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Self-regulated learning in blended learning approach

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Abstract. Blended learning allowed students to manage their own pace of learning especially in the online session. This might foster students' self-regulated learning. This claim, however, need to be investigated with more empirical data. This study, therefore, intended to examine the effect of blended learning on students' self-regulated learning. A quasi-experiment with the pretest and posttest group design was employed in this study. A total of 115 grade 10 students was cluster randomly selected among senior high schools in the city of Yogyakarta. Two different classes of samples were set, namely experiment class using blended learning android-based-game, and control class using offline class. The students in the two classes learn the same material that is about Function and its graph. Data of students' self-regulated learning was collected through a questionnaire with five Likert scale. The data was analyzed using Analysis of Variance (ANOVA) technique and it was found that: there is a significant difference of self-regulated learning between students who learn in blended class and those in offline class. This study offers insights on the use of blended learning to foster the students' self-regulated learning especially in learning mathematics. Nevertheless, the design of blended learning need to considered particularly when and what kind of learning material should be delivered online and offline.

1. Introduction

Self-regulated learning (SRL) is one of the important topics in education including mathematics education. SRL is one of the conditions in life-long learning [1]. The definition of SRL has always grown in the last three decades [2]. Bandura [3] defines self-regulated learning from a social cognitive perspective, where SRL is an interaction between personal, behavioural and environmental. Whereas according to Boekaerts and Corno [4], SRL is a relatively stable tendency in responding to various learning situations in a typical way. In more detail, SR can be define as thoughts, feelings and actions produced by someone who has been systematically planned and adjusted to the achievement of his personal goals [5].

As the definition of SRL is still diverse and growing, Winne and Perry [6] divided two models of definitions, namely component-based and process-based. Pintrich and Garcia [7] define SRL by looking at the components that build SRL, namely 1) cognitive strategies which include elaboration, organization; 2) metacognitive strategies include monitoring and regulation; and 3) source management strategies include extraneous resources by organizing the environment and internal resources by maintaining attention, and concentration. Meanwhile, as a process, SRL refers to metacognition, motivation and behaviour strategies that students use to achieve skills and knowledge [5]. In this study, SRL will be measured using process approach which is based on Zimmerman definition.

The literature suggests that SRL abilities could change as students might self-regulated differently when moving to different tasks or learning contexts [8]. SRL can improve at the learning environment

that allow and facilitate control of the essential dimensions of learning [9]. Blended learning is one of the environments that allows students to manage and control their learning activities [10]. Therefore, this study examines the SRL in blended learning environment.

Blended learning is a pedagogical approach that combines the effectiveness and socialization opportunities of the classroom which can be done through face-to-face and online delivery systems [11, 12]. Blended learning incorporates direct instruction, indirect instruction, collaborative teaching, individualized computer assisted learning [13]. Blended learning is not only simply integrating the face-to-face and online learning, the percentage of these two aspects should be considered (Table 1). Blended learning used in this study composed 30-40% of online and 60-70% of face-to-face delivery.

Table 1. Types of courses

Online	Face to Face	Type of Course	Description
0%	100%	Offline class	Course with no online technologycal used content is delivered in writing or orally
1 to 29%	71 to 99%	Online enhanced learning	Course with uses web-based technology to facilitate what is essentially a face-to-face course. Uses a course management system (CMS) or web pages to post the syllabus an assignments, for example.
30 to 79%	21 to 70%	Blended/ Hybrid learning	Course that blends online and face-to-face delivery. Substantial proportion of the content is delivered online, typically uses online discussions, and typically has some face-to-face meetings.
80+%	0 to 20%	Online	A course where most or all of the content is delivered online. Typically have no face-to-face meetings.

Source: The Sloan Consortium

There are a number of previous studies investigated SRL in blended learning however most of them are conducted at higher education level such as Broadbent [14] and Broadbent & Fuller-Tyszkiewicz [15]. As there are limited studies on secondary level education and particularly in the field of mathematics education, this study therefore seeks self-regulated of secondary school students who learn mathematics in blended learning environment. In particular, this study compares students SRL before and after learning in blended classroom.

