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Harmonization of Active Learning: A Driver of Nurturing Engineering Learner's Motivation?

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ABSTRACT

The realization of fostering continous education requires foundations in an educational surrounding. This is pertinent to learners with an engineering background for they should not only be prepared with technical skills, but also equipped with an outstanding drive to enhance motivation during academic sessions. A compulsory subject in the technical institution encompasses Engineering Mathematics where learners require appropriate encouragement in order to accomplish the learning outcomes and fulfil the needs of the syllabus. The outstanding achievement in content mastery is closely related to the implementation of active learning. Instructional methods such as role playing, mastery learning, case studies, cooperative learning and problem solving exercises are important. The fundamental aims of this paper are to determine students' acceptance of active learning, the relationship between role playing and students' motivation and to identify the most challenging chapter in the Engineering Mathematics 3 (BA301) course. The Pearson correlation of two variables was used to analyse the questionnaires answered by 80 student respondents. The sample comprised of two groups (DKA 3B and DKA 3C) of third semester (June 2012) Civil Engineering students at a polytechnic in Merlimau, Melaka. The sample selection was based on the engineering students enrollment in Engineering Mathematics 3. The findings indicated the existence of a significant relationship between role playing and students' motivation (r=0.6159). The most challenging chapter was related to the Numerical Method. The findings highlighted the need for meaningful experiences acquired from active learning and reinforcement strategies by instructors in order to ensure students could cater with tough situations and grasp the challenging materials. Hence, the students' motivational spirit and strength of pedagogical process apparently should be encouraged.

Keywords: Active learning, students' motivation, role playing, numerical method

INTRODUCTION

Active Learning and Motivation in the Educational System

Educational system plays an important role to transform multiple pedagogical strategies whether the academic session occurs in or outside the classroom. An approach of active learning entails lively involvement of project-based exercises and highlights a non-unilateral source of information. In the same way, the strategies of active learning nurture comprehensive engagement activities of group discussions, collaborative programs, case studies, brainstorming, demonstrations as well as role playing (Payne, Sumter & Sun, 2003). Although these activities require an investment of a significant amount of mental energy, they can reduce learners' mathematics anxiety, embolden learning interests, problem solving skills and

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learning achievement (Huang, Huang & Wu, 2014). Active learning assists students' understanding in physics conceptual problems, specifically in mechanics and hence improved lecturers' presentation as compared to the traditional delivery methods (Hake, 1997; Saul & Redish, 1998). Furthermore, in the context of mathematics learning, it is pertinent to take into account the requirement to apply methods, strategies and appropriate materials to ensure learning encourages active, adventurous and investigative students' participations.(Ajogbeje, Borisade, Aladesaye & Ayodele, 2013).

The educational entities require experiential learning in active classroom which entails flip lessons as impressive instructional design reflects on students' experiences and desires (Petriglieri, Wood, & Petriglieri, 2011; Spelman, 2010). In particular, active classroom emboldens lesson engagement and experiences, and students will eventually realize the significance of achieving excellent learning outcomes (Hung, 2014). Some of the related activities in formal or informal sessions to be implemented in the Polytechnic Institution are role-playing, mastery learning, case studies, cooperative learning and problem solving exercises. The justifications of applying these methods are to increase collaborative learning among students outside the classroom, enhancing communication and to create availability for students. The approach of active learning allows students to accomplish the course-intended goals, such as an increase the application of good knowledge and character as well as proficiency. Thus active learning helps students to be more critical when solving problems and expertise in social communication (Jessica & Joseph Wu, 2015). The next reason to have active learning is to increase student participation in discussions. Cooperative group activites, unique program structures, assessment and evaluation of the individual learning encourage enthusiasms among learners (King, 2009). Furthermore, students' involvement will facilitate students' ability to access and manipulate information using audience feedback systems or 'clickers'. The clickers allow the instructors to pose questions to the class and easily collect the responses. Advocates of this technological solution reported, when used in a learner-centered framework, the increased interactions through strategically posed questions can, among other things, assess prior knowledge; elicit a misperceptions; stimulate discussions; and exercise cognitive skill (Beatty & Gerace, 2009; Fies & Marshall, 2008).

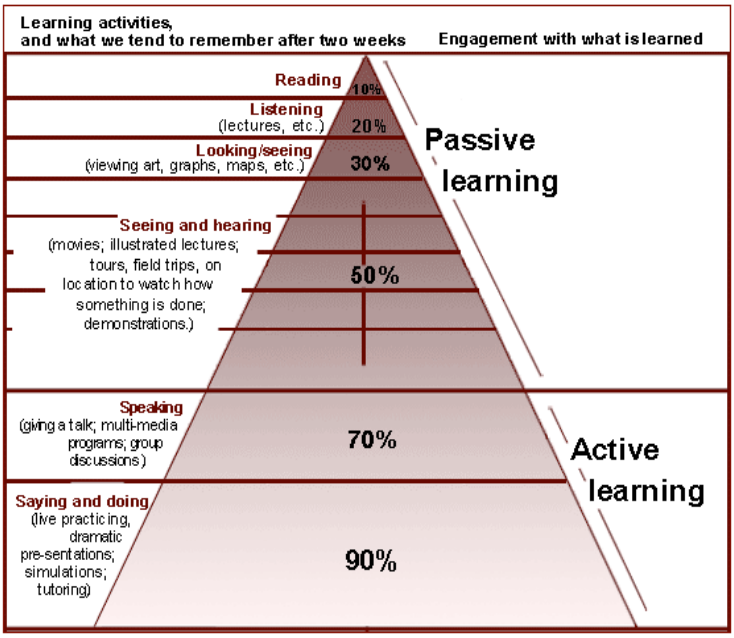
Motivation is a psychological feature that arouses actions towards a desired goal and elicits, controls, and sustains certain goal directed behaviors. A wide technique arising from motivation absorbs the tasks suitably and deliberately, hence cognitive activities are involved as the main learning session (Biggs & Tang, 2007). The desire to reduce physical pain and enhance delight or precise requirements make encouragement and motivation as two significant behaviors in learning. Similarly, encouragement yields positive results as well as benefits even though learning requires challenging interactions among educational entities and surrounding features (Astin, 2012; Law & Meyer, 2011). Motivation can be enhanced if it is earned from another essence whether social, physiological, behavioral and cognitive. It has two main classifications; intrinsic and extrinsic (Pinder, 2011). Intrinsic motivation is defined as doing an activity for its inherent satisfactions rather than for some separable consequence and not influential for other outcome (Kanfer et al., 2012). When intrinsically motivated, a person is moved to act for the fun or challenge entailed rather than because of external prods, pressures, or rewards. The other common approach to the measurement of intrinsic motivation is the use of self-reports of interest and enjoyment of the activity. Experimental studies typically rely on task-specific measures (Ryan, 1982; Harackiewicz, 1979). However most field studies used more focused measures, such as intrinsic motivation for education (Harter, 1981). Research into intrinsic motivation has placed much emphasis on those conditions that elicit, sustain, and enhance this special type of motivation versus those that subdue or diminish it.

