

Increasing mathematical proficiency

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Increasing mathematical proficiency and students character: lesson from the implementation of blended learning in junior high school in Bali

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Abstract. This article documents the experience and lessons from implementing a blended learning model aimed at increasing the mathematical proficiency and student character of 8 graders of junior high school students in Bali. It presents some series of mixed method-research result during 2016-2018. Lessons from the experience for the future implementation of blended learning model that can enhance the success of blended learning programs in junior high school are : (1) assessing school and teacher readiness for using blended learning program, (2) facilitating students and teacher with adequate learning sources, (2) increasing teacher competence (a) in designing lesson media such as clear and interesting tutorial videos, and authentic student tasks, (b) in developing strategy to facilitate meaningful students discussion forum, (c) in challenging students to develop higher order thinking, (3) in developing students character such as curiosity, critical thinking, hard work, the sense of community, cooperation and collaboration. The article concludes that enhancing the teacher competence in implementing blended learning program plays a very important role in increasing students mathematical proficiency and their character.

1. Introduction

The availability of sophisticated digital technology leads many changes in learning mathematics, starting from changing the way of thinking about mathematic as well as the way to teach mathematic effectively. On one side the availability of a variety animation video software can be used to present and visualize mathematical problems in real and challenging situation, that aims to improve student understanding, reasoning, problem-solving ability, even enhancing student character such as curiosity, creativity and self-independence. On the other side learning mathematics can also takes place everywhere, every time with multichannel learning sources through internet. What so called blended learning is become popular in recent decades. Therefore, in this research a prototype of blended learning using animated video tutorial has been developed and implemented in some junior high school¹¹ Bali. According to the newest literature this kind of blended learning is very promising. It involves students in thinking and doing mathematic learning effectively, faster, and deeper rather than²¹ traditional way in which teaching and learning takes place in the form of paper-based activity in a face-to-face classroom. Blended learning is a formal education program in which a student learns at least in part through online learning¹⁹, with some element of student control over time, place, path, and/or pace [1]. Literature review revealed that the results of research on the impact of using blended learning on various



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learning outcomes vary [2]. In the early days of blended learning experiments carried out with different features, depending on the availability of existing technological resources. Some authors also found different results, for example, [3], [4] revealed that blended learning did not significantly improve the learning achievement. According to [5] blended learning in nursing undergraduates was found to have no direct impact on knowledge acquisition. However, motivation and teaching methods have an interaction effect on knowledge acquisition by students. This blended-teaching method could better suit some students, depending on their degree of motivation and level of self-directed learning readiness. Some positive result of blended learning among others are (a) online math-learning videos provide students with a safe, personal, comfortable and thought-provoking experience. Students can experience the moments of "Aha", in which students can confidently understand the concept of mathematics in depth [6], (b) blended e-learning improves students' attitudes and confidence in learning math [7], (c) blended learning supports authentic knowledge transfer in the online discussion forum on a student-to-student basis, but not from faculty to student [8], (c) blended learning environment in the form of online material sharing, forum, exam, text picture and lesson summaries supported by videos facilitate the students to learn more effectively, (d) there was a significant difference between students' view in relation with blended learning environment as well as online and face to face learning environments [9], (e) there are four components in the model of collaborative blended learning namely principles, objectives, procedures and instructional activities, and measurement and evaluation. Through the blended learning students showed gains in learning achievement and thinking abilities [10], (f) the implementation of blended learning models has a positive effect on the problem-solving skill and conceptual understanding of student grade 7 of Junior High School [11], (g) blended learning through videos or animated videos is promising. Through videos teacher can explain various concepts very easily and in interesting way. It is strongly related to constructivism, that knowledge is connected with daily life. Students deal with real life problem solving. This approach makes the difficult concepts become more concrete and easier for the students [12], [13], [14], [15], (h) blended learning experience benefitted students in the experimental group by having a positive effect not only on the learning outcomes it also on their attitudes toward studying mathematics in a blended environment [16], (i) there was a significant and positive relationships between student participation in online discussion and their final course mark [17].

