THE INTEGRATION OF BALINESE LOCAL WISDOM INTO THE INFORMATION TECHNOLOGY SUPPORTED-GENERATIVE MODEL

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Abstract: This research aimed at increasing students'mathematical proving ability through the implementation of the Generative Model based on local wisdom assisted by video learning on Khan Academy website. The subjects of this Classroom Action Research were 30 students in class II B of the Department of Mathematics Education Universitas Pendidikan Ganesha in the year of 2015/2016. This research was completed in 2 cycles with the steps of each cycle were planning, treatment action, observation and evaluation, and reflection. The data was analyzed descriptively. The result shows that the students' mathematical proving ability was increased from the average 13.20 in enough category in cycle I to the average 15.83 in the high category in cycle II. Therefore, the implementation of generative model based on local wisdom assisted by video learning in Khan Academy website increase the students' mathematical proving ability.

Keyword: mathematical proving, generative model, local wisdom, Khan Academy.

A curriculum has high demand on educational process in a university. College students are requested to be able to apply his/her knowledge and to give a positive impact on the society. University education aims at preparing the students to be the members of the society. The students will use their abilities professionally to increase the standard of living (Pongtuluran, 2008).

The curriculum of the Department of Mathematics Education Universitas Pendidikan Ganesha which lies on the Study Book Guideline Year 2012 is composed based on the competency with the concept that education not only infuses knowledge to the students, but also is expected to produce professional, pedagogic, personality, and social competencies. The Regulation of the Ministry of National Education No. 16 The year 2007 requires alumni to have those competencies.

To obtain professional teachers, the Department of Mathematics Education Universitas Pendidikan Ganesha improves many aspects. However, there are difficulties are found in this effort, such as students' understanding of certain topics and learning process in the class. Moreover, the quality of students' candidate and their academic ability are limited. They mostly confuse when facing problems which require advance analytical thinking, for instance, mathematical proving, thus the students need intensive and well-planned coaching in the learning process. Therefore, the learning process requires serious attention in order to improve alumni quality.

Almost all courses have the same problem, including Linear Algebra, a compulsory course for the students. Linear Algebra is a mandatory course before taking many other courses. Mastering this course will ease students to understand other courses.

However, students' understanding of this course is not satisfying. It is shown from the observation of the students' outcomes in the last two years. Of all students, only 10% achieved A, 30% of B, 40% of D, and 20% of D and E. This result leads to a big question regarding the learning process and the learning support materials used in the process. The content of Linear Algebra consists of the contents in junior and senior high school, such as linear equation and matrix, thus the students

should achieve a minimum of C. However, some students do not pass the course and results in D and E.

One of the difficulties of giving a lecture in Linear Algebra is its abstract concepts. Furthermore, students not only face problems in the level of concept and application but also in the level of investigation and proving. To be able to verify an equation, students must have an advanced thinking ability which requires analysis, synthesis, and evaluation (Krathwal, 2002). Generally, students do proving problem at latest in the exam, or maybe not even try it. Sugiarta (2013) found that students failed in a mathematics course because of his/her lack ability to solve proving problems.

According to observation from three lecturers, an improvement for Linear Algebra course has been implemented. However, it showed an insignificant result. It was also found that of all classes, the most problematic class was IIB in the academic year of 2015/2016. The observation led to three things. Firstly, the learning process did not give any chance for the students to obtain his/her concepts and freedom to propose an idea, questions, and problems. The lecturer focused on exercises to solve procedural and mechanical problems than understanding ones. Abdullah (2013) stated that procedural problem solving was not optimum in developing students' mathematical proving ability which required critical thinking. Secondly, the learning process in the class did not emphasize in students' character development, such as honesty, discipline, respect, individual responsibility, never give up, and empathy. Thirdly, an integration or an application of information technology (IT) based instructional media was not optimum. Lecturers used only a few videos or mathematics software. The application of software was limited to Maple to check the manual answers. Instructional videos have never been used to help students to explore his/her understanding.

From the clinical interview with ten students who failed in Linear Algebra course, it was known that the students had difficulties in the lecture process. Beside its abstract concepts, the students showed their weakness in proving problems. The students felt pessimistic when they faced a proving question. They left the question without even trying it. Moreover, a proving question meant "do the next question" for the students.

Based on observation and interview, a lecturer should implement an instructional model which creates a learning atmosphere for the students to propose an idea, questions, and problems freely; develop students' character, and integrate IT. One of this model which are believed to accommodate those learning atmosphere is Generative Instructional Model or Generative Model.

