INVESTIGATING SELF-ESTIMATED MULTIPLE INTELLIGENCES AMONGST MALAYSIAN SCIENCE-BASED SECONDARY SCHOOL STUDENTS

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Abstract

A cross sectional survey was conducted to explore whether there were gender and ethnicity differences with regard to each of the eight multiple intelligences as measured by the 80-item Malaysian-Based Multiple Intelligence Inventory (MBMI^2), an adapted version which has appropriate validity and reliability established through a pilot study. The participants, comprising 426 science-based Form Four students who were drawn from nine secondary school classes in Manjung District, were selected using a cluster random sampling. In terms of gender, the analyses from the dataset using independent samples t-test indicated that females self-estimated themselves significantly more dominant in verbal-linguistics, visual-spatial, interpersonal and intrapersonal intelligences as compared to their male counterparts. In terms of ethnicity, the analyses from the dataset using ANOVA indicated that Malays self-estimated themselves significantly more dominant than Chinese in verbal-linguistics, visual-spatial, bodily-kinesthetic, naturalist, interpersonal and intrapersonal intelligences whilst Indians are more dominant than Chinese in self-estimation for verbal-linguistics, naturalist, interpersonal and intrapersonal intelligences. Implications from these findings for enhancing the teaching and learning in science are discussed.

Keywords *Multiple Intelligences, Multiple Intelligence Inventory, Malaysia*

Abstrak

Satu tinjauan keratan rentas dilaksanakan bagi meneroka sama ada terdapat perbezaan jantina dan etnik dalam setiap satu daripada lapan aneka kepintaran yang diukur dengan menggunakan Inventori Aneka Kepintaran Berkonsepkan Malaysia (MBMI^2). Inventori ini yang mempunyai 80 item merupakan inventori yang diadaptasi dan mempunyai kesahan serta kebolehpercayaan yang sesuai untuk kegunaan penyelidikan. Seramai 426 pelajar Tingkatan 4 Sains telah dipilih daripada 9 buah sekolah menengah melalui persampelan rawak kluster. Berdasarkan jantina, penganalisisan data menggunakan ujian-t tak berpasangan menunjukkan bahawa penarafan kendiri pelajar perempuan adalah lebih tinggi dan signifikan secara statistik daripada penarafan kendiri pelajar lelaki dalam kepintaran verbal-linguistik, visual-ruang, interpersonal dan intrapersonal. Berdasarkan etnik, analisis daripada ANOVA menunjukkan penarafan kendiri pelajar

Melayu adalah lebih dominan berbanding dengan penarafan kendiri pelajar Cina dalam kepintaran verbal-linguistik, visual-ruang, badan-kinestetik, naturalis, interpersonal dan intrapersonal manakala pelajar India adalah lebih dominan berbanding dengan pelajar Cina dalam penarafan kendiri untuk kepintaran verbal-linguistik, naturalis, interpersonal dan intrapersonal. Implikasi daripada dapatan kajian ini untuk memantapkan lagi pengajaran dan pembelajaran sains dikupas.

Kata kunci *Aneka Kepintaran (Pelbagai Kecerdasan), Inventori Aneka Kepintaran, Malaysia*

Introduction

The Theory of Multiple Intelligences, conceptualised by Howard Gardner in 1983, advocates a pluralistic stance in that human beings are better described as having a set of relatively autonomous intelligences. Such a stance is in stark contrast to the traditionalist view that reckons intelligence as a uniform cognitive capacity people are born with, and this capacity can be psychometrically evaluated using short-answer tests. In his ground breaking book, *Frames of Mind*, Gardner (1983) defines seven intelligences, namely (1) Linguistic Intelligence, (2) Logical-Mathematical Intelligence, (3) Spatial Intelligence, (4) Musical Intelligence, (5) Bodily-Kinaesthetic Intelligence, (6) Interpersonal Intelligence, and (7) Intrapersonal Intelligence with two more additional intelligences theorised in *Intelligence Reframed* (Gardner, 1999), namely (8) Naturalist Intelligence, and (9) Existential Intelligence.

