Desain and Implementation of Virtual Laboratory of C Programming in Virtual Classroom Based on Moodle

Azizah Zakiah
Polytechnic Pos Indonesia, Sariasih 54, Bandung 40151

Abstract

It is important in the teaching of procedural programming to transfer the concept of procedural programming into a language that can be executed by machine. The elements of procedural programming must be translated to the selected language. The teaching should not only syntax oriented but also semantics oriented. The objectives of learning cannot be gained if the design of interaction of the practicum of C programming in a virtual laboratory is inappropriate. In this research, a virtual laboratory of C programming is designed and implemented with approach of usability and user experience. The testing result showed that respondents agree that the virtual laboratory is in accordance with the goals of usability and user experience that is effective, efficient, safe to use, good utility, easy to learn and to remember by users. Respondents also agree that the virtual laboratory will support them to get the objectives of learning of C programming.

Keyword: C programming, usability, user experience, virtual laboratory.

1. Introduction

E-Learning is learning media using electronic devices. The most popular type of e-learning media are Interactive CD and Web Based Learning. In the first teaching about programming, programming concepts and elements in this paradigm should have covered in full, so students have an integral vision. Teaching programming will be very abstract and difficult to understand if students are only exposed to concepts without ever "play" with computer and language processing. In the teaching of procedural programming is deemed necessary to "unearth" the concepts of procedural programming paradigm in a language that can be executed by a machine. Whatever language is chosen, the elements must be translated in a procedural programming language, and teaching is not just oriented to the syntax, but rather to the semantics of the programming elements [3].

2. References Study

2.1 Pedagogy of practicum in learning

According to Hoogveld, pedagogy is the science of how to guide children toward a specific purpose, so that he was "able to independently accomplish the task of his life" in the future. So, pedagogy is the science of children education. Langeveld (1980) distinguish the term "pedagogic" with the term "pedagogy". Pedagogy interpreted with the science of education, is
more focused on thinking, reflection on education. A concern of how we guide and educate the children. While the term of pedagogy means of education, which emphasizes the practice, regarding the activities of educating and guiding children. Pedagogic is a theory that accurately, critically and objectively develop the concepts of human nature, the nature of the children, also the nature of educational goals and process [8].

The first teaching of programming should provide the most basic programming. This programming will be the basis for further programming. Therefore, in the first teaching of programming should consider the following [3]:

- the establishment of systematic thinking patterns according to "standard",
- should cover the essential points,
- understanding of specification versus coding. This lesson cover only the coding stage, and did not cover design of program specifications,
- although not said explicitly, the first language will be a "meta language" that will be used in the teaching of the next programming language,
- aspects of the execution (the results of a program) should never be given in class in detail, except if the lecture using computers. This aspect should be separated.

2.2 Content management system of moodle

Content Management Sistem (CMS) is a system that provides convenience to its users to manage and make changes to the contents of a dynamic website without prior equipped with knowledge about things that are technical. Thus, every person, writer or editor, at any time can use it freely to create, delete or update the content of website without any direct intervention from the webmaster.

Moodle CMS has become a tool for teachers to create a course website. Moodle is a name for an application program that can change an instructional media into web forms. This application allows students to enter the digital "classroom" to access learning materials. Some description and advantages of Moodle [5]:

- 100% suitable for online and classroom learning as well as additional face to face with lecturer / teacher;
- simple, lightweight, efficient, and using simple technology;
- easy to install on many programs that can support PHP for only one database;
- display an explanation of the lessons and can divide the lesson into several categories;
- can support more than 1000 subjects;
- have a robust security with the registration form for students who have examined the validity and have some encrypted cookies.

Moodle provides a full language package in 45 languages, including Indonesian. The existing language can be edited using the editor that have been available.

2.3 Interaction design

Designing interaction means making a product that can be used. Can be used means that the product is easy to learn, effective to use, and it is comfortable for its users. Therefore, designing the interaction between the product and human being needs [6]:

• input, ideas and feedback from users based on what they feel and experience,
• pay attention and consideration on who will use that interaction
• know how they use it
• know the activities of its users.

Job description as [6]:
• interactive designers - people who are involved in all aspects of interaction design in a product,
• usability engineers - people who deal with product evaluation, use and principles,
• UI designers - people who are experts in the field of methodology is user-centered design,
• UI designers engineers - people who build and model how to use, methods of analysis workflows and prototypes,
• Information architects - people who give you an idea how to plan and develop interactive products, especially the website

User Experience (UX) designers / architects / Researchers - people who are not only do all the above but also conduct field studies to examine the needs of users and turn it into a real product.

