Optimization design of CAI for computer programming language to improve student’s competence

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Abstract. Computer Assisted Instruction (CAI) for computer programming was rare in order to improve student’s competence, the general design of CAI should be optimized. Optimized design produced proper CAI learning media targeted for vocational high school (SMK). The product implemented in certain SMK to verify the effectiveness and efficiency of learning media in the field. The research used R and D method. The study population was all students of Vocational High School class IX. The results of this study are that the use of CAI can improve student learning outcomes for mass production planning material using the VB.net programming language.

1. Introduction
The development of Information and Communication Technology (ICT) has opened opportunities for various alternatives in the delivery of Learning Media. In particular, the development of ICTs has led to the development of ICT-based learning models, which enable the delivery of material and learning processes not limited by place and time. The State Ministry of Research and Technology provides a formula for understanding ICT as part of science and technology. ICT in general are all technologies related to retrieval, acquisition, processing, storage, distribution and presentation of information.

Donald Blitzer as Mr. PLATO (Logic Programmer for Automated Teaching Operations) developed computer-based learning (CAI: Computer Assisted Instruction) in 1966 at the University of Illinois at Urbana-Champaign. The first computer-based learning trial was conducted in 1976 at Waterford Elementary School. Since then, computer-based learning has begun to be published and used in public schools as a computer-based learning media [1].

The CAI (Computer Assisted Instruction) program is basically a learning program that is packaged in the form of computer software. Learners can learn by running programs or software on a computer. The Association for Education Communications and Technology (AECT, 1977) defines CAI (Computer Assisted Instruction) as a learning method that uses computers to teach students, where the computer contains teaching materials designed to teach as a learning resource, and as a learning skill evaluation tool students to the desired level of skills that should be mastered [2].

According to Hick and Hyde in Wena CAI is a teaching process directly involving computers in the presentation of instructional models in interactive mode to provide and control the individualized learning environment for each individual student [3].

The same opinion explains that the CAI program is a learning program that is used in the learning process by using software in the form of computer programs that contain subject matter. "Computer
system delivery instruction by allowing them to interact with the programmed lesson into the system is referenced to CAI' [4].

.Net, "dot net" framework is software that supports the process of developing and executing programs in a Windows environment [5]. The framework was developed by Microsoft. There are two important parts or entities in the .Net framework that we need to know before making programs that use the framework, namely: Class Library and Commons Language Runtime (CLR). The Base Class Library (BCL) contains a collection of core classes (subnets of all classes contained in the .NET Class Library that provide basic functions of CLR. The classes are stored in the mscorlib.dll function file and some classes are contained within The System.dll and System.core.dll files are specified as part of BCL. The Framework Class Library (FCL) is a superset of BCL and refers to all class libraries contained in the .NET Class Library. Thus, FCL is actually another name or term from the .NET Class Library. FCL contains a set of classes for creating programs involving Windows Form (WF), ADO.NET, ASP .NET, Language Integrated Query (LINQ), Windows Presentation Founts (WFF), Windows Communication Foundation (WCF), and others.

1.1. Common Language Runtime (CLR)
Common Language Runtime (CLR) is an environment or system (virtual machine) that regulates the execution process of programs written using the .NET library. When we compile program code written using C #, VB. NET, VC. NET, and J #, the results given by the compiler (compiler) are actually not an executable file (.exe), but a file containing a special code called Microsoft Intermediate language (MSIL). The MSIL file is a set of instructions that are portable, which can be run on all types of CPUs that have been installed by the .NET Framework. When the program starts, CLR will activate the JIT compiler (short for: "Just-In-Time") to convert MSIL files to .exe files. Thus, the .exe file is run even though before the program code will be processed into the MSIL file first.

The process of compiling and executing programs in the .NET Framework can be seen as shown below:

![Diagram](image)

**Figure 1.** Process of compiling and executing programs in the .NET Framework.
1.2. Competence
Understanding Competence according to Law No. 13 of 2003 is the work ability of each individual which includes aspects of knowledge, skills, and work attitudes that are in accordance with the standards set [6]. Etymologically the term competency comes from the English word "competency" which means skill or ability [7].

Whereas according to Purwadarminta explain competence as an authority or power to determine or decide things [7]. In other words, competence is called authority or authority. According to Mangkunegara definition of Competence is a fundamental factor possessed by someone who has more ability, which makes it different from someone who has average ability or just ordinary [8].

Theoretical learning activities in subjects Creative products and entrepreneurship in the state SMK 5 of the city of Bekasi experience weaknesses in learning, due to the mastery of very many materials, while the allocation of learning time is lacking and requires time to practice the material. The students prefer practical learning rather than discussing the material in theory. Learning also lacks variation using conventional models, lack of using tools or media to teach in learning and the monotony of this can be seen from the enthusiasm in teaching and learning Creative Products, from interests these students cause saturation during teaching and learning activities. System/approach to maintain the expected standard of competence, we use computer assisted instructional (CAI) so that students feel happy in learning activities, students assume the material they learn is a practice material and does not consider a boring and saturating theory material because during the teaching and learning activities students interact directly with computers.