Gardner's Multiple Intelligences Theory (1983) has a reverberating impact on the field of education around the world. Many educational theorists, policymakers and teachers have given a strong positive response by applying this theory in schools and other learning institutions. Educators are increasingly applying this theory since it "provides educators with a conceptual framework for organizing and reflecting on curriculum assessment and pedagogical practices. In turn, this reflection has led many educators to develop new approaches that might better meet the needs of the range of learners in their classrooms" (Kornhaber, 2001, p. 267). Realising the profound impact this theory has in the field of education, many researchers around the world have been doing research on multiple intelligences theory and its application, and the consequences it brings to curriculum, instructions, pedagogy, as well as to teachers, students and parents. Contrary to the long accepted idea that intelligence can be measured through mental tests, multiple intelligences theory presents a better understanding of how students learn and how they should be involved in the learning process.

Statement of the Problem

Many established Multiple Intelligences (MI) instruments were developed in the context of the western culture. In other words, the items constructed in such instruments are based on the common experiences of children in the west. Thus the results of these instruments may not reflect the closest possible scenario in relation to the Asian

experience, particularly in the Malaysian context. It is vital that students who complete such instruments clearly understand each of the items asked and that the items mirror students' common mundane experience. As such, there is a need to adapt and establish a Malaysian-based inventory to measure students' self-perceived (or self-estimated) multiple intelligence level.

Even though there are local multiple intelligence inventories, such as the Malaysian Multiple Intelligence Checklist for Adults (*MyMICA),* developed by Siti Rahayah Ariffin, Roseni Ariffin, and Hafsa Mohamed Makkin (2008) that may be relevant to the Malaysian scenario, the instrument is very much catered for Malaysian adults as reflected by its items, and hence fall short for the purpose of gauging young Malaysian adolescents who, for example, may not have the complete grasp in addressing items that relate to existential intelligence. In *MyMICA*, items for existential intelligence are included as the ninth dimension of the multiple intelligences which represents one's spiritual understanding, experience and belief. As such, it is felt that the instrument may not fit for the purpose of gauging the intelligence inventory of our young adolescents in the context of secondary schools. Thus a much relevant and adolescent-friendly instrument is warranted.

One of the grave concerns among teachers in the Malaysian education context is the gender and ethnicity achievement gap (Zalizan Mohd Jelas, 2010) as indicated in the standardised national examination results from 1996 to 2007 where girls consistently scored higher than boys. Many science teachers (personal communication, August 23, 2010) of Manjung District asserted that particular races perform relatively well in specific subjects such as Malays generally perform well in the Malay Language, Chinese generally obtain high scores in Mathematics whilst Indians generally constitute high achievers in English Language. Accordingly, such phenomenon triggers some questions as regard to the level of multiple intelligence dimensions possessed by the students in terms of ethnicity and gender. By illuminating the ethnicity and gender differences in students' multiple intelligences, appropriate and compatible teaching approaches could then be thoughtfully planned and judiciously executed, minimising the prevalent and pervasive use of verbal-linguistic and logical-mathematical approaches (Berdie, 1982; Gardner, 1983; Oddleifson, 1994). Besides, Uysal (2004) maintains that identifying and knowing students' intelligence profiles have implications for instruction.

Research Questions

The main objective of this study was to explore the gender and ethnicity differences in self-perceived multiple intelligence dimensions among Form Four students in the District of Manjung as measured by the adapted Malaysian-Based Multiple Intelligence Inventory (MBMI^2). As such, the following research questions were investigated:-

a. Is there a significant difference in each of the eight dimensions of self-perceived multiple intelligences (MI) between Form Four male and female science-based students in the District of Manjung, Perak?

b. Is there a significant difference in each of the eight dimensions of self-perceived multiple intelligences among the Form Four Malay, Chinese, and Indian science-based students in the District of Manjung, Perak?

