Improving Students' Self-efficacy Used Brain Based Learning in Mathematics

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Abstract. The article explained to Brain Based Learning (BBL) to improve the students' self-efficacy in mathematics. It is a foundation to support of science and technology and it must be taught in each level of education. Self-efficacy is the important ability in mathematics learning. Self-Efficacy learning connected to convince the students' self and the students' endurance in learning to solve the mathematics problem. Students who had high self-efficacy, they did not give up to find the solution in mathematics. Teachers had an important role to increase the students' self-efficacy in teaching learning process. They are educators who had abilities to select and implement the better learning model in improving the students' self-efficacy. BBL was chosen to be the alternatives in learning model. It stimulated the self-efficacy students' brains. On the other words, BBL can be the one of learning model to be implemented in improving self-efficacy. It created comfort situation, emotional, physically and facilitated the students to get the goal in learning, so the students got motivation and self-efficacy.

1. Introduction

Mathematics is one of important studies in educational system. Mathematics as a basis of science and technology has an important role in various disciplines and human mind-set development. Mathematics is used to develop an ability of logical, analytical, critical, and creative thinking to solve problems. Those competencies are required for pupils to have and to utilize information in order to survive in difficult and changing situation in the future. NCTM [1] explained, "In this changing world, those who understand and can do mathematics will have significantly enhanced opportunities and options for shaping their futures. Mathematical competence opens doors to productive futures". Therefore, mathematics is important to put as a subject for elementary education to higher education.

Mathematic learning not only emphasizes on science aspect, but also on attitude and skill. Student's attitude affects learning achievement. Self-efficacy is one of learning achievement's effects. It is as a belief of individual's ability to achieve goals. Bandura [2] explained, self-efficacy takes a big role on mathematics' achievement and writing ability. According to Schunk & Miller in Pajares & Urdan [3], they explained that self-efficacy has an important impact on motivation and achievement.

Self-efficacy is a part of mathematic learning. Student's ability to complete math problem relates to the student's ability of mathematic learning. Student fruitfulness to complete math problem is affected by student's belief to complete and comprehend mathematical characteristics [4]. Student's self-efficacy affects to student's quality to complete the task. In line with Schunk [5], "self-efficacious students mastered various academic tasks better than students with weaker self-efficacy. Many students have low performance in self-efficacy because they have lack of belief in their ability to

complete math problems. Experience of unsuccessfulness to complete math problems may affect students to be doubt in mathematics and also be doubt in a career, which includes mathematics [6].

A teacher is a key element on learning system, which is expected to develop student's self-efficacy. Teacher requires effective learning, which can increase student's self-efficacy. It may use Brain Based Learning (BBL). It is aimed to create conducive mathematic learning. It applies how brain optimally learns. In BBL application, three main strategies are performed: creating learning environment, which may challenge student's thinking, creating pleasant learning environment, and creating active and meaningful learning atmosphere. Teachers take a role in creating the three strategies in order to stimulate brain to develop, so it may improve student's motivation. Hence, BBL model is expected to facilitate students to have positive thinking of learning in order to develop student's self-efficacy.

2. Mathematic Learning

Santrock [7] explained that learning is a process to affect behaviour permanently since knowledge and ability to think occur as the experience's result. It is line with Phye's [8] explanation, which mentioned that "learning is vieved as a relatively permanent recognization of cognitive structure, such as in the integration of existing schema, or the development of new schema". The preivious statement defines that learning is considered as a structure of cognitive compilation, of which through several schemes may create knowledge and develop an ability as learning result.

Learning can also be defined as the manifestation of social values in addition to cognitive, affective and psychomotoric activities. Arends [9] supports this notion by stating that "Conceptions of teaching reflect the values and social philosophy of the larger society, and as these elements change, so, too, does society's view of its teachers". It implies that the learning concept as the developing values and philosophy which the society firmly hold; therefore, teachers must draw their attention on the values embedded in the learning objectives. Nitko and Brookhart [10] explain that "instruction is the process you use to provide students with the conditions that help them achieve the learning targets". Sit is necessary for students to acquire abilities which enable them to comprehend various conditions and problems in learning process. The problems do not only limit to numbers but also problem solving questions.