Extrinsic motivation refers to the performance of an activity in order to attain an outcome. It involves incentives or instrumental gains and reinforcements that come from outside the individuals (Frey, 1997). Common incentives in extrinsic motivations are rewards like money, grades, support from others, trophies and threats of punishment (Greene, 2011). Competition is in general extrinsic because it encourages the performers to win and beat others, not to just simply enjoy the intrinsic rewards of the activity. The concept of motivation both intrinsic and extrinsic can be instilled in students, by promoting and evoking interests in learning. For instance, students will be automatically interested in an animated discussion with peers over a book which is extrinsic motivation while the reward given to them at the end of a succesful discussion is extrinsic motivation. Additionally, the discussion would be made more interesting if the technique of short video presentation is used as a pedagogical approach with the intention of encouraging and enriching mathematics learning (Kinnari-Korpela, 2015). Polytechnics as the technical educational institution provides suitable facilities for various and recognized programs. Synchronizing the learning approaches with the Polytechnic Studies Department mission will create a transformational learning environment. It enriches creativity in learning so as to generate innovative ideas and enhancing students' self-esteem in order to adapt to future challenges.

LITERATURE REVIEW

Active learning is a terminological phrase. It is a student-centered teaching approach as opposed to the content-centered instruction (Halonen, Brown-Anderson, & McKeachie, 2002). The approach is determined by events that entail students to think wisely as well as implementing activities they are being tasked (Bonwell & Eison, 1991). Likewise education sessions require activities to identify the active involvement by students. Inspirational and suitable surroundings are necessary success components during active learning sessions. Face-to-face or group discussions can be done systematically whether in the conventional mode or online format. For facilitators, in order to conduct discussion activities, the class size will determine effective implementation of active learning in terms of management, guidance and monitoring the progress. Equally important these activities comprise of critical thinking on the subject matter during the learning process and evaluation. Eventually, facilitators will allow the students to take responsibility and the opportunity to manage their own learning in the classroom (Sims, 2006, p.343).

To elaborate, discussion plays an outstanding follow-up learning activity as shown in the Figure 2 below. The Cone of Learning adapted from Edgar Dale (1946) explains the harmonious interrelationship with multiple senses. For instance, the skills of speaking, performing, simulating, designing and performing presentation are based on a synthesis of learning modalities.



Cone of Learning adapted from Edgar Dale (1946)

Figure 1: Model by Wagner, Robert W. Edgar Dale, 1970

From the model above, it depicts 70% to 90% engagement of active learning comprising of speaking, saying and doing. The examples of learning activities are giving talks, multimedia programs, group discussions, live practice, simulations and tutoring. In the same way, active learning emboldens not only discussions in a group; it also enhances think-pair-share. In this activity, the role of students begins with taking a minute to ponder the previous lesson. Next step refers to discussing the matter with one or more of their partners and ultimately the sharing of conclusion with the classmates. If any misconceptions occurred, the facilitator will guide and clarify the actual situation. The think-pair-share is mostly significant if students acquire the prior knowledge and familiar with the subject matter. Nevertheless, it can be a 'warm-up' and spontaneous trial activity to determine and interconnect the understanding between current knowledge and the new terminologies. Facilitators should realize the potential of students in preparing the knowledge and skills as key components to run the process of think-pair-share session.

Almost all, the final target of implementing active learning is to yield harmonious classroom surroundings as well as learn together from other parties (Monk-Turner & Payne, 2005). The appropriate courses in active learning can be related to the nature of subject whether most of the contents are facts or hands on. Therefore, preparation is the key. Learners are provided with verbal instructions before they are expected to review and explain on their own. In order to inspire learners' captivation, thought-provoking questions method in framing

discussions can be implemented both in small peer teams and among the class overall (King, 1995). The teaching and learning will be more meaningful personally for students, hence it stimulates them to apply critical thinking when the measurement scale and underlying construct have been decided. Active learning ensures a pair of students to enjoy and gain the benefits of learning together. The role of lecturers as facilitators are activated in using the technology of learner response system to pre-service education students. They can enhance the ability to adapt questions of the clickers by phrasing questions in order to allow students to absorb the learning contents (Campbell & Monk, 2015). It has been shown the pedagogical approach in active learning incorporated open-ended higher-order questions.