User Experience (UX) means how the product is covered and used by peoples in the real world. UX is about how people feel and enjoy and they satisfied when using, seeing, holding, opening and closing the product. UX cannot be designed. But designing for the sake of UX means that the resulting design the resulting design cause effects which causes the UX, such as taste or a particular impression as comfortable or sensual.

The steps in the process of interaction design are as follows [6]:
1. identifying needs and building needs / requirements for UX, X,
2. using user-centered approach by involving users in the design process: observing, interviewing, talking with users, to test their performance, modeling the way it works, use questionnaires, or make them as part of the design team,
3. building alternative designs that meet the needs / requirements,
4. building interactive versions of the design so that they can be communicated and tested,
5. evaluating what has been created through prosses and UX presented. Ensure that the product can be used.

Interaction design and user experience, usability goals: relating to interactive products are easy to learn, effective, and convenient to use from the user point of view. This objective is intended to provide the interaction designer a concrete way to test various aspects of interactive products and UX. Things that must be met for this purpose are [6]:
1. effective: how well the product works,
2. efficiency: how the product supports the user to do their jobs,
3. safe to use: protecting users from dangerous situations,
4. have a good utility: how the functions available to users,
5. easy to learn: how easy the product can be used,
6. easy to remember its use: how easy of use in mind.
The purpose of the user experience is more related to the taste and experience that is felt and experienced by users with products they used. Judgments can be provided by the user as a result of the testing / evaluation are: satisfying, comfortable, entertaining, helpful, beautiful, creative, cognitive stimulation, fun, funny, surprising, challenging, tedious, frustrating, annoying. These issues arise because users use the results of the design.

The principles of designing [6]:
1. visibility: clear functions, clear parts, clear symbols,
2. feedback: the feedback given as a result of the action are given,
3. constraints: give establish certain guidelines for users to understand what was done,
4. consistency: the use of operation, and the elements on the products to do the same. For example, the red color is always used to give an error message, blue for confirmation.
5. affordances: attributes of an object that lets people know how to use it. For example: button to be pressed, check boxes to unchecked. Another designing principle is simplicity that is usually imposed on the website

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Bulleted lists may be included and should look like this:
- First point
- Second point
- Etc.

3. Analysis and Design

3.1 System description

To analyze the business processes that are running, there should be observation of activities conducted at the lab the C programming language by students and faculty in carrying out its functions. In this business process, there are several actors who played the function of activities, namely:
- Lecturers,
- Students,
- Laboratory Assistant (As.Lab.)
- Technicians,
- Head of the Computer Laboratory (Ka.UPT Lab.)
- Head of the Department (Ka.Jur),
- Head of Academic and Student Affairs (Ka.Baak)
Activities in the programming laboratory is divided into two major sections of the lab user and lab managers, with the following details:

1. Students do the registration to BAAK for taking the courses of programming with the approval of advisor based on the curriculum of the department,
2. Department assign the lecturer.
3. Lecturer determine the specifications of software and hardware as needed for practicum subjects they teach.
4. UPT Laboratory received a list of specifications of software and hardware as needed for practicum that has been approved by the department.
5. UPT Laboratory prepare the laboratory in accordance with the specifications of the Department.
6. UPT Laboratory provide a list of laboratories that have been grouped based on a variety of programming subjects to BAAK.
7. BAAK scheduling practicum in the laboratory.
8. Lecturers and Students do practicum in the laboratory for the course of programming in accordance with the schedule given by BAAK.
9. UPT Laboratory allocate the use of laboratory in accordance with the schedule of BAAK.

3.2 General Description of The System to be set Up

From the analysis of business processes that have been run, then a new business process that utilizes information technology is created. The system to be built is a complement to the system that has been running, which is implementing a virtual laboratory which is reflected below.

This new system became an option because it has several advantages, namely ease of access to laboratories. Only by having access to this virtual lab, students can do their practicum
of C programming at anytime and anywhere. Students are not limited by time of use, where in the old system, their access is usually limited to the lecture on practicum course. So with the construction of this new system then the learning objectives will be achieved by the interaction design that does not make users frustrated in using it because the virtual laboratory was built with the same metaphor as in the old system.

