The Relationship between Multiple Intelligences with Preferred Science Teaching and Science Process Skills

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Abstrak

Kajian ini dilaksanakan bagi mengenal pasti hubungan di antara kecerdasan pelbagai dengan pengajaran sains yang diingini dan kemahiran proses sains. Reka bentuk kajian adalah tinjauan menggunakan soal selidik iaitu Soal Selidik Kecerdasan Pelbagai, Soal Selidik Pengajaran Sains yang Dingini dan Soal selidik Kemahiran Proses Sains. Sampel kajian berjumlah seramai 300 orang pelajar Tahun 6 daripada lima (5) buah sekolah rendah yang berlokasi di Pulau Pinang, Malaysia. Dapatan kajian mendapati bahawa terdapat hubungan diantara kecerdasan kecerdasan kinestetik, kecerdasan logik matematik, kecerdasan visual ruang dan kecerdasan naturalis dengan pengajaran sains yang diingini dan terdapat hubungan diantara kecerdasan kinestetik dan kecerdasan visual-ruang dengan kemahiran proses sains. Dapatan kajian ini menunjukkan bahawa kecerdasan pelbagai adalah berkait dengan pembelajaran sains.

Kata kunci: *kecerdasan pelbagai; pengajaran sains yang diingini, kemahiran proses sains*

Abstract

This study was undertaken to identify the relationship between multiple intelligences with preferred science teaching and science process skills. The design of the study is a survey using three questionnaires reported in the literature: Multiple Intelligences Questionnaire, Preferred Science Teaching Questionnaire and Science Process Skills Questionnaire. The study selected 300 primary school students from five (5) primary schools in Penang, Malaysia. The findings showed a relationship between kinesthetic, logical-mathematical, visual-spatial and naturalistic intelligences with the preferred science teaching. In addition there was a correlation between kinesthetic and visual-spatial intelligences with science process skills, implying that multiple intelligences are related to science learning.

Keywords: *multiple intelligences; preferred science teaching; science process skills*

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Introduction

Teaching styles play an important role in determining the level of student achievement (Garrett, 1986). When the preferred teaching style by student does not match the practice of teaching or the learning environment, negative behavioral reactions and reduced student motivation could be the consequences (Kreuze & Payne, 1989). If the conflicts between learning styles and teaching styles continue and there is no attempt to deal with it, it could create physical, mental and emotional problems among students (Gregorc, 1979). Dunn and Dunn (1979) noted that students weak in certain subjects could be due to learning styles and teaching styles that are not parallel. This illustrates that not all teaching practices are considered effective from the perspective of a teacher pedagogy that is congruent with the desired or preferred teaching by students. Goodnaugh (2001) stated that the learning environment is not likely to weaken the orientation of students' motivation. The ability of students who are not dominating orientation-introduced-intelligence led to learning sessions that were a chore. Leaving that the orientation of intelligence is a necessity to create a learning environment that is conducive for learning to occur (Che Nizam, Kamisah & Lilia, 2010).

Accordingly, the action of the Malaysian education system to implement the higher order thinking skills (HOTS) element proposes to enable rational science subjects in various students in the hopes of expanding the scope of intelligence. The act opened more branches of evaluation in addition to evaluation or assessment only oriented towards verbal-linguistic and logical - mathematical intelligences (Goodnaugh, 2001). Sarrazine (2005) described the present education system largely dependent on linguistic and logical – mathematical intelligences, i.e. to teach and assess student academic achievement through writing assignment and examination. Conventional teaching is more teacher-centered, under the supervision of teachers (Che Nizam, Kamisah & Lilia, 2010). A few teachers still use teaching and learning methods from the past (Saban & Bal, 2012). This situation leads to a lack of students' interest in the learning activities (Noor Akmar, 2007). In addition, there are problems among students, they are interested in learning certain subjects but cannot go through the learning process because they lack the confidence and consider themselves less intelligent (Sternberg, 2002).

