Research Skill Development (RSD)-Integrated Online Report for Critical Thinking Skills

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Abstract

This study aims to examine the use of a Research Skill Development (RSD)-integrated online report in an Indonesian context for the teaching of critical thinking skills. Action research was adopted as the methodology, because it enables researchers to apply and evaluate the initiative directly in the targeted populations. The action research was conducted in one class, to provide a rich and detailed understanding of the factors involved. The project was undertaken in a Plant Physiology class in the Biology Education Department at the University of Jambi, Indonesia. Questionnaires and interviews were conducted to analyse the effectiveness of RSD-structured laboratory reports in developing student critical thinking. Student participants were asked to answer a questionnaire after using RSD-integrated online reports at the end of the semester. Additionally, the lab tutors were interviewed about their perspectives on student engagement with the online laboratory reports.

Keywords: *research skill development, critical thinking skills.*

Introduction

The course of plant physiology is the benchmark for students majoring in biology education in order to become professional biology teachers; with regards to the regulation of teacher competence standard Republic of Indonesia that teachers are required to master the content of their disciplines (Ministry of Research, Technology and Higher Education Republic of Indonesia, 2015). However, student academic records on plant physiology for the previous three years show that 73% of the students in 2013, 58% of the students in 2014 and 65% of the students in 2015 achieved marks below 70/100, in which the marks are adjudged as a poor academic achievement according to Indonesian University standards. Accordingly, Interviews conducted on four faculty

lecturers revealed that this might due to the abstract content of the course. Therefore, new strategies in teaching the course might be required in order to encourage students in achieving a better score.

The Biology education department at Jambi University provides an opportunity for students to engage with biological content through weekly laboratory activity. Previous studies have emphasised the importance of research skills for undergraduate students' future study and employment (Peirce et al, 2009; Loveys et al, 2014). In the light of this need, Willison and O'Regan (2007) developed the Research Skill Development (RSD) framework, which outlines the facets of inquiry involved in applying critical thinking skills. Critical thinking skills are some of the most important elements for students to exercise when engaging in a science subject (Robinson & McDonald, 2015). Rumpagaporn (2007) argued for a link between integrating information, communication and technology (ICT) and critical thinking skills. Action research studies have shown improvements in student critical thinking skills after blended learning in clinical reasoning in a Health Sciences course (Snodgrass, 2011). At the same token, study comparison found that online discussion methods resulted to a more effective learning than face to face methods (Guiller et al., 2007). Thus, this project will determine the effectiveness of the RSD in structuring online research laboratory report writing in terms of the critical thinking that students develop over the semester.

Theory Gap

Previously, a number of studies have looked at the effect of integrating technology in teaching towards students' learning outcome which investigated the use of ICT in learning and teaching biology with limited computer hardware and software provided (Van Rooy, 2012). However, none of them examined the application of online tools by focusing on students' critical thinking skills in a developing nation by using particular framework for scaffolding the skills.

Methodology

This research examined the use of an online tool with RSD integration for students writing plant physiology laboratory reports. The RSD framework was used in this research to guide students in reporting their laboratory activity results based on the six facets (Willison, 2012). Participants were39 students studying plant physiology and 2 lab tutors in biology department, Jambi University. The effectiveness of the RSD-integrated online report was reviewed by looking at the attitudes and perceptions of students and tutors towards the online tools after 13 weeks' implementation. Following implementation, students were asked to complete questionnaires, whilst tutors conducted interviews to assess their perspectives on the initiatives.

The questionnaire consists of 13 seven-point Likert scale questions that examined student attitudes towards the use of an RSD-integrated online report during the thirteen weeks in which the initiative was implemented. On the seven point scales used, '3' means 'strongly agree', '-3' means 'strongly disagree', and '0' means 'neutral'. Questions 3-13 are integrated with the six facets of Research Skill Development (RSD), asking students about their perceptions on the initiative for their critical thinking. Along with the general questions 1 & 2, thus the questionnaire might have a reasonable or higher level of construct validity. Cronbach's Alpha of the questionnaire was determined to be 0.901. Additionally, 3 open-field questions were provided that draw students' perception regarding to their critical thinking skills.

Results

Table 1. Mean scores and standard deviations of student attitudes towards critical thinking skills.

