Identifying students’ learning difficulties in human and computer interaction course through the implementation of project based learning model

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Abstract. This study aimed at identifying students’ learning difficulties in Human and Computer Interaction course through the implementation of Project Based Learning model (PjBL model). PjBL Model has 6 stages, starting from giving essential questions, continuing with designing a project, writing the project implementation schedule, monitoring, carrying out the project product evaluation, and ending with carrying out the learning experience evaluation. The study used observation sheet, rubric and interview guide for collecting the data and descriptive qualitative analysis for analyzing the data. The collected data were reduced and presented and then analyzed to get some conclusions. The result of the study showed that it was still found out or identified that the students had difficulties in learning in Human and Computer Interaction course through the implementation of the PjBL model. However, the amount of the difficulties was not significant. The learning difficulties experienced by the students were caused more by an internal factor, namely the low motivation of the students as the result of their low interest in courses that contain programming and they tended to prefer a multimedia course. However, it was admitted by the students that Human and Computer Interaction course taught by the PjBL model had given them unique experiences. The students felt that there was an increase in knowledge from the problem-solving activities that they did, since they had a great opportunity to explore their abilities by themselves so that they had new knowledge and experience which made their learning activities better.

1. Introduction

Human and Computer Interaction (ICI) is a course that studies the design of interfaces for software. The materials studied consist of design, aspects, implementation and interface evaluation. Specifically, ICI studies about 1) information processing system in human beings. 2) human and computer interaction aspects, 3) designing processes, 4) graph interface, 5) prototyping, 6) construction, and 7) multiple-window strategy. Human and Computer Interaction is a course in the computer field.

Informatics Engineering Education Study Program with its main teaching basis in the field of computer offers Human and Computer Interaction (ICI) course as a compulsory course in its curriculum structure. This course is offered to or can be programmed by the students in the even semester (the 6th semester). As a compulsory course, ICI can be programmed by the students only if they have attended and passed Information System (IS) and Software Engineering (SE). In other words, ICI can be
programmed if the students have attended and passed the prerequisite course. For most of the students that have attended and passed ICI, this course is a complex course; since they are required to be able to design “an interaction between human and computer” well by using a correct design model based on human and computer interaction concepts. The designing of “human and computer interaction” is based on cases and problems found in the field.

So far, the teaching process followed by the ICI lecturer focuses more on the transfer of knowledge, in which the students spend more time listening to the lecturer’s explanations as they are placed as passive students. The lecturer concentrates more in presenting the materials in a seminar (lecturing), and sometimes giving tasks to the students to review their experiences when using a system or an application. It continues this way, repeating this condition during the implementation of the teaching process by continuing to treat the students as passive learners. This condition is of course contradictory to the principle of active learning that becomes the basis of teaching at the college level. Problem solving ability is the most important objective in the ICI teaching. Based on the case or problem faced by the students in the field, they have to be able to design the concept of interaction that occurs between human and computer. This means that through the problems the students are stimulated to be able to learn something based on knowledge and experiences; so that they can construct new knowledge and experiences. The fact shows that the ability to solve problems has not yet become the main focus in the ICI teaching. As the consequence of this condition, some students were seen apathetic, ignoring the tasks given and showing a low motivation to learn. This affect their achievements which were also low. Therefore, it can be assumed that the students were experiencing learning difficulties.

A person can be assumed to be experiencing learning difficulties if he or she shows a certain failure in attaining learning objective [1]. In other words, he or she fails to attain a specified learning qualification level (based on the criteria in the instructional objectives or the measurement of his or her learning capacity) in a certain time limit. The learning difficulties that students face can be caused by internal and external factors. Learning is naturally a process of change in person’s behavior. However, not all of the behavior changes can be defined as learning [2]. This made a different view about the nature of learning emerge that views learning as a mental process. According to cognitive psychology, learning process will run well if the new learning material is appropriately and harmoniously assimilated with the cognitive structure of the learner. This means the material should fit with the learner’s ability and relevant to his or her cognitive structure. Hence, it is important for the lecturer to organize relevant concept of materials which suitable with the learner’s cognitive structure; thus, it can create a meaningful learning process.

One of the ways to identify clearly and deeply the learning difficulties faced by the students is by selecting an appropriate teaching model [3]. A teaching model is a conceptual framework that describes a systematic procedure in organizing learning experiences to attain certain learning objectives [4]. The relevant teaching model for organizing students’ learning experiences in ICI course is Project Based Learning model (PjBL). This model is selected since it is able to provide opportunities for the students to construct their learning quality actively through the process stages such as designing, planning, implementing a project until producing an outcome that is ready to be exhibited to the public. This is of course very relevant to the requirement of the achievements in the IC course, that is, the students’ “problem solving ability”, in which the students have to design interactions between human and computer based on the problems found in the field.

