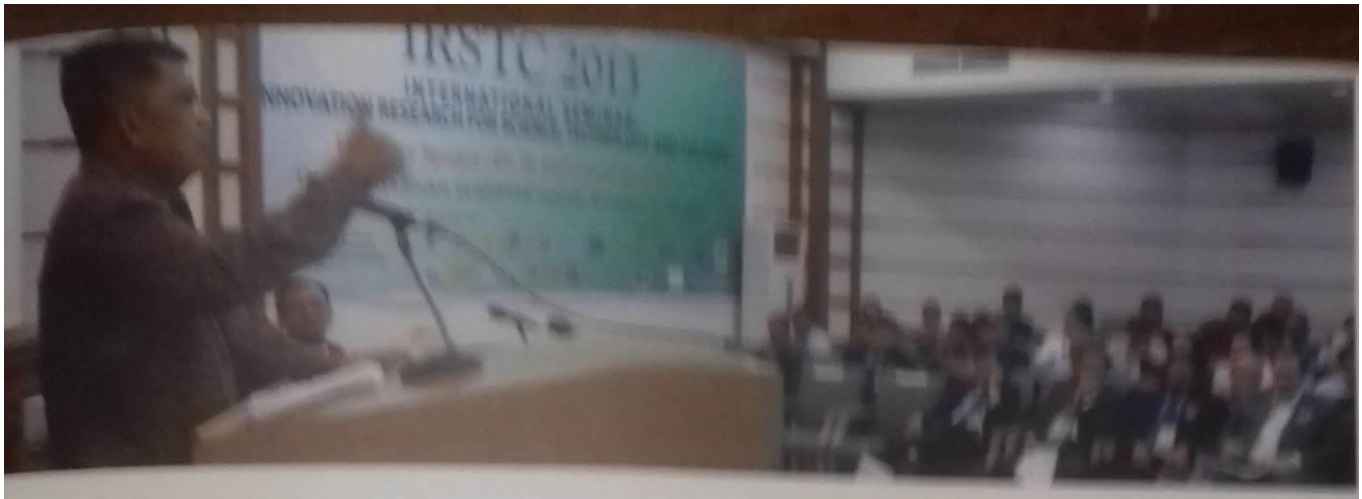

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IRSTC 2013 PROCEEDINGS

International Seminar;
Innovation Research for Science, Technology, and Culture

Serpong, 19 - 20 November 2013

ISTN

School of Postgraduate
National Institute of Science and Technology

PROCEEDINGS

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Innovation Research for Science, Technology and Culture
IRSTC 2013

Organized by:

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Preface

International Seminar on Innovation Research for Science, Technology and Culture (IRSTC) 2013 organized by School of Post Graduate, National Institute of Science and Technology (ISTN) with collaboration several university, research institutes, and professional organizations. The seminar will be held in Gedung Widya Graha Widya Bhakti, Dewan Riset Nasional, Kompleks Pusat Penelitian Ilmu Pengetahuan dan Teknologi (Puspiptek), Serpong, Banten on 19–20 November 2013. This seminar is also realization as a part of the concurring of 63th ISTN and 14th School of Postgraduate ISTN anniversary event and commitment to provide the second ISTN international seminar in contributing to the enhancement of he international cooperation among Indonesia institutes and the other countries.

International Seminar on Innovation Research for Science, Technology and Culture (IRSTC) 2013 provide an international forum for the sharing of the knowledge, information, experience and result research as well as the review of progress and discussion on the state of the art and Innovation Research For Future Nation and Sustainable Development In Science, Technology And Culture for sustainable development.

The Honorary speakers is Dr. Muhammad Yusuf Kalla, former vice president of Republic Indonesia and the invited speakers and participant come from Malaysia, Germany, South Korea, England, Singapore and Indonesia. The papers will published in the proceeding and selected paper will be published on Journal of Makara, University of Indonesia and other related international journals.