	Mean	SD	Item
1	**.74**	**.85**	I am good at critical thinking in general
2	**.49**	**.91**	I am good at critical thinking in laboratory activities in plant biology
3	1.18	1.34	The online reports for this course have helped me to specify clear hypotheses in biology lab reports
4	1.74	1.02	The online reports for this course have helped me to gather information and data in biology lab reports
5	1.54	1.05	The online reports for this course have helped me to generate alternative ideas in biology lab reports
6	1.23	1.01	The online reports for this course have helped me to evaluate the study design of my biology lab reports
7	**.92**	1.11	The online reports for this course have helped me to manage resources and teams during the plant biology laboratory activities
8	1.44	.99	The online reports for this course have helped me to analyse the information and data for biology lab reports
9	1.49	.97	The online reports for this course have helped me to synthesise the information and data for biology lab reports
10	1.28	1.08	The online reports for this course have helped me to communicate orally what I understand from biology laboratory activities
11	1.49	1.12	The online reports for this course have helped me to communicate in writing what I understand from biology laboratory activities
12	1.38	1.04	The online reports for this course have helped me to communicate in tables what I understand from biology laboratory activities
13	**2.18**	1.10	The ability to think critically in learning biology will be important in my career

The items of 7-point scale questions are shown in Table 1. Generally, most students realise that critical thinking skills in learning biology will be important for their career (M: 2.18, SD: 1.11). According to the table, we can see

that mostly students are almost neither agree nor disagree regarding to their skills in general critical thinking (M: .74; SD: .850). Correspondingly, they are slightly hesitant about their own critical thinking skills in the laboratory activity of Plant Biology (M: .49; SD: .91).

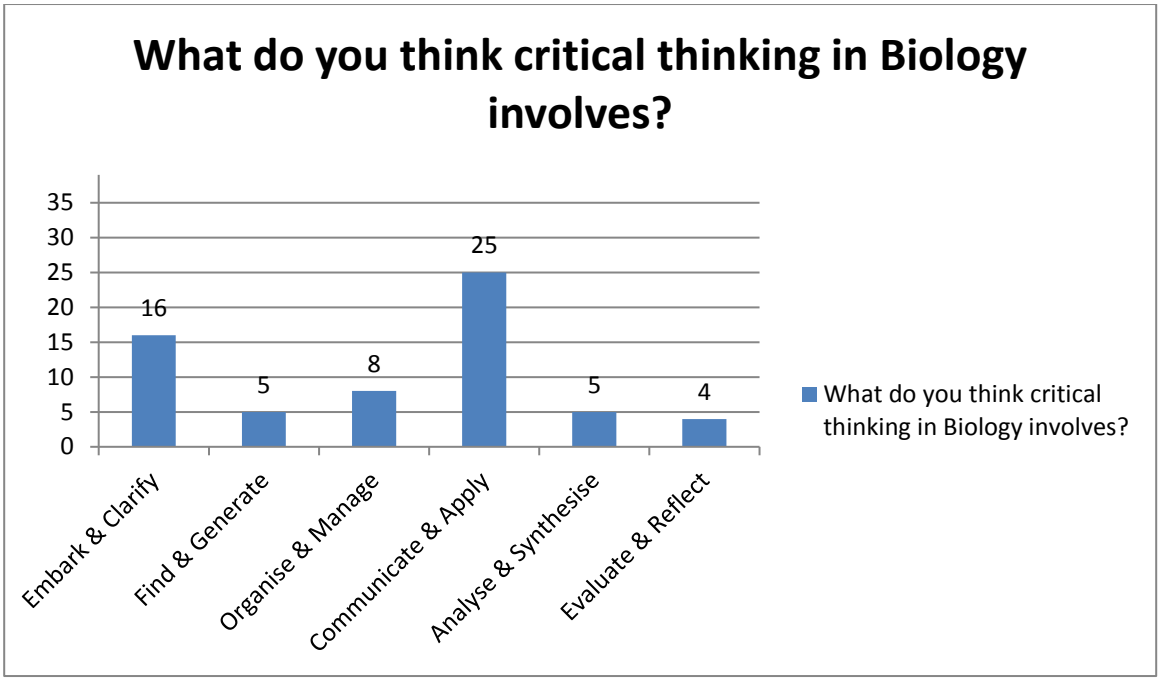

Figure 1. Distribution of students' answers on open-ended question number 14.

