Development of problem based learning for online tutorial program in plant development using Gibbs’ reflective cycle and e-portfolio to enhance reflective thinking skills

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Abstract. Reflective thinking skill is needed by prospective and in-service teachers. A study about developing problem based learning for online tutorial program using Gibbs’ reflective cycle and e-portfolio was conducted to enhance reflective thinking skills of biology education students who participated in Plant Development. Development research used in this study was conducted through preliminary study, program development, trial of the program, program revision, and program implementation. This paper will discuss about the results of the program development and the trial of the program that were conducted in 2017. The Program development is conducted through program design development, instrument development, validation of program design and instrument by experts, and program development based on the revised program design. The trial of the program is conducted three times with different strategies to see which strategy is the most effective to be implemented. Based on the results of expert’s validation, research results show that the design of programs and instruments can be used as references in the development of the program with some improvements. Based on the trial of the program, the results obtained that the program needs to be improved in terms of setting access between sub-initiation and between initiations.

1. Introduction

Students of Biology Education Program at the Faculty of Teacher Training and Educational Sciences, Universitas Terbuka (FKIP-UT) are in-service Biology teachers. A teacher should have the skills as a professional teacher. One of such skills is reflective thinking skills that will help the teacher learn advanced, improve professional skills and other skills. Reflective thinking is a part of the critical thinking process that specifically refers to the process of analyzing and making decisions about something that has happened. Reflective thinking is an active, persistent, and cautious consideration of the belief or form expected of knowledge, of the reasons that support that knowledge, and the further conclusions leading to that knowledge [1].

Reflective thinking skills can be encouraged by Problem Based Learning (PBL) [2]. The reflective thinking skill that is used by prospective teachers to solve problems, indicates that significant differences are not determined between the teacher's skill level reflecting thinking and the problem-solving [3]. The reflective thinking encourages learners to be more active and helps them to express their opinions in a
more democratic environment, and lays the groundwork for student-centered learning [4]. The reflection model using video based on the Gibbs’ cycle concept in electronic portfolio can improve the students' reflective thinking level [5]. The Gibbs' Reflective Cycle is a theoretical model often used by students as a framework within which requires reflective writing of lecture assignments. This model was created by Professor Graham Gibbs and appeared in Learning by Doing [6]. The use of e-portfolios on the development of reflective thinking and self-study readiness, shows significant differences of influence [7]. Use of Blogs plays an important role in fostering the development of reflective thinking skills [8]. The e-service learning program provides a broad opportunity for reflective and collaborative learning for interdisciplinary students [9]. Although the online tutorial activity using the PBL approach has been built by discussion and is turned on by active interaction, but if the discussion does not go completely, it can not provide a thorough understanding for students [10].

The course of Plant Development is a subject that must be taken by undergraduate students of Biology Education at Open University (FKIP-UT), therefore this course is one of the potential courses for developing students' reflective thinking skills. The course of Plant Development discusses the structure and development of plant tissue, structure, development, and reproduction of Algae, Moss, Pteridophyta, Gymnospermae, and Angiospermae, and control of plant development. Many concepts of plant development are difficult to understand and/or even cause misconceptions among students. The difficulty in understanding the concept of giving rise to misconceptions, is the problem that can be addressed through problem-based learning.

Along with the development of information technology, Universitas Terbuka provided learning assistance services in the form of online tutorials using moodle as a learning management system (LMS), in addition to a face-to-face tutorial which was first known. Plant Development online tutorial has been provided since 2007. The online tutorial consists of eight (8) online tutorial initiations and three assignments. At each online tutorial initiation there is content delivery and discussion. The content in the online tutorial initiation is to clarify the descriptions of content in the printed learning materials (known as Modules) and the topic of discussions given by the tutors. From the preliminary studies that have been conducted in term 2015.2 and 2016.2, the results showed that online tutorial sections need to be improved. The sections to be improved among others are the interaction between students and tutors, initiation material, the interaction among students and the assessment. The reflective thinking level of Biology Education students in the 2015.2 term consecutively occupy the level of understanding, followed by reflection, critical reflection, and habitual action. Meanwhile, the reflective thinking level of Biology Education students in 2016.2 term consecutively occupy the level of reflection, understanding, critical reflection and habitual action [11].

To improve the reflective thinking skills of Biology Education students, the research needs to develop problem based learning program on Plant Development online tutorial with Gibbs’ reflective cycle and e-portfolio to enhance reflective thinking skills of Biology Education students.

