UNIVERSITI TEKNOLOGI MARA

Monograph Series of UiTM Pahang

COMPASS

Compilation of Pahang Scholars' Synergy

Vol. 1. No. 1 (Research & Innovation) ISSN 1985-9937

Left-Right Brain Hemisphere Dominance among First Semester Computer Science Students in Introductory Computer Programming Course

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ABSTRACT

The study was carried out to investigate the left or right brain dominance among Computer Science students who enrolled in the Introductory Programming course offered in Universiti Teknologi MARA (UiTM). The investigation of their brain dominances is to further understand the students' thinking and learning preferences towards the course. A selected group of fifty-one first semester students from this university were asked to take the Cognitive Styles Analysis (CSA) in order to measure their brain dominances. The results show differences in brain lateralization among the respondents. The results can be used to improve students' learning processes and lecturers' abilities to deliver knowledge and skills that can meet their students' thinking preferences. This will improve the process of teaching and learning in the programming course.

Keywords: *Cognitive Styles Analysis (CSA), Left-right brain dominance, thinking and learning styles*

Introduction

Programming is claimed to be a process of problem-solving (Malik, 2004). Once, it required the problem-solving techniques. Therefore, it is an essence to study the cognitive abilities of students while they are solving problems. In the programming environment, the problem-solving phase involves few major steps which are 1) analysing the problem, 2) designing the algorithm for the solution, 3) implementing the algorithm in a programming language, 4) verifying it, and 5) doing the maintenance of the program for problem domain changes. Malik (2004) claimed that the first phase, which is analysing the problem is the first and most important step. Then, after a thorough understanding of the problem domain and requirements, the algorithm needs to be designed to show the step-by-step process to produce solution.

In the Computer Science community, it is widely known that students have difficulty in programming courses and this can result in high drop out and failure rates (Bergin and Reilly, 2005). In addition, the learning curve of programming is said to be a step function for many students; students struggle to assimilate the concepts involved in the early stages, making little progress and becoming more and more confused and, sadly, resulting in some of the students either failing or withdrawing (Maltby and Whittle, 2000). Assiter (2005) added that her research was prompted by the decline of her students' performances in the first week of the analysis course.

It was revealed that problem-solving ability is an important component in programming and computer science curriculum (Chung, 1988). A previous study showed that Computer Science and Mathematics students are also left brain users (White and Sivitanides, 2002). According to Hermann Brain Dominance Theory, the left brain constitutes logical, analytical, problem-solving and calculation (Hermann, 1999). The occupational types that are suitable for the left brainers are engineers, technicians and system analysts (Vaughn, 2006). This is supported by a claim made by Malik (2004) that programming is a process of problem-solving. Thus, to be able to learn programming successfully, a person needs to think analytically. Analytical thinking styles belong to those people who use the left brain hemisphere to perform problem-solving task (Hermann International Asia, 2003). Previous studies have reported that the analytic-decision makers are better programmers than the heuristic-decision makers (Cheney, 1980).

Therefore, the main objective of this study is to investigate the left or right brain dominances among first semester students in the computer programming field. This study is aimed to further understand their thinking and learning preferences in the programming course. The results will encourage the students to take responsibilities for their own personal developments in becoming confident, intellectual, independent and global individuals as well as increasing the awareness of educators about the variations of thinking preferences among their students.

Materials and Methods

Cognitive Style Analysis (CSA)

A group of fifty-one first semester students who enrolled in the Introductory Programming course were asked to answer questions in

order to determine their cognitive styles. A method incorporating the theory of Hermann Brain Dominance was used in this study. This method, identified as Cognitive Style Analysis (CSA), has been widely used in psychology field to study the cognitive styles differences among students (Hasan, 1995). It consists of twenty questions that need to be answered and later analysed for cognitive styles differences. The data were analysed using SPSS 12.0 to see the frequency of brain dominances among the students. According to Hermann Brain Dominance Theory, there are four quadrants of brain regions, which consist of the left and right cerebral hemispheres and the left and right halves of the limbic system. The two left side structures combine to represent what is popularly called as left brain thinking. The two right side structures combine to represent right brain thinking (Hermann, 1999).

Results and Discussion

The students took the CSA test at the beginning of their first semester. This is because it is crucial for the educators to know what their brain dominances are before starting the lectures. Educators must be aware of the differences of thinking patterns among the students so that the knowledge and skills can be distributed equally among different types of learners. Besides that, the educators must also be aware of the differences of thinking and learning preferences between them and their students. This awareness, if being considered wisely, can help the transmission of knowledge and skills become more successful between skilled (educators) and novice (students) programmers.

The results shown in Table 1 illustrate the brain dominances among the first semester Computer Science students in UiTM Pahang. As shown in this table, the brain dominance can be divided into three different categories. They are the left brain dominance, right brain dominance or the whole brain dominance. Students who use much of their left brain to process information belong to the left brain dominance category. On the other hand, the right brain dominance shows that students use much of the right brains, whereas for the whole brain dominance, students will be using both of the left and right brain while processing the information.