Besides teaching science with the orientation of certain intelligences, important in science learning, science process skills are also an indicator of how one can master the science subject. Mastery of science process skills is an important way to gain knowledge (Karslo, Yemen & Ayas, 2010). Students need to get acquainted and master the science process skills by conducting scientific investigation and their learning (Taconis, Ferguson-Hessler & Broekkamp, 2000). However, applications of science process skills as a way to master the sciences are still short from the goal (Aktamis & Ergin, 2008). This situation is caused by the pedagogy of teachers who do not model the processes of scientific exploration and students' thinking skills (Aktamis & Ergin, 2008).

According to Pyatt and Sims (2007), students seldom are given the freedom to explore their understanding in their own way by their teachers: Most practical activities were designed and the procedures for the activities have been provided in order to save time and prevent material waste, damage and injury (Pyatt & Sims, 2007). There are also students who are just observers and are not directly involved in science activities (Siti Aloyah 2002). This condition may be caused by the pedagogy of teachers who only favor certain intelligences. Thus science becomes a difficult subject (Carroll, 2000) and demonstrates the lack of variation based on multiple intelligences in the orientation of the science teaching and learning process.

In addition, Hodson and Reid (1988) pointed out that science is capable of achieving better if the theory of multiple intelligences becomes part of the thinking style and are known by the teacher. In science learning, mastery of science process skills is important for students to not only produce knowledge in science but also able to apply scientific skills in their daily lives. Shahrokhi, Ketabi and Dehnoo (2013) stated that intelligence should be combined in a variety of educational settings to meet the needs of all students. In science learning sessions, students need to master science process skills and apply them in scientific testing (Aktamis & Ergin, 2008). Science process skills are indispensable in the production and use of scientific information; perform scientific research and problem solving (Aktamis & Ergin, 2008). According to Fatin Aliyah and Nor Athirah (2011), science process skills can be developed with specific teaching methods while doing science in the laboratory. Hu and Adey (2002) suggest that teachers need to create and show an element of creativity in designing science teaching and learning. Therefore, teachers are given the freedom to use the appropriate pedagogy that suits the needs of all students in order to raise students' interest in learning science.

Pedagogy which is appropriate to the needs of all students is a pedagogy that integrates multiple intelligences. There are more than ten countries that integrate the principles of multiple intelligence in shaping educational mission, curriculum development and pedagogy (Chen, Moran & Gardner, 2009). According to Hopper and Hurry (2000), the multiple intelligences approach emphasizes

their own exploration and understanding of the students in their learning process. This suggests that the multiple intelligences approach is student-centered. According to Carroll (2000), a student-centered approach is more effective in developing science process skills. This is because activities involving science process skills involve affective, cognitive and psychomotor dimensions in the student, especially when the experiment is performed in a group. This situation is likely to be associated with the use of certain intelligence that allows successfully do scientific experiments. Based on these arguments this study seeks to investigate the relationship between multiple intelligences, preferred science teaching and science process skills.

Multiple intelligences are referred to as a range of abilities, talent or skills of individuals that exist in nature (Armstrong, 2000). As outlined by Gardner (1993, 1999) there are nine (9) different types of intelligences that are examined in this study, namely verbal-linguistic, logical-mathematical, visual-spatial, musical, interpersonal, intrapersonal, kinesthetic, naturalistic and existential. Preferred science teaching refers to science teachings that are desired by students; these are experimentally oriented and the science process skills are grounded in a basically research context. These science process skills are outlined by the Ministry of Education (MOE) Malaysia as the skills of observing, classifying, measuring and using numbers, making inferences, predicting, communicate, using the relationship of space and time, interpreting data, defining operations, controlling variables, making hypothesis and experimenting.

Research Method

This study was undertaken to determine the relationship between multiple intelligences with preferred science teaching and science process skills. The instrument for this study was a survey by using questionnaires. The three types of questionnaires used are (i) Multiple Intelligences Questionnaire (McKenzie, 1999), that measures the nine (9) types of intelligences; verbal linguistic, logical mathematical, visual-spatial, kinaesthetic, interpersonal, intrapersonal, musical, naturalistic and existential, (ii) Preferred Science Teaching Questionnaire (Enger & Yager, 1998) and (iii) Science Process Skills Questionnaire (Enger & Yager, 1998). The reliability for the three questionnaires referred to Cronbach Alpha values as shown in Table 1.