Another effective method introduced by Marcel Goldschmidt of the Swiss Federal Institute of Technology in Lausanne is learning cell. It is an effective way for a pair of students to study and learn together (Goldschmidt, 1971). A learning cell is a process of learning where two students are alternately asking and answering questions on commonly reading materials. To prepare for the assignment, the students will read the assignment and write down questions that they have about the reading. At the next class meeting, the teacher will randomly put the students in pairs. The process begins by designating one student from each group to begin by asking one of their questions to the other. Once the two students discuss the questions, the other student will ask a question and they will alternate accordingly. During this time, the facilitator goes around the class from group to group to give feedbacks and answer questions. This system is also referred to as a student dyad.

Short written exercises that are often used is the "one minute paper." This is a good way to review materials and provide feedbacks. However a "one minute paper" does not take one minute and for students to concisely summarize, it is suggested they have at least 10 minutes to work on this exercise. Collaborative learning group is a successful way to learn different materials for different classes. It is done by assigning students in groups of 3-6 persons and they are given an assignment or task to work on together. This assignment could be either to answer a question to be presented to the entire class or a project. It is necessary to ensure that the students in the group choose a leader and a note-taker to keep them on track with the process. This is a good example of active learning because it causes the students to review the work that is being required at an earlier time to participate. The collaborative learning embeds the game-building experience as they combine with technology. A research by Li, Lemieux, Vandermeiden and Nathoo (2013) indicated games method performed deal with challenges, problem solving and attitudes. Thus, they also highlighted the good understanding of cognitive and pedagogical elements.

On the other hand, educational games allow problem solving skills to overcome the challenging stage during learning sessions. They inspire a method of posing problems with different approach dimensions. The process of forming their own hypotheses from trials is important as games involve open-ended problems and do not require students to prove them. Moreover, problem solving can be eased by verbalization, embedded with group discussions during the game activitives (Pinter, 2010).

Reaction to a video is also an example of active learning because most students love to watch movies. The video helps the student to understand what they are learning at the time in an alternative presentation mode. Ensure that the video relates to the topic they are studying at the moment. A few questions should be included before starting the video so the students will pay more attention and to focus at during the video. After the video is completed students are divided either into groups or pairs so that they may discuss what they learned and write a review or reaction to the movie (McKinney & Kathleen, 2010).

Class game is also considered as an energetic way to learn because it does not only help the students to review the course material before a big exam but also help them to enjoy learning about a topic. Different games such as jeopardy, crossword puzzles, and creative drawing always seem to get the students minds going (McKinney & Kathleen, 2010). The Math App usage among students indicated positive performance compared with those who applied paper-and-pencil drills. The research aim for the efforts was to identify whether the level of mathematics proficiency would obtain the majority from participating the game (Chang, Evans, Kim, Norton, & Samur, 2015).

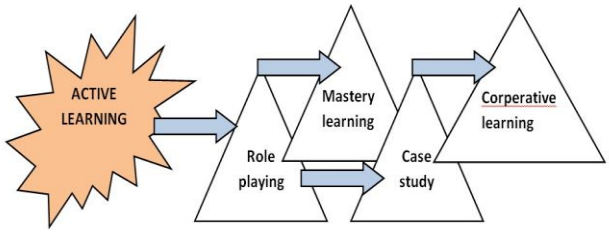


Figure 2: Activities of Supporting Active Learning (Illustration by the writer)

The implementation of active learning consists of activities such as role playing, mastery learning, case studies and cooperative learning. Role-playing refers to the changing of one's behavior to assume a role, either unconsciously to fill a social role, or consciously to act out an adopted role. In learning Mathematics, it can be applied through the concept of monitoring group mate's achievement and assisting on understanding the content and relating it with the real life. Meanwhile, the Oxford English Dictionary offers a definition of role-playing as the changing of one's behavior to fulfill a social role. The term is used in four senses:

1. To refer to the playing of roles generally such as in a theatre, or educational setting.
2. To refer to taking a role of an existing character or person and acting it out with a partner taking someone else's role, often involving different genres of practice.
3. To refer to a wide range of games including role-playing video game, play-by-mail games and more.
4. To refer specifically to role-playing games.

Case studies have also been used as a teaching method and as part of professional development, especially in Business and Mathematics. The problem-based learning (PBL) movement is such an example. When used in (non-business) education and professional development, case studies are often referred to as critical incidents. G. Thomas (2011) offers the following definition of case study: "Case studies are analyses of persons, events, decisions, periods, projects, policies, institutions, or other systems that are studied holistically by one or more methods. The case that is the subject of the inquiry will be an instance of a class of phenomena that provides an analytical frame, an object, within which the study is conducted and which the case illuminates and explicates." Rather than using samples and following a rigid protocol (strict set of rules) to examine limited number of variables, case study methods involve an in-depth, longitudinal (over a long period of time) examination of a single instance or event, a case. They provide a systematic way of looking at events, collecting data, analyzing information, and reporting the results. As a result, the researcher may gain a sharpened understanding of the instance happened and important to look at more extensively in future research. Case studies lend themselves to both generating and testing hypotheses.

Another suggestion is case study should be defined as a research strategy, an empirical inquiry that investigates a phenomenon within its real-life context. Case study research can mean single and multiple case studies, can include quantitative evidence, relies on multiple sources of evidence, and benefits from the prior development of theoretical propositions. Case studies should not be confused with qualitative research and they can be based on any mix of quantitative and qualitative evidence. Single-subject research provides the statistical framework for making inferences from quantitative case-study data. This is also supported and well-formulated by Lamnek (2005). The case study is a research approach, situated between concrete data taking techniques and methodology paradigms. *Role Playing Games*

Role-playing game is a game in which the participants assume the roles of characters and collaboratively create stories. Participants determine the actions of their characters based on their characterization, and the actions succeed or fail according to a formal system of rules and guidelines. Within the rules, they may improvise freely; their choices shape the direction and outcome of the games. Role-playing can also be done online in the form of group story creation, involving anywhere from two to several hundred people, utilizing public forums, private message boards, mailing lists, chat rooms, and instant-messaging chat clients to build worlds and characters that may last a few hours, or several years. Often on forum-based role plays, rules, and standards are set up, such as a minimum word count, character applications, and "plotting" boards to increase complexity and depth of story.