Generative model is a constructivist instructional model which states that knowledge is built inside students' mind. Lecturer's role is a facilitator and mediator in the learning process. Osborno and Cosgrove (in Holil, 2008) mentioned that Generative Model is an instructional model emphasizing the integration of the new knowledge to the basic knowledge of the learners. It requires the students to communicate actively and construct his/her knowledge by himself/herself. Russel Tytler (1996) stated that the model consists of four phase: exploration, concentration, challenge, and application. Through those phases, the teacher will be able to create a learning environment in which students have freedom to propose ideas, questions, and problems, thus learning mathematics becomes more effective and meaningful (Martunis et al., 2014).

In the challenge phase of Generative Model, a lecturer role as a facilitator and a mediator in the learning process to change students'misconception into the scientific concept by presenting scientists' theories as a proof, such as demonstrating equations proving (Russel Tytler, 1996). Therefore, this phase facilitates students to develop their ability in mathematical proving. Moreover, Osborne and Wittrock in Holil (2008) emphasized that the essence of this model was the students' brain did not receive information passively, instead constructed the information actively and made a conclusion.

The Generative Model does not facilitate the character development directly. Sugiarta (2011) noted that theories and values which develop students' positive character are desired in mathematics learning process. The model may develop students' advanced analytical thinking; however, positive character and attitude should be integrated into

it. For instance, to solve the unusual model, e.g. proving problems, a student should have both advanced thinking ability and positive attitude, thus he/she has a passion for solving it.

The suitable value to be integrated into the Generative Model is local values from Balinese culture. There is much local wisdom which can be implemented, for example, *Jengah, Nyepi,* and *Tri Pramana* (Widja, 1990; Suja, 2010; Sudiana and Sudirgayasa, 2015). Those local values can not be applied in the learning process separately, but it works as a support for the model.

Besides its strength point, the Generative Model has one main weakness, i.e. the limitation of facilitation and infrastructure to support the visualization of related problems (Sugiarta, 2013). Thankfully, the use of IT can be used to overcome this limitation. Mac Kinnon in Muderawan (2011) stated that technology will help to improve all thinking skills, from the basic to the advanced skills; thus, the lecturers are required to integrate IT into the learning process. It will eventually optimize the implementation of the model based on local values to better understand any concepts. Even, the lecturers may use IT in exploration phase to identify misconception. An instructional video can be used in the beginning of the class and even applied in the pre-learning class. The appropriate instructional video can be found on the Khan Academy website. Soebagyo (2016) claimed that the website meets the criteria as a good website and easy to use.

Khan Academy is a non-profit education organization which provides more than 3500 learning materials, such as videos and tutorials in mathematics. The website also facilitates a collaboration between lecturers/teachers, students, and parents in the learning process. A lecturer may give assignments to the students to learn or to do the assignments, and monitor their improvement at each competency. A student may complete the recommended assignments and receive recognition from the system. Meanwhile, a parent may monitor their son/daughter through the system.

The objective of this research was to describe the improvement of students' mathematical proving ability in Linear Algebra through the implementation of Generative learning model based on local wisdom assisted by video learning on Khan Academy website.

METHOD

The subject of this classroom action research was 30 students of the Department of Mathematics Education, Universitas Pendidikan Ganesha, who registered for Linear Algebra course in class IIB academic year of 2015/2016. Meanwhile, the object was students' ability in mathematical proving.

The research was implemented in two cycles with each cycle consisted of four steps, i.e. planning, implementation, observation/evaluation, and reflection (Kemmis et al., 2004). In the initial reflection, we identified that students' learning outcome was not satisfying and students' proving ability was weak. In the planning step, we took our perception to the same level regarding what we would implement; discussed and reviewed learning materials; compiled and reviewed observation and evaluation forms, and reviewed other indicators such as pass percentages and curriculum achievement. In the implementation cycle I, we carried out the Generative Model based on local wisdom and assisted by Khan Academy Website. In the observation and evaluation cycle I, we observed and evaluated the learning process carried out. We recorded its weaknesses, its strengths, and difficulties during implementation to improve the next process. We also observed and evaluated students' ability in mathematical proving after the implementation of the model. In the reflection cycle I, we performed two reflections. The first was a small reflection, i.e. review in the end of each action, based on the forms of the learning process observation and score rubrics of students' mathematical proving. This reflection controlled the quality of the learning process and viewed the trend of students' performance. The second was a big reflection, i.e. review in the end of the cycle to notice the weaknesses and strengths of the previous cycle. On the next cycle, we would eliminate its weaknesses and prevent its strengths. After cycle I, we continued to cycle II with the same steps as those in cycle I. We modified the

action of each step according to the reflection, without changing the process substantially.

