Developing CAI-PBL with DDD-E model on magnetic fields concept

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Abstract: Technological developments are widely used in various fields including education. Computers is a product of technological development where in the world of education is used as a tool or media in learning. Today has been a lot of computer-based learning media but still focused on the delivery of material only. While the research will be developed is the making of CAI were in it integrated a model of learning to deliver the material. The purpose of this research is to develop a product of CAI through problem-based learning on magnetic field material. This research uses DDD-E (Decide, Design, Develop and Evaluate) development method. At the phase of the decision has analysed the needs associated with the manufacture of CAI-PBL. Furthermore, based on the results of needs analysis, CAI-PBL is designed and developed by researchers. Then validated at the evaluate stage by three validators (two physicists, and one media expert). It can be concluded that the development of CAI-PBL can have the potential to solve problem-solving skills.

1. Introduction
Today, the use of media in learning is not new. Learning media has become an integral part of the learning process. Media is anything that can be used to transmit messages from sender to recipient so that it can stimulate students’ thoughts, feelings, and interests and attention in such a way that the learning process takes place. The computer is one of the learning media that is widely used. Asri [1] stated that computers are technological development products that are used as the main media in learning because of the various capabilities they have, such as having a virtual rapid response (view) to the input given the learner (user), has the capacity to store and manipulate information, and can be used in multimedia (broad computer as a tool in learning activities.

Multimedia is the delivery of information using a combination of text, graphics, sound, video, and animation [2]. Based on the definition of the tool that allows being able to convey information is the computer. Today, various computer-based learning models are evolving along with the development of computer technology itself, such as CAL (Computer Aided Learning), CBT/L (Computer-Based Training/Learning), MBL (Multimedia-Based Learning), WBT/L (Web-Based Training / Learning), CAI (Computer Assisted Instruction) and the study of online learning and e-learning, from the above terms, basically have the same basic concept that utilizes computer technology as the basis of multimedia technology in model development teaching media.

The existing and used multimedia in today's learning mostly focuses only on the delivery of the material without looking at the learning process experienced by the students while using it. While CAI is a computer system that can deliver individual and direct learning to students by interacting with
subjects programmed into computer systems. CAI can provide several potential benefits for learning activities, including self-directed learning, self-directed learning, various sensory training and the ability to present content from various media. By using the CAI students are expected to experience the learning process independently with the help of computers. Therefore, the integration of learning model in CAI is very important so that students can experience the learning process not only get the material just like that.

One of the most widely used models today is the Problem Based Learning (PBL) model. This learning model can train students’ problem-solving skills. PBL is a learning model based on the principle that problems can be used as a starting point to gain or integrate new knowledge [3]. Problem-based learning (PBL) aims to provide free thinking space for students to search for concepts and solve problems related to the material presented by teachers.

Through PBL integrated into CAI besides can help to solve problem-solving ability can also help understanding student concept of the abstract material, such as in magnetic field material. Magnetic field material is an abstract material that needs media help to be able to visualize the phenomena that occur in the material. With the help of computers can help visualize the phenomena that occur in magnetic field materials. Magnetic field material taught at high school level relates to the process of the magnetic field occurring by a wire with electric current. Where the magnitude of the magnetic field generated by the electrically grounded wire can be formulated by the Biot-Savart Law.

\[
\begin{align*}
\vec{d}B &= \frac{\mu_0 l}{4\pi r^3} d\vec{l} \times \hat{r} \\
\int \vec{d}B &= \frac{\mu_0 l \sin \theta}{4\pi r^4}
\end{align*}
\]

The resultant magnetic field felt at a point with the distance \( r \) on the wire is \( B = \int dB \). The Biot-Savart law helps determine the magnitude of the magnetic field that appears on the electrified wire. Such material is very difficult when explained by conventional learning methods and utilizing multimedia learning that there is only emphasize on the provision of material only. Students will be better understood if invited actively to see the direct phenomenon visualized by computer assistance and invited to explore the problem based on the visualization presented.

Based on the description above, through this research developed a learning media Computer Assisted Instruction (CAI) with learning model problem-Based Learning (PBL) on magnetic field material that is integrated into a Compact Disk (CD).

2. Methods

Developing a multimedia program requires careful planning in order to produce a better product [4]. This study uses research methods developed by Ivers and Baron. The models are developed based on four stages: 3D and one E, Decide, Design, Develop, and Evaluate (evaluation) or called DDD-E. The Decide Stage focuses on the determination of program objectives and materials through analysis of CAI-PBL development needs. Design stage shows the design structure of the program. And the development stage includes production and media programming. While in the Evaluate stage see the whole process that occurs in the development of multimedia validated by the validator. This evaluation was conducted by three experts (two expert of physics and one expert of media). Analysis of the validation results using Percentage Analysis of Each Aspect (PSA). This PSA calculates the percentage of each aspect of the variables contained in CAI-PBL media evaluated by equation (2).

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PSA = \frac{\sum \text{answers selected every aspects}}{\sum \text{ideal answers every aspects}} \times 100 \%
\]
To provide an explanation of the number % used the assessment qualitative criteria shown in Table 1.

| Percentage | Criteria   |
|------------|------------|
| 86 – 100 % | Very Good  |
| 66 – 85 %  | Good       |
| 56 – 65 %  | poorly     |
| 0 – 55 %   | Bad        |

3. **Result and Discussion**

3.1. **Decide**

At this stage, some activities such as curriculum analysis, conceptual analysis, and instructional goals are specified. In the curriculum analysis activities, determined a topic based on the curriculum set by the government by looking at the basic competencies to be achieved in the learning process. In this activity selected magnetic field material with basic competence analysing magnetic field, magnetic induction, and magnetic force in various technology products. After conducting curriculum analysis activities, followed by concept analysis activities where identification of the main concepts in the subject matter (magnetic field) is selected, then created a concept map for each main concept. The formulation of learning objectives is the final step of the decision stage. Learning objectives are formulated based on indicators with operational verbs that can be measured and made the assessment instrument. The indicator is derived from the previously selected basic competence. This instructional objective is transferred into the Media Program Outline (MPO) that can prime to developing CAI-PBL media on magnetic field materials.

