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The Effectiveness of the Brain-Based Teaching Approach in Generating Students' Learning Motivation Towards the Subject of Physics: A Qualitative Approach

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The aim of this study was to measure the effectiveness of the BBTA (brain-based teaching approach) in dealing with issues related to the learning motivation towards the subject of physics amongst secondary school students in Malaysia. This research sample constitutes 100 Form Four science stream students from two science secondary school in the Northern Peninsular, Malaysia. The implementation of this study was made based on the qualitative approach using achievement analysis of the experimental group and control on pre- and post- tests. Data collection techniques involved the questionnaire of physics learning motivation, the questionnaire of student learning style, journal documentations and student interviews. Qualitative data obtained were then analyzed using the progressive focus technique and were then triangulated to obtain the required results. The findings of this study showed that the BBTA module was an effective teaching approach in dealing with the issue aforementioned. It was found that students who followed the BBTA module possessed a better physics learning motivation compared to students who received CTM (conventional teaching method).

Keywords: BBTA (brain-based teaching approach), students' learning motivation, physics education

Introduction

In the Malaysian education scenario, it has been found that students generally lack interest towards the subject of physics compared to other science subjects in schools (Abd. Karim et al., 2006; Lee, Yoong, Loo, Khadijah, Munirah, & Lim, 1996). It has also been found that they are more inclined to avoid choosing subjects involving physics at the higher education level (Abd. Karim et al., 2006). Results from studies conducted have identified that one of the major causes that has contributed to the lack of student interest in the subject of physics in schools was ineffective instruction methods (Sidin, 2003; Syed Zin, 2003; Syed Zin & Lewin, 1993). Teachers have been found to be overly inclined towards linear instruction techniques, rote learning methods such as memorizing and notes copying, doing exercise drills and focus only on important topics to ensure their students are able to pass their exams in physics (Syed Zin & Lewin, 1993; Ngah Razali et al., 1996). This phenomenon has indirectly caused physics instruction in schools to appear to be too academic, passive and mechanistic (Malcom, 1989; Forgarty, 1992). Ideas in physics taught as abstract concepts and separated from students' real world experience, particularly when the learning process involves only one particular type of

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teaching medium, certainly makes physics education in schools a dull subject (Hestenes, 1992). Therefore, most students have been compelled to label physics as a difficult subject matter to study, thus resulting in a general lack interest towards the subject.

Thereby, it has been found that a more effective teaching strategy is needed to attract students' attention to learning physics successfully. Latest achievements in the field of neuroscience have shown that a more comprehensive approach is required to ensure the effectiveness of a teaching and learning process (R. Caine & G. Caine, 1991; Jensen, 1996). This development fundamentally prompted novel explorations on a more brain compatible strategy known as BBTA (brain-based teaching approach).

In general, the BBTA is a strategy implemented based on the brain-based learning principles developed by R. Caine and G. Caine (1991); R. Caine, G. Caine, McClintic, and Klimek, 2005; Jensen (1996); and Sousa (1995), based on theoretical observations and latest research discoveries related to the human brain. It was designed in such a way so that it will be compatible to the structure, tendency and optimum function of the human brain, to ensure the effectiveness of a student's learning process. Although all teaching processes are essentially brain based, compared to other methods, the BBTA is a strategy specifically created to value the true potential of the brain in a learning process. Unlike traditional methods, this approach is based on the theory that every individual keeps on learning, as long as the human brain is not prohibited from undergoing its routine processes (R. Caine & G. Caine, 1991; Caine et al., 2005; Jensen, 1996). The assumption is made on the basis of the fact that the human brain is an organ of extremely high potential and that every student is able to learn effectively, if their brain is given the opportunity to function in an optimum manner (Jensen, 1996). With emphasis on the integration of optimal learning states, involving aspects of relaxed alertness, orchestrated immersion and active processing, this strategy is believed to be able to fulfill various learning requirements whilst fostering a higher interest for the students to master the subject. Based on these characteristics, the BBTA is perceived to be a potential solution in dealing with issues related to the learning motivation towards the subject of physics amongst students.

Brain-Based Learning Principles (R. Caine & G. Caine, 1991, 2005; Jensen, 1996; Sousa, 1995)

According to this theory, each education should integrate all of these elements:

(1) Relaxed alertness—emotional climate:

(a) The brain learns best in its optimal state;

(b) The brain's bio-cognitive cycle influences the learning process;

(c) Emotions are critical to the brain's patterning process;

(d) Learning is enhanced by challenge and inhibited by threat;

(e) Positive climate stimulates brain function;

(f) Appropriate environment, music and aroma excite brain activity.