We would also like to express our heartiest to thank to the honorary speakers, Dr. Muhammad Jusuf Kalla, invited speakers and participants of IRSTC 2013. I would like also to thanks all member of advisory board, steering committee, member of organizing committee, peer reviewers, sponsors and National Institute Science and Technology staff for their support to success of this seminar. We do hope that all participants will have enjoyable meeting at this seminar.

Jakarta , 19 November 2013

Jagore

Prof. Dr. Masbah RT Siregar, APU
Chairman of Organizing Committee IRSTC 2013

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THE STRATEGIES FOR IMPROVING TEACHING-LEARNING PROCESSES OF ENGINEERING MATHEMATICS AT ELECTRICAL TECHNOLOGY DEPARTMENT FACULTY OF TECHNOLOGY YOGYAKARTA STATE UNIVERSITY

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Abstract— The quality of Engineering Mathematics teaching-learning processes in Electrical Technology Study Program Faculty of Technology State University of Yogyakarta has found under expected. In general, more students just listened to lectures, recorded material and example problems written on the board lecturers and only a small percentage of students who want to ask questions. In addition, based on a little research showed that most students did not have the teaching materials of lecturer recommended. Therefore, it is necessary for implementing effective learning strategies, systematically, and sustained so as to improve the quality of Engineering Mathematics teaching-learning processes.

The strategies discussed in this paper have been implemented in Electrical Technology Study Program Faculty of Technology State University of Yogyakarta in recent years. Those strategies are: 1) cooperative learning strategies, 2) contextual teaching-learning; and 3) blended learning strategy. They implemented by using classroom action research approach.

The teaching-learning strategies are proven to increase the positive attitude of students toward course of Engineering Mathematics. Indicators of success can be seen from the liveliness of students attend the lectures as well as cooperation among students in completing the tasks given lecturer goes well, the increasing number of students who dared to ask in the classroom, learning materials can also be obtained easily through the internet facilities (e-learning). From the results already obtained can be considered quite successful. This is indicated by the percentage of students who obtained a score of 60 or more, or classified into the category quite well (C +) to very good (A) on average by 60,5%, which about 50% previously. Another condition is the percentage of students that scored 70 to top of or classified into good category (B) to very good (A) on average by 30%, which about 20% previously.

Key words— blended learning strategy, contextual teaching-learning, cooperative learning, improving quality, Engineering Mathematics teaching-learning process.

I. INTRODUCTION

Engineering Mathematics subject matter is basic courses for students of Electrical Vocational Technology Department, Faculty of Technology, Yogyakarta State University that has 3 credits theory. The teaching-learning processes outcomes for this subject matter has not fulfilled as expected. Student understanding and mastery of learning materials is still low, there are still many students who find difficulty in understanding the learning material. Students assumed that Engineering Mathematics course is a difficult subject. Whereas the course is a basic concept that would undergird the engineering subject matters. Students who mastered this subject properly would be easier to understand the next-engineering courses. Also, their academic achievement will be better.

Student achievement in Engineering Mathematics Course can be categorized “fair”. As an illustration, the average score of Engineering Mathematics Courses for the previous semesters, about 2.00 in 1 – 4 scale, when converted into the alphabet value included in C. For further information, the category of fairly good (C +) up to very good (A) is about 50% for all participants, and the percentage of students who has score 70 upwards or categorized as either (B) to excellent (A) ranges from 20% for all participants. The lecturer worried about this condition.

Results of reflection on the implementation of the course before showed that most students participate less in the lecture. In general, students just listened lecturer’s explanation, noted the concepts and examples that are written on the board. And, less students (2 – 4 people) dared asking question. In addition, based on observation and supervision indicated that most students did not have the teaching materials as suggested. Instructional materials or learning resources that are not utilized by students as well. Students rely solely on learning material presented by the lecturers. In fact, learning materials that support understanding of the concepts being studied many available on the internet and library.

Based on a variety of reasons and phenomena that occured in the teching-learning processes above, to improve the quality of the teching-learning processes should be developed and implemented learning model in accordance with existing conditions. The effective learning strategies that can motivate students to learn in attending Engineering Mathematics Courses need to be managed in a systematic and sustainable. The quality of learning discussed in this paper refers to the learning process and learning outcomes.