3.3 System Requirements

The software for practicum of C programming language in a virtual laboratory that will be developed are expected to do some things according to plan. Things that are expected for the administrator are as follows:

1. Management of laboratories using the application.
2. Having the ability to share authority with the login process using the system for virtual laboratories
3. The ability of user data management (user management) as a function of additions, changes and removal of users.
4. The ability to do configuration management system
5. The ability to manage backing up and restoring data.
6. The ability to change passwords.
7. The ability to manage the information.

For the lecturer, the things that are expected are as follows:

1. The ability to manage the programming practicum materials,
2. The ability to manage the problem or task of practicum programming c,
3. The ability to do run, debug c programs such as the old systems laboratory,
4. The ability to write, modify and save the program
5. The ability to evaluate and comment on tasks that are submitted by students,
6. The ability to display the tasks submitted by students,
7. The ability to give time limits of practicum tasks are given.

For students, things that are expected are as follows:

1. The ability to view and download material provided by lecturer,
2. The ability to see a description of practicum problems
3. The ability to upload / submission program tasks,
4. The ability to write, save, debug and run programs,
5. The ability to display re-submission that was sent,
6. The ability to see the results of evaluations and opinions of lecturer from the task program that has been sent,
7. The ability to deal with the deadline of practicum assignment.

3.4 Use Case Diagram

Use case diagram is used to model system requirements and to identify architecturally significant functionality of the software being developed. Use case is a pattern of behavior of the software,
this is a sequence of transactions related to something done by the actor. Use case based on the needs actors. Details of use case is as follows:

1. Managing the system configuration.
   Use case that serves to maintain the data needs of practical implementation.

2. Managing user.
   Use case that serves to manage users. The process is carried out includes displaying user information, adding users, changing data and data deletion.

3. Manage permissions
   Use case which is used to manage user rights. Processes that do include information display user access rights, adding users, changing data and data deletion.

4. Manage backup and restore.
   Use case that serves to manage the data in the system. Backup is the process of copying files from the database system into a target or a specific folder, while the restore is the process copying files from a specific folder (the backup) into the system database.

5. Manage password changes.
   Use case that serves to manage password changes. Processes that do include information display password changes, additions, alter data and data deletion.

6. Manage the material.
   Use case that serves to manage the material. The process is carried out includes displaying information material changes, additions, alter the material and removal of material.

7. Managing practicum assignment.
   Use case that serves to manage the practical tasks. Process performed tasks include displaying the information changes, additions, alter data and data deletion.

8. Managing practicum program task.
   Use case that serves to manage the task of the program. The process is carried out includes displaying information changes, additions, changes and deletions.

9. Manage the lab.
   Use case that serves to manage the lab. The process is carried out includes displaying information changes, additions, changes and deletions.

10. View a list of practical tasks.
    Use case that serves to see a list of tasks a student practicum.

11. Managing practicum task processing time limit.
    Use case which serves to limit time spent on the task of managing the lab. The process is carried out includes displaying information changes, additions, changes and removal of processing time limit.

12. Login.
    Use case that serves to process the access to the virtual laboratory system.
3.5 Activity Diagram

Activity diagram illustrates the flow of activity in the designed system. It is about how each stream will start, decisions that may occur and how to end. An activity can be realized by one or more use cases. Activities describe the processes that are running while the use cases describe how actors use the system to perform the activity. Activity diagram in this system are as follows.
a. Activity diagram of administrator.

![Activity diagram of administrator](image)

**Figure 4.** Activity diagram of administrator on virtual laboratory.

b. Activity diagram of lecturers.

![Activity diagram of lecturers](image)

**Figure 5.** Activity diagram of lecturers on virtual laboratory.

c. Activity diagram of students

![Activity diagram of students](image)

**Figure 6.** Activity diagram of students on virtual laboratory

### 3.6 Analysis of Domain Class Diagram
At this stage, the domain classes are defined along with static and dynamic relationships between classes contained in the system. As a reference in performing domain analysis, use case that has been defined in the requirement analysis phase is used. Class describes the state (attributes / properties) of a system, while offering a service to manipulate the circumstances of any method or function.

4. Conclusion and Suggestions

Conclusions
Based on test results and the discussion that has been described, the following can be concluded:

1. This virtual laboratory is very helpful to achieve the objectives of learning of C programming language.
2. The results of testing and processing of qualitative data showed that the respondents agreed that a virtual laboratory in accordance with the goals of usability and user experience that is effective, efficient, safe to use, has a good utility, easy to learn and easy to remember by the users.
Suggestions

The development of the virtual laboratory is expected to be more applied, so it can support the learning of other programming languages. It is needed to implement the application on the internet to optimize the advantages of this virtual laboratory.

5. References

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