2. Research methods
In this study using research and development methods (R & D). Robert Maribe Branch developed Instructional Design with the ADDIE approach which is an extension of Analyst, Design, Development, Implementation and Evaluation [9].

This can be described as below:

![ADDIE approach to develop products in the form of learning design.](image)

Analysis, related to the analysis of work situations and the environment so that what products need to be developed. Design is a product design activity in accordance with what is needed. Development is the activity of making and testing products. Implementation is the activity of using the product, and evaluation is an activity to assess whether each step of the activity and product that has been made is in accordance with the specifications or not.

The development of computer assisted learning media (CAI) which will be carried out using the 5 phases of the ADDIE model, while the 5 phases are as follows:
2.1. Analysis

In this phase, the developer carries out a needs analysis to clearly know the specific learning media that will be created, including the analysis of the character of students, analysis of the learning environment, and analysis of learning materials.

2.1.1. Character analysis of students

- Learners who use learning media are students of class XI 36 Software Engineering Vocational Competency Skills in SMK Negeri 5 Bekasi as many as 36 students.
- The low interest in reading possessed by students.
- Interest in Production subject theory theory material is very lacking.
- The age range of students ranges from 16-17 years.
- The level of absorption of different students, this allows time for the mastery of material for each student is different.

2.1.2. Analysis of the learning environment

- Most of the students of SMK Negeri 5 Kota Bekasi already have a laptop or personal computer at home and can be taken for learning at school.
- Infrastructure Facilities in the Vocational School environment are very supportive of teaching and learning activities.
- Students have been very proficient and familiar with the media of laptops or computers.
- In learning activities both in the school environment and outside the school environment, do not yet have interactive learning media that are packaged in the form of CDs, especially creative product subjects and entrepreneurship.
- Teachers in delivering learning materials still use the lecture method and discussion where students feel bored and bored in participating in learning activities.
- The interactive learning media that are developed can be used either in the school environment or outside the school environment, especially for students who are conducting the internship activities.

2.2. Design phase

At this stage the developer designs an interactive computer program in accordance with the learning media design flow and the purpose of the learning material in order to improve the competencies to be achieved.

2.3. Development phase

At this stage the developer prepares to develop computer-based learning media by carrying out the following steps:

2.3.1. Making Media Program Outline (GBPM). In this stage the developer makes an Outline of the Media Program that contains identification of the programs made. Through the identification of the program, it is determined: Title, Target, Objectives and points of material to be set forth in the MMI. The GBPM format that can be used is:

Subjects: Creative Products and Entrepreneurship
Title: Mass Production Planning
Class: XI RPL SMK Negeri 5 Kota Bekasi
| No | Competence                                                                 | Subject Matter                                                                 | Presentation Form                                                                 | Bibliography                                                                 |
|----|----------------------------------------------------------------------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| 1  | Analyzing mass production planning                                         | Make mass production planning                                                   | 1. Definition of production planning.                                             | Neti budiwati (2004), pengelolaan proses produksi/jasa.                     |
|    |                                                                            |                                                                                | 2. Types of production planning                                                   | Hendra kusuma (2001), manajemen produksi,perencanaan dan pengendalian produksi, ANDI Yogyakarta |
|    |                                                                            |                                                                                | 3. Function and purpose of production planning                                   | Soersarsono wijanti (2000), pengantar kewirausahaan, sinar baru algensido, bogor. |
|    |                                                                            |                                                                                | 4. Preparation of production process planning                                    | Pengestu subagyo (2000), manajemen operasi,BPFE Yogyakarta                   |
|    |                                                                            |                                                                                | 5. The steps determine the scale of the production process                       | Lili asdjudiredja dan kusmana permana (1990), manajemen produksi, armico bandung. |

2.3.2. Making a flowchart. CAI Flowchart
Title: Optimization Design of CAI for Computer Programming Language to Improve student’s Competence

![Flowchart Image]

Figure 3. Flowchart.
2.3.3. **Storyboarding.** In the storyboard stage, the developer divides the material into several program views, in each program view is divided into audio, visual and interactive visuals. In the visual section consists of text, navigation and illustrations. In the text section is the material that will be presented. The navigation section is the buttons that appear in the program and have special functions. In the interactive section is a range of explanations of material related to the concept, an explanation in the form of interactions between students and learning media. Interaction in the form of feedback on each stimulus given.

2.3.4. **Collection of materials needed.** At this stage the developer collects teaching material in accordance with the curriculum used. Material was obtained from several printed books and the internet. Besides that, the developer collects other related material such as images, software and background music to clarify interactive visual effects.

2.3.5. **Programming.** The first step that developers do in programming is to discuss the manuscript with material experts and media experts. Discussion of manuscripts is done to equalize the perception or understanding of the storyboard that has been made, to avoid fatal mistakes when learning media are produced or duplicated. The next step is to present the collected ingredients according to the needs of the text. Making this media consists of the appearance of the main menu, display of material or subject matter and sub-subject matter, by including images that support the material, adding text with the selection of fonts, font size and color, adjusting the appearance (background), color selection, creation interactive visuals into learning media, making buttons, and adding accompaniment music in the production process.