II. DISCUSSION (EXPLANATION)

A. The Engineering Mathematics Course

Engineering Mathematics course is a basic subjects and must be taken by all students in the Electrical Vocational Technology Department, Faculty of Engineering UNY has three (3) credits theory with EKO304 code. Competence that required in the subjects of Mathematics Engineering is able to apply these concepts: differential and integral of multivariable function, multiple integrals, vector analysis, ordinary differential equations, and the introduction of Laplace transforms; in studying concepts in electrical engineering courses next [11].

When traced further the understanding of mathematics, according to Courant and Robbins [1]: Mathematics as an expression of the human mind which reflects the ability of active, reasoning based on the results of contemplation (thinking deeply), and the desire for aesthetic perfection which is essentially an element of logic and intuition , analysis and construction, generalized and individuality. Russell [10] defines Mathematics as a study at the beginning of the assessment of the parts that are well known (simple) toward the unknown. Towards a more structured well known (constructive), gradually towards the complicated (complex), from integers to fractions, from real numbers to complex numbers, addition and multiplication to differential and integral, and toward a more Mathematics high level.

As described above, Engineering Mathematics is the foundation of knowledge to understand the concepts of engineering science, especially in the field of Electrical Engineering. Each student is expected to master the concepts taught in the classroom so they can follow lectures in this Department with good results. A good mastery of the concepts in Mathematical Engineering, will be able to facilitate them in understanding the concepts of engineering science, especially in the field of Electrical Engineering and will ultimately facilitate their completion of the study.

B. Learning Strategies

1. Cooperative Learning

Cooperative learning is a learning model that promotes collaboration among students to achieve learning goals. Roger and Johnson [6] said that not all cooperation could be considered cooperative learning. Furthermore, Roger and Johnson [6] said also that there are five elements of cooperative learning model that should be applied: (i) A positive interdependence efforts; to create an effective working group, a lecturer should be able to arrange the task, so that each member of the group to finish its work to achieve group goals. Barker [6] suggests, implementing the Jigsaw method should be restricted number of members of the group of four students; (ii) Individual responsibility; in the preparation of the task should be designed such that each group member must carry out its own responsibilities to the next task in the group can be implemented; (iii) Face to face; each group should be given the opportunity to meet face to face and discuss. The interaction among group members will build synergies that benefit all the members in respect for differences, utilizing the advantages and fill the gap of each; (iv) Communication among members; as an introduction to work group, teachers need to provide a practical means of communicating, because not every student has the skills to listen and talk. The success of a group also depends on the willingness of its members to listen to each other and to demonstrate their skills or ability to express their opinions; (v) Evaluation process group; evaluation schedule for measuring the process and outcome of cooperation should be arranged properly, so that cooperation can be more effective next. Evaluation does not need to be held each work group, but can be held in accordance with existing conditions.

In the management activities of Engineering Mathematics course need to set the interaction, between students and students and between students and teaching materials. How to structure student interaction patterns with students, will affect how students learn best, the attitude of students towards Engineering Mathematics courses, student attitudes toward other students, and student attitudes toward instructional materials. There are three models of student interaction with other students while they learn the course of Mathematics in Engineering. First, they compete to be the best. Second, they learn individually to achieve the learning goals without regard to other students. Third, they learn cooperatively in study group activities as well as their own learning [6].

2. Contextual Teaching-Learning (CTL)

Contextual-based learning and teaching, according to Blanchard, is a form of learning that help educators (lecturers or teachers) in linking the material taught to real life, and motivate learners (students or students) can make the relationship between the knowledge learned with problems in their life [2]. Also within the framework of learning, the association of context with the concept being discussed intends to enhance the meaning of what has been learned by the student [9]. Context is very important for all learning situations. By applying this learning strategy students are expected to be able understanding what they learned better and easier, because the concepts that have been obtained and studied is associated with the real conditions of everyday life.