2. Methodology
This study employed a quasi-experiment approach with the pre-test and post-test group design. The respondents are 115 grade 10 students from two senior high schools in the city of Yogyakarta. One school is considered as experimental group and the other as a control group. The experimental group employed blended learning approach in which the learning material delivered online and face-to-face. Meanwhile, the control group used conventional approach in which the teaching and learning process conducted in face-to-face only.

Data of students' SRL is gathered using Motivated Strategy for Learning Questionnaire (MSLQ). MSLQ is a questionnaire that is often used to measure SRL in various countries, various fields and various levels of education including universities [16]. MSLQ was developed by the National Center for Research USA, by conducting several correlational studies that focus on motivation and SRL [17]. MSLQ has also been translated into more than 20 languages including Malaysia, Pakistan, China, Spain and Turkey. In addition, MSLQ is also the basis for developing learning strategy questionnaires in Germany known as the German Learning Strategies Inventory [2]. Therefore, this study adopted statements in MSLQ to develop student self-regulated learning questionnaires.

The MSLQ consisted of two sections motivation and learning strategy. Motivation section refers to students'goals and beliefs for the value of a course, beliefs about skills to succeed in a course, and test anxiety [17]. Meanwhile, learning strategy assess cognitive and metacognitive strategy as well as management of resources [17]. MSLQ employed in this study consisted of 81 questions put in five Likert-scale (very true – not true). Among 81 items, 31 items measure motivation and 50 items related to learning strategy. Example of statements (items) in motivation section are:

7. Getting a good grade in this class is the most satisfying thing for me right now.
8. When I take a test, I think about items on other parts of the test I can't answer.

Example of learning strategy statements:

61. I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying for this course.
67. When I study for this course, I write brief summaries of the main ideas from the readings and my class notes.

This questionnaire instrument had validated by expert judgment. The reliability of the questionnaire was measured using Alfa Cronbach with the point of reliability is 0.89. The data gathered from MSLQ were then analysed using ANOVA to compare SRL of students who learn in blended and offline environment.

3. Findings and Discussion

Data collected from questionnaire showed that the average pre-test score of students' self-regulated learning in blended learning setting was 201.34 out of 405. Meanwhile, those who in face-to-face method have the average score 200.01 (Table 2). There was no significant differences between the blended and face-to-face groups on prior condition ($F(1,118) = 2.36$, $p > 0.05$). This implies that the initial conditions of both groups are similar in terms of prior knowledge. Tabel 2 also inform the mean scores of the post-test and estimated effect size in both conditions. In order to determine the self-regulated learning differences between blended learning and face-to-face learning environment, data from post-test was analyzed using Analysis of Variance (ANOVA). The data also suggested that there is a big difference in the self-regulated learning (73.34) at the end of the treatment between experimental and control groups. As can be seen from Tabel 2, students who studied with blended learning had a higher mean than those who studied in direct learning (face-to-face). This implies that there is significant difference in terms of self-regulated learning between those who learn in blended and face-to-face environments ($F(1,87) = 4.77$, $p < 0.05$).

Table 2. Pre-test and Post-test results

	Blended		Face-to-face	
	Pre	Post	Pre	Post
Means	201.34	348.65	200.01	275.31
Std dev	10.71	8.02	11.35	9.27
Var	38.32	23.63	40.02	25.12
Effect size	0.34		1.25	