From the above description, it can be concluded that the potential implementation of blended learning in Indonesia seems very high and promising in providing theoretical and practical innovation and contribution in solving the problem of mathematics learning in Indonesia. But until now there has been no in-depth research results and adequate literature in the context of Indonesia to answer critical questions like: (1) how is the best blended learning model which is also most suitable with the students' characters and schools in Indonesia, (2) which blended learning model is the most effective and gives the most positive impacts towards essential mathematical competence such as (a) conceptual understanding, (b) reasoning and proof, (c) problem solving, (d) mathematical connection, and (e) mathematical representation and (3) which blended learning process is the most effective and gives the most positive impacts towards the students' essential characters, such as hard-working, honesty, curiosity, and even adoration for mathematics. This paper presents the experience and lessons from implementing a blended learning model aimed at increasing the mathematical proficiency and student character of 8 graders of junior high school (SMP) students in Bali.

2. Method

This paper summarizes the results of a two-year research approach aimed at developing blended learning using video tutorial on grade 8 at junior high school (SMPN) in Bali. The method for developing of blended learning prototype was based on the 4D-Model [18]. The developed blended learning model was tested in two schools and implemented in three SMPN. This report will be based on the implementation of those blended learning at SMPN namely SMPN 1 Denpasar, SMPN 1 Tabanan and SMPN 1 Sukawati Gianyar. This implementation involved 3 post-graduate students (each 24, 25, 26 years old, two male and one female), 3 experienced teachers (each 35, 54, 59 years old, two male and

one female). These three schools were chosen based on the criteria of teacher and student readiness, especially in ICT literacy related to the use of blended learning. Three quasi-experimental series with posttest only control group design and mixed method approach carried out in each school. Previously, teachers and post-graduate students were trained in planning, implementing blended learning and assessment. They were also trained in making learning scenario, learning materials such as interesting and challenging math video tutorial, and designing online discussions. The variables studied are those related to (a) mathematical proficiency [19] and (b) students character.

3. Result and Discussion

The characteristics of teachers and instructors collaborating on the implementation of blended learning are presented in Table 1. It appears that there are differences in teacher and instructor backgrounds, especially in terms of age, gender, and blended learning skills.

Table 1. The Teacher and Instructor's Background

Instructor' background	SMPN 1 Denpasar	SMPN 1 Tabanan	SMPN 1 Sukawati
Academic	postgraduate students	postgraduate students	postgraduate students
GPA	3,4	3,45	3.68
Age	25	26	24
Gender	male	female	male
Blended learning skill	very high	moderated	high
Teacher' background	SMPN 1 Denpasar	SMPN 1 Tabanan	SMPN 1 Sukawati
Academic	graduated	master degree	master degree
Experience	more than 20 years, certified teacher	less than 10 years, certified teacher	more that 20 years, , certified teacher
Age	54	35	59
Gender	male	female	male
Blended learning skill	very high	moderated	moderated

Table 2 shows the distribution of students' posts on the online discussion recorded in the online discussion dashboard. It appears that there was a significant difference in the intensity of online discussions between schools, especially between the lower result of SMPN 1 Tabanan (21.7%) and SMPN 1 Denpasar (32.2%) and much lower compared to SMPN 1 Sukawati (46.1%)

Table 2. The Distribution of Students' Post on the Online Discussion

No.	Description	School					
		SMPN 1 DPS		SMPN 1 TBN		SMPN 1 SKWT	
		VOL	%	VOL	%	VOL	%
1.	The number of students	40		47		34	
2.	Questions-Students' Post	325	58.5%	180	48%	252	31.62%
3.	Answers-Students' Post	231	41.5%	149	40%	545	68.38%
4.	Total number of students' post	556	100%	376	88%	797	100%
5.	Comparison among schools	32.2%		21.7%		46.1%	

Table 3 shows the distribution of significant mathematical proficiency (conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, productive disposition) and social communication skills (clarification, critic and suggestion) that appeared in online discussion. It seems that there are significant differences regarding mathematical proficiency, namely 15.6% (SMPN 1 Tabanan), 32.5% (SMPN 1 Denpasar) and 51.9% (SMPN 1 Sukawati).