From Table 1 above, it can be clearly seen that the number of students who belong to the left brain dominance category are higher than the other types of brain dominances. Out of fifty-one students, there are

Table 1: Brain Dominance among First Semester Computer Science Students

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Left Brain	30	58.8	58.8	58.8
	Right Brain	17	33.3	33.3	92.2
	Whole Brain	4	7.8	7.8	100.0
	Total	51	100.0	100.0	

thirty of them (58.8%) who process information using their left brains. This supports the claimed made by White and Sivitanides (2002) that most Computer Science and Mathematics students are left brainers. Meanwhile, from the statistics above, students who use right brain to process information is only seventeen, which is 33.3%. And finally only four or 7.8% of them who are using both left-right brain to process information.

The results of these statistical differences between left, right or whole brain dominance reflect the differences of thinking patterns among the first semester students in Diploma in Computer Science in UiTM Pahang. The students themselves will realize and understand their own thinking patterns and become more responsible in their own personal developments in studying computer programming. The characteristics of people of left and right brain dominance are as listed in the Table 2 below. These characteristics were highlighted by Vaughn (2006), Morris (2007) and Hermann (1999).

Table 2: Characteristics of People of Left and Right Brain Dominance

Left Brain Hemisphere	Right Brain Hemisphere
• Analytical time sequence processing	• Copying of designs
• Mathematical	• Discrimination of shapes e.g. picking out a camouflaged object
• Problem Solver	• Understanding geometric properties
• Rational	• Reading faces
• Technical	• Music
• Administration	• Global holistic processing
• Conservative	• Understanding of metaphors
• Organized	• Expressing emotions
• Planner	• Reading emotions
• Structured	

What will the educators gain from these results? The educators, as mentioned before will have more understanding in the differences of the thinking and learning patterns. They will have more insightful meanings of people with different styles of thinking. Therefore, it is crucial for the educators to prepare lecture notes and materials that will not only favour one type of learners but also all types of learners. For instance, they will accompany their lecture notes with visualization aids to help the right brain thinkers to absorb knowledge successfully. They can use diagrams, pictures or visual algorithms to accompany their lessons in selection control programs to help the right brainers to think and learn successfully in computer programming. Other than that, pairing programming or cooperative learning between the left and the right brainers can also be a method to help the right brainers to gain full understanding in computer programming field.

Conclusion

From the study, it can be concluded that most of the first semester Computer Science students in UiTM Pahang are left brainers who use their left brain to process information. However, even though the majority of the students are left brainers, the right brainers should not be left out in the learning process. Lecturers must be aware of the differences of the students' thinking styles as it will reflect the differences of the students' learning styles as well. Right brainers think differently compared with the left brainers. Left brainers tend to be analytical, sequential and logical. While, the right brainers think and learn in kinesthetic, visual and audio images. They do not memorise well and need to visualise the picture so they can recall the facts. Therefore, the lecturers should prepare teaching aids that are suitable for both types of learners.

References

Assiter, K.V. (2005). Analysis of algorithms: Programming to problem solving. *35th ASEE/IEEE Frontiers in Education Conference.* Indianapolis: IEEE.

Bergin, S., & Reilly, R. (2005). The influence of motivation and comfort-level on learning to program. *17th Annual Workshop of the Psychology of Programming Interest Group.* United Kingdom: University of Sussex.

Cheney, P. (1980). Cognitive style and student programming ability. *AEDS Journal, 13*, 285-291.

Chung, C. (1988). Correlates of problem-solving in programming. *CUHK Education Journal, 16*(2), 185-190.

Hasan, A.F. (1995). *Kecemerlangan minda: Dalam pembelajaran keseluruhan otak dan daya berfikir.* Kuala Lumpur: Dayasitis Sdn. Bhd.

Hermann International Asia. (2003). *Creating whole brain learning.* Retrieved December 21, 2007, from South Australian Centre for Leaders in Education: http://www.sade.edu.au

Hermann, N. (1999). The theory behind the HBDI® and Whole Brain® Technology. *Hermann International.*

Malik, D. S. (2004). *C++ Programming: From problem analysis to program design.* United State of America: Thomson Course Technology.

Maltby, J. R., & Whittle, J. (2000). Learning programming online: Student perceptions and performance. *The American Journal of Distance Education, 7,* 54-61.

Morris, R. (2007). *Left brain, right brain, whole Brain?An examination into the theory of brainlaterilization, learning styles and the implications for education.* Retrieved December 11, 2008, from http://www.singsurf.org/index.html

Vaughn, A. (2006). *Hermann brain dominance theory.* Retrieved July 25, 2008, from Hermann Brain Dominance Theory: http:// www.vaughns-1-pagers.com/psychology/brain-dominance.htm

White, G.L., & Sivitanides, M.P. (2002). A theory of the relationships between cognitive requirements of computer programming languages and programmer's cognitive characteristics. *Journal of Information Systems Education, 13*(1), 59-66.

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