Given the research questions, this study examined the following hypotheses:

a. There is no significant difference in each of the eight dimensions of self-perceived multiple intelligence between Form Four male and female science-based students in the District of Manjung, Perak.

b. There is no significant difference in each of the eight dimensions of self-perceived multiple intelligence among the Form Four Malay, Chinese, and Indian science-based students in the District of Manjung, Perak.

Review of Literature

There is a plethora of research on multiple intelligences, ranging from instrument development, instrument adaptation, exploration of dimensions that contribute to students' academic achievement, to illumination of multiple intelligence differences in self-perceived ratings. However, given the aims of this study, the scope of the review will be confined to two variables at hand, namely gender and ethnicity.

Gender and Multiple Intelligences Theory

Researchers have provided evidence for gender differences in multiple intelligences. Using a sample of 112 males and 118 females amongst Malaysian adults which represent 51% Malay, 30% Chinese, 10% Indians and 9% of other ethnic backgrounds, Swami, Furnham, and Kannan (2006) found that males rated themselves significantly higher than did females on overall multiple intelligences, verbal-linguistic, logical-mathematical, and visual-spatial intelligences.

Gutierrez et al. (2006) claimed that substantial differences were found between male and female students across the multiple intelligences profiles. The sample of the research includes 90 community college students in Florida, United States with 71% females and 29% males taking a summer online course. The findings indicated that, while males had a higher proportion than females in five intelligence profiles, namely naturalist, logical-mathematical, bodily-kinesthetic, intrapersonal, and visual-spatial, females had a higher proportion in musical-rhythmic, interpersonal, and verbal-linguistic.

Neto and Furnham (2006) conducted a survey on 190 Portuguese students and discovered that males rated significantly higher than did females on logical-mathematical, visual-spatial, and naturalist intelligences. Meanwhile, a study by Furnham, Shahidi, and Baluch (2002) on 212 British and 154 Iranian students indicated that males tended to rate themselves higher in logical-mathematical and visual-spatial intelligences than females.

Chan (2006) claimed that significant gender differences on multiple intelligences

were found in a study of 1,560 primary and secondary pupils of Chinese schools in Hong Kong. The boys tended to perceive themselves higher than girls in logical-mathematical intelligence whilst girls perceived themselves higher than boys in interpersonal intelligence. Similarly, the study conducted by Loori (2005) on 90 English language learners showed that males rated themselves higher than females in logical-mathematical intelligence whilst females had a higher self-rating than males in intrapersonal intelligence. This finding is further supported by Razmjoo (2008) who discovered that females rated themselves significantly higher in intrapersonal intelligence than did males.

The study by Furnham, Clark, and Bailey (1999) on 180 British adults indicated that males rated themselves significantly higher than females in only logical-mathematical intelligence. Furnham et al. (1999) repeated the survey using 180 students and found that males rated themselves significantly higher than females in logical-mathematical, musical-rhythmic, and visual-spatial intelligences.

In summary, males seem to consistently self-rate themselves significantly higher than females in logical-mathematical intelligence while the self-rating pattern amongst females was less clear. Besides, this review shows that differences in self-perceived multiple intelligences do occur in terms of race, gender, nationality, age, and level of education.

Race and Multiple Intelligences Theory

Nasser et al. (2008) conducted a study to compare the self-estimated multiple intelligences between 648 Lebanese and 252 Indian students based on Gardner's conceptualization. Taken as a whole, significant differences were found between the Lebanese and Indian students on verbal-linguistic, visual-spatial, and logical-mathematical abilities. However, by gender, Indian females were significantly lower in logical-mathematical ability than the Lebanese females. A study on 212 British and 154 Iranian students by Furnham, Shahidi, and Baluch (2002) found that the Iranians rated themselves higher in visual-spatial, musical-rhythmic, and intrapersonal but lower in logical-mathematical intelligence as compared to the British.