There are seven main components that underlie the application of CTL in the class, Nurhadi [8] explain the meaning of the seven components, as follows:

a. Constructivism

This component means that people develop or build their understanding of new experiences based on their prior knowledge and beliefs. The draft of teaching-learning prepared in the form of things as follows: learners work, they are practicing something, practicing physically, write essays, demonstrate, create ideas, and so on, adapted to the concepts being studied and learning conditions.

b. Questioning

This component can be useful to guide the thinking of students to be better than just giving information to deepen students' understanding. Questioning useful for encouraging, guiding, and assessing thinking skills of students. It useful to obtain information both technical and academic, to know students' understanding, evoking the response of students, know how far a student's curiosity, to know things that are already known to students, focusing student attention on the concept being studied, and refresh the knowledge of students.

c. Inquiry

This component can be interpreted as an art and science of asking and answering questions at a time through a systematic series of activities (Zahorik, et al. [3]). In the learning process, students are invited to have critical thinking skills as they discuss and analyze the evidence, evaluate the ideas and propositions, reflecting the validity of data, processing, making conclusions. Of these things then students are expected to determine how to present and explain his findings, and connect ideas or theories to get the concept. Inquiry activities covering several stages of which is to formulate the problem, observe or observations, analyze and present the results in various forms, writings, drawings, reports, charts, tables, and other forms. Furthermore, students can communicate their work both orally and in writing to classmates, professors, or other audiences.

d. Learning Community

Community learning is a form of group consists of several students engaged in learning activities to occur more in the learning process. Learning communities can be defined as a group learning (cooperative learning), through learning groups of students can pass the points of his mind, discuss, and exchange ideas that ultimately can mengkonstruk understanding of new knowledge. All group members should have the opportunity to talk and share ideas, listen to ideas of other students closely, and cooperate to build the knowledge with friends in the group. This concept is based on the idea that learning together is better than learning individually.

e. Modeling

Modeling is the process of the appearance of an example for others to think, work, and learn. Modeling is not uncommon to require students to think out loud with the issue and demonstrate what students will do. At the time of learning, frequent lecturer in order to model how students learn. Lecturers show how to do something to learn something new.

f. Reflection (Reflection)

Reflection allows a way of thinking about what students have learned and to help students describe the personal meaning of their own students. In the reflection, students examine an event, activity, and the experience and think about what students learn, how to feel, and how students use the new knowledge. Reflection can be written in a journal, could occur through discussion, or a creative activity like writing poetry or creating artwork. Realization of reflection can be applied, for example at the end of the lesson teachers leaving time for students to reflect for a moment. This can be: a direct statement about what students gained today, notes or journal in the student book, impressions and suggestions regarding student learning today, discussions, work.

g. Authentic Assessment

Authentic assessment is actually a terminology of invented to describe the various strategies or methods of alternative assessment. Various methods enable students to demonstrate their ability to complete tasks, solve problems, or express their knowledge in a way that can simulate the situation encountered in the real world outside the school environment. A variety of such simulations should be able to express achievement

(performance) encountered in real world practice such as the workplace. Authentic assessment should be able to explain how students solve problems and possible have more than one correct solution. Assessment strategies that match the criteria meant is a combination of several evaluation techniques

3. Blended Learning Strategy

The blended learning strategy is a model of teaching-learning process that combines the conventional model with learning by using e-learning system [5]. What is meant by the conventional learning model is a model that characterized by a meeting of lecturers with students to do teaching-learning processes. This has been going on since the first so far to meet the main goal of teaching and learning. This model is facing obstacles related to the limitations of location and time of implementation of teaching-learning processes, caused by increasing the activity of students and lecturers.

E-learning system is one of model distance learning using electronic media as a sender of content and communication between teachers with students. "E-Learning" is the latest term in the system of distance learning and the term is reserved for learning electronics including computers and telecommunications media −web-based learning− (Goran et al, in [4]).

According to Chu et al., in [4], an e-learning characteristics include (i) learning material arranged in the form of text, graphics and multimedia elements like video, audio and animation, (ii) synchronous or asynchronous communication such as video conferencing, chat rooms or discussion forums, (iii) storage, maintenance and administration of the material on the web-server, (iv) using TCP/IP as the communication facilities between the learner and learning materials and/or other sources.

