Developing 21st century student research skills through assessment matrix and edmodo in biology project

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Abstract. This research aimed to develop 21st century student research skill by using assessment matrix and guidance through edmodo. An assessment matrix based on a research skill development framework modified by Venning & Buisman-Pijlmann. The study was using mixed method which combine qualitative and quantitative data. Design of the study was embedded experimental. Research subject used 2 class XI in senior high school that consist of RSD1 and RSD2. Instruments that used were assessment matrix and research skill test. The results showed that the students research skill by using assessment matrix were increased with recurring guidance in edmodo application. There was significant difference of research skill scores between class RSD1 and RSD2. The average student score in RSD1 class was higher than average score in RSD2 class. Our finding may aid in reforming 21st century student research skill, particularly in project learning by using assessment matrix and edmodo.

1. Introduction
Development in society and economics requires the education system to equip young people with new skills and competencies. It relates for graduates who need a set of skills to deal with the varied of real life situations, especially critical thinking, problem-solving and lifelong learning. In line with 21st century demands put forward by Partnership for 21st Century Skills, six key elements in learning at school which one of them is learning skills. Students need to know how to use their knowledge and skills by thinking critically, applying knowledge to new situations, analyzing information, understanding new ideas, communicating, collaborating, solving problems, and making decisions [1].

Skills that lead students to think critically and to solve problems are research skills. Research skills acquired through a series of research activities in helping students to critically examine a problem, generating and evaluating data, ideas, and hypotheses of relevant data, forming and testing, and succeeding in producing a conclusion [2]. The development of research skills should be in line with the demands of the 21st century, where Partnership for 21st Century Learning recommends components in learning that include knowledge work, thinking tools, digital lifestyles, and learning research [3]. Learning research is one of important component in learning, especially in improving student research skills. However, even though the developed curriculum has directed students to conduct research, the reality in Indonesia has not really applied research activities on its learning.

One of the most recent researches related to the development of student research skills has been done by Willison & O'Regan who created the Research Skill Development (RSD) framework by integrating the level of inquiry with the student's anatomy in the study. Within the RSD framework
there are six aspects of the research process, namely embark and clarify, find and generate, evaluate and reflect, organise and manage, analyse and synthesise, communicate and apply [4]. RSD framework is in line with the demands of 21st century research that requires students to not only answer questions from a problem but also to use engineering design method to find and verify a question. Students are expected to be able to create solutions to a problem through a scientific process [3].

The ideal learning was recommended to improve 21st century research skills is project-based learning. Project-based learning is an innovative approach to learning that teaches many important strategies for success in the 21st century. Students encourage their own learning through inquiry, and work together to research and create projects that reflect their knowledge. This teaching approach advantage student to collecting decent new technological skills, being an advanced communicator and advanced troubleshooter [5]. Project-based learning is a systematic learning model that involves students in learning knowledge and skills through a long, structured inquiry process with authentic and complex questions and carefully designed tasks and product [6]. By applying project-based learning students can do their own research and integrate research skill development framework on their research.

However in project learning, it is important for student to management their time properly. One of solution to solve that condition is applying Edmodo application in supervising the students during project work outside the classroom. The Edmodo app is a personal micro-blogging platform that provides a safe space for teachers and students to connect and collaborate [7,8]. This application is easy to apply by students because it is almost similar to Facebook [9]. The advantage of Edmodo that teachers can emphasize is that using technology in education can help students prepare for their work in the future [10]. Students will have flexible working hours inside and outside the classroom [11]. They have the opportunity to achieve up-to-date information from both teachers and colleagues [12].

Project learning with assisted by tutorial through Edmodo needs to be complemented by an assessment that can assess students’ research skills. One of them is by making an assessment matrix. The assessment was assist teachers in collecting information on the extent to which students have achieved targets in learning [13]. Assessments supported by the matrix can improve learning outcomes, especially in building student research skills [14]. The matrix provides explicit instruction and serves to expose any implicit or hidden requirements that teachers may have [15]. In addition, the effectiveness of the matrix assessment depends on the integration and feedback in the assessment [14]. The matrix assessment based on the research skill development framework can lead teachers and students to identify important things in conducting research, in addition through its use in an iterative feedback reinforces the development of students’ research skills [16]. Therefore, this research is important to solve problems in the learning and to develop 21st century student research skills through using of matrix assessment and edmodo.