We collected data using instruments such as daily journals, observation forms, mathematical proving performance tables, and learning test results. Daily journals and observation forms could be used to take notes of learning process development. Meanwhile, we analyzed students' mathematics improvement in Linear Algebra course using mathematical proving performance tables and learning test results. All data was then analyzed descriptively. Whilst, daily journals, and observation forms were analyzed logically.

Mathematical proving ability (KPM) is presented using a Likert scale from 1 to 5 for each indicator. KPM is an average score of classical mathematical proving ability. There are 4 indicators, thus the ideal minimum and maximum score are 4 and 20, respectively. The ideal mean (MI) and the ideal standard deviation (SDI) are calculated using the equation:

$$MI = \tfrac{1}{2}(20 + 4) = 12$$
$$SDI = 1/6(20 + 4) = 4$$

Table 1 shows the complete classification of students' mathematical proving ability.

No.	Interval		Category
	Equation	Score	
1.	$MI + 1.5SDI \leq KPM$	$18.00 \leq KPM$	very high
2.	$MI + 0.5SDI \leq KPM < MI + 1.5SDI$	$14.00 \leq KPM < 18.00$	high
3.	$MI - 0.5SDI \leq KPM < MI + 0.5SDI$	$10.00 \leq KPM < 14.00$	moderate
4.	$MI - 1.5SDI \leq KPM < MI - 0.5SDI$	$6.00 \leq KPM < 10.00$	low
5.	$KPM < MI - 1.5SDI$	$KPM < 6.00$	very low

Moreover, to improve the result, we calculated students' learning result score after the implementation of Generative Model based on local wisdom and assisted by Khan Website Academy. We considered that this research was succeed when (1) the minimum average score of students' mathematical proving ability was within category of high and there was improvement at each cycle quantitatively or qualitatively, and (2) the average score of students' learning result was at least 70 and there was no decrease at each cycle quantitatively or qualitatively.

RESULTS AND DISCUSSION

Results

Results show that on average, there was an increase of 2.63 of students' mathematical proving ability from cycle I to cycle II (Table 2). Students' ability was also improving, from an average of 69.33 to an average of 75.57, after the implementation of Generative Model based on local wisdom and assisted by Khan Academy Website (Table 3). We noticed that more students passed the Linear Algebra course after cycle II (Table 4).

Table 2. The summary of students' mathematical proving ability.

KPM	Cycle I	Category	Cycle II	Category
Average	13.20	Moderate	15.83	High
Standard deviation	3.50	-	1.56	-

Table 3. The summary of Linear Algebra learning result.

KPM	Cycle I	Description	Cycle II	Description
Average	69.33	Cukup	75.57	Baik
Standard deviation	8.30	-	6.56	-

Table 4. The summary of the score composition.

	Cycle I					Cycle II				
	Score composition					Score composition				
	A	B	C	D	E	A	B	C	D	E
Amount	3	22	4	1	0	7	20	3	0	0
Percentage (%)	10	73.33	13.33	3.33	0	23.33	66.67	10	0	0
Pass percentage	96.67 %					100 %				

Discussion

The implementation of Generative Model based on local wisdom and assisted by Khan Academy Website increased students' mathematical proving ability. We noticed that in the end of cycle II, all students passed the course and the average of students' result was within the good category. Therefore, the increasing of students' mathematical proving ability would improve the learning quality, and eventually, will increase students' learning result.

We achieved improvement through four steps of the Generative Model, i.e. exploration, concentration, challenge, and application. At each step, we integrated local wisdom such as *Jengah*, *Nyepi*, *Tri Pramana*, *Tri Hita Karana*, and *Mulat Sarira* to develop students' character. Furthermore, to optimize its implementation, we used learning videos in the Khan Academy Website thus the students could explore their ability for a deep understanding of mathematics concepts.

The given model does not only focus on training students' proving ability. It also develops students' character. A good character will motivate a student to make effort in finishing any given tasks. Sudiana and Sudirgayasa (2015) stated that local wisdom was responsible for the development of this affective domain. To be able to solve proving problem in mathematics, students' must have a deep and comprehensive understanding of the concept. This is where the Khan Academy website takes part. Learning videos in the website may help students to explore the concept; thus, the student will have a better understanding.

