

## ASSESSMENT IN DEVELOPMENT COMPUTER-AIDED INSTRUCTION

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### Abstract

*Assessment in development computer-aided instruction (CAI) is not only done on the final products, but the assessment also takes place during the development process. Similar to assessments conducted by experts (Expert Judgment), the assessment also carried out by the user to individual persons (one to one), a small group, an expanded group, and real users (in dissemination process). In developing CAI, there are several aspects to be assessed such as programming, learning design, contents, and also its visual aspect. Moreover, there are several indicators that should be included in developing CAI which are:*

*a. Software Engineering/Programming: (1). Effectiveness and Efficiency in the development and use of instructional media; (2). Reliable; (3). Maintainable (can easily be maintained and managed); (4). Usability (easy to use and simple in operation); (5). The accuracy in selection of the type of application / software / tool for development; (6) Compatibility (learning media can be installed / run on existing hardware and software); (7). Packaging of integrated instructional media and easy in execution; (8). Completeness of instructional media program documentation which consist of: installation manual (clear, brief, and complete); troubleshooting (clear, structured and anticipated); program design (clear and complete in describing program workflow); (9) Reusable (part or all program learning media can be reused to develop other learning media).*

*b. Aspects of Learning Design and Content Items: (1) Clarity of learning objectives (formulation, realistic); (2) The relevance of the learning objectives with SK / KD / curriculum; (3) The scope and depth of learning objectives; (4) The accuracy of the use of learning strategies; (5) Interactivity; (6) Provision of motivation to learn; (7) Contextuality and actuality; (8) The completeness and the quality of learning support materials; (9) Compliance with the aim of learning materials; (10) The depth of the material; (11) Ease to be understood; (12) The systematic, continuous, clear logic flow; (13) The clarity of description, discussion, examples, simulations, exercises; (14) Consistency of evaluation with the aim of learning; (15) The accuracy and provision of evaluation tools; (16) The provision of feedback on the evaluation results.*

*c. Aspects of Visual Communication / Display: (1) Communicative; according to the message and can be received / in line with the expected target; (2) Creative ideas pouring in the following idea; (3) Simple and attractive; (4) Audio (narration, sound effects, back sound, music; (5) Visual (layout design, typography, colour); (6) Media movement (animation, movie); (7) Interactive Layout (navigation icons).*

**Keywords:** *Assessment, Development, CAI, Programming, Design, Visual*

### Background

Development of Computer-Aided Instruction (CAI) is one of the areas of learning development that utilizes the computer as a tool and resource in the learning process. In the development, systematic steps are needed which include how to assess this CAI device. These assessed aspects depend on which way the computer-aided were developed. In this

development process, the emphasis is usually focussed on some parts, such as tutorial, drill and practice, animation, simulations, games, quizzes, problem solving and others. Utilization of this technology will result in good quality output if they were utilized properly.

Inappropriate utilization of technology/media will almost certainly not result in a productive learning environment which can ensure better learning. Schramm (1973) describes that the availability of media in the learning process is very important in order to stimulate a child's attention, so that it can increase the motivation to learn, help to facilitate the understanding of a given learning materials, which can ultimately improve learning outcomes. One of challenges and golden opportunities in the future is the growth of information technology that can be considered as an alternative option to be utilized in education, particularly in vocational education.

Instructional media is also a tool that must be available in the learning process. As the result would be skilled people, then better facilities are required in the process of learning. Learning planning and development are different to those in public schools. Vocational technology education is closely related to the world of work, so its instructional design will be different with instructional design in general. Learning experiences which are given in Vocational Schools is designed to be as close as possible to the conditions encountered in the work where learning is given.

These problems can be solved with complete equipment procurement, adequate teacher education, adequate managerial support, as well as the use of technology, especially information technology in teaching and learning. Associated with the development trend of information technology, the benefits of these technologies in education needs to be studied and further developed to aid the learning process, and to improve the quality of teaching and learning process. Thus in a series of education goals, especially in vocational schools, it is essential to do a maximum effort to utilize more of the information technology, such as software or hardware.