Table 1. Questionnaires Reliability

QUESTIONNAIRE	CRONBACH ALPHA'S VALUE
Multiple Intelligences	0.983
Preferred Science Teaching	0.837
Science Process Skills	0.880

As shown in Table 1, the value of Cronbach Alpha coefficients for each questionnaire were good and suitable to be used in this study to investigate the relationship between multiple intelligences with preferred science teaching and science process skills. The sample size was 300 primary school students selected from five (5) primary schools in Penang, Malaysia.

Data Analysis

Data collected through questionnaires were analyzed using the statistical program, SPSS version 20. The analysis involved inferential analysis to test the null hypothesis. The inferential analysis used was the Pearson correlation test to test the null hypothesis about the relationship between multiple intelligences, preferred science teaching and science process skills. Significance level was at 0:05.

Findings and Discussion

Based on analysis, it was found that the multiple intelligences are related to preferred science teaching and science process skills. Here is a detailed description of the analysis.

Multiple Intelligences with Preferred Science Teaching

Pearson correlation analysis results indicated that there was a significant correlation between the type of preferred science teaching - experimental oriented with kinaesthetic intelligence, $r = .146$, $p < 0.05$, logical mathematical intelligence, $r = .157$, $p < 0.05$, visual-spatial intelligence, $r = .202$, $p < 0.05$ and naturalistic intelligence, $r = .138$, $p < 0.05$.

Table 2. Relationship between Preferred Science Teaching - Experimental Oriented with Multiple Intelligence

		Existential	Inter personal	Intra personal	Kinaesthetic	Logical Mathematical	Musical	Visual Spatial	Naturalistic	Verbal Linguistic
Preferred Science Teaching - Experimental Oriented	Pearson Correlation	.099	.043	.099	.146*	.156*	.053	.202*	.138*	.096
	Sig. (2-tailed)	.092	.468	.090	.013	.008	.370	.001	.020	.105

Multiple Intelligences with Science Process Skills

Based on analysis of the decisions of multiple regression tests for each forecaster (intelligence) (Table 3), visual-spatial intelligence was the science process skills forecaster which was significant, Beta = 0.82, t (267) = 14:15, p <.05. Likewise, kinesthetic intelligence was the science process skills forecaster which was significant, Beta = 0:19, t (267) = 4.66, p <.05. Visual-spatial intelligence was found to be the forecaster of science process skills with mean scores better that kinesthetic intelligence due to the value of Beta coefficient. For visual-spatial the value (0.815) was higher than the value of Beta coefficient for kinesthetic intelligence (0186).

Table 3. Regression Testing Decision for Every Intelligence

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-14.228	.324		-43.882	.000
Verbal-Linguistic Intelligence	-.007	.009	-.011	-.844	.400
Musical Intelligence	-.005	.010	-.007	-.522	.602
Interpersonal Intelligence	-.009	.010	-.013	-.945	.346
Intrapersonal Intelligence	-.009	.010	-.012	-.851	.395
Existential Intelligence	.004	.009	.006	.402	.688
Logical- Mathematical Intelligence	.091	.051	.089	1.760	.080
Visual-Spatial Intelligence	.804	.057	.815	14.149	.000
Kinesthetic Intelligence	.184	.039	.186	4.660	.000
Naturalistic Intelligence	-.086	.059	-.087	-1.464	.144

The results showed that multiple intelligences were related to preferred science teaching - experiments oriented. Among the nine different types of intelligence, only kinaesthetic, logical-mathematical, visual-spatial and naturalistic intelligences had a relationship with preferred science teaching - experiment oriented. According to Kelly, Brown and Crawford (2000), experimentation has played a central role in the construction of scientific knowledge. Besides, experiments have been used in school science as a means of communicating abstract concepts through examples, demonstrating what counts as good practices and identifying approaches to problem solving (Millar, 1989). By conducting science experiments in school, students' accounts of experimental procedures and results weighed heavily in reconstruction of the experiments and logic of experimentation (Kelly et al., 2000). Hence, students will use their logical mathematical intelligence to solve the experimental problem, analyse and interpret the experiments data. Logical-mathematical intelligence is the understanding and use of logical structures, including patterns and relationships, statements and propositions through experimentation, quantification, conceptualization and classification (Armstrong, 2003). Students also will use the visual-spatial intelligence while solving the experimental problem. According to McKenzie (2009), visual- spatial intelligence is defined as the ability to learn visually and organize ideas spatially. For example, through this intelligence, people will see concepts in action in order to understand them and have the ability to "see" things in their mind while planning to create a product or solve a problem. Therefore, logical- mathematical and visual-spatial intelligences are related with preferred science teaching – experiment oriented.