2.3.6. **Finishing.** The steps taken in the finishing stages are:

- Revision: After the computer-assisted learning media is complete, a study is carried out by media experts. With the intention to find out whether this learning media is in accordance with the intended target based on the layout, display format and writing, color selection and appearance and others.
- Preview program: After the program has been revised, the developer sees whether the computer-assisted learning media is ready to be produced.
  - Initial production
  - Field test
  - Revisions and packaging
  - Final production

2.4. **Implementation stage**

At this stage, computer-assisted learning media are implemented with trials conducted by media experts, creative product subject teachers as material experts, and students as feedback in the form of criticism and suggestions which are then revised to improve the quality of computer-assisted media products.

2.5. **Evaluation phase**

In the ADDIE development model, the evaluation and revision process is carried out at each stage, both in the analysis, design, development, implementation and evaluation stages based on the results of consultations with media experts and material experts, learning design experts and students who study the material.

The research subjects were students of STATE SMK 5 Kota Bekasi in class XI Software Engineering expertise program in creative product development and entrepreneurship subjects.
3. Results and discussion

The results of the development of computer-assisted learning media for mass production planning material in creative product development and entrepreneurship subjects consist of computer user interaction and subject matter packaged in a Visual Basic.net programming language that can be run on various personal computers or laptops without the need to install the application.

The effectiveness of the use of computer-assisted learning media in improving competencies in terms of: 1) learning outcomes of students increases, 2) differences in the average score of learning outcomes before and after using instructional media increases, 3. Students' mastery learning, 4) enthusiastic students in learning activities.

The realization of the appearance of computer-assisted learning media is as follows:

3.1. Opening view

![Figure 4. Opening view.](image)

3.2. Display of student data contents

![Figure 5. Display of Student data contents.](image)
3.3. Display main menu

![Figure 6](image6.png)

**Figure 6.** Display the main menu.

3.4. Material display

![Figure 7](image7.png)

**Figure 7.** Material display.

3.5. Material display 1

![Figure 8](image8.png)

**Figure 8.** Display of material 1.
3.6. *Display of material objectives 1*

![Figure 9. Display of learning objectives material 1.](image)

3.7. *Display of practice material question 1*

![Figure 10. Display of exercises about learning material 1.](image)

3.8. *Display of material question 1*

![Figure 11. Display Results of work on material questions 1.](image)
3.9. *Display of material questions 1 (question number 1)*

![Image of question 1](image1)

**Figure 12.** Display of material questions 1 (question number 1).

3.10. *Display of material questions 1 (question no. 20)*

![Image of question 20](image2)

**Figure 13.** Display of material questions 1 (question no. 20).
3.11. Material view 2

![Image of Jenis Pelaksanaan Produksi]

**Figure 14.** Display of material 2.

4. Test results

4.1. Small group trial results

Small group trials were conducted on 10 students with different levels of intelligence. The data obtained from the assessment of small groups in the aspect is 88.9%.

| Aspect                      | Presentase (%) |
|-----------------------------|----------------|
| Display                     | 85             |
| Learning materials          | 90             |
| Communication with users    | 92             |
| Mobile media                | 88             |
| Text                        | 90             |
| Evaluation                  | 89             |

**Table 2.** Table of recapitulation of the results of small group tests.

4.2. Results of evaluation by media experts

| Assessment aspects   | Average score | Total score | Maximum number of scores | Perzentase (%) |
|----------------------|---------------|-------------|--------------------------|----------------|
| Communication with users | 4             | 19          | 20                       | 95             |
| Display              | 4             | 17          | 20                       | 85             |
| Benefits             | 3             | 3           | 4                        | 80             |
| Evaluation           | 3             | 6           | 8                        | 80             |
| Text                 | 4             | 12          | 12                       | 99             |
| Mobile media         | 4             | 16          | 16                       | 99             |

**Table 3.** Table Percentage of results of assessment by media experts.
4.3. The results of the material assessment

Table 4. Percentage of results of material expert assessment.

| Assessment aspects   | Average score | Total score | Maximum number of scores | Percent age (%) |
|----------------------|---------------|-------------|--------------------------|-----------------|
| Learning materials   | 3.5           | 19          | 20                       | 91              |
| Activity             | 4             | 4           | 4                        | 100             |
| Benefits             | 3.7           | 22          | 24                       | 92              |
| Evaluation           | 3.5           | 6           | 8                        | 80              |
| Language             | 4             | 8           | 8                        | 100             |
| Mobile media         | 4             | 11          | 12                       | 92              |

Figure 15. Graph of assessment by media experts.

Figure 16. Graph of assessment by material experts.
4.4. Testing the effectiveness of learning media

Table 5. Table of learning outcomes.

| Stage   | Overall average value |
|---------|-----------------------|
| Pre Test| 50.5                  |
| Post Test| 88.5               |
| Increase| 38                    |

Based on data in table No. 5, there is an increase in student learning outcomes by 38 after using this learning media.

5. Conclusion

- The results become Computer Assisted Learning Media (CAI) to improve competence in mass production planning materials using the VB.net programming language.
- The results are seen in the form of program design, images and sounds that are interactive and not boring.

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