In order to make the development process becomes more effective and efficient, it is necessary to have some stages by looking at its media (visual and programming) and content aspects. Accurate assessment by considering many aspects will result in maximum results.

## **Problems**

Based on the above issues, this paper will discuss what aspects should be assessed in the development of computer assisted learning.

## Discussion

### 1. Aspects Considerations in Designing Program of Computer-aided instruction

In order to improve the quality of learning in CAI, it should be developed according to the principles of good learning. Thus, CAI must have certain characteristics. CAI typically has characteristics similar to the one that possessed by programmed instruction. This occurs because the shape of programmed instruction that is most common today is the CAI and it has replaced the programmed text. Diaz-Martin (2001) mentioned some of the characteristics of this CAI, namely:

*... CAI provides regular and timely interaction with the instructor and current feedback. Students can repeat tutorials as often as needed and work at their own pace. CAI also can be used with greater numbers of students than a traditional classroom would hold. CAI and web-based instruction have opened avenues of access to individuals with disabilities that were not possible before.*

Diaz-Martin (2001) argues that CAI provides timely and regular interaction current feedback to the instructor. The learner can repeat additional teaching whenever necessary and work at their own way. CAI can also be used in a larger number of learners than a traditional classroom had. CAI and web-based instruction has paved the way for access to individuals with disabilities that were not possible before.

Meanwhile, Eisenberg (1986) in (Sugilar, 1996) states several CAI characteristics which are: (1) it is possible for learners to learn anytime,(2) students cannot proceed to continue study if she or he do not know the whole problems during the learning process (3) there is a response promptly to any questions put by the learner, (4) if the learner answered incorrectly and felt embarrassed then nobody will know, (5) it allows each learner to participate in the learning process, and there is no possibility of learning is dominated by particular people. Elida & Nugroho (2003) more specifically mentioned characteristics possessed by developed CAI which becomes the specification of this model, namely:

#### a. Attractive

The first activity of learning is to attract the attention of students so that in the next events in learning process can work well. Learner's attention can be enhanced by providing sudden stimulation changes. There are many things can be done to attract the attention of students at the beginning of learning. According to Gagne and Briggs (Sadiman, Rahardjo, & Haryono, 2002), direct oral questions may attract attention. The

moving images and text on the monitor screen may also show the strange event, and therefore can bring attention of the students. Efforts to attract the attention of the students made with the intention that learners are motivated to learn.

### **b. Learning materials**

Learning materials in CAI gradually prepared by utilizing existing facilities in computer software. It is carried out so that students can freely move within materials as desired. However, each time they start to study one learning material, it must be accompanied by a goal. Thus, the students will know the kind of capabilities that must be achieved after learning is complete.

### **c. Exercise Practice and Feedback**

In practicing, a student can do exercises repeatedly, until he was able to answer every question. Every time each question is answered, the computer will provide feedback whether the answer given is right or wrong. If the answer is wrong then the computer will direct the students to try to find the correct answer. Meanwhile, if the answer is correct, the computer will also give some feedbacks. When finished answering the questions, the obtained scores will appear, along with a recommendation to repeat the material or proceed to the next subject. This is one of CAI advantages which is able to provide feedback to the learner. This is similar to what has been proposed by Sugilar.

Supriyono (1991) explains that there are two aspects that need to be emphasized in building CAI module package. They are: (1) The concept of computer-assisted instruction (CAI) is by considering the characteristics of students in the preparation of teaching strategies to be displayed in the monitor screen, and (2) implementation and the concept of computer-aided learning model. Meanwhile, Suryono (1995) has conducted research in the subject of electronic by using several aspects of CAI in the evaluation which included: (1) material, (2) display, (3) the interaction of students, and (4) program interactivity. The results showed that learners respond positively to the four aspects of CAI.