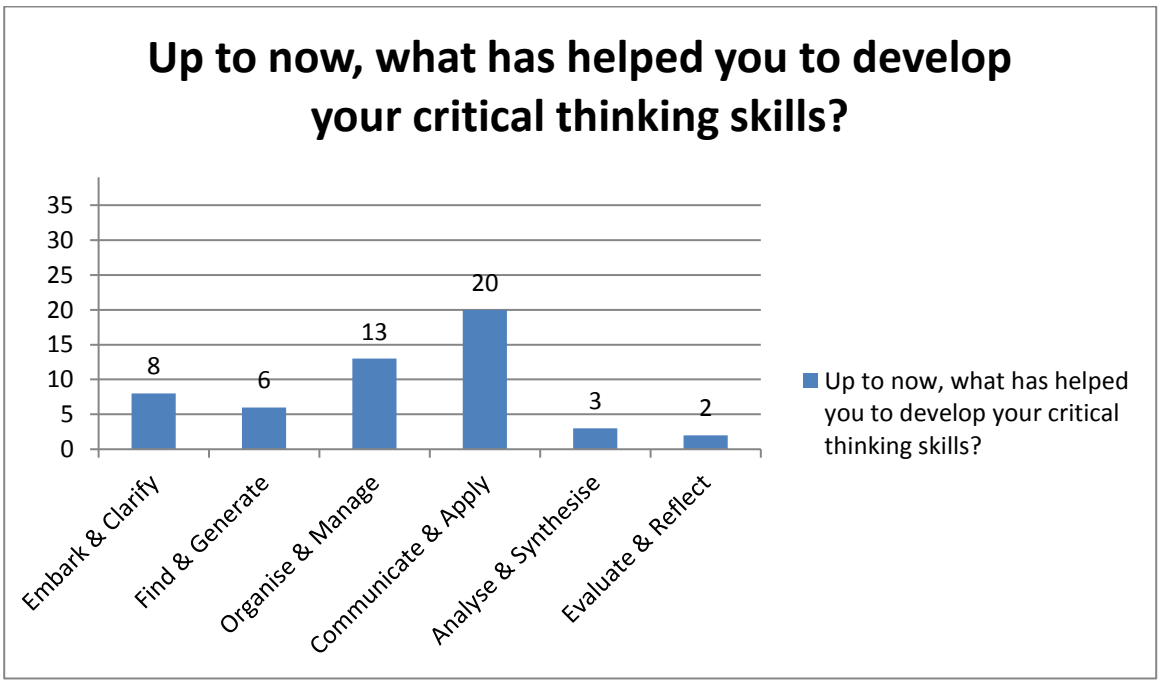

Figure 2. Distribution of students' answers on open-ended question number 15.

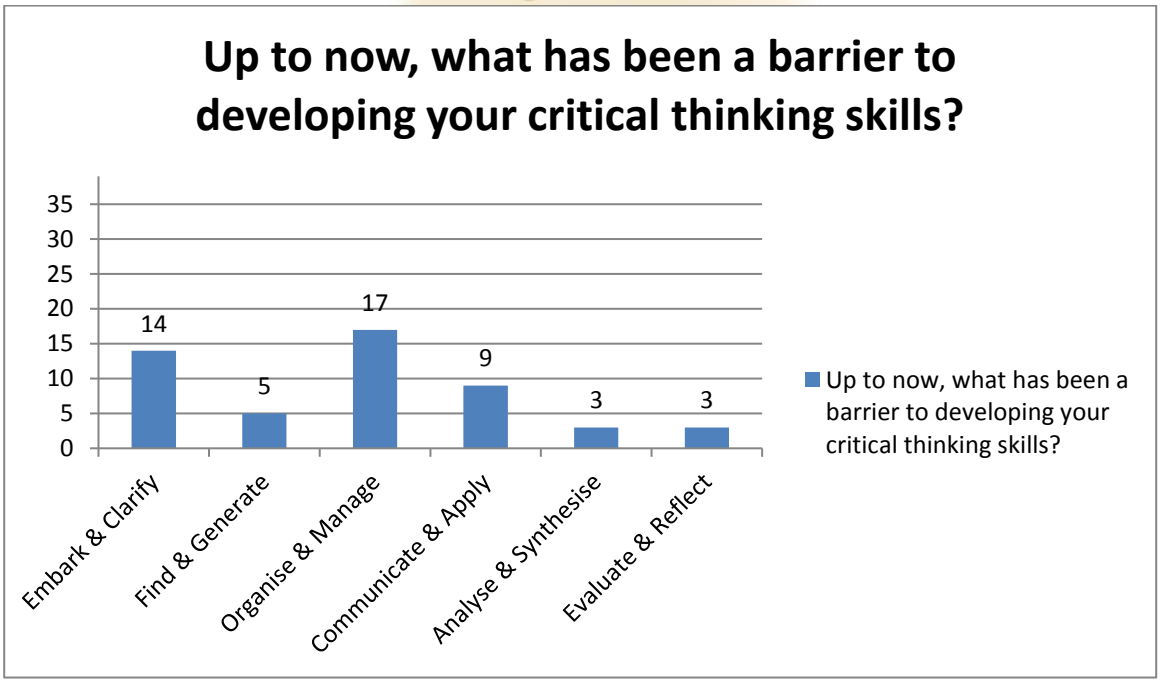

Figure 3. Distribution of students' answers on open-ended question number 16.