(2) Orchestrated immersion—instruction:

(a) The brain is unique and is a parallel processor (able to perform several activities at the same time);

(b) Search for meaning comes through brain patterning process;

(c) The brain processor works in wholes and parts simultaneously;

(d) Complex and active experiences involving movements stimulate the brain development;

(e) Learning engages the whole physiology.

(3) Active processing—strengthening:

(a) Learning involves both focused attention and peripheral perception;

(b) Learning involves both conscious and unconscious processes;

(c) Learning always takes place in two memory approaches—to retain facts, skills and procedures; and/or making sense of experience;

(d) The brain can easily grasp and remember facts and skills embedded in its memory space;

(e) Rehearsal necessary to retain information in the brain.

This study was designed to measure to what extent a student's learning motivation can be generated by the implementation of the BBTA in secondary school physics education. Explicitly, this research was conducted to study the learning motivation patterns of physics amongst students who are exposed to the BBTA as compared to students who are only exposed to CTM (conventional teaching method).

This study was implemented based on the illuminative model to gather the required data where the researcher was also involved in the total process by taking up the role as both the participant and the observer in all the activities which the students are subjected to. Two data gathering methods, namely, document analysis (journal documentation) and case study (interview technique), were chosen to complete this study. The research sample constitutes 100 students: 50 in an experimental group, and the other 50 in a control group, randomly selected from two equivalent schools. The study population is Form Four science secondary school students in the northern peninsular Malaysia. The experimental group was then given the BBTA whereas the control group followed the conventional method, in learning the topic of force and motion, according to the current Form Four physics syllabus. Students involved were required to write a journal of their motivational state before and after the experimental treatment. At the same time, a structured interview session was also carried out on eight randomly selected students to verify data acquired from students' journals.

Implementation Strategy of BBTA

The implementation of the BBTA this study is, in general, based on the integration of the brain-based learning principles (R. Caine & G. Caine, 1991; Caine et al., 2005; Sousa, 1995, 1998; Jensen, 1996) via seven brain compatible learning phases (Sousa, 1995; Smith, 2003), which are: (1) Activation; (2) Clarify the outcome and paint big picture of the lesson; (3) Making connection; (4) Doing the learning activity; (5) Demonstrate student understanding; (6) Review for student recall and retention/Closure; and (7) Preview the new topic.

Research Objectives

This study was designed to measure to what extent a student's learning motivation can be generated by the implementation of the BBTA in secondary school physics education in Malaysia. Explicitly, this research was conducted to study: (1) the effectiveness of the BBTA in generating students' learning motivation; and (2) the learning motivation patterns towards the subject of physics; amongst those who are exposed to this teaching method (BBTA) as compared to those who are only followed the CTM.

Research Methodology

This quasi-experimental research approach involved a sample constitutes 100 students: 50 in an experimental group and the other 50 in a control group, randomly selected from two equivalent schools. The study population is Form Four science secondary school students in the Northern Peninsular, Malaysia. Two data gathering methods, namely, document analysis (journal documentation) and case study (interview technique), were chosen to complete this study. The experimental group was then given the BBTA by the selected and trained (for at least six hours) physics teacher whereas the control group followed the CTM, in learning the topic of "Force and Motion", according to the current Form Four physics syllabus. Students' learning motivation from both groups was measured before and after the intervention to determine the effectiveness of the implemented BBTA. They were required to write a journal of their motivational state before and after the experimental treatment. At the same time, a structured interview session was also carried out on eight randomly selected students to verify data acquired from students' journals. The implementation of this intervention took about three months to be completed. Data obtained from students' journal documentation and interviews were then analyzed qualitatively using the progressive focus technique and then triangulated to obtain the required results.

Findings

Students' Physics Learning Motivation Before the Experimental Treatment

From the 50 journals belonging to students who followed the BBTA module, analysis has found that only 11 students possess high learning motivation, 23 students possess medium learning motivation and 16 students possess low learning motivation.