Role play simulation is a form of experiential learning that allows you to "cover" the same sort of topics as you create certain principles in mind (Laure Paquette, 2011). The facilitator can break down the role play simulation into specific tasks with due dates. This will keep students organized and on track, and prevent them from getting overwhelmed. It is important to structure the tasks so that the relevant content is covered as close to reality as possible. It also helps to start with a role play simulation that imitates a well-known situation. Allow some class time for teamwork, but let students know that most of the work will need to be done outside of classroom whether in face-to-face or online collaborations.

A. Mastery Learning in Learning Engineering Mathematics 3

In Mastery learning, "the students are helped to master each learning unit before proceeding to a more advanced learning task" (Bloom 1985) which is in contrast to the "conventional instruction". Mastery learning may be implemented as teacher-paced group instruction, one-to-one tutoring, or self-paced learning with programmed materials. It may involve direct teacher instruction, cooperation with classmates, or independent learning. It requires well-defined learning objectives organized into smaller, sequentially organized units. Individualized instruction has some elements in common with mastery learning, although it dispenses with group activities in

favor of allowing more able or more motivated students to progress ahead of others and maximizing teacher interaction with those students who need the most assistance.

The concept of mastery learning can be attributed to the behaviorism principles of operant conditioning. According to the operant conditioning theory, learning occurs when an association is formed between a stimulus and response (Skinner, 1984). In line with the behavioral theory, mastery learning focuses on overt behaviors that can be observed and measured. The material that will be taught to mastery is broken down into small discrete lessons that follow a logical progression. In order to demonstrate mastery over each lesson, students must be able to overtly show evidence of understanding of the material before moving to the next lesson (Anderson, 2000).

After beginning a unit, students will be given a meaningful and formative assessment so that the teacher can conclude whether or not an objective has been mastered. At this step, instruction goes in one of two directions. If a student has mastered an objective, he or she will begin on a path of enrichment activities that correspond to and build upon the original objective. Students who do not satisfactorily complete a topic are given additional instruction until they succeed. If a student does not demonstrate that he or she has mastered the objective, then a series of correctives will be employed. These correctives can include varying activities, individualized instruction, and additional time to complete assignments (Guskey, 2007). These students will receive constructive feedback on their work and will be encouraged to revise and revisit their assignment until the objective is mastered.

C. Assessment of Engineering Mathematics 3 (BA301)

TABLE 1
Assessment of Engineering Mathematics 3 (BA301) Based on Quantity, Chapter, Content and Program

Number	Name of Assessment	Quantity /Percentage of Grade	Chapter / Course Learning Outcome (CLO)	Related program for BA301 course
1	Quiz	1 / 10%	Descriptive Statistics (CLO1)	Electrical, Mechanical and Civil Engineering program in third semester.
2	End of Chapter	1/ 20%	Progressions (CLO2)	
3	Group Discussion	2 /15%	Area of Irregular Shapes (CLO2), Numerical Methods (CLO3)	
4	Tutorial Exercise	3 / 25%	Area of Irregular Shapes (CLO2), Progressions (CLO2), Numerical Method (CLO3)	
5	Theory Test	2 / 30% = PKK	Descriptive Statistics (CLO1), Area of Irregular Shapes (CLO2), Progressions (CLO2), Matrices (CLO3)	
6	Final Examination = PA	1 / 100%		
Total (Quantity/ Percentage)		10 / 200%		
Final Marks		Score (PKK+PA)/2		

*PKK: Course work Assessment
*PA : Final Examination
CLO1 : Transform raw data into useful statistics to compute central tendencies and dispersions using appropriate formulae or graphical methods.
CLO2 : Apply Trapezium and Simpson's Rules, Arithmetic Progression and Geometric Progression formula in solving given problems.
CLO3 : Select suitable methods to solve simultaneous linear equations and non-linear equations problems.

D. Stimulating the Cooperative Learning and Problem Solving Exercises.

Cooperative or collaborative learning is a team process where members support and rely on each other to achieve an agreed-upon goal (Baum, 2005). The classroom is an excellent place to develop team-building skills needed later in life. It is interactive as a team members develop and share a common goal. Each member empowers the other to speak and contribute and to consider their contributions. A good learning team begins with training and understanding group processes with three to five people. The facilitator will assign groups.

They function better than self-assigned groups. Any member who is at a disadvantage or not comfortable with the majority should be encouraged and proactively empowered to contribute. Learning is positively influenced with a diversity of perspectives and experiences increasing options for problem solving, and expanding the range of commitment to attend, prepare and be on time for meetings. Teams with problems should be invited or required to meet with the facilitator to discuss possible solutions.

E. Motivation and Success in Studies and Daily Life

Motivation is defined as an internal drive that activates behavior and gives direction. The concept has 2 types of motivation; Intrinsic and Extrinsic Motivation. Intrinsic motivation is the doing of an activity for its inherent satisfactions rather than for some separable consequence. An intrinsically motivated person is moved to act for the fun or challenge entailed rather than external rewards. Intrinsic motivation reflects the desire to do something because it is enjoyable. If we are intrinsically motivated, we would not be worried about external rewards such as praise. Meanwhile, extrinsic motivation reflects the desire to do something because of external rewards such as awards, money and praise. People who are extrinsically motivated may not enjoy certain activities. They may only wish to engage in certain activities because they wish to receive some external reward.