The most important aspect in learning process is to accomodate the behavioral changes in daily life. This goal becomes the ultimate point in all subjects taught in school including math subject. Lawrence in Chambers [11] states that "mathematics is the study of pattern from the word around us do anything we learn in math has literally thousands of applications, in arts, sciences, finance, health and leisure". Mathematics teaches the students about the patterns which exist in our daily life. Besides, this subject is applicable to all disciplines necessary to establish good communication in society. Mathematics is not merely a theory since it can be directly applied in the social communication.

In teaching Mathematics in schools, teachers must have a good strategy to deliver learning material effectively. Regarding of this matter, NCTM [1] explains that "effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it". An effective mathematics learning refers to the ability of the teachers to accommodate what the students needs and to explore the students' skills in order to achieve learning goals for both teachers and students. The prior experiences can be used during the learning process in schools.

Mathematics is one of learning aspects which is ultimately important in the daily life. It is assumed that all learning processes must involve the integrated skills and knowledge. The decisive learning objective does not solely depend on the prior knowledge. Teachers are expected to provide interesting and joyful mathematics learning. In implementing mathematics learning process, teachers encourage students to use their thinking and reasoning abilities. Long, Wood, Littleton, Terri & Sheey [12] underline that "learning is a central and pervasive concept in education and involves changes in pupils' knowledge, skill and understanding". Learning process needs students' three skills, so a teacher carries a duty to shape pupils' skill comprehensively.

Mathematics learning process provides pupils a method in solving the existing problems. Further, Suneetha, Rao & Rao [13] explain that "the study of mathematics help to develop all the mental abilities of students. It provides all the opportunity to the students to develop their observation power, logical power, memory, concentration, originally, power of discovery, thinking power, reasoning power, self-reliance and hard work, etc.,". It emphasizes that mathematics learning develops the mental ability for the students to learn, observation skills, logical reasoning skills and other mental abilities. These processes are useful for improving students' cognitive ability and developing students' mental ability.

Mathematics learning should be conducted within an atmosphere in which students feel less pressure in learning. Self confidence enables them to study in a relaxing learning situation. Mathematics learning in school is expected to enhance pupils' knowledge, capability and attitude to achieve learning objectives. Haylock and Thangata [14] mention that mathematics learning objectives consist of 5 important aspects: 1) utilitarian; 2) application; 3) transferable skills; 4) aesthetic; and 5) epistemological. Due to the desirable learning objectives, teachers must be able to create a more conducive and effective learning atmosphere. Thus, teachers must have another skill in addition to teaching skill. A teacher must be able to use an interesting learning method to attrack students' curiosity during the learning process. If perceiving from the cognitive aspect, a teacher needs to pay more attention to the pupils' behavior and ability because mathematics learning does not only care for the academic achievement but also mathematics problem solving. Teachers need to comprehend many factors, one of which is the psychological factors in learning consisting of self efficacy, emotion and motivation.

3. Self-efficacy

Self-efficacy is essential for students during the learning process. Bandura [15] explains that self-efficacy refers to pupils' confidence to manage and accomplish the tasks. A student with high self-efficacy finishes the tasks well and persistently. Self-efficacy enables the students to differentiate good or bad, and correct or wrong. They are also capable to decide whether they can do the assignment or not. Thus, students' self-efficacy affects their persistence in facing adversities and finding solution for the problems.

Bandura & Adams [16] explain that expectations of personal efficacy stem from four main sources of information include performance accomplishments, the vicarious experiences of observing others succeed through their efforts, verbal persuasion that one possesses the capabilities to cope successfully, and states of physiological arousal from which people judge their level of anxiety and vulnerability to stress. It can be summed up that self-efficacy stems from 4 important aspects. Bandura [17] delineates the sources of self-efficacy consist of performance accomplishments, vicarious experience, verbal persuasion, and emotional arousal. Performance accomplishments refer to failure and success. Self-efficacy is possible to decline if students fail in performing the tasks. On the other hand, self-efficacy rises up when students succeed in finishing their tasks.

Vicarious experience is the source of self-efficacy resulting from the observation on others' failure and success. Success is believed to enhance self-efficacy when students try to finish similar assignments. Others' failure will impaire students' self-efficacy when performing similar tasks. Verbal persuasion describes a condition in which a student has more confidence in doing certain tasks after getting advice or guidance from other people. Emotional Arousal is closely related to students' emotional states. More intense emotion will decrease students' self –efficacy.