In relation to that, amongst the 11 students possessing high learning motivation, six students mentioned pure interest as main inspiration, three students mentioned knowledge aspects and two mentioned the importance of physics as main stimulation for their motivation. Of the 23 students possessing medium learning motivation, seven confessed a lack of interest in the subject of physics; seven acknowledged a low understanding of physics, six found learning physics discouraging or boring, and the final three students account difficulty factors, calculations and rules as the demotivator to physics education. Furthermore, based on the 16 students possessing low learning motivation in physics, as many as seven stated that they were not interested in physics, three confessed that they did not understand physics, a further three felt that learning physics was depressing or boring, and the final three students accounted difficulty factors, calculations and rules as the demotivator to physics education.

Results from the interviews conducted verified the findings obtained from the analysis of the students' journals. From the eight students interviewed, four students were found to possess simple motivation and the other four possess low motivation. Students A, B, C and D indicated their reasons for having medium motivation was based on the grounds of lack of comprehension, lack of interest in subjects involving calculation and also a general lack of interest in physics. On the other hand, students E, F, G and H were found to have low motivation, because they considered physics a difficult subject, in addition to being uninterested, they had an aversion to calculations and could not understand what was being studied in class. When the triangulation process has been completed, overall results showed that the responses acquired were somewhat similar to the comments written down in students' individual journals.

As for the group of students who received CTM, based upon the 50 journals analyzed, 13 students were found to possess high learning motivation, 20 students possess medium learning motivation, while the remaining 17 students possess low learning motivation.

Among the 13 students possessing high learning motivation, as many as six students mentioned pure interest as main inspiration, four attributed comprehension as main motivator and three accounted the importance of physics in their lives as main inspiration. Of the 20 students possessing medium learning motivation, eight confessed a lack of interest of the subject of physics, seven found learning physics discouraging, four reasoned a lack of understanding in the subject of physics and the other one stated that physics was a pretty tough subject to be learned. In addition, out of the 17 students found to possess low learning motivation, ten stated that they were not interested in physics, four confessed that they did not understand physics and the final three students felt that learning physics is discouraging, thus demotivating them from acquiring further interest in physics.

Results from the interviews conducted also verified the findings obtained from the analysis of the students' journals. From the eight students interviewed, two students were found to possess high learning motivation, three students were found to possess medium learning motivation and the other three were found possess low learning motivation. Students I and II were really fond of physics and attributed their love of calculation as a key factor to the possession of high learning motivation. Students III, IV and V admitted to possessing medium learning motivation due to the lack of understanding in the subject of physics and did not enjoy studying physics. On the other hand, students VI, VII and VII were found possess low learning motivation due to the lack of amusement in the learning process, lack of interest in physics and generally did not understand physics. When the triangulation process has been completed, overall results showed that the responses acquired were somewhat similar to the comments written down in students' individual journals.

Based on the analysis conducted, it has been found that before the experimental treatment was carried out, the overall sentiment gathered was that students possessed a low motivation in physics. Result research showed that from the total of 100 students included in this study, less than one fourth of them, which was about 23%, confessed to having a high motivation to study physics. The remaining 77% lacked the interest and were unmotivated to study physics. Results obtained also indicated that there were no huge gaps between the responses given by students in the experimental group and the control group when asked for their comments on the motivation to study physics. The most influential factors that have contributed to this motivational state include the lack of interest in the subject, lack of understanding in the taught subject, along with the viewpoint that physics education is a discouraging subject. In addition, research results showed that there were no early differences in physics learning motivational patterns between students in the experimental group and that of the control group.

Students' Physics Learning Motivation After the Experimental Treatment

Results from the analysis of students' journals from the experimental group (exposed to BBTA) showed that there was a change in physics learning motivational patterns after the implementation of the experimental treatment. It has been found that the motivational pattern of most of the students involved has turn out to be more positive. Only a small number of students still possess low learning motivation.

From the 50 analyzed journals belonging to students who followed the BBTA module, 25 students were found to now possess high learning motivation, 18 students possess medium learning motivation, while only seven remaining students still possess low learning motivation. In contrast to the results obtained before the experimental treatment, it has been found that the major catalyst to the motivational change among the majority of the students from negative to positive is the factor of learning pleasure, enjoyment of the teacher's teaching method and the ease of comprehension of the subject of physics.

Based on the findings of 25 students who claimed to possess high learning motivation, as many as 12 students acknowledged pleasurable learning conditions as a key factor to the possession of high learning motivation. Eight students stated that they had become more motivated when studying became easily understood. Three students placed interest as a key aspect of consideration in their motivational assessment and two students took into account the facility of strategic teaching involved in the learning process in helping them to remember more of what was being studied. From the 18 students who possess medium learning motivation, six students confessed a lack of interest in the subject of physics, five students acknowledged that they had a low understanding of physics; five students considered physics education difficult to study and the remaining two students felt that learning physics was boring. In addition, from the seven students who still possess low learning motivation in physics, as many as four students clarified that they had no interest in physics, while three more students acknowledged that they still found it is difficult to study physics, did not understood what was being taught and felt that physics education was uninteresting.