Furthermore Harun & Aris (2001) from students' perspective found several aspects that need attention of CAI program builder. They are:

- 1) The information design. This design can be understood as the process of determining the purpose of communicating through design of the material (contents) in the form of built CAI.
- 2) The interaction design. This design can be understood as a process to identify how to give control to the students. A good design is a design that makes the learner can

control and direct the flow of information available in CAI. Students can manage the flow of information to match with their expectations. The design of interaction should have four criteria:

- a) It can motivated students to obtain experiences by providing clear direction through relevant menu selection.
  - b) It can create an attractive searching path through the available information in CAI.
  - c) It can provide clear guidance that can be chosen by students whether they want to browse and do whatever they need to do.
  - d) It can make learning experience becomes easier and more intuitive.
- 3) The presentation design. This design relates on how to present the information and instructions in the display screen. There are several things that should be noted such as :
- a) The display must be simple.
  - b) The display should be consistent in terms of searching rules which were presented on the monitor screen, for example: the placement of the menu, the use of icon and the use of term in the icon .

Simonson and Thompson (1994) stated that there are 6 aspects that should be considered in developing CAI program. They are:

- 1) Feedback. Good CAI programs are seen when the students respond, the program will give immediate feedback in term of comments, praise, warning, or certain commands that help showing and directing the students to be correct or incorrect. Feedback will be more attractive and increase the motivation to learn if accompanied by illustrative sounds, images, or video clips.
- 2) Branching. CAI programs provide branching based on students' response. For example, if a student is always wrong in answering questions about a particular topic, then the program should recommend studying that section again. Furthermore, if a student is progressing faster than others then he can go directly to the top level. In another hand, if he performs less then he can back to study the previous section or given additional exercises.
- 3) Assesment. This is one of important aspects to know how far one student can understand the material that he has already studied. A student can asses himself through his final score or success chart which documented automatiCAlly. Teacher can then monitor his performance in other time.

- 4) Progress Monitoring. CAI program would be more effective if it always provide information to a student on which part of learning material that he should work on, what to be studied next and what to be achieved when finishing the learning process.
- 5) Direction. Effective CAI program is a program that can provide guidance to students towards the achievement of the correct answers. In addition, the instructions in the CAI program can make learning process becomes easier for students to study individually without the help of others.
- 6) Display. Planning the display screen CAI programs include the type of information, display components, and legibility.

According to Arsyad (2010), visualization of messages, information, or concepts to be conveyed to the learners can be developed into various forms such as photographs, drawings / illustrations, sketches / line drawings, graphs, block diagram, chart, and a combination of two or more forms. In order to design learning programs display refers to the four principles of design such as simplicity, coherence, emphasis and balance. Visual elements are used as the primary consideration in designing learning programs in order to look more interesting and will not make student bored. The elements are the background (background), text, images, colors, buttons, animations, sound, and video.

#### **a. Simplicity**

The meaning of simplicity in visual concept is the number of elements to be displayed matched with the target and will not be boring for students as one of learning communities. Messages or information will be presented in brief and accurate to make it easier for student in understanding the material compared to the long one before.

#### **b. Integration**

Integration means that the relation between object elements such as text, picture, buttons, sound, animation and visualization that included in program presentation should be interconnected and integrated in function as a unity. Each object must be interrelated and integrated as a unified system that can help the understanding of messages and information within the material.

#### **c. Emphasis**

Emphasis in visual learning concept is focusing on one of elements that should be highlighted to the students. Objects that have to be emphasized should be presented in such a way as colour, size, and links.

#### **d. Balance**

Balance concept needs high imagination level and experiments willingness in designing learning display. The example of balance concept implementation in learning program can be shown in term of colour selection and button/link placement, background visual, animation, text, logo and used visualization. Elements that should be considered in designing visualization of learning program such as background, text, picture, colour, button, animation, sound, and video.