The concept of e-learning is basically arising because of the limited interaction between teachers and students due to constraints related to limitations of space, time and distance. As part of the process of teaching and learning, e-Learning is intended to complement the teaching, not to substitute teachers in the teaching-learning processes. So that the important thing is increase distribution of learning materials and communication between teachers and students. Flexibility is the keyword in the e-learning system [5]. In other words, learners can decide when and where he will learn. This is because the implementation of learning is not depend by a specific time and place. In addition, for lecturers also have more chance that they can renew the various aspects associated with the concepts without depending on the time and place.

E-learning model can be implemented in three forms of asynchronous, synchronous, or a mixture of both. Asynchronous e-learning model can be found on the internet either simple or integrated through e-learning portal. Synchronous e-learning model, teachers and learners should be in front of the computer together, although not in the same place, because, the learning process is directly implemented, either through video or audio conference. Subsequently learning that combines all forms of learning such as on-line, live, or face to face (conventional) known as blended learning [4].

C. Results of Learning Strategy Implementation

1. Results Implementation of Cooperative Learning

The mechanism is divided in several groups of students with limited members should not exceed three (3) people. Then teacher teachers assign to students to learn the concepts and working on the problems of the concepts that have discussed and/or not discussed in class. This strategy is managed to provide facilities for students to learn to work closely with someone else, who is currently with friends with a first class although initially they feel less need to study this group. However, that strategy should always be monitored so that in the group each member may actively participate. The individual work strategy is also carried out, this action is taken to ensure that every student can still do an active role in the lecture. Also, for the development of each student understanding of concepts that have been given can be known to what extent are their masters. In addition, to provide another alternative for students who have a character like working independently, this is also done based on the feedback obtained from filling the questionnaire [6].

Overall, when seen from a process that has been done so that the actions have given a positive impact on student attitudes toward mathematics courses. They became courageous raising questions during lectures, although not all students. Also, it has been the establishment of good cooperation among students. When seen from the results already obtained, the results can be considered quite successful. This is indicated by the number of students that has a score of 60 or more, categorized into quite well (C+) to very good (A) as many as 20 students of 34 people (58.82%). In addition, students who scored 70 upwards, categorized into good (B) to excellent (A) as many as 8 people (26.47%) [6].

2. Results Implementation of Contextual Teaching Learning

In the application of contextual learning is evident that the process of learning Engineering Mathematics is declared effective technique because of the seven components of the required learning (constructivism, discovering, questioning, learning community, modeling, reflection, and authentic assessment) has been shown in the implementation of learning. Implementation of learning also refers to the competencies that must be mastered by students. It is intended to focus on achieving learning outcomes that must be mastered student competency. With such a procedure the benchmark of success in both learning process and learning outcomes become more clear and focused [5].

The effectiveness of this contextual learning can be seen from the side or from the learning process. In terms of process, the application of contextual learning has been successful in increasing student motivation, active involvement of students, enhance a conducive learning atmosphere, interesting and fun, students more easily understand and master the competencies that are required so that learning becomes more meaningful. In terms of learning outcomes, indicated by the number of students that have a value of 60 or more or categorized into quite well (C+) to very good (A) as many as 21 students from 33 people (63.6%), while students who scored 70 upwards categorized into good (B) to excellent (A) as many as 11 people (33.3%) [5].

3. Results Implementation of Blended Learning

Based on data obtained from the implementation of the lectures, showed that there is a positive contribution of several actions that have been made using a blended learning approach. These actions are realized through the act of empowerment group work, individual work, and giving feedback on assignments that students have done. In addition, basic learning materials can also be obtained easily through e-learning. Various supporting materials are available in e-learning the Mathematics Engineering. With these actions, students have been given a variety of facilities to get more alternative ways of learning and learning resources, in order to understand the various concepts in math they are learning technique [7].