On the whole, it has been found that the number of students who have acquired high motivation has increased by over 50% from the assessment before the experimental treatment was implemented. Results acquired also showed that the BBTA implemented was able to form students' positive perception on physics education. Only a small number of students were found to still possess low learning motivation in physics, and most of them seemed to be genuinely uninterested in the subject of physics right from the very beginning. Apart from that, results obtained also showed that in general, students did not face any problems with the implemented strategy.

Results from the interviews conducted also verified the findings obtained from the analysis of the students' journals. From the same eight students interviewed, five were found to possess high learning motivation after the experimental treatment, while the remaining three possess medium learning motivation. Among the five students who possess high motivation, four students, namely, A, D, G and H acknowledged pleasurable learning conditions as a key factor while another, student B, acknowledged the fact that physics education is now more easily understood than before. Meanwhile, three students, namely, C, E and F admitted to possessing medium learning motivation due to a rather negative perception of the subject of physics, thereby making them less interested in the subject, less able to understand what was being taught in class, and consider physics as something difficult. When the triangulation process has been completed, overall results showed that the responses acquired were somewhat similar to the comments written down in students' individual journals.

Meanwhile, from the 50 analyzed journals belonging to students who follow the control group (receiving CTM), it has been found that 12 students possess high learning motivation, 23 students possess medium learning motivation, and the remaining 15 students possess low learning motivation. From the 12 students who possess high learning motivation, as many as eight of them stated that they were very interested in the subject of physics, two attributed their love of calculation as a key factor and the remaining two attributed comprehension and teacher teaching styles as a key consideration. From the 23 students who possess medium learning motivation, nine mentioned a lack of understanding of what was being taught, six stated a lack of interest, another six disliked the lessons implemented and finally, two students felt that physics was a rather difficult subject. From the 15 students who possess low learning motivation, four people confessed that physics was a difficult subject for them, four acknowledged that they had no interest at all in physics, two admitted that they did not understand what was being taught, two more admitted that physics education is boring and the remaining three attributed their dislike of physics as a subject as the main reason for possessing low learning motivation in physics.

On the overall, it has been found that there has been no apparent change in figure on the motivational aspect of learning physics in the control group (receiving CTM) from before and after the experimental treatment. This shows that conventional teaching methods (CTM) is incapable of forming students' positive perception on physics education. Results from the interviews conducted also verified the findings obtained from the analysis of the students' journals. From the same eight students interviewed, two students were found to possess high learning motivation after the experimental treatment, the other three were found to possess medium learning motivation while the remaining three possess low learning motivation. Students III, IV and VII were found to possess high motivation on the basis of high interest in physics, in addition to liking the teachers' teaching style. Students II, V and VI admitted to possessing medium motivation because of lack of understanding of what was being taught in the classroom. The remaining students I and VIII admitted to possessing low motivation because they were bored by the lessons, in addition to not being able to understand the taught subject. When the triangulation process has been completed, overall results showed that the responses acquired were somewhat similar to the comments written down in students' individual journals.

Students' Physics Learning Motivational Pattern After the Experimental Treatment Compared to the Pattern Before the Experimental Treatment

This study has found that there is a change in the motivational pattern of learning physics amongst students due to the conducted experimental treatment (see Figure 1). In general, the group of students who followed the BBTA module and those who received CTM showed similar motivation learning patterns, namely: (1) The level of student motivation remained parallel to that before the experimental treatment; (2) Students' motivation became more positive; and (3) Students' motivation became more negative. However, data acquired showed that compared to the students who received CTM, the physics learning motivational pattern in the majority of the students who underwent the BBTA module has showed changes inclining to the positive.