Students are able to accomplish their tasks when having self-efficacy. However, students have different level of self-efficacy which mainly results from three dimensions; magnitude, generality and strength [17]. Magnitude describes the complexities of problems. This dimension determines decision which students will make and attitude which they will avoid. Students' self efficacy in accomplishing certain tasks in various activities belongs to generality dimension. Higher self-efficacy sustains students' persistence to accomplish tasks. Despair will impact the quality of students' tasks.

The indicator of self-efficacy depends on those three dimension. Moores, Chang, & Smith [18] mentions that the indicators of self-efficacy cover ; 1) the assurance to finish the tasks; 2) self-motivating ability to finish certain tasks, 3) confidence to finish all tasks by themselves; 4) confidence to cope with the failure and move on from the failure; 5) confidence to accomplish tasks at any situation and condition. Those indicators serve as the benchmarks for teachers to discover to what extent the students are able to reach succees in finishing all tasks.

4. Brain Based Learning

Brain-based learning is a learning model which puts more emphasis on optimizing the function of brain at the fullest way. Brain can work at the maximum level when its potential can be utilized optimally. Brain-based learning refers to a learning model which depends on the natural brain function and are mostly influenced by the learning process environment. Brain-based learning is argued as the suitable method for the brain to work naturally and is designed to maximize the students' potential to learn. This learning method provides condusive atmosphere for students to learn and prepare their brain to store, proceed and retrieve the information in a joyful learning process [19, 20, & 21]. The important point in brain-based learning is a enjoyable learning environment which also underlines the correlation of learning emotional and the ability of brain to absorb the materials. The fundamental in brain-based leaning is the ability of students' brain to focus on the materials taught when these students have a good learning emotional. Having good emotional state while learning something enables the students to focus in studying and to build better motivation. Ratzer explains the strategies to optimize the function of brain in learning process. One of the best strategies is 'Elicit emotion" which carries the meaning that Emotion can transform a disaffected learner and generate enthusiasm in a student who doesn't care [22]. Students will have a smoother way of learning if teachers are good at keeping the students' attention by involving emotional and reasoning ablities on students.

The peculiar aspect in brain-based learning is the use of classical music during learning process. This music is believed to stimulate the brain nerves to work more properly. As a result, students memorize the material more easily since they are studying in a relaxing environment. The main purpose of using this classical music is to put these students in a soothing atmosphere, so they have more concentration on the subjects taught. Campbell [23] believes that music increases students' potential, enables students to memorize the lessons faster, and induces students' creativity.

4.1. Principles of Brain Based Learning Model

It is found twelve principles of brain based learning by Caine & Caine [24], which need to comprehend: 1) brain is a parallel processor; 2) learning engages the entire physiology; 3) the search for meaning is innate; 4) the search for meaning occurs through patterning; 5) motions are critical to patterning; 6) every brain simultaneously perceives and creates parts and wholes; 7) learning involves both focused attention and peripheral attention; 8) learning always involves conscious and unconscious processes; 9) we have at least two types of memory systems: spatial and rote learning; 10) the brain understands and remembers best when facts and skills are embedded in natural spatial memory; 11) learning is enhanced by challenge and inhibited by threat; and 12) every brain is unique.

Principles in the application of brain based learning model can be a basis to conduct learning system using this model. However, three out of twelve principles by Caine & Caine are important to be considered by teachers, who apply brain based learning, such as: 1) orchestrated immersion, creating a learning environment, which can stimulates students to think, 2) relaxed alertness, an attempt to dismiss student's fear to learn and to involve students in a pleasant learning environment, 3) active processing, a possibility of students to have active and meaningful learning [25]. Therefore, teachers should provide a comfortable-safe learning environment for students.

4.2. Syntax of Brain Based Learning Model

Besides the previous principles, according to Jensen [26 & 27], there are steps for brain based learning, which teachers should consider.