Through PjBL the students can plan the form of a project that they will make by themselves based on their knowledge and experiences in their cognitive structures, which, of course, correlate with what has occurred in the daily life. Hence, through PjBL the lecturer can clearly identify various learning difficulties that are experienced by the students through every stage in the process of a project implementation, both individually and collectively. It is hoped that in the end, all learning difficulties can be overcome.

A study on identification of students’ learning difficulties through PjBL was done by [3]. The study used 68 third year students of Mathematics Education Study Program who studied Mathematics Process and Product Evaluation as the sample. The result showed that the students’ learning difficulties during
the PjBL model implementation were caused by an internal factor, namely the lack of the students’ motivation to read and search for various references related to the materials taught. They generally depended more on a resource or reference used at the time of the course. This of course had an effect on the students’ lack of understanding of the materials taught.

Based on the explanation above it is important to identify learning difficulties faced by the students of Informatics Engineering Education study program in learning ICI through the implementation of PjBL model. Basically, the main objective of ICI and mathematics is the same; that is the ability to solve problems. This is as what was stated by [5], problem solving ability is one of the main objectives in mathematics. Especially in ICI problem solving ability required from the students is the ability to design interactions between human and computer based on problems found in the field. Thus, through this study all findings found hopefully can be used as the basis in making the process of further help easy, so that all learning difficulties faced by the students were not permanent and occur in a long time and all learning objectives specified can be attained well.

2. Methods and Procedures

This study was a descriptive study with a qualitative approach. It aimed at identifying and describing clearly learning difficulties experienced by the Informatics Engineering Education Study Program when they studied ICI through a PjBL model implementation based on project tasks given to design “human and computer interactions” by basing it on problems faced in the field. According to [6], a descriptive study is a study approach that tries to describe factual conditions that exist now systematically that urgently need a solution. Hence, the use of this descriptive method is very appropriate to obtain the objective of the study. The results or findings of the study can be used as the basis for giving further help, so that all learning difficulties experienced by the students will not become permanent and occur in a long time. Figure 1 shows the steps from the PjBL model.

![Figure 1. Steps in the project based learning model.](image-url)

Based on Figure 1, it can be explained that the steps in the Project Based Learning model starts with essential questions, that is, questions that can give the students the tasks in doing an activity. The second step is designing the project plan. The planning is done collaboratively between the lecturer and the students. It consists of rules, selection of activities that can support in answering the essential questions, and tools and materials that can be accessed to help in the completion of the project. The lecturer and the students collaboratively write the schedule of the activities which include: writing a schedule for completing the project, setting the project deadline, asking the students to design new ways of doing things, guiding them when they doing irrelevant things to the project, asking them to give reasons about the time setting. The schedule has to be agreed upon in order that the lecturer can monitor the study progress and the project work outside of the classroom. The fourth step is monitoring the students’ work and project progress. The lecturer is responsible for monitoring the students’ project completion. Monitoring is done by facilitating the students in every process. To facilitate monitoring, a rubric can
be written to record all important activities. The fifth step is evaluating the project product. The evaluation is done to help the lecturer in measuring the attainment of the standard achievement, and it is important in evaluating the progress of each student, giving feedbacks about the level of understanding that has been attained by the students and helping the lecturer in designing future teaching strategies. The final step is doing an evaluation of experiences. At the end of the teaching process, the lecturer and the students do a reflection about the activities and the product of the project that have been implemented. At this stage, the students are asked to express the feelings and experiences during the course of the project completion. The design of the students’ tasks following the PjBL model is as shown in Table 1.

Table 1. The design of students’ project tasks with the PjBL Model

| No | Steps in the PjBL Model | Students’ Activities |
|----|-------------------------|----------------------|
| 1  | Giving Essential Questions | Students are given questions by the lecturer about:  
1. What application or system has you ever used or accessed?  
2. What experience did you have when using or accessing the system, both in terms of interaction that occurred (between the system and the user) and the use of technology? |
| 2  | Designing the Project Plan | 1. Students determine the title of the project that they will do based on the problems that they find in the field.  
2. Students identify the characteristics of the users and the goals of the product.  
3. Students analyze the tasks (scenarios) in the clients.  
4. Students design the User Interface model  
Students describe five tasks in the form of documents according to the format given by the lecturer. |
| 3  | Writing the Schedule of the Project Implementation | The duration of the project work is designed to be 3 months with the time details of every task as follows:  
1. Determining the project title (10 – 24 February, 2020)  
2. Identifying the characteristics of the users and the goals of the product (24th Feb - 15th March, 2020)  
3. Analyzing tasks (scenario) of the clients (15th – 29th March, 2020)  
4. Designing the User Interface model (29th March - 19th April, 2020)  
5. Product Evaluation (19th - 26th April, 2020). |
No | Steps in the PjBL Model | Students’ Activities
---|----------------------|------------------
6 | Implementing the monitoring of the tasks by each group which will be done outside the schedule from the deadline of each task, but is still within the limit or range of time of completion in every task.
4 | Monitoring | Monitoring is done by facilitating the students and at each process. To facilitate the monitoring process a rubric is written that can record all important activities.
5 | Evaluating the Project Product | Project products that have been produced by the students are then evaluated by the lecturer. This evaluation is important to help the lecturer in measuring the standard achievement of each student, giving feedbacks about the students’ level of understanding and facilitating the lecturer in writing future learning strategies.
6 | Evaluating Experiences | Students express their feelings and tell their experiences during the project completion, both individually and collectively.