Furthermore, LIPI, Pustekom and Ilmukomputer.com have already agreed the assesment criteria in software engineering aspects especially in developing learning media. The criteria consist of nine aspects such as (Wahono, 2006):

##### **a. Effectiveness and Efficiency in Developing and Use of Learning Media.**

Every time a program that has small size and not complicated features but works very slow. If a computer has unlimited speed and free memory (RAM) then it would be a problem. However, a computer has limited speed, memory (RAM) and permanent storage (hardisk) capacity. Therefore, it is really important to manage the resource use (CPU, RAM and hardisk) effectively and efficiently. Delays, poor response and throughput usually occurs because the manufacturer did not think about the efficiency of the resources absorbed by the program. For example, to display small size picture, the manufacture should use original image with high resolution, do not use compression efforts and accurate cropping. On the other hand, there are some images that should have high resolution but in reality, they use low resolution image. Furthermore, there are other factors that make resource uses become inefficient, for example incorrect use of algorithm. For example, to sort a group of data, manufacture does not use famous and effective sorting algorithm such as insertion-sort, merge-sort and so on. If the computer A with 100 times faster in speed compared to computer B with different algorithm for the same cases, the logic will be that computer A will perform faster than computer B. However, if computer B uses more precise and efficient algorithm then program in computer B can perform faster 10 times tan computer A.

One case that often arises in developing instructional media is the learning media creator is too excited and he presents all images library that he has. He also inserts several animation and simulation effects that he knows into his instructional media even though they are not really important and effective in helping learning process.

**b. Reliability**

The program is said to be reliable if the program can run well, not easily hang, crash or stop during operation. The reliability of the program was also judged on how far it can continue to run despite the error in the operation (error tolerance). Users need feedback in accordance with the conditions of the system (including how long a user must wait, etc.).

**c. Maintainability (can easily be maintained and managed)**

The structure of the program should be compiled with algorithms, flow presentation, organization, and linkages between parts so it is easy to modify. Code or script has to be made simple and easy to be understood even though its function is complex. The code is modular with documentation on each section that may facilitate the modification and changes (maintenance). It will be easier for everyone who wants to change/repair/add program features. Moreover, a programmer can also easily find bugs in the program. There is a statement that 60% of the work in cleaning bugs is one of a programmer's job.

The less code that has been written, the less need to maintain code or program. The more code a programmer writes, the more the programmer should think about its maintainability.

**d. Usability (Easy to be used and simple in its operation)**

It can be imagined that if one road does not provide traffic signs and road marking, people may get lost and do not know which way he should go. Similar to learning media, the availability of tool tip, help, icon, logo, button, etc will help user who use the media for the first time. Design and navigation placement will help user in operate the media. If there is a fault in program (error), then there will be a message with clear language displayed so that it can be easily understood.

The consistency of the shape and location of the navigation also affects user comfort when comprehend implicit information in learning media. By looking the first appearance of program, user can know the condition of program can decide other alternative action. Every choice and visual material can be found if necessary without disturbing the user with overwhelmed information. User can also guess, predict, and determine the relation between action and results, control and resulted effects, software status and what visible in the program.

**e. Accuracy in selecting the type of application/software/tool to be used in development.**

Learning media products will be developed with proper application and tools based on developer needs. For example, in creating graphi CAI design, the programmer needs graphi CAI processing software and not software that created to proceed words. Another example, if a user wants to make presentation, it will be easier for him to use a software that made special for creating presentation. Therefore, it is suggested to use proper and easy tools in making animation, simulation, tests, and other features.

**f. Compatibility (Learning media can be easily installed/operated in various existing hardware and software)**

The development of software and hardware are varied with higher specifications and higher speed in process. Several years ago, the highest access speed of RAM was only 8 MB. Nowadays, it can reach up to 1 G and more. CD ROM, before, has reading speed the highest 4x, nowadays it has more function and becomes more general with the highest speed similar to CD-RW speed 52X. It even can read DVD. The same happens for application software. It was simple and had longer process to operate all application inside it. Recently, the application software become more beautiful with better graphiCAI display and animative. They come with easier navigation and faster in their operation.

Learning becomes better if every person can work everywhere without any obstacles in computer specification and required software to operate the computer. Therefore any good product should be operated in many varied hardware and software condition. It means that it can operate in the lowest possible computer specification, various operating system in many platform and version, from the earliest until the latest version, and software with unlimited version (old and new version).