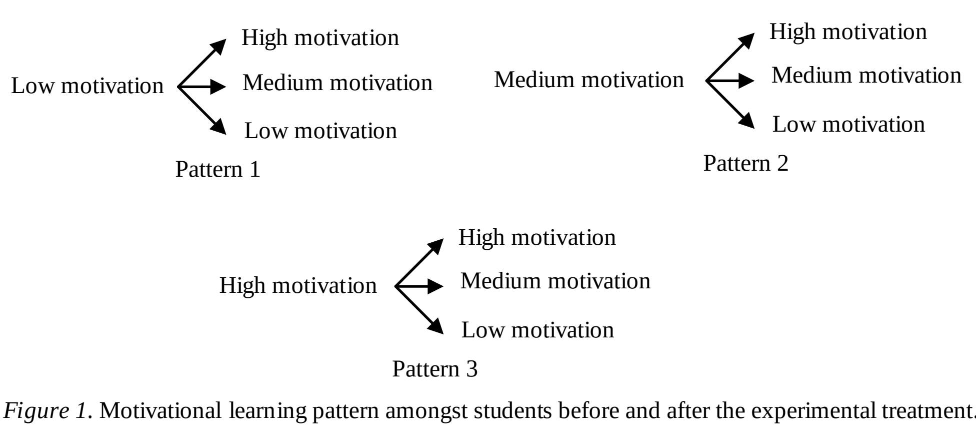

Figure 1. Motivational learning pattern amongst students before and after the experimental treatment.

Discussion

In general, the analysis conducted found that students from the two groups, ones which follow the BBTA module (experimental group) and one which received CTM (control group) possess either high/medium/low motivation after the experimental treatment. Research results showed that physics learning motivational pattern in the majority of the students generally shifted to the positive as compared to that before the experimental treatment. However, it has been found that there were still a few students who did not benefit from any motivational change even after being exposed to the relevant lessons. Data obtained from the research conducted found that students in the group that followed the BBTA module showed a percentage increase in physics learning motivation as compared to the students within the group receiving CTM. The majority of the students within the group that followed the BBTA module have been identified to have undergone positive modification after the experimental treatment. Interview results with the students also confirmed the date obtained from the journal analysis conducted. Results obtained also showed that students who followed the BBTA module (experimental group) have acquired a higher motivation to learn physics as compared with the students who received CTM (control group).

Results obtained have also proven that an education approach based on the brain compatible is able to generate study motivation amongst students. This discovery has indirectly supported the data obtained from the implementation of quantum teaching technique (De Porter, Reardon, & Singer-Nourie, 1999) which took into account brain research as fundamental development, reportedly to be successful in increasing students' learning motivational levels. Focused on the strategy involving the individual's complete physiology, with consideration on suitable positive emotional elements within an optimum learning environment, this technique has been proven to be capable of attracting students' interest to be actively engaged in the organized learning activities.

In relation to the same subject matter, it has also been found that there are three types of student motivational patterns generated after the experimental treatment. The first pattern is a parallel student motivation to that before the experimental treatment. This may be due to the fact that the student may not have benefitted from the motivational exposure generated from the implemented lessons. Due to the lack of student commitment to actively engage in the learning process, the optimum learning state may not be achievable. As a result, they may not be able to feel the positive impact of the organized activities. This may also result in the group members thinking that the strategy carried out by the teacher is not encouraging.

The second pattern is a conversion of students' motivation into the positive after the experimental treatment. This pattern is produced when the implemented approach manages to stimulate student motivation. This implies that when technique complements students' interests and tendencies, students will regard the teaching and learning processes implemented in the classroom as being exciting and enjoyable. In this situation, when the teachers' delivery strategy combines well with compatible and matching learning experiences to students' learning methods, the information internalization process of a student's processing system can occur more efficiently. Mental conceptual relationships can also be shaped in a more systematic and flawless manner and as a result, more of the subjects delivered can be easily understood by the students, thereby making the taught subject matter more enjoyable (R. Caine & G. Caine, 1991; Caine et al., 2005; Sousa, 1995, 1998; Jensen, 1996).

The third pattern is a conversion of students' motivation into the negative after the experimental treatment.

The phenomenon generally occurs when the teaching and learning process strategy implemented is found to be less effective in stimulating students' interest. This is probably due to a divergence in the implemented learning approach from the students' current learning style tendencies. In addition, other contributing factors may include a student's lack of initiative to actively participate in the learning process organized by the teacher. When this occurs, they will find it is difficult to assimilate and process the information delivered, thereby concluding that the lesson is difficult and boring.

In relation to the research conducted, it is generally found that students' physics learning motivational patterns are similar to students from both groups, one of which followed the BBTA module (experimental group) and one of which received CTM (control group). However, it has been found that compared to the group which received CTM, more students from group which follow the BBTA module possess higher physics learning motivation. This is probably due to the fact that the main feature of the brain-based teaching approach emphasizes on the integration of optimal learning states, involving aspects of relaxed alertness, orchestrated immersion and active student processing in an optimal learning environment, thereby greatly facilitating students' assimilation process.