2. Method
The research was mixed method that combine qualitative and quantitative data [17]. Design of the study was embedded experimental. Population in this research is senior high school student of class XI in Bandung Barat. Sample of this research were chosen in 2 class by cluster random sampling technique, namely RSD1 and RSD2. Both of class doing project learning and using edmodo, but matrix assessment was given only on class RSD1. Instruments that used were assessment matrix and research skill test. Assessment matrix that used is modify from Venning & Buisman-Pijlman with three level of performance (unsatisfactory, pass, and distinction) based on research skill development framework.
3. Result and discussion

3.1. Student research skill result

In this research, the data of student research skill is collected through research skill test and matrix assessment. The research skills test consists of 11 multiple-choice questions reasoned. Based on that, the data of research skills test can be seen in Table 1.

Table 1. Recapitulation of research skill test.

| Parameters               | RSD1  | Class        | RSD2  |
|--------------------------|-------|--------------|-------|
| Sum of students          | 27    | 26           |       |
| Score averages           | 50.18 | 39.52        |       |
| Standard deviation       | 13.40 | 14.28        |       |
| Minimum scores           | 36.40 | 18.20        |       |
| Maximum scores           | 72.70 | 63.60        |       |
| Normality test           | 0.001 | 0.026        |       |
|                         |       | Not Normal   | Not Normal |
| Mann Whitney-U test at α 0.05 |       | 0.008        |       |

Table 1 shows that there is a significant difference between Class RSD1 and RSD2 with level significance (U test 0.008<0.05). It indicate that there is an impact of providing an assessment matrix to improve the students' research skills in projects learning. Furthermore, the average student score in RSD1 class (50.18) was higher than average score in RSD2 class (39.52) that have not an assessment matrix. It shows that matrix can help students to understand course requirements and the criteria that are assigned to particular levels of performance [14]. Student can follow development of learning project and improve their research skill by using assessment matrix.

3.2. Development of student research skill by assessment matrix

Assessment matrix based on research skills framework consists of three levels of performance. The project activities equipped with an assessment matrix can lead students to develop their research skills. The matrix provides greater clarity of the learning behaviours, required to enhance research skills so that student can monitor their own performance and as such it provides a focus on skill development [16]. Meanwhile development of research skills student through assessment matrix during implementation of project learning is shows at Table 2.

Table 2. Development of averages research skill student.

| Facet of Inquiry                | RSD1  | RSD2  |
|--------------------------------|-------|-------|
|                               | Report 1 | Report 2 | Report 1 | Report 2 |
|                               | U*  | P* | D* | U  | P  | D  | U  | P  | D  | U  | P  | D  |
| Embark and clarify            | 37  | 45 | 18 | 64.3 | 35.7 | 21.2 | 0  | 48.1 | 51.9 | 0  |
| Find and generate             | 31  | 59 | 11 | 82.1 | 10.7 | 25  | 75 | 0  | 25  | 75 | 0  |
| Evaluate and reflect          | 18  | 85 | 0  | 100  | 0  | 65.4 | 34.6 | 0  | 42.3 | 57.7 | 0  |
| Organise and manage           | 79  | 21 | 0  | 100  | 0  | 53.9 | 46  | 0  | 15.4 | 84.6 | 0  |
| Analyse and synthesise       | 29  | 71 | 0  | 100  | 10 | 27  | 73  | 0  | 29.9 | 53.8 | 19.2 |

*Unsatisfactory
*Pass
*Distinction
Tabel 2 shows that student research skill by using matrix assessment is increased with recurrent guidance made through by edmodo. In both of classes seen an improvement in pass criteria of each student report that assessed through an assessment matrix. Feedback that given repeatedly influence the students' ability to work on the project and the development their research skills. The guidance through Edmodo facilitate teachers and students in the process of projects carried out outside the classroom. Students can easily improve their products according to incoming criticism and this supports student control over their own products [18]. Teacher feedback can seen in Figure 1.

![Figure 1. Feedback of student project reporting.](image)

Feedback provided by teachers to students through the Edmodo application allows students to learn independently. Students can report the progress of their research through edmodo and the teacher will provide feedback on the report. Students have chance to reach most updated and functional information with Edmodo [12]. Furthermore, student have flexible work hours inside and outside the classroom and these support students who have different learning styles [11]. This suggests that feedback through Edmodo helps students to achieve their development in learning projects.

4. Conclusion
Project learning that has been done through the assessment matrix and edmodo were able to improve students' research skills. Feedback through edmodo assist student to reform their own development on learning. Moreover, RSD1 class that used assessment matrix can construct their own research skill. This is indicated on the average student score on RSD1 class is higher than RSD2 class. Based on that, Our finding may aid to reforming 21st century student research skill, particularly in using assessment matrix and edmodo in biology project.

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