**g. Packaging Integrated Learning Media Program and Easy in Execution.**

Learning media should be packaged nicely. Installation process can run automatically by using Autorun feature. Once installed, the program can directly be used without any need to install the file one by one (plugin, etc) or computer rebooting process. Shortcut/icon can automatically appear after installation process with easy identifiable name. Feature to uninstall program is available to help users if they do not need the program anymore. Program can be developed without installation process. It means that by only one click, every process can operate by itself. It is getting easier for users, especially for students who are less familiar with computers.

#### **h. Complete Documentation of Learning Media Program.**

This question arises when the media that we have made was not equipped with documentation on how to install and how to use. The definition of software engineering by Ian Sommerville is: "Computer programs and associated documentation". Therefore, it cannot be forgotten that the term software does not only belong to computer program, but also documentation and related data configuration to make the program operate correctly. By this definition, the output of software production, computer program and complete documentation are related one another. This is less understood by developer so that they assume that it will be enough to give running program to the users.

Documentation of learning media that has been made should include : installation manual (clear, brief, and complete), trouble shooting (clear, structured and anticipatory), program design (clear and describe the workflow of program). Documentation is not only oriented to the easy use by providing help, readme, user manual, etc, but also oriented to the developer that imply to the completeness of documentation and explanation of program code so that it will be easier to modificate the program.

#### **i. Reusability (Part or All Learning Media Program can be reused to develop other learning media)**

After building level has been passed, a developer has to improve his ability not only oriented to the making process, but also oriented to how the features and program function can be reused in other programs. Reusability, in this case, means that the source code, icon, logo, button and so on should be designed so that the program can be easily reused in other learning media program.

Template menu, icon, logo, button, etc that have been made can be easily used in other program. Library (DLL, API, etc) are also packaged nicely so that it can be implemented by other program. Program is arranged in modular so that it can be reused (reusabilitas).

### **Conclusion**

Based on above discussion, there are several aspects that become assessment in developing CAI that can be concluded as follows: Assesment indicators in developing CAI such as: a. Software Engineering/Program aspect: **Aspek Rekayasa Perangkat**

**Lunak/Pemrograman:** (1).Effectiveness and Efficiency in the development and use of instructional media; (2). Reliable; (3).Maintainable (can easily be maintained and managed); (4). Usability (easy to use and simple in operation); (5).The accuracy in selection of the type of application/software/tool for development; (6) Compatibility (learning media can be installed/run on existing hardware and software); (7). Packaging of integrated instructional media and easy in execution; (8). Completeness of instructional media program documentation which consist of: installation manual (clear, brief, and complete); troubleshooting (clear, structured and anticipated); program design (clear and complete in describing program workflow); (9) Reusable (part or all program learning media can be reused to develop other learning media). b. Aspects of Learning Design and Content Items: (1) Clarity of learning objectives (formulation, realistic); (2) The relevance of the learning objectives with SK/KD/curriculum; (3) The scope and depth of learning objectives; (4) The accuracy of the use of learning strategies; (5) Interactivity; (6) Provision of motivation to learn; (7) Contextuality and actuality; (8) The completeness and the quality of learning support materials; (9) Compliance with the aim of learning materials; (10) The depth of the material; (11) Ease to be understood; (12) The systematic, continuous, clear logic flow; (13) The clarity of description, discussion, examples, simulations, exercises; (14) Consistency of evaluation with the aim of learning; (15) The accuracy and provision of evaluation tools; (16) The provision of feedback on the evaluation results. c. Aspects of Visual Communication/Display: (1) Communicative; according to the message and can be received/in line with the expected target; (2) Creative ideas pouring in the following idea; (3) Simple and attractive; (4) Audio (narration, sound effects, back sound, music; (5) Visual (layout design, typography, colour); (6) Media movement (animation, movie); (7) Interactive Layout (navigation icons).

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