This study took place at the Informatics Engineering Education Study Program, Technical and Vocational Faculty, Ganesha University of Education. The subjects of the study were Class A (24 students) of the 6th semester in the 2019/2020 academic year. The study used observation sheet, rubric and interview guide to collect data. Interview is a method used to obtain answers from respondents through unilateral questions and answers [7]. This technique was used to collect data about the possibility of learning difficulty faced by the students who studied ICI through the implementation of the PjBL model. Whereas observation is a technique used by careful observation and systematical note taking [7]. In this study the researcher observed or monitored the progress in completing project tasks by the students within the time that had been agreed upon or set. The data obtained were analyzed using the qualitative data analysis according to [8], which was done in three stages: 1) data reduction, that is, the process of simplifying data by selecting, focusing and abstracting raw data to get meaningful data; 2) data presentation, that is, the process of presenting data in a simpler way in narrative form, tabular representation, including matrices and graphs and 3) drawing conclusions, that is, the process of extracting the core of the data presentation that has been organized briefly and densely but has a broad meaning.

3. Result and Discussion
The implementation of PjBL in this study was started from giving essential questions and continued by designing a project, wrote a schedule of the project implementation, monitored and ended it with an evaluation of learning experiences, some learning difficulties that were faced by the students in learning ICI could be identified as shown in Table 2.
Table 2. Students’ activities and learning difficulties found in learning ICI that used the Project Based Learning (PjBL) Model

| No | Steps of the PjBL Model | Students’ Activities | Learning Difficulties Found |
|----|-------------------------|----------------------|-----------------------------|
| 1  | Giving Essential Questions | Students were given questions by the lecturer about:  
1. What application or system has you ever used or accessed?  
2. What experience did you have when using or accessing the system, both in terms of interaction and interaction that occurred (between the system and the user) and the use of technology? | No difficulties found. |
| 2  | Designing the Project Plan | 1. Students were assigned a task to determine the title of the project to be done that is related to human and computer interactions based on problems they faced in the field.  
2. Students identified the characteristics of users and goals of the product based on the title of the project proposed.  
3. Students did a task analysis (scenario) of the clients.  
4. Students design a User Interface model based on the results of the identification of the users’ characteristics and goals of the product and the results of task analysis (scenario) of the clients. | 7% of the students still had difficulties in determining or formulating the title of the project to be done based on the problems found in the field.  
11% of the students still had difficulties in identifying the characteristics of the users and the goals of the product.  
15% of the students still had difficulties in doing task analysis (scenario) of the clients.  
15% of the students still had difficulties in designing a User Interface model based on the result of the identification of the characteristics of the users and the goals of the product as well as the result of tasks analysis (scenario) of the clients. |
| 3  | Writing the Schedule of the Project Implementation | Students wrote a schedule of the project implementation in detail according to the contents of the task in the project. | No problems found |
| 4  | Monitoring | Students did every part of the project or task (starting from | It was found that the students had difficulties in |
| No | Steps of the PjBL Model | Students’ Activities | Learning Difficulties Found |
|----|--------------------------|----------------------|-----------------------------|
|    | determining the title of the project, identification of the users’ characteristics and tasks up to the writing of the design of the User Interface model according to the time that has been set for it. | learning in doing each part of the project or task, with the following details. |
|    | 1. 7% of the students still had difficulties in determining the title of the project. |
|    | 2. 11% of the students still had difficulties in identifying the characteristics of the users. |
|    | 3. 15% of the students still had difficulties in doing task analysis. |
|    | 4. 15% of the students still had difficulties in designing the User Interface model. |
| 5  | Evaluating the Project Product | Students write all parts of the project or task in the form of documents by referring to the format of documents given by the lecturer | 1. Documents produced follow the format specified (no difficulties found) |
|    | 2. The completion of the project was on time (no difficulties found). |
|    | 3. From the project done 5% of the students still had difficulties, especially in using the standard language or grammatical sentences. |
### Steps of the PjBL Model

| No | Students’ Activities | Learning Difficulties Found |
|----|----------------------|-----------------------------|
| 6  | Evaluating Experience | From the summary of the result of interview with the students it was found out that the students liked to learn with the PjBL model although some of them still had difficulties when doing the project task given by the lecturer. These students felt that there was an increase in knowledge from the problem-solving activities that the did, since they had a great opportunity to explore their knowledge by themselves, so that they had new knowledge and experiences which made their learning activities better. |