F. Herzberg's Two-factor Theory.

Frederick Herzberg's two-factor theory intrinsic/extrinsic motivation concludes that certain factors in the workplace result in job satisfaction, but if absent, they do not lead to dissatisfaction but no satisfaction. The factors that motivate people can change over their lifetime, but "respect me as a person" is one of the top motivating factors at any stage of life. It can be distinguished into motivators referring to challenging work, recognition, responsibility which gives positive satisfaction. Hygiene factors are status, job security, salary and fringe benefits that do not motivate if present, but, if absent, can result in demotivation. The name Hygiene factors is used because, like hygiene, the presence will not make you healthier, but the absence can cause health deterioration. The theory is sometimes called the "Motivator-Hygiene Theory" and/or "The Dual Structure Theory." Herzberg, (1968).

G. Self-determination Theory.

Self-determination theory (SDT), developed by Edward Deci and Richard Ryan, focuses on the importance of intrinsic motivation in driving human behavior. Like Maslow's hierarchical theory and others that built on it, SDT posits a natural tendency toward growth and development. Unlike these other theories, however, SDT does not include any sort of "autopilot" for achievement, but instead requires active encouragement from the environment. The primary factors that encourage motivation and development are autonomy, competence feedback, and relatedness.

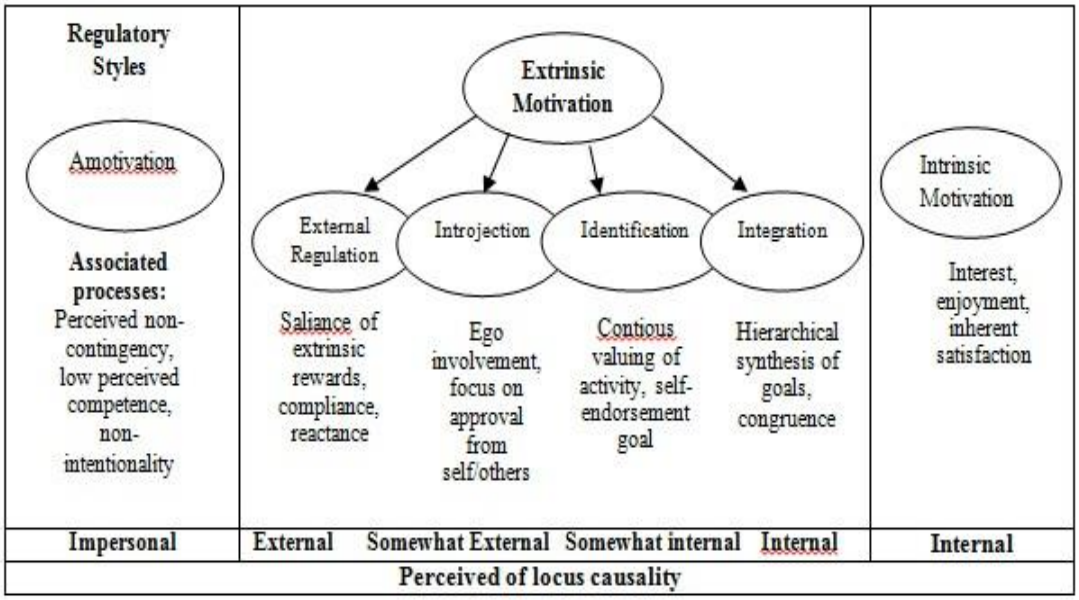


Figure 3: Taxonomy of Human Motivation

PROBLEM STATEMENT

1. *Students Assume Mathematics is Difficult, Complex, and Need Extra-Ordinary Thinking.*

For engineering students, calculation and technical courses are the core courses to be learned during the academic session. Some of the students had set their mind that Mathematics is not interesting with complicated problems to be solved on their own. After secondary school learning, students found many dimensions of the content, formulae and intensive exercises are difficult to cope with. The main constraints are students directly assume Mathematics is difficult, complex, and need extra-ordinary thinking. The findings from the final examination of Engineering Mathematics (1-3) from January 2011, July 2011 and December 2011 indicated there was an increase of 15% failures in each session. As a consequence, more repeated classes were required to be opened during the May 2012 Short Semester. Hence, absolutely new techniques were also required to deal with the situation (JMSK 'Kajian Semula Pengurusan' report, 2011).

2. *Not Closely-Related with Daily Routines or Future Academic, Lazy to Think or Generate Ideas.*

Learning Mathematics requires the application of critical thinking which consists of analysing, reasoning, evaluating, problem solving and decision making. It is part of the formal educational process and is increasingly significant as the students' progress through their education to graduate from their institutions (Brookfield, 2000). Students face difficulties in forming the relationship between Mathematics theory and daily life usage even though they succeed to pursue their study for the first degree. The students may think it as merely learning about the concepts and each problem must be prepared utilizing one method with concise answers. Thus, the management team from the Polytechnic of Merlimau, Melaka suggested during the Management Meeting in July 2012 to collaborate with the Malaysian Technical University Network (MTUN) such as UTeM or UTHM for tracing, giving extra guidance and Mathematics literate skills to students so they could excel and hoping at least 20 students could pursue their first degree in Mathematics.

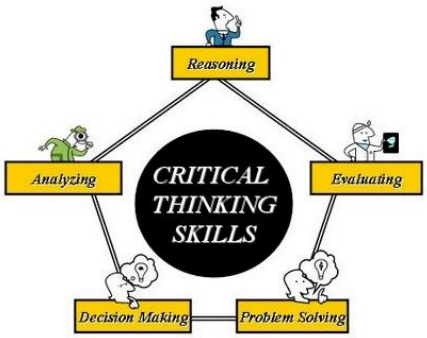


Figure 4: Learning Mathematics needs Critical Thinking Skills

3. De-Motivation Symptoms Tend Occur.

Furthermore, if Mathematics is taught in mass lectures via one-way communication for more than an hour, students tend to show the de-motivation symptoms. It produces negative attitudes such as sleepiness, coming late to class, less attention given, late or fail to submit assignments to the lecturers and distracting others during the learning sessions. In addition, the students' background knowledge of that course which does not fulfill the excellent standard can influence the teaching process. It was proven by the findings from the first semester of December 2011 intake, only 40% of the engineering students took Additional Mathematics in secondary school, while the rest took Modern Mathematics.