Furthermore, by teaching science through experiment orientation will provide students with opportunities to engage with science and in the practices of scientists (Kelly et al., 2000). Student will gain experience through science experiments. In addition, conducting science experiments will involve the movement of the whole body. This is the reason why science learning involves hands-on activities and practice (Kamisah, Zanaton & Lilia, 2007). By learning science through experiment orientation, students will use their kinaesthetic intelligence while conducting science experiments. Therefore, kinaesthetic intelligence relates to preferred science teaching – experiment oriented. According to

Gardner and Hatch (1989), people with kinaesthetic intelligence are sensitive to time and are skilful at using the whole body movement in a coordinated way and also good at manipulating objects by using their hands. Such people have control of the motions of their body and are able to handle objects in skilful ways. Besides, this intelligence also allows people to learn through interaction with their environment and promotes understanding through concrete experience (McKenzie, 2009).

Other than logical-mathematical, kinaesthetic and visual-spatial intelligences, naturalistic intelligence also relates to preferred science teaching - experiment oriented. Naturalistic intelligence is defined as the capacity to recognize and classify the numerous species of flora and fauna in one's environment and the ability to care for, tame, or interact subtly with living creatures, or with whole ecosystems (Armstrong, 2003). By conducting science experiments in school, students will interact with experimental materials that consist of living things, such as animals (fauna) and plants (flora), showing that science experiments are related with the natural world. Hence, it supports Goodnough (2001) that stated that "students should gain an understanding of science as being part of their natural world." Therefore, naturalistic intelligence is related to preferred science teaching - experiment oriented.

The findings also revealed that multiple intelligences were related to science process skills. Among the nine different types of intelligences, only kinaesthetic and visual-spatial intelligences were the predictors of achievement mean scores in the science process skills test. According to Bilgin (2006), the theoretical knowledge related to science process skills included observation, measurement, inferences, prediction, operational definition, identifying and manipulating variables, organizing and interpreting data, and formulating hypotheses and experimenting. Kinaesthetic intelligence was relates to science process skills because science process skills involved observation and experimentation. Observation uses the senses of sight, hearing, touch, taste or smell to gather information about objects and phenomena. Meanwhile experimenting carries-out an investigation. Both skills require students to actively engage in science learning, not just sitting listening to the teacher's explanation. They involve the movement of the whole body. Therefore, science process skills are related to the kinaesthetic intelligence which according to Gardner (1983) is defined as "abilities to control body movements and to handle objects skilfully. In addition, visual-spatial intelligence relates to science process skills due to experimenting skill." Experimenting is testing a hypothesis that includes data collection which involves the change of parameters such as location, direction, shape, size, volume, weight and mass with time. This relates with visual-spatial intelligence and according to McKenzie (2009), people with this intelligence have the ability to use shapes, colors, graphics and space. Therefore, kinaesthetic and visual-spatial intelligences are related to science process skill.

Multiple intelligences were related to preferred science teaching – experimental oriented and science process skills. This finding supported the recommendation by Shahrokhi, Ketabi and Dehnoo (2013) by which multiple intelligences should be applied in education in order to meet the needs of all students. This is because multiple intelligence theory is a powerful tool that can help to achieve educational goals more effectively (Hopper & Hurry, 2000).

Conclusion

This study proved the relationship between multiple intelligence, preferred science teaching and science process skills. Therefore, in order to maximize student involvement in the classroom and produce meaningful learning it is recommended that teachers gain competence in integrating the various elements of intelligence and design their pedagogy so it strengthens science education in the school system, in addition to developing the human capital required by an ever increasing global system.

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