Generative Model has challenge step to facilitate mathematical proving ability. In this step, a lecturer has a role as a facilitator and a mediator to change students' misconception into scientific concepts. Lecturers should provide theories from related scientists as a proof, for instance, by demonstrating how to decompose equations (Tytler, 1996). Students will be trained to construct the information actively; thus, they will be able to verify deductively.

Referring to students' character development, the Generative Model does not facilitate it directly. It has to be integrated with the implementation of Balinese local wisdom. A recent study from Sudiana and Sudirgayasa (2015) emphasized that learning process which integrated local values would create students with positive character. The local values can be used as a baseline to develop all aspects of society life, including education. The main concept of the value, however, has to be considered to optimize the Generative Model. Widja (1990) explained that basic culture concepts, for example, *rwabhineda*, *tri hita karana*, and *desa kala patra*, can be integrated to education process to support national development. Additionally, there are also other values which are related to the model and support materials in mathematics. Suja (2010) mentioned that values in *Nyepi*, *Tri Pramana*, and *jengah* are important for the learning process. *Jengah* may motivate a student to make effort in obtaining results from a given question or problem. The concept of *Nyepi* may be applied to establish a calm and quiet condition for students when they are finishing proving questions. *Tri Pramana* integrated learning process will facilitate students to study and to practice thinking, doing, and speaking right regarding the content. And, the application of *Tri Hita Karana* concept in each learning process will make the students understand themselves as God's creatures with faith; social beings who need each other; and understand the importance of taking care of nature.

In the exploration step, a lecturer explores and classified students' thought regarding a given concept. Students' pre-concept is used as a baseline to plan the learning program. Students' pre-concept is usually a misconception, which may disturb the correct concept building. To optimize this step, we use learning videos in Khan Academy website, as recommended by Soebagyo (2016). The website facilitates collaboration between lecturers, students, and parents (Hernawati, 2015). A lecturer gives an assignment for the students and he/she can monitor its progress through the website. The students work on the assignment and receive compliments for what they have finished. Meanwhile, parents are able to monitor their son/daughter activities and developments through the website easily.

The collaboration of Generative Model, local wisdom and Khan Academy website increased students' mathematical proving ability. Practically, we achieved it after applying the model into several cycles. In cycle I, we noticed that several things in the challenge step of the model need revising. Students' felt pessimistic when they faced proving problems. It was indicated by the domination of students with good abilities and other students waited for the results. Students found difficulties in planning and applying mathematical proof in a group. Therefore, the lecturer motivated students to try harder using the concept of *mulat sarira.* The lecturer also used the concept of j*engah* thus the students would feel ashamed if they could not solve the assignment and eventually, they would try their best.

In the application step, we recognized that the students felt reluctant to do self-evaluation, internal reflection, and clarification of the concept. Therefore, the teacher motivated the students using the concept of *mulat sarira.*

According to observation and evaluation of cycle I, we decided to make improvement in the cycle II. The lecturer guided the students intensively and motivated them to cooperate each other and to do internal reflection using varied local wisdom and advice which fit the students' need. The lecturer also monitored less active students and motivated them. As a consequence, students' proving ability was improved and the process was not dominated by only a few good students. Generally, cycle II showed positive results as we expected. The students gave comments, answers, and questions actively. The interaction between students-lecturer and students-students was noticeable. The students showed positive responses while solving the assignment within the group or when presenting their results. The problematic students had been taken off and joined the process better. The lecturer did not have to guide the group discussion intensively because the students accustomed to solve the assignment in the group. The students got used to solve assignments which take advanced thinking and got used to utilize IT, such as videos on the Khan Academy website and Maple software, in the learning process.

Results of this study are in accordance with a study from Sugiarta (2013) who concluded that the implementation of Generative Model based on local wisdom improved students' results in Real Analysis course. Subagyo (2016) stated that the use of Khan Academy website would finally improve the learning process quality. Sudiana and Sudirgayasa (2015) supported the integration of Balinese local wisdom into the learning process to achieve competencies which appropriate to the local culture.

CONCLUSION

The integration of Balinese local wisdom into the Generative Model and supported by learning videos in Khan Academy website can improve students' ability in mathematical proving. The Generative Model advances the students' thinking, while the local wisdom develops the students' character which supports their ability. Khan Academy website facilitates the learning process and collaborates the lecturer-student-parent activities.

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