4. Teaching & Learning Delivering Approaches Need Innovation and Improvement.

The approach of delivering the Mathematics content includes revising the syllabus and ways to make students understand in wide concepts. The facilitators are required to cover the contents within certain time in a semester. With a number of topics needed to be exposed to the students, somehow the elements of educational technology should be considered. Innovation in self-learning, interactive materials and encouragement in Mathematics learning are merely highlighted and given focus in certain educational institutions. These methods are supposed to enhance active learning strategies in a wide context and simultaneously spiritual motivation will be generated. Learning Management System (LMS) such as CIDOS e-learning, social media usage or mobile learning with good internet access are teaching and learning hubs for innovation which should be considered.

5. Differences in Learning Styles

The strategies of learning implemented differently depend on the students' capability. If weak students do not want to mix with proactive students and feel shy to explore the knowledge, they will create constraints to the facilitator. There are three basic types of learning styles. The three most common are visual, auditory, and kinaesthetic. To learn Mathematics, it depends on the senses to process the information. Most students tend to use one of their senses more than the others.

6. Not Interested and Determination to Teach Math Learning Disability

There are challenges when dealing with disability and uninterested learners as in Dyscalculia cases. It means "counting badly" which is ironic since those who suffer from it need to count often. The phenomenon refers to the students who have the difficulties when they come across numbers, and they think and act slowly. Dyscalculia is inherited, and specific abnormalities in the brain might be the cause. Despite their challenges, many become proficient at calculation topics. With the right teaching strategies, they can count themselves among the mathematics literates.

Research Questions

1. What is the students' acceptance of active learning?
2. What is the relationship between role playing and students' motivation?
3. What is the most challenging chapter in Engineering Mathematics 3 (BA301)?

Research Objectives

1. To determine students' acceptance of active learning
2. To determine the relationship between role playing and students' motivation.
3. To identify the most challenging chapter in Engineering Mathematics 3 (BA301).

METHODOLOGY

This was a desriptive research design utilising the relational statistical method through observations and questionnaires. It is a scientific quantitative measurement implemented through a test. The Pearson's correlation coefficient analysis was employed to interpret data because it is known as the best method of measuring correlations, and is based on the method of covariance. It gives information on the magnitude of correlation as well as the direction of the relationship.

Assumptions:

A. Independence of case: Cases should be independent to each other.
B. Distribution: Variables of the correlation should be normally distributed.
C. Linear relationship: Two variables should be linearly related to each other, or if the value of variables on a scatter diagram is plotted, it should yield a relatively straight line.
D. Dependent variables: measured variables, motivation (variety learning style, varying environment, consequences of certain actions and competition).
   Independent variables: affects the dependent variable, dependent variable depends on independent variable. It refers to active learning (role playing, mastery learning, case studies, cooperative learning, problem solving).

Properties:

A. Limit: Coefficient values lie between +1 to -1.
B. Pure number: It is independent of the unit of measurement. For example, if one variable's unit of measurement is in inches and the second variable is in quintals, even then, Pearson's correlation coefficient value does not change.
C. Symmetric: Correlation of the coefficient between two variables is symmetric. This means between X and Y or Y and X, the value of will remain the same.
D. Respondents' description and Instrument. The respondents of the research are Civil Engineering Diploma students, DKA 3B and DKA 3C who register the course of Engineering Mathematics (BA301) as their core subject in the third semester. It refers to 40 students of DKA 3B and 40 students of DKA 3C from June 2012 session. This sample was selected due to the justification and determining process of

approaching an active learning to the Civil Engineering students who register Engineering Mathematics 3 for encouraging their motivation in the course.

The questionnaire items using the LIKERT scale with several number arrangements, normally 5 or odd numbers (Borg & Gall, 1989). The score for number 1 is strongly disagree, 2 somewhat disagree, 3 neutral/no opinion, 4 somewhat agree and 5 strongly agree. It consists of 3 parts, Part A: Background of the respondents, Part B: Elements of Active Learning and Part C: Encouraging Student's Motivation. In Part A, the respondents had to fill in information on the current semester, Gender and Grade of Engineering Mathematics 2 (BA201) from the previous semester. The result of BA201 was used to identify the performance and background achievements in Engineering Mathematics before the students continued to the next level of learning Engineering Mathematics. Part B was measuring active learning. Questions 1,2,3,4 and 5 were role playing, mastery learning, case studies, cooperative learning and problem solving respectively.

The application of role playing implemented the mentor-mentee concept. The facilitator assisted and helped the students in the learning process. Each of the group created a special names related to Mathematical features. In role playing there was a feeling of teamwork and they encouraged each other to succeed with flying colors for that course.

Role playing encouraged them to play games, volunteering and participating actively in classrooms to generate critical thinking. Mastery learning encompassed the process of giving the well-defined learning objectives to ensure that students understood the vital concepts. The students were assisted to master each learning unit before ing proceed to the next unit. Formative assessment was conducted as an evaluation.