Even though there are various ethnic groups in Malaysia, no study has been conducted to compare the differences in multiple intelligence dimensions amongst the three dominant races in Malaysia. As such, the findings on race differences would further contribute to the body of knowledge on multiple intelligences.

Methodology

Research Design

Cross-sectional survey was chosen to explore possible main effects for gender and race with regard to the overall multiple intelligences and also each of the eight multiple intelligences as measured by the adapted Malaysian-Based Multiple Intelligence Inventory (MBMI[2]). Furthermore, the use of a cross-sectional survey has the advantage of providing data relatively quickly for a survey on a large sample at the same time (Gay, Mills & Airasian, 2009).

Population and Sampling

The main study was carried out at nine schools in the District of Manjung, Perak. Four of the selected schools are located within 10 km from Sitiawan town centre whilst the other five are located more than 10 km from the town. This is due to the fact that majority of the Chinese students presumably reside in the town centre whilst more of the Malay and Indian students reside in the outskirt of the town centre. According to Mr. Kamaruzzaman (personal communication, 2010), an officer from Manjung District Education Office, Chinese students constitute 47.8% of the total population of secondary school students in Sitiawan area. As such, it is assumed that the sample population would cover equal proportions of the races in the study.

Using the population of 18 secondary schools in Manjung District in Perak State, cluster random sampling was used in which school constituted a sampling unit. Based on the statistics of 4,230 students who sat for the National Standardised Examination in the previous year of 2009 as given by an officer from the Manjung District Education Office (personal communication, March 2, 2010), nine secondary schools were selected in which the total number of science-based students (i.e., students taking Physics, Chemistry, and/or Biology) was 426 (i.e., 120 males and 306 females by gender, and 256 Malays, 86 Chinese, and 82 Indians by ethnicity).

Instrumentation

An 80-item 5-point Likert scale Malaysian-Based Multiple Intelligence Inventory ($MBMI^2$) -- 10 items for each of the eight multiple intelligences (i.e., verbal-linguistic, logical-mathematical, visual-spatial, musical-rhythmic, bodily-kinesthetic, naturalist, interpersonal, and intrapersonal), was used in this study. This inventory was adapted from the Multiple Intelligences Inventories by Ivanco (1998) and McKenzie (1999) so that the adapted version is suitable for the Malaysian context with various ethnic groups and more importantly, it is suitable for secondary school students. Besides, adaptation, revision, or refinement of existing measuring instruments have been strongly advocated by Mayer and Richmond (1982) while many researchers (i.e., Krosnick et al., 2005; Mayer & Richmond, 1982; Munby, 1997; Ramsden, 1998) have levelled criticisms on the occurrence of an extensive duplication of effort in new instrument developments.

This inventory has sufficient content and face validity in that the items adapted have been checked by two senior university educators for multiple intelligences indicator fit as outlined in *Eight Ways of Knowing: Teaching for Multiple Intelligence* (Lazear, 2004), in addition to the screening for three other criteria, namely appropriateness, clarity, and accuracy. Besides, this inventory has the appropriate reliability (Fraenkel & Wallen, 1996) with the Cronbach's Alpha measuring at 0.85.

Results

(a) Gender Differences

Table 1 Results Obtained from Independent Samples t-Test by Gender for Each Multiple Intelligence

	Male			Female				
	N	**Mean**	**SD**	**N**	**Mean**	**SD**	**t**	**p**
Verbal- Linguistics	120	28.85	5.05	306	30.52	5.22	3.00	.003*
Visual-spatial	120	32.01	4.82	306	33.58	5.18	2.88	.004*
Interpersonal	120	36.38	5.09	306	38.07	4.93	3.15	.002*
Intrapersonal	120	33.12	4.58	306	34.58	4.78	2.88	.004*
Naturalist	120	32.61	5.10	306	33.06	5.12	.818	.414
Logical-Mathematical	120	35.91	6.01	306	35.31	5.84	.941	.347
Bodily-kinesthetic	120	33.68	5.23	306	33.98	5.17	.543	.587
Musical-rhythmic	120	28.80	5.47	306	29.74	5.42	1.598	.111

* significant at $p < .05$

As shown in Table 1, the results obtained from the independent samples t-tests by gender for each multiple intelligence indicate that females perceived themselves statistically significantly higher than did their male counterparts across four multiple intelligences, namely verbal-linguistics ($t = 3.00$, $p < .01$), visual-spatial ($t = 2.88$, $p < .05$), interpersonal ($t = 3.15$, $p < .05$) and intrapersonal ($t = 2.88$, $p < .05$).

(b) Ethnicity Differences

Table 2 Results Obtained from ANOVA for 8 Multiple Intelligences by Ethnicity

ANOVA						
Intelligence		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Verbal-Linguistics	Between Groups	646.33	2	323.163	12.50	.000*
	Within Groups	10938.54	423	25.859		
	Total	11584.86	425			
Logical-Mathematical	Between Groups	112.27	2	56.133	1.62	.199
	Within Groups	14666.04	423	34.671		
	Total	14778.31	425			
Visual-Spatial	Between Groups	554.67	2	277.336	11.07	.000*
	Within Groups	10600.16	423	25.059		
	Total	11154.83	425			
Bodily-Kinesthetic	Between Groups	492.29	2	246.147	9.53	.000*
	Within Groups	10929.57	423	25.838		
	Total	11421.86	425			
Musical-Rhythmic	Between Groups	116.64	2	58.322	1.98	.140
	Within Groups	12481.52	423	29.507		
	Total	12598.16	425			
Interpersonal	Between Groups	460.88	2	230.440	9.48	.000*
	Within Groups	10286.23	423	24.317		
	Total	10747.11	425			
Intrapersonal	Between Groups	808.66	2	404.330	19.38	.000*
	Within Groups	8826.51	423	20.866		
	Total	9635.17	425			
Naturalist	Between Groups	542.63	2	271.31	10.86	.000*
	Within Groups	10572.40	423	25.00		
	Total	11115.03	425			

* significant at $p < .001$

The results presented in Table 2 indicate that there are significant ethnicity differences across six multiple intelligences, namely Verbal-Linguistic Intelligence ($F = 12.50$, $p < .001$), Visual-Spatial Intelligence ($F = 11.07$, $p < .001$), Bodily-Kinesthetic Intelligence ($F = 9.53$, $p < .001$), Interpersonal Intelligence ($F = 9.48$, $p < .001$), Intrapersonal

Intelligence (F = 19.38, p < .001), Naturalist Intelligence (F = 10.86, p < .001). The significant omnibus F indicates that within each significant intelligence, at least one pair of ethnicity is significant. Hence, the necessity to do a post-hoc test for the significant multiple intelligence to determine the significant pairs of ethnicities.

Table 3 Results of Post Hoc Tests for Statistically Significant Multiple Intelligences

Subscale	Malay (n=258)		Chinese (n=86)		Indian (n=82)		Differences		
	M_a	SD	M_b	SD	M_c	SD	$M_a - M_b$	$M_a - M_c$	$M_b - M_c$
VL	30.53	4.94	27.64	4.90	31.09	5.70	2.89* (p=.000)	-0.56 (p=1.00)	-.3.45* (p=.000)
VS	34.00	4.74	31.16	4.80	32.52	5.90	2.83* (p=.000)	1.47 (p=0.64)	1.36 (p=.236)
BK	34.64	4.90	31.88	5.44	33.71	5.29	2.75* (p=.000)	.93 (p=0.451)	-1.82 (p=.062)
Inter	37.92	4.50	35.60	4.93