In addition, the effect size of the blended is higher that face-to-face. This indicates that blended learning more effective to improve self-regulated-learning than face-to-face approach. This result support previous studies in this field such as [18] which suggest that self-regulated learning is significantly related to the use of blended learning.
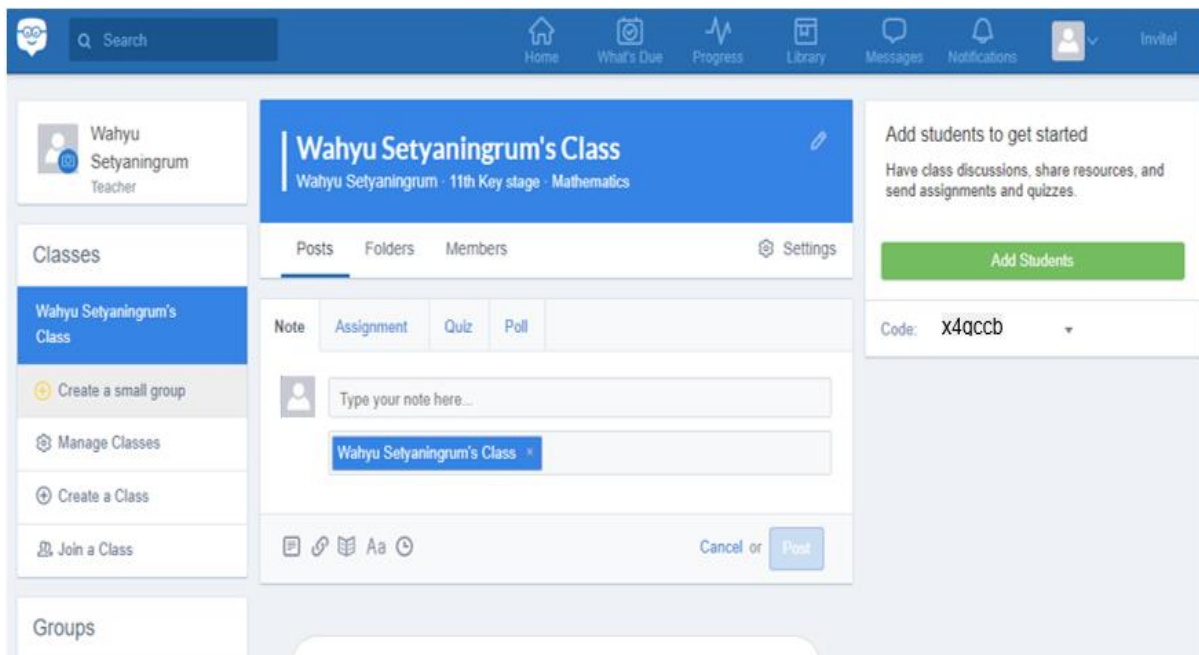
Figure 1. Example of Class's Interface in Moodle

In this study, blended learning was performed using Moodle (Figure 1), an online learning management system that is free and dynamic. It allows for communication between students to teachers or students to students through forums, blogs, chats and messages. These features allow students to post or discuss learning material anytime and anywhere. The online version also give opportunity for students to revisit learning materials that are difficult for them. This flexibility might affect students SRL as it provides students a room to control their learning processes and strategies. Autonomy in and control over one's learning process can be seen as a condition for self-regulated learning [19].

Table 3. SRL's Score each Aspect

	Blended	
	Pre	Post
Motivation Scales		
Intrinsic goal orientation	9.21	18.2
Extrinsic goal orientation	8.34	17.41
Task value	12.72	28.83
Control of learning beliefs	9.37	17.71
Self-efficacy for learning and performance	27.31	38.05
Test anxiety	14.20	23.07
Learning strategies scales		
Rehearsal	10.01	17.31
Elaboration	12.57	24.20
Organization	6.25	19.57
Critical thinking	14.51	23.01
Metacognitive self-regulation	30.71	38.52
Time and study environment management	20.50	32.61
Effort regulation	12.08	18.28
Peer learning	6.21	13.86
Help seeking	7.35	18.02

Analysing more detail in each aspect of the SRL, there are two aspects that improve significantly (Table 3). First, there is positively significant change in the value of the course. As students get more exposure on learning material through video and additional resources provided in blended learning environment compare to the traditional one, students can explore and investigate the learning materials in order to find the value of the course. This might influence student's beliefs on the value of the course.

Another aspect that increase significantly is organization in resource management. This can possibly be explained by understanding the nature of learning processes in blended learning, which provides students with more resourceful and encourage to use external resources (such as, internet links and videos). This helps them to find relevant material to support their studies in any topic as well as explore the topics more deeply.

4. Conclusion

Data of this study reveals that students in blended learning have higher self-regulated learning score than their counterparts. Flexibility of accessing and controlling learning speed seems to be the main reason that contributes to increase students' self-regulated learning. This study also found that task value and organization resources management are the two aspects that rise significantly in blended learning environment. These results imply that blended learning could improve students' self-regulated learning in mathematics class. Nevertheless, there is a need to explore more deeply on the design of blended learning that would affect self-regulated learning more effective. The design including selecting the learning material or mathematical concepts that are suitable to deliver in online system. Another issue related to classroom management in online system, it would be beneficial for teachers if the system colud provide tracking system or report on how long students access material as well as learning activities reports. These could be explore deeply in the next research study.

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