Table 3. The Significance of Students' Posts on Online Discussion

No	The Significance of Students' Online Discussion	School						Total
		SMPN 1 DPS		SMPN 1 TBN		SMPN 1 SKWT		
		Vol	%	Vol	%	Vol	%	
A.	Mathematical proficiency							
1	Conceptual Understanding	169	11.8%	116	8.1%	325	22.6%	610
2	Procedural Fluency	148	10.3%	53	3.7%	256	17.8%	457
3	Strategic Competence	80	5.6%	21	1.5%	78	5.4%	179
4	Adaptive Reasoning	46	3.2%	18	1.3%	64	4.5%	128
5	Productive Disposition	23	1.6%	16	1.1%	22	1.5%	61
	SUM	466	32.5%	224	15.6%	745	51.9%	1.435
B	Social Communication Skill							
1	Clarification	51	25.4%	68	33.8%	26	12.9%	145
2	Critic and Suggestion	17	8.5%	21	10.4%	18	9.0%	56
	SUM	68	33.8%	89	44.3%	44	21.9%	201
C	Unclear	22	23.7%	63	67.7%	8	8.6%	93
	Grand Total	556	32.2%	376	21.7%	797	46.1%	

Table 4 summarizes the result of blended learning implementation in the three school. It is generally concluded that the results are almost the same in term of blended learning influence towards the students mathematical proficiency, that is; blended learning has given a significant gain for the increasing of mathematical proficiency. Nevertheless, the quality, intensity of mathematical proficiency, students' character seems to vary and depends on the teacher and instructor readiness, skills and motivation, as well as student readiness. Teacher's skill in facilitating and moderating online discussion, as well as developing high quality learning material are very critical. The quality of learning sources, such as tutorial video developed by teacher, the quality of students' online and classroom discussion determines the success of blended learning implementation.

Table 4. The Result Summary of Blended Learning Implementation in Three School

School	Result Description
SMPN 1 Denpasar	Students' mathematical proficiency of the intervention group taught using video-based blended learning was better than those taught using conventional learning. Both in the group of higher and lower level of self-independence, the blended learning has given a significant gain on students' mathematical proficiency. Students had high self-confidence in conveying opinion during online as well classroom discussion. Classroom interaction were more meaningful and pleasant during blended learning process, students were able to look for and select relevant information independently. Meaningful online discussion took place, and contained very significance mathematical proficiency, social communication skill and only a little unclear students' post. Students were highly motivated to discuss and share ideas among them, and interacted actively with teacher. Students character grew well. Their curiosity and self- independence significantly increased. No complain or serious obstacle in the implementation of blended learning model in this school.
SMPN 1 Tabanan	Blended learning is able to give a positive contribution towards students' conceptual understanding.

SMPN 1
Sukawati

Both in the group of lower and higher logical intelligence levels, students' conceptual understanding is better than those using conventional learning.

At the beginning, it was a lack of quality participation from students in online discussion.

Many students frequently posted unclear and irrelevant information in the discussion dashboard. Instructor readiness, ability and motivation as well as student readiness also appear to be very influential

The quality of learning sources, (in this case, the tutorial video developed by teacher) also play important role to motivate and engage students.

Even though, in compare to the control group, students in the experimental group were more enthusiastic and motivated in problem-solving activities. It seems also that students were braver and more independent in stating their opinions or difficulties during the online discussion.

Mathematical proficiency of students who participated in the implementation of video-based blended learning was significantly better than those in the conventional learning

Both in the group of higher and lower levels of self-independence, the blended learning has given significant gain on students' mathematical proficiency

The students' participation in online forum as well classroom discussion was very high, and the highest among the three schools.

Students' critical thinking and engagement were significantly observed during online discussion as well as during the classroom problem solving activity.

Classroom interaction was more meaningful and a sense of community, encouraging collaboration and exchange were increased.