2. Method
Development research in this study is conducted through preliminary study, program development, trial of the program, program revision, and program implementation. This paper will discuss about the results of the program development that was conducted in 2017.1 term, and the results of the trial of the program that was conducted on the Plant Development online tutorial in 2017.2 term which was attended by 24 Biology Education students.

The Program development is conducted through program design development, instrument development, validation of program design and instrument by experts, and program development based on the revised program design. In the development stage of the program design, a problem-solving plan is designed based on preliminary study results, including the design of the development of a problem-based online tutorial program with Gibbs’ reflective cycle and e-portfolio for the course of Plant Development. At the stages of instrument development, performed questionnaire development, test instruments, scoring rubrics of problem solving and reflection, e-portfolio assessment rubrics and interview guidelines that will be used to assess the program, measure students' reflective thinking skills,
pre-test and post-test, assessing the ability of students to solve problems, assess the results of the e-portfolio, as well as to determine the response of students to the online tutorial program. After the design of the program and the instrument had been developed, the expert validation is conducted to get feedback and become a source for program improvement and instrument design. In the last stage, performed program development is based on a revised program design.

The trial of the program is conducted three times with different strategies to see which strategy is the most effective to be implemented. The first strategy was implemented in the 1st – 3rd initiation, the second strategy was implemented on the 4th – 5th initiation, and the third strategy was implemented on the 6th – 8th initiation.

3. Result and discussion

3.1. Program design

The program design was developed based on the preliminary research and other supporting references. The program development was conducted through program design development, instrument development, validation of program design and instrument by expert, and program development based on the revised program design. The program design can be seen in figure 1.

Figure 1. The design of problem based learning program on Plant Development online tutorial with Gibbs’ reflective cycle and e-portfolio.

Figure 1 shows that before entering the first initiation, the student is expected to have studied the program introduction, fill out the reflective thinking questionnaire, do the pre-test, and do the exercise
to identify conceptual knowledge. Each initiation begins with the identification of initial concept knowledge and then proceeds by studying initiation materials, learning visualization/OER, conduct discussions, work on reflections beginning with problem solving, identifying final concept knowledge, and uploading e-portfolio tasks. In the problem solving there provided a discourse that will be used as material for students in raising the problems contained therein. The discourse topics discussed at each initiation are: 1) Is this a moss or Algae?; 2) What if the position of xylem and phloem is inverted; 3) Double fertilization in *Gnetum gnemon*: The relationship between cell cycle and sexual reproduction; 4) Annual rings: Tells about its environment; 5) Is this a petal?; 6) The plant hormone of a farmer’s creation; and 7) Dormancy and growth of shoots and roots of Mangosteen.

The expert validation results on the program design and the content can be seen in table 1. Meanwhile the result of the instrument validation can be seen in table 2.

Table 1. The results of expert validation on the program design and the content.

| Aspect           | Experts feedback                                                                                                                                 |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Program Design   | • The final goal of the program should be included at the beginning of the program so that students are more focused  
|                  | • For the first initiation, especially in doing the reflection need an example / model  
|                  | • Questions in the reflection need to be more specifically associated with the content  
|                  | • Maximize discussion forums to provide direction in filling in reflection questions  
|                  | • The integrity of the learning flow is clear  
|                  | • Clarify the PBL syntax in the chart, although in the initiation guide and in the discourse already exists  
|                  | • Students may have difficulty in answering reflection question No. 1-6. because each of them is not specific what is meant. It is feared that not clear instructional task will increase the cognitive load to students.  
| Content          | • Discourse has been good for directing reflective thinking learners  
|                  | • In general, the subject of discourse is good to guide learners reflective thinking, but there are still to be reviewed (discourse of initiation 2, 3 and 7)  
|                  | • Images / visualizations should be supported with adequate explanation  
|                  | • Explanation of content among initiations should be in balance.  

Table 1 shows that the design of programs can be used as references in the development of the program with some improvements in the program design and in the content. The topic of the discourse on the 7th initiation, based on expert feed back, was changed to The Germination of Coffee Seeds.

Table 2. The results of validation on the instrument.

| Instrument                             | Experts feedback                                                                                                                   |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Questionnaire of reflective thinking   | • Questionnaire is adopted from Kember et.al and already translated. Questionnaire needs to be tested legibility. Cronbach-Alpha reliability coefficient for reflective thinking scale is 0.795.  
| Questionnaire of program evaluation    | • Questionnaire needs to be more simple and the number of questions need to be reduced. Cronbach-Alpha reliability coefficient for 4 scale is 0.63 and for 2 scale is 0.70  
| Test instruments (pretest and postest) | • There are some questions need to be revised. Cronbach-Alpha reliability coefficient for pretest is 0.91 and for postest is 0.90. Item reliability score for pretest is 0.73 and for postest is 0.49  
| Scoring rubrics                        | • Scoring rubrics of problem solving and reflection and scoring rubrics of e-portfolio assessment need to be revised in indicators.  