The elements of case studies consisted of providing a systematic way for events, collecting data, analyzing information and reporting the results. The most relevant topic for case studies was Descriptive Statistics that applied empirical inquiry, and investigating a phenomenon within its real life context. It was a teaching method and part of a professional development. When the students worked cooperatively in a specific groups, they learned positively and interdependently, and developed social skills which were necessary for success outside the classroom. Lastly, problem solving involved the determination of the correct way to obtain answers for any scenario of Mathematics. The challenging questions need the focus and analogy of the concept wisely. Thus, students would clarify with the facilitator when dealing with the problems. Part C was students' motivation where Questions 1, 2, 3 and 4 which referred to the exposure on the variety of learning styles, various environments, consequences of certain actions and competitions. Items for the variety learning styles were online questions from the Curriculum Information Document Online System (CIDOS) to add more interest and value. Next was learning by storytelling and memorization which created added value knowledge. Besides, the sitting in groups was good for the students for they could discuss and share ideas to solve problems rather than sitting alone.

The next items in the questionnaire for students' motivation were the varying environments. It was about choosing different places, lighting, layout, and scenes of the classroom and applying mental-calculations that affected attention during learning and the assessment process. The consequences of certain actions were paying attention, submitting assignments on time and respecting the lecturers. The items on competition referred to enjoyment while participating actively in group discussions and avoiding from feeling bored and sleepy during class. To complete the questionnaire, students needed to fill in the Part C, Question 6 which referring to the challenging topic and its reasons in Engineering Mathematics 3 (BA301).

DATA ANALYSIS

Descriptive statistics of central tendency (mean, median, and mode) and dispersion (standard deviation and variance) were utilized. Table 2 shows the summary of the data of 80 respondents, which includes the semester categories (Semester 3, 4 and 5), gender (Male or Female) and results (in grades) of previous Engineering Mathematics.

TABLE 2
Analyses of Total Respondents Based on Semester, Gender and Results of BA201

Number	Total Respondents / / Semester			Total of Respondents / Gender		Engineering Maths 2 Number of students / Results BA201) fo)							
	Sem 3	Sem 4	Sem 5	Male	Female	A	A	B+	B	C+	C	D	Ongoing (June 2012)
1	61	16	3	43	37	10	2	7	28	7	21	4	1
Total		80			80					80			

RESULTS AND FINDINGS

Based on the feedbacks gained from the questionnaire. Below are the information gathered on the acceptance of active learning in Engineering Mathematics 3. The information include elements of active learning, scores, mean, standard deviations and percentages.

TABLE 3
Findings of Active Learning Elements

Number	Elements of Active Learning	Scores	Mean	Standard Deviation	Percentage (%)
1	Role playing	Somewhat agree	4.663	0.5078	93
2	Mastery Learning	Somewhat agree	4.634	0.5083	93
3	Case Studies	Strongly agree	4.609	0.5221	92
4	Cooperative Learning	Somewhat agree	4.606	0.5313	92
5	Problem Solving	Somewhat agree	4.425	0.5886	89

From the table above, role playing had the highest mean score (m 4.663, sd 0.5078) and 93% as compared to the other elements of mastery learning, case studies, cooperative learning and problem solving. Perhaps this was due to the respondents' tendency to learn given a role play whether as a mentor or mentee and the ability to relate the concepts learned as well as knowing the importance of Mathematics in daily life. Hence, they liked to solve Mathematics problems in groups inside or outside the classroom. In addition, the elements of problem solving indicated problem solving had the lowest mean (m 4.425, sd 0.5866) and 89%. Perhaps this was due to problem solving needed special skills which included diagnosing, applying, analysing and synthesising. This situation might be related to the background knowledge of Mathematics since secondary schools and the previous semester (BA201) which showed only 10 out of 80 respondents (12.5%) obtained an A.

TABLE 4
Elements in Encouraging Students' Motivation

Number	Elements of Encouraging Student's Motivation	Score	Mean	Standard Deviation	Percentage (%)
1	Expose the variety learning styles	Somewhat agree	4.546	0.6027	91
2	Varying environment	Somewhat agree	4.476	0.5308	90
3	Consequences of certain actions	Strongly agree	4.489	0.5336	90
4	Competition	Strongly agree	4.634	0.5509	93

Positive influence would produce good competition during the learning process. Results showed the element in encouraging motivation i.e. competition element had the highest mean (m 4.634, sd 0.5509) and 93%. The respondents gave positive commitment when the facilitator rewarded them with praises, motivational quotes, surprise presents and consistently stimulating them to succeed without giving up even if they failed. Instead of learning at the same place, changing the sitting positions in the groups motivated the participants to actively participate. For varying environment, the mean indicated 4.476, sd 0.5308 and 90%.

TABLE 5
Relationship between Active Learning Approach and Students' Motivation

Active Learning	Elements of Encouraging Student's	Correlation 'r'
Role Playing	Expose the variety learning style	**0.7190**
	Varying environment	**0.5605**
	Consequences of certain actions	**0.4926**
	Competition	**0.6915**
Mastery Learning	Expose the variety learning style	**0.7913**
	Varying environment	**0.5111**
	Consequences of certain actions	**0.4819**
	Competition	**0.7736**
Case Studies	Expose the variety learning style	**0.8436**
	Varying environment	**0.5721**
	Consequences of certain actions	**0.5041**
	Competition	**0.7431**
Cooperative Learning	Expose the variety learning style	**0.7716**
	Varying environment	**0.5560**
	Consequences of certain actions	**0.4872**
	Competition	**0.5949**
Problem Solving	Expose the variety learning style	**0.4850**
	Varying environment	**0.7113**
	Consequences of certain actions	**0.7289**
	Competition	**0.4633**

- **Significance level at 0.05**

Pearson's correlation coefficient, or small r, represents the degree of linear association between any two variables. It is also dimension-free, but it requires a good deal of variability or randomness in the outcome measured.