Based on Table 2 it was found that in general some learning difficulties were still found among the students who learned ICI through the implementation of the PjBL model. However, the number was not significant. The highest percentage of learning difficulties found at the time the students did task analysis (scenarios) of the clients form the project task that they did and this had an effect on difficulties at the time they designed the User Interface model. Task analysis is the core of a job in human and computer interactions. Through task analysis it will be understood how people do their jobs to achieve a particular goal. If in this stage (task analysis) a person has difficulties then it will have an effect on the next stage, that is at the time of designing a User Interface model. Because task analysis functions as the basis for evaluating or determining how the users in doing their jobs complete the jobs and react to the jobs from the system that they have designed.

Another difficulty that was also found or identified in ICI was related to the time when the students identified the characteristics of the users and goals of the product. The students at this stage tended to not to fully consider the condition that could be experienced by the users. The users are the human component in ICI. The users vary and have their own characteristics according to their needs and abilities in using computer.

At the time of determining the title of the project it was also found that some students still had difficulties. They generally had difficulties in expressing their ideas implicitly based on the condition or problems that they faced in the field. The students were actually rich with resources or ideas that might be selected to be the topic or title of the project in ICI, but since they lacked the abilities in expressing ideas; this impedes them in learning. From the product of the project that had been developed by the students, it can be seen that some of the students had difficulties. Especially in using the language or sentences which are not grammatical in describing the project product in the form of document.

Furthermore, in the aspect of learning difficulties that was faced by the students in ICI, it w started from determining the title of the project, identifying the users’ characteristics and goals of the product, doing task analysis (scenarios) of the clients, designing a User Interface model until the production of the the project in the form of document, it can be explained that all of the learning difficulties occurred because of the students’ internal factor. The internal factor here is more of the lack of motivation in
learning the material taught further. From the summary of the result of the interview with the students it was found out that the students tended to focus only on the resources or references given by the lecturer. They did not enrich themselves through searching for other relevant resources. In this case they placed or perceived themselves like high school students in general who only use a textbook recommended by their teacher.

According to [9], motivation is the desire or passion to do something. In other words, motivation is the desire in a person that stimulates him or her to take actions. Motivation generally arouses because of interest. Interest is the tendency of a person toward an object as shown by pleasure or attraction toward the object. In this study lack of students’ motivation to learn the material taught further was caused more by their low motivation. From the result of the interview with the students some of them stated that the courses that they did not like courses that are related to programming very much and tended to prefer courses that are oriented toward multimedia. Thus, it was this condition that caused the low level of activity or effort of the students in learning. However, it was admitted by them that ICI with the PjBL model had given them unique experiences. The students felt that there was an increase in their knowledge after doing problem-solving activity since they had a great opportunity for exploring their abilities by themselves. In addition, they had new knowledge and experiences which made their learning activities better. This conforms to the opinion of [3] that teaching with the PjBL model can give opportunity to the students to build their learning quality better through the activity of problem solving by themselves. Thus, through PjBL the students are trained not only about how to learn (learning how to learn), in which the students are hoped not only to hear and see to accumulate their knowledge but they also can learn by doing an activity to acquire a certain competence (learning to do).

4. Conclusion
From the results of the study that has been done, there were still found or identified learning difficulties that the students had in learning ICI through the PjBL model. However, the number was not significant. The learning difficulties faced by the students were caused more by internal factors. The internal factor that is meant here is the lack of motivation of the students due to their low interest in courses which are related to programming and that they tended to prefer courses that are oriented toward multimedia. Thus, the activity or effort that was done or made by the students in learning became less optimal. For example, the students tended to only focus on the resources or materials given by the lecturer. They did not enrich themselves by searching other relevant resources. In this case, they placed or perceived themselves as high school students in general who only use textbooks recommended by their teachers. However, it was admitted by them that the teaching of ICI with the PjBL model has given them unique experiences. The students felt that there was an increase in their knowledge after doing problem solving activities, since they had a great opportunity to explore their abilities by themselves. Thus, they had new knowledge and experiences which made their learning better.

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