In the BBTA, knowledge/information is internalized when the teaching strategy matches that of the students' information processing strategy. Through activities related to orchestrated immersion, it has been found that when students are exposed to various suitable techniques in an enrich learning experiences, information assimilation can be occurred as easy. This situation is supported by relaxed alertness state created in a learning environment that stimulates positive emotions in the students to perform a more efficient absorption process. Activities that stimulate students' active processing are found to be capable of ensuring that the assimilated information is retained in the students' storage system (R. Caine & G. Caine, 1991; Caine et al., 2005; Sousa, 1995, 1998; Jensen, 1996). In the end, learning becomes easy and enjoyable, and will result in students possessing a higher motivation to learn physics.

Conclusions

In conclusion, although generally the learning motivation patterns towards the subject of physics amongst students who are exposed to the BBTA are the same as students who followed the CTM, it has been found that the motivation to learn physics in the majority of the students who received BBTA has changed to become more positive/relatively higher than those who received CTM. Students who have been exposed to the BBTA possess a more positive/relatively higher motivation as compared to those who has followed CTM. Therefore, it can be safely concluded that the BBTA is effective in generating positive physics learning motivation amongst students.

References

Abd. Karim, M. M., Hussain, B. H., Yusoh, O., Razak, N. A., Musa, M., Rahmat, F., & Azmi, N. A. (2006). The study of students' performance and profile enrollment in faculty of science and technology. Proceedings of *Malaysian Association of Science & Mathematics*. Universiti Pendidikan Sultan Idris.

Caine, R. N., & Caine, G. (1991). *Making connections: Teaching and the human brain*. Alexandria, Virginia: Association for Supervision and Curriculum Development.

Caine, R., Caine, G., McClintic, C., & Klimek, K. (2005). *12 Brain/Mind learning principles in action*. Thousand Oaks, California: Corwin Press.

De Porter, B., Reardon, M., & Singer-Nourie, S. (1999). *Quantum teaching orchestrating student success*. Boston: Allyn & Bacon.

Forgarty, R. (1992). Teaching for transfer: If minds matter. In J. B. Costa, & R. Forgarty, (Eds.), *A foreword to the future* (Vol. 1). Palantine, I. L.: Skylight.

Jensen, E. (1996). *Brain-based learning*. Del Mar, Ca, USA: Turning Point Publishing.

Hestenes, D. (1992). Modeling games in the Newtonian world. *American Journal of Physics, 60*(8), 732-748.

Lee, M. N., Yoong, S., Loo, S. P., Khadijah, Z., Munirah, G., & Lim, C. S. (1996). *Students orientation towards science and mathematics: Why are enrolments falling?* Monograph 1, School of Educational Studies, USM. Publisher: Universiti Sains Malaysia.

Malcolm, C. (1989). Trends in school science curriculum and their implications for teacher education. In *Department of Education, Employment and Training, discipline review of teacher education in mathematics and science* (Vol. 3, pp. 210-229). Canberra: Australian Government Printing Service.

Ngah Razali, S., Siow, H. L., Wong, H. H., Lim, M. M., Lew, T. S., Lee, V. M., … & Daniel, E. (1996). *Assessment of the achievements, enthusiasm and creativity of students*. PIER Research Report, Faculty of Education, University of Malaya.

Sidin, R. (2003). Cultivation of science and technology: A standard proposed. *Jurnal Pendidikan, 28,* 47-63.

Smith, A. (2003). *Accelerated learning in practice: Brain-based method for accelerating motivation and achievement*. Network Educational Press Ltd. Great Britain.

Sousa, D. (1995). *How the brain learns: A classroom teacher's guide*. National Association of Secondary School Principals. Reston, Virginia.

Sousa, D. (1998). *Learning manual for how the brain learns*. Thousands Oaks, C. A.: Corwin Press.

Syed Zin, S. M. (2003). Reforming the science and technology curriculum: The smart school initiative in Malaysia. *Springer Netherlands, 33*(1), 39-45.

Syed Zin, S. M., & Lewin, K. M. (1993). *Insight into science education: Planning and policy priorities in Malaysia*. Research Report: Collaboration between Malaysian Ministry of Education and International Institute for Educational Planning, UNESCO. Paris: IIPP's Printshop.