Degree of Correlation

1. **Perfect**: If the value is near ± 1, then it is said to be a perfect correlation.
2. **High degree**: If the value lies between ± 0.75 and ± 1, then it is said to be a high degree of correlation.
3. **Moderate degree**: If the value lies between ± 0.25 and ± 0.75, then it is said to be moderate degree of correlation.
4. **Low degree**: When the value lies between 0 and ± 0.25, then it is said to be a low degree of correlation.
5. **No correlation**: When the value is zero.
   (Guilford's Rule of Thumbs)

Table 5 above shows the highest correlation was between active learning approach and case study (r=0.8436). This was followed by mastery learning (r= 0.7913) and thirdly with competition in mastery learning (r=0.7736). The moderate degree of correlation was between active learning approach and competition in problem solving w(r= 0.4633). The findings above also showed there existed a significantly high degree of relationship between exposure to the variety learning style in case studies (r=0.8436).

TABLE 6
Relationship between Role Playing Approach and Students' Motivation

Active Learning	Elements of Encouraging Student's	Correlation r
Role Playing	Expose the variety learning style	**0.7190**
	Varying environment	**0.5605**
	Consequences of certain actions	**0.4926**
	Competition	**0.6915**
Role Playing	**Encouraging Students' Motivation**	**0.6159**

*** Significance level at 0.05**

The findings above show that there was a highly significant correlation between role playing and exposure to the variety learning style (r=0.7190). However the overall correlation between role playing and encouraging students was at amoderate level (r= 0.6159).

From the data analysis, the most challenging chapter and contents in Engineering Mathematics 3 (BA301) are shown in table 7 below:

TABLE 7
The Most Challenging Chapters, Percentage and Reasons

Number	The Most Challenging Chapters and Content	Percentage (%)	Reasons of Challenging
1.	Descriptive Statistics (CLO1)	1	Solve problem grouped and ungrouped data within certain time constraint
2.	Area of Irregular Shapes (CLO2)	4	Must understand clearly about terms of width, sub intervals and calculate the curve area.
3.	Progressions (CLO2)	34	Difficulties to understand the requirement of questions and tricky statement
4.	Matrices (CLO3)	9	Needs understanding of types, and multiplying determinants, scalar matrices
5.	Numerical Methods (CLO3)	52	Many subtopics with different ways of solving and formulae. Long steps and needs to remember all the methods.

The Table shows Chapter 5, the Numerical Methods (CLO3) was the most challenging. The Chapter included in the BA301 syllabus of the Department of Mathematics, Science and Computer was the advance knowledge of Matrices and Algebraic concepts. What was challenging, the subtopics included the Gaussian Elimination Method, Doolittle, Crout LU, Cholesky, Iteration and Newton Raphson. Basically, the chapter was more on solving three simultaneous linear equation, x, y and z using the Matrices form. Each of the subtopics needed different methods to follow besides testing the students' ability to apply Algebraic, Substitution Method, Differential (dy/dx) and multiplication of Matrices type (3x3).

CONCLUSION

The active learning approach encouraged learning experiences that could be effective and interesting. It was especially critical in an online environment where facilitators and students did not meet. Some activities in active learning such as role playing, mastery learning, case studies, cooperative learning and problem solving had significant relationships. For example there was a significant but moderate relationships between active learnng and encouraging students' motivation (r=0.6159). For the elements of active learning, role playing (mean=4.663) and mastery learning (mean = 4.634) indicated the highest percentage (93%), while for motivational elements of competition (mean = 4.634) was 93%. The variety learning styles in case studies had a significant relationship with active learning (r=0.8436). The acceptance of active learning among the students impacted positive attitude such as interested in each of the games implemented and energetic, which also influenced the passive students to participate and did some exercises as well as positively getting involved in competitions during class. They projected highly self-esteem and self-confidence and improved their communication skills. Even though from the research, 52% of the respondents stated Chapter 5: Numerical Methods was the most challenging topic, their mind set of absorbing the difficulties changed them to be interested in learning in depth about that topic. They eagerly memorized formulae, followed the steps given and they ensured themselves to avoid careless mistakes in the Mathematical' problem solving. Meanwhile, active learning hasd been successfully applied over the years among young children, and hence it is also suitable to be implemented among adult learners with good strategic teaching approaches. Lastly, students will feel the sense of self-belonging. With such teaching approaches even mass lectures can have active participations and social skills will blossom in a good relationship.

RECOMMENDATION

In order to sustain the success in academic achievement, mainly in Mathematics or in any other specific courses, it requires the commitment before, during and after each classroom sessions. The mood and scenario of the learning process will be determined by the way of the facilitators are handling it. For the process of encouraging motivation to proceed in a study or continue the success in academics, one should consistently apply the active learning approach. It is suggested for future to use, short videos in Mathematics education should be encouraged to foster personalized learning. Students need to be activated with the elements of role playing, mastery learning, case studies, cooperative learning and problem solving exercises. The facilitators must know the tricks and techniques to motivate the students to love Engineering Mathematics by inviting them to look around, buildng relationships and using the framework between theories as well as practices in real life. Next, students are enhanced and changed in the dimension of thinking from "Mathematics is difficult" to "Let's enjoy actively the challenges in learning Mathematics". The facilitators must be patient, avoid the feelibs of frustrations, and be energetic in handling the slow learners, laziness or "Dyscalculia". Furthermore, it is recommended to develop attractive learning materials such as online materials, logical games and drawing that can generate the right or left brain usage. Besides, they can form the discussion groups in WEB 2.0 applications to monitor, share and brainstorm techniques to encourage active learning. One important thing to be considered is to continue handling the role playing technique among excellent students and ensure it will become an encouraging motivation. Facilitators should guide students to collect real data based on the current issues and phenomenon so that the alertness is always triggered in their mind. Students should be influenced and convinced to attend seminars or activities related to learning Mathematics. Lastly, they must practise solving problems in Mathematics every day, to stimulate the mental-calculation to become progressive active learners and trainers. Future researches with related representative data, there should be more inclusive active learning strategies in order to nurture motivation**.**

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