Figures 1, 2 and 3 provide a picture of students' attitudes towards their own critical thinking skills, categorised by the six RSD facets (Willison & O'Regan, 2007). Figure 1 shows the distribution of students' overall attitudes regarding the involvement of critical thinking in biology. Most of the students (25 of 39 students) agreed that the skills of communication and application involved in biology require critical thinking skills. Based on figure 2, it can be noted that most of the students (20 of 39 students) feel that the skills of communication and application have helped them in developing their critical thinking skills. Meanwhile on Figure 3, most students (17 of 39) agreed that the lack of skills in organising and managing facilities required for learning, peer learning, learning innovation and learning time had been a barrier for them in developing their critical thinking skills.

Table 2. Interview results (lab tutor).

No.	Question	Facets Involved	
		Tutor 1	Tutor 2
1.	Do you notice any difference, compared to previous years students, in the quality of lab reports during the twelve weeks of conducting the initiative? If so, why do you think that may have been the case?	Organise & Manage, Embark & Clarify, Communicate & Apply	Organise & Manage, Find & Generate, Communicate & Apply
2.	How effectively did the RSD-integrated online report enhance critical thinking skills of students in Plant Physiology course?	Organise & Manage, Embark & Clarify, Communicate & Apply	Communicate & Apply
3.	To what extent could the RSD-integrated online report help you in your teaching of Plant Physiology course?	Organise & Manage	Organise & Manage, Communicate & Apply
4.	Do you think that the RSD-integrated online report was suitable to be implemented in Plant Biology learning? Why?	Analyse & Synthesis, Evaluate & Reflect, Organise & Manage, Communicate & Apply	Evaluate & Reflect, Organise & Manage
5.	What suggestions do you have for improvement of the RSD-integrated online report?	Communicate & Analyse, Organise & Manage	Evaluate & Reflect
6.	Do you recommend that (improved) RSD online reports be used in future Plant Physiology courses?	Evaluate & Reflect	Evaluate & Reflect

7.	Do you think it may be appropriate to use the RSD framework for other aspects of the PP course?	Evaluate & Reflect	Embark & Clarify, Find & Generate, Evaluate & Reflect
8.	Do you think that RSD online reports could be used in other lab-based courses?	Evaluate & Reflect, Analyse & Synthesise	Communicate & Apply, Embark & Clarify, Analyse & Synthesise

Not only for the questionnaires data, the data obtained from the interview as shown in Table 2 was also analysed by categorising the lab-tutors' answers into themes based on the six RSD facets (Willison & O'Regan, 2007).

Discussion

The six facets (Willison & O'Regan, 2007) were used as the coding frame to analyse open-ended questions and interview results. Thus, construct validity in this study is considered to be acceptable.

From the results, we could see that most of the students are hesitant about their own critical thinking skills, despite their agreement that these skills are important for their career. Nevertheless, mean scores for all items were positive, means that students in general show positive attitudes on the use of RSD-integrated online report. The positive mean numbers in Table 1 corresponds with their answers on open-field questions, in which they agree that skills of application and communication are significantly involved in Biology (Figure 1), and the skills considerably contribute in developing their critical thinking skills (Figure 2). In other words, the positive mean numbers in the 7-point scale questions indicate that the students may considerably agree that the use of RSD-integrated online reports have contributed positively for their critical thinking skills.

According to the lab-tutors, the initiative has encouraged students to communicate their acquired knowledge into the form of appropriately-structured lab reports. However, it appears that the organisational and management aspects embedded on the initiative could be a challenge for the initiative's effective

implementation. Both tutors agree that the RSD-integrated online report has contributed to improved qualities of student lab reports compared to the written one. Nevertheless, issues of time management result to the lack quality of some online reports. Accordingly, in the open-field question, students consider that the online environment could somehow discourage them to effectively make use of the initiative due to the lack of facilities and skills in managing online tools (Figure 3). The tutors also suggest that clear instructions for using the RSD-integrated online report are required for students. Together with the suggestion, the tutors propose an idea of creating a guidebook for the students, containing ways to use the online report. The tutors believe that clear instructions and guidebooks of using the online tool will address the organisational and management issues appeared within the six months implementation of the initiative, which is relevant to instructional approach (Kirschner et al., 2006).

Conclusion

The Research Skill Development (RSD) framework was introduced for the purpose of articulating and scaffolding student research skills (Willison & O'Regan, 2007). However, the explicit articulation and scaffolding of the skills used in RSD-integrated online report is regarded by some as essential, determining the efficacy of the learning itself (Kirschner et al., 2006). As this research was conducted in a developing nation, comparisons regarding the use of RSD in other developing countries are required in order to measure the extent to which the skills for using the initiative should be spelt out to students.

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