Overall, when seen from a process that has been done then the actions that have been implemented to give a positive impact on student attitudes toward college of Engineering Mathematics. They became bolder raising questions during lectures, although not all students. On the other hand, when seen from a product that has been obtained from the implementation study of this class action, it can be considered quite successful. In terms of learning outcomes, indicated by the number of students that have a value of 60 or more, or categorized into quite well (C+) to very good (A) as many as 23 students from 38 people (60.5%), students who scored 70 upwards or categorized into good (B) to excellent (A) as many as 11 people (28.9%) [7].

III. CONCLUSION AND SUGGESTION

A. CONCLUSION

Cooperative learning strategies, models of contextual learning, and blended learning has succeeded in increasing the positive attitude of students toward teaching-learning processes of Engineering Mathematics. Indicators of this success can be seen from the activeness of students in upper division courses as well as cooperation among students in completing the tasks given lecturer goes well, increase student motivation, improve the learning atmosphere conducive, attractive and fun, the increasing number of students who dared to ask in the class during lecture. Another indicator of the increasing number of students who dared to ask in class during lecture, as well as the learning outcomes of students who improved compared with before.

From a product side that has been obtained from the implementation of the learning strategies, it can be considered quite successful. This is indicated by the number of students that has a value of 60 or more, or categorized into quite well (C+) to very good (A) an average of 60.5% which were previously about 50%. Other conditions that can be obtained also quite well because the students who scored 70 upwards categorized into good (B) to excellent (A) an average of 30% which were previously about 20%.

B. SUGGESTION

Based on the results of the implementation of three learning strategies that have been described above that obtained a positive impact on improving quality of the teaching-learning processes, it is recommended that in the implementation of other basic courses can implement those models. Of course, the procedure is performed according to the conditions respectively.

REFERENCES

[1] Courant, Richard & Robbins, Herbert. 1996. What Is Mathematics? An Elementary Approach to Ideas and Methods. New York: Oxford University Press, Inc.

[2] Edy Supriyadi. 2007. Pelatihan dan Pendampingan Pembelajaran Kontekstual bagi Guru SMP di Kabupaten Bantul. Yogyakarta: Laporan PPM LPM UNY.

[3] Hartoyo, Joko Laras BT, Muhamad Ali, & Nur Kholis. 2009. Model Pembelajaran Kontekstual Berbasis Kompetensi untuk Meningkatkan Efektivitas pembelajaran Mata Kuliah teknik Pendingin dan Tata Udara. Yogyakarta: Laporan Penelitian UNY.

[4] Herman Dwi Surjono. 2008. Pengantar e-learning dan penyiapan materi. Modul Pelatihan E-learning Universitas Negeri Yogyakarta UPT Puskom UNY 4-6 November 2008.

[5] Nur Kholis & Hartoyo. 2009. Penerapan Model Contextual Teaching and Learning (CTL) untuk Meningkatkan Efektivitas Pembelajaran Matematika. Yogyakarta: Laporan Penelitian FT UNY.

[6] Nur Kholis & Sunaryo Soenarto. 2004. Peningkat-an Kualitas Perkuliahan Matematika Melalui Rekonstruksi Strategi Pembelajaran Kooperatif. Laporan Penelitian Hibah TPSDP UNY ADB Loan-1792 INO Tahun Anggaran 2004

[7] Nur Kholis, Hartoyo, Muhammad Ali, & Nurhening Yuniarti. 2010. Peningkatan Kualitas Pembelajaran Matematika Teknik Melalui Model Blended Learning. Laporan Penelitian Hibah Pengajaran PHK-I UNY Tahun Anggaran 2010.

[8] Nurhadi. 2003. Pembelajaran Kontekstual. Jakarta: Direktorat PLP Depdiknas.

[9] Ome'ara, David. 2002. Contextual Teaching and Learning. Jakarta: Depdiknas.

[10] Russell, Bertrand. 1996. The Principles Of Mathematics . London: WW Norton & Co Inc.

[11] Tim Fakultas Teknik UNY. 2009. Kurikulum 2009 Fakultas Teknik Universitas Negeri Yogyakarta. Yogyakarta: FT UNY.