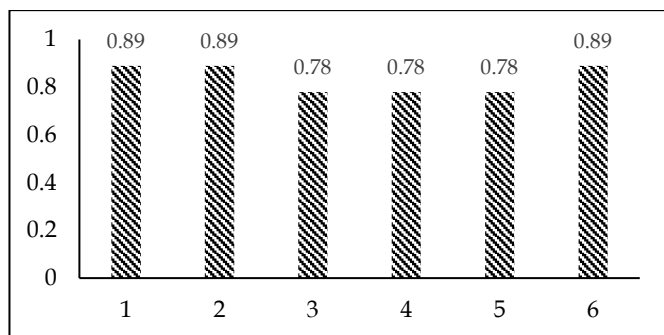

Figure 10. Visual Communication Display Validation Results

Figure 10 shows that the value of the visual communication display indicator ranges between 0.78 and 0.89. Two of the six indicators (0.78) are classified as moderate, while four (0.89) are classified as good. The visual communication indicator has an average validation score of 0.84. As a result, the visual communication display's validation value is included in the valid category.

Fourth, the software usage component consists of three indicators, namely 1) MI is interactive in providing feedback to users, 2) MI uses supporting software, and 3) MI is original work. The results of the value data plot for each software usage indicator are shown in Figure 11.

Figure 11 shows that the value of the software utilization indicator ranges from 0.67 to 0.89. Three indicators are included in the medium category. The software usage indicator has an average validation score of 0.78. Therefore, the value of visual verification of visual communication is in the medium category.
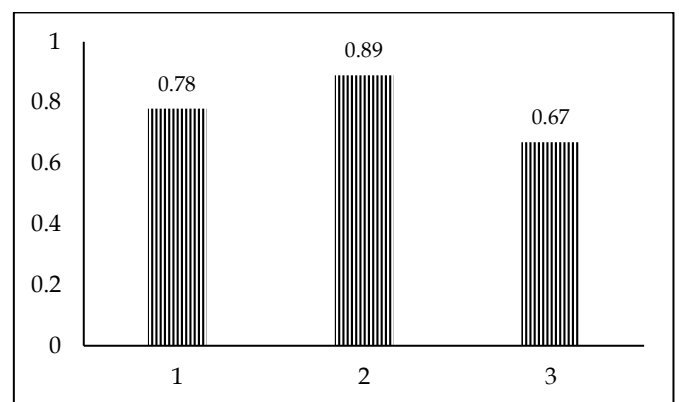

Figure 11. Software Utilization Validation Results

The final step is to calculate the average score for each component of the cognitive competition-based interactive multimedia assessment in order to improve students' understanding of the concept of straight

motion material. The developed interactive multimedia includes four components for developing ICT-based teaching materials: 1) material substance, 2) learning design, 3) visual communication display, and 4) software utilization. Figure 12 depicts the outcome of the validity value plot.
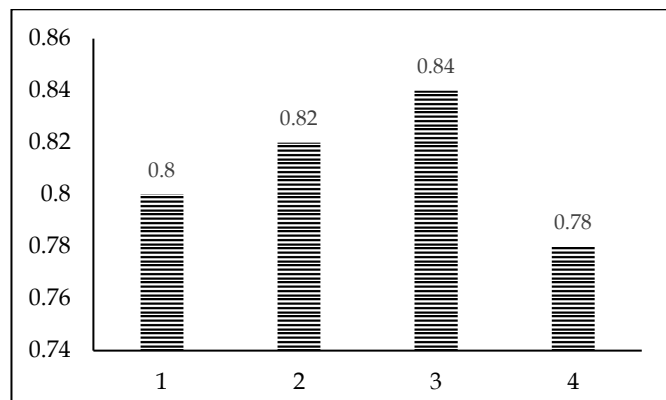

Figure 12. Interactive Multimedia Validation Results

Based on Figure 12, it can be seen that the validation indicator values of the four interactive multimedia indicators include 0.80, 0.82, 0.84, and 0.78. The average value of interactive multimedia validation is 0.81 with valid categories. So, the validation value of this interactive multimedia is very valid.

Interactive multimedia teaching materials based on cognitive conflicts are effective and worthy of use in the learning process. In line with research conducted by Saputri et al., (2021) which states that cognitive conflict-based physics teaching materials are categorized as valid and suitable for use. This is also in line with the research of Delvia et al., (2020), namely the level of validation of cognitive conflict-based teaching materials on atomic nucleus motion material obtained in the valid category.

Conclusion

Based on the results of research that has been carried out, cognitive conflict-based interactive multimedia was obtained on straight motion material designed using Adobe Animate CC 2019 software and compiled with 4 syntactic cognitive conflict-based learning models, namely Activation of Preconceptions and Misconceptions, Presentation of Cognitive Conflicts, Discovery of Concepts and Equations, and Reflections. This interactive multimedia consists of titles, learning instructions, competency standards and basic competencies, competency achievement indicators, materials, practice questions, competency tests, summaries, author identity, and references. The interactive multimedia produced in Adobe Animate CC has a variety of displays that can be used as teaching materials that can improve the quality of learning and increase students' understanding of concepts. The resulting interactive multimedia can be accessed on the student's smartphone with an attractive display. The results of interactive multimedia validation based on cognitive conflicts on straight motion materials have validation values with valid categories. The characteristics of the validity of cognitive conflict-based interactive multimedia are valid in terms of material substance, learning design, visual communication display, and software utilization.

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