3.2. **Design**

At this stage, a flowchart has been developed to illustrate the presentation of the material in CAI-PBL. This sequence should be visible globally and can be easily embedded in the making of the storyboard. The manuscript is made to design the appearance of the drawing and the learning presentation in accordance with the flow of material on the flowchart. In scriptwriting, all components that will appear such as text, images, animation, audio, or video, buttons and navigation links to be used must be included. In addition, consider that delivery strategies generated display will interesting to see and not repetitive.

3.3. **Develop**

At this stage is done assembling all elements of the media that includes text, images, animation, audio, and video so ready to become media CAI-PBL on this magnetic field concept. In this stage of development is also done harmony between the scripts (storyboard) with the development of media programs created in order to obtain maximum results. The following is the result of CAI-PBL development on magnetic field material as shown in Figure 1.
3.4. Evaluate

At this stage, the CAI-PBL media on magnetic fields is validated by experts of content and expert of media. The material expert studies the concepts of magnetic field materials and the Problem Based Learning (PBL) model developed in the CAI-PBL media that includes competency, conceptuality, breadth and depth of concept, systematic presentation of the material, and the compliance of learning evaluations. While the media expert reviewed and reviewed from the side of the CAI-PBL program developed includes visual elements consisting of the graphical display (selection of letters, text, images, and animation) and sound elements viewed from the sound quality on each display. Other than that also media expert to review about format aspect of the presentation about layout at every view.
Results of expert validation of the CAI-PBL content are presented in Table 2.

Table 2. Results of expert validation of the CAI-PBL content

| Indicators                                                                 | Scales |   |
|----------------------------------------------------------------------------|--------|---|
| The learning competencies are presented clearly and in accordance with the curriculum | Validator 1 | 2  |
| The description of the material is easy to understand                       | Validator 2 | 2  |
| The concept of the material presented is valid and nothing is wrong          | Validator 1 | 3  |
| Content presented contextually                                              | Validator 2 | 2  |
| The material presented in accordance with the concept and theory of magnetic field material standard | Validator 1 | 3  |
| Exposure of material in accordance with the values prevailing in the community | Validator 2 | 3  |
| The concept described is intact in accordance with the field of science     | Validator 1 | 2  |
| The scope and depth of the material is appropriate for high school level     | Validator 2 | 2  |
| Systematically presentation of coherent material so as to facilitate understanding | Validator 1 | 2  |
| Vocabulary used in accordance with the level of high school students         | Validator 2 | 3  |
| Presentation of the problem in accordance with the concept to be delivered  | Validator 1 | 2  |
| The problems presented bring the students to solve them                      | Validator 2 | 2  |
| Giving students the opportunity to practice on their own                      | Validator 1 | 2  |
| The reinforcement for the correct answer is clear                            | Validator 2 | 3  |
| Giving feedback for wrong answers                                            | Validator 1 | 3  |
| The instructions on the test are clear                                       | Validator 2 | 2  |

While the validation results of media experts on the developed CAI-PBL media are presented in Table 3 below.

Table 3. Results of media expert on CAI-PBL

| Indicators                                      | Scale |
|------------------------------------------------|-------|
| **Visual Elements**                            |       |
| Selection of letter type and size              | 2     |
| Distance usage (line, paragraph, and character)| 3     |
| Readability of texts                           | 2     |
| display images                                 | 2     |
| Image placement                                | 2     |
| Harmony background with text                   | 2     |
| **Voice Elements**                             |       |
| Voice Quality                                  | 3     |
| Sound effect                                   | 2     |
| Choice of background music                     | 2     |
| **Present Format**                             |       |
| Tidiness of slide show                         | 2     |
| Layout                                         | 2     |
| Placement of video or animation                | 2     |
The validation results of each expert use scale 1 to 3, where scale 1 = less good, scale 2 = good, and scale 3 = very good. Experimental validation of CAI-PBL media developed was analysed using Percentage Analysis of each Aspect (PSA). So that the results obtained are summarized as indicated in Table 4.

| Validator          | Result  | Criteria |
|--------------------|---------|----------|
| Expert of Content 1| 83.33 % | Good     |
| Expert of Content 1| 75 %    | Good     |
| Expert of Media    | 72 %    | Good     |
| Average of Result  | 76.77 % | Good     |

Separately from the summary of expert validation results on the developed CAI-PBL media, there is also input from experts for advanced media. The following input from experts related to CAI-PBL for the advance of the media: 1) video needs dubbing to make it easier for students, 2) problems related to the magnetic field should be added so students can solve the problem-solving skills of students, 3) needs to be added caption or animation on the electrically straight wire magnetic field, 4) consistency of use of font size and type should be distinguished such as letter size for title, subtitle, and content, 5) needs a slide which covering an explanation of the navigation buttons, and 6) needs to be added a description of the field diagram.

4. Conclusion
The process of developing CAI-PBL media on magnetic field material has been done. Development of this media using DDD-E model that begins with activities decide (decide), design (design), develop (develop), and end with evaluate (evaluation). The evaluation results from content experts and media experts showed that this CAI is feasible and good. Consequently, this CAI potentially can practice problem-solving skill by integrating learning model Problem-Based Learning (PBL).

5. Reference
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