Very significant mathematical proficiency, social communication skills and very little unclear students' posts found in the online discussion dashboard.

Students developed critical thinking in problem solving, actively engaged in constructing and sharing ideas and solutions.

Students' character grew well, such as hard work, critical thinking, the sense of community, cooperation and collaboration.

Students, and teacher responses were positive, and no complaints or serious obstacles in the implementation of blended learning models in this school.

3.1. Lesson learned

What can be learnt from the experience of blended learning implementation in the three school are (a) Blended learning in variety of its type is very promising to improve students mathematical proficiency and students character. In this research it is already proven that blended learning using video tutorial has given significant gain in learning achievement, thinking abilities and character such as curiosity, critical thinking, hard work, the sense of community, cooperation and collaboration. This is consistent with the previous work such as [6],[7],[8], [9],[10],[11],[12],[13],[14],[15]. But the success of the blended learning implementation depends on many factors such as on the teacher readiness, skills and motivation. Teacher's skill in facilitating and moderating online discussion, as well as developing high quality learning material are very critical. In the case of SMPN 1 Sukawati for example, the teacher and the instructor have a very high skill in developing high quality video tutorial which are indicated by its clearness, interesting and challenging. It is exactly what is called by Khan [6] as "AHA-Video", that provides students with a safe, personal, comfortable and thought-provoking experience. Besides that, the teacher in SMPN 1 Sukawati was also able to facilitate the online and classroom discussion forum very well. He succeeded to focus on the struggles of participants and offered practical advice, suggestions and encouragement. He also continually indicated the quality of what was being taught in the lesson. He has behaved as both Counselor and Reinforcer [20]. The similar result but with a bit lower quality and intensity has also been achieved in SMPN 1 Denpasar, (b) The implementation of blended learning requires a good and rigorous effort, highly skilled and motivated teacher. Beside that school and students readiness are also appear to be very influential. This is in line with the previous thesis stated by some author such as [12], [13], [21], [22]. In the case of SMPN 1 Tabanan for example, the teacher skill was assumed to be "moderated", but because of low quality of self-developed video tutorial which were uploaded into the LMS, and lack of strategy and focus on facilitating student's online

discussion, it resulted on lower quality of blended learning benefit. In this case, it seem that the quality of learning sources, such as tutorial video developed by teacher, the quality of students' online and classroom discussion determines the success of blended learning implementation. Besides that and in line with [10], at least four components of blended learning, namely principles, objectives, procedures and instructional activities, measurement and evaluation are also critical. In term of school and students readiness, the availability and accessibility through internet network infrastructure is very crucial. Also the right models and methods of blended learning need attention [23], [24]. (c) Lessons from the experience for the future implementation of blended learning model that can enhance the success of blended learning programs in junior high school are : (1) assessing school and teacher readiness for using blended learning program, (2) facilitating students and teacher with adequate learning resources, (2) increasing teacher competence (a) in designing lesson media such as clear and interesting tutorial videos, and authentic student tasks, (b) in developing strategy to facilitate meaningful students discussion forum, (c) in challenging students to develop higher order thinking, (3) in developing students character such as curiosity, critical thinking, hard work, the sense of community, cooperation and collaboration.

4. Conclusion

This research has already proven that (a) blended learning using video tutorial has given significant gain in learning achievement, thinking abilities and character such as curiosity, critical thinking, hard work, the sense of community, cooperation and collaboration, (b) the implementation of blended learning requires a good and rigorous effort, highly skilled and motivated teacher. School and students readiness are very influential, (c) lessons from the experience for the future implementation of blended learning model that can enhance the success of blended learning programs in junior high school are : (1) assessing school and teacher readiness for using blended learning program, (2) facilitating students and teacher with adequate learning resources, (2) increasing teacher competence (a) in designing lesson media such as clear and interesting tutorial videos, and authentic student tasks, (b) in developing strategy to facilitate meaningful students discussion forum, (c) in challenging students to develop higher order thinking, (3) in developing students character such as curiosity, critical thinking, hard work, the sense of community, cooperation and collaboration.

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