Table 1. Syntax of Brain Based Learning Model

Syntax of Leaning	Student and Teacher's Activity
Pre- Exposure	1. Pay attention to student's brain nutrition and make sure students to drink enough water. 2. Conduct muscle stretching by bending body down to the right and left or perform simple physical activities / movements before learning. 3. Find student's passion and background. 4. Have a learning review before mind mapping.
Preparation	1. Present problems of facts like symptoms of daily activities related to materials or conduct apperception before starting the learning process. 2. Use concrete media before relating to learning materials.
Initiation and acquisitions	1. Prepare students to conduct observation outside class. 2. Give student a worksheet. 3. Present a project, which may facilitate student's favorite learning activity.
Elaboration	1. Students have a group discussion and class discussion, and report the discussion's result in the front of class. 2. Question and Answer 3. Mind mapping in a group.
Incubation and insert a memory	Play music during learning process and once ask students to stretching in order to make students relaxed and enjoyable.
Verification and checking conviction	1. Teachers and students conclude what is being discussed during the day. 2. Give students a quiz. 3. Give students opportunity to write learning reflection of what they have discussed.
Celebration and integration	1. Give active students appreciation 2. Allocate time for students to share with their friends. 3. Display student's works

5. Brain Based Learning to Improve Self-Efficacy

Brain-Based Learning (BBL) is a learning model to optimize brain to learn. BBL creates a learning environment, which can stimulates brain to develop gradually. Brain's ability to develop is acquired from learning process experienced by students. Learning process presents various experiences for students. Strong emotional experience can be restored permanently in brain. Students will remember the best and the worst event of life. BBL model involves two aspects, which can improve self-efficacy such as mastery experiences and improvement of physical – emotional conditions in learning process. Both aspects affect self-efficacy in addition between BBL and academic self-efficacy are related. It presents in the following chart.
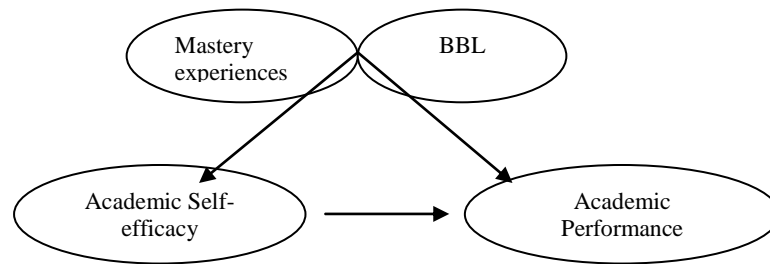
Figure 1. The effect of mastery experiences and BBL

Hill [28] states that the presence of relation between BBL and self-efficacy. BBL develops mastery experiences in learning process in addition BBL and mastery experiences may increase the academic effectiveness and performance. It also can create a direct relationship between mastery experiences and academic performances. Hence, academic self-efficacy can increase student's performance towards learning retention. Learning activity applies BBL model, which affects student's attitude in learning process. The application of learning environment can make students consider that the whole content can be easier and more meaningful. Research which has been conducted by Tufekcial & Demirel [29] has provided the findings that brain based learning influences qualitative learning. They explain that students have stated that content has been presented in a meaningful whole, importance has been given to their feelings and that they have had a rich learning life organized according to the student preferences. To sum up, brain-based learning has a positive effect on the learning process. Haghighi [30] supports learning activity with BBL model can improve student's performance and attitude in elementary level. Due to BBL creates active and meaningful learning situation, which prioritize coziness during the study, students are being motivated and confident.

The application BBL involves student's emotion during learning process in addition to mathematic learning. It can create pleasant and enjoyable situation. Teachers manage to present positive emotional affection of mathematic learning; therefore, students can be competent and can enjoy learning process. Listening music can be one of ways to stimulate student's emotion and intelligent. It also can help students to stay focused on mathematic problems presented at class [31]. In addition, Jensen (27) states that listening to the music can improve student's comfort and change class's situation to become a fun and pleasant place. In line with Call [32], he's states music can be used to improve pleasant feeling and to celebrate student's performance during learning process. According to the previous explanation, the application of BBL is expected to improve self-efficacy in mathematic learning, which formerly frightens students.

6. Conclusion

According to the research, it concludes that Brain-Based Learning can improve and develop student's self-efficacy especially to learn mathematics. It is represented by the steps in learning on Brain-Based Learning model, which creates student's experience to survive on failure and success or called mastery experiences. In addition, it acquires that students can build self-efficacy of their ability in line with self-efficacy indicators.

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