Table 2 shows that the instruments need to be revised. The Cronbach-Alpha value indicates that questionnaire of reflective thinking, pretest, and postest are reliable because they have Cronbach-Alpha value > 0.70. The item reliability of pretest is 0.73 and posttest is 0.49 it indicates that the item reliability
of pre-test is in a good category and the item reliability of post-test is in a weak category. Meanwhile, the Cronbach-Alpah value for questionnaire of program evaluation indicates that it is not reliable because its Cronbach-Alpah value is ≤ 0.70.

3.2. The trial of the program

After having been revised, then the program design is developed using Moodle. Table 3 shows the Strategy and results of the trial of the problem based learning program on Plant Development online tutorial with Gibbs’ reflective cycle and e-portfolio, also shows that the program needs to be improved in terms of setting access between sub-initiation and between initiation in order to avoid the jumping learning.

Table 3. Strategy and results of the trial of the problem based learning for online tutorial program on Plant Development with Gibbs’ reflective cycle and e-portfolio.

| Design | Strategy | Results |
|--------|----------|---------|
| **Introduction:** | Learning the guides; filling out the reflective thinking questionnaire; pre-test; Exercise to identify conceptual knowledge | Not all students read the guide, filling out the reflective thinking questionnaire, do pre-test, and do exercise |
| **A 1st to 3rd Initiation:** | Delivering the following activities according to schedule: (Identification of the initial concept knowledge; Initiation materials; Open Educational Resources (OER); Discussion; The task of Reflection; Identification of the final concept knowledge; The first assignment (required on the 3rd initiation); and E-portfolio tasks) | Although the delivery of activities is scheduled (whichever comes first), but the possibility of students read the initiation material, work on identifying the final concept first before identifying the initial concept cannot be avoided. |
| **B 4th to 5th Initiation:** | Identification of the initial concept knowledge be a precondition for accessing initiation materials, accessing OER, doing discussion, doing the task of Reflection, doing identification of the final concept knowledge, and doing the second assignment. | Students identify the initial concept knowledge to be able to access the initiation materials, discussions, work on reflection assignments, and e-portfolio tasks. However, since the e-portfolio task does not require to identify initial concept knowledge, some students directly work on e-portfolio tasks. |
| **C 6th to 7th Initiation:** | Identification of the initial conceptual knowledge be a precondition for accessing initiation materials, OER, discussions, the tasks of reflection, and identification of the final concept knowledge. The e-portfolio task can be accessed if the student has worked on the identification of initial concept knowledge, identification of final concept knowledge, and performs the reflection task. | All activities on the 6th and 7th initiations are accessed by students on a regular basis without jumping activity. |
| **8th Initiation:** | Summary of initiation materials, post-test, reflective thinking questionnaire, evaluation questionnaire of online tutorial activities | Not all students read summary of initiation materials, filling out the reflective thinking questionnaire, filling out evaluation questionnaire of online tutorial activities, and doing post-test. |
Based on the trial of the program, the program was revised with design as shown in figure 2. Figure 2 shows that conducting Identification exercise concept knowledge, doing pre test, and filling out a reflective thinking questionnaire becomes a prerequisite for being able to access first initiation. Identification of the initial conceptual knowledge be a pre-condition for accessing initiation materials, OER, discussions, the tasks of reflection, and identification of the final concept knowledge. The e-portfolio task can be accessed if the students have worked on the identification of initial concept knowledge, identification of final concept knowledge, and perform the reflection tasks. To access the next initiation, all activities and tasks in the previous initiation must be done completely.

![Diagram](image)

**Figure 2.** The revised design of problem based learning program on Plant Development online tutorial with Gibbs’ reflective cycle and e-portfolio.

4. **Conclusion**

Problem based learning on Plant Development online tutorial program with Gibbs’ reflective thinking and e-portfolio has been developed with some revisions and has been tried out. To monitor whether the revised program can improve reflective thinking skills, then the program needs to be implemented fully in the Plant Development online tutorial program. The program can also be implemented to other potential courses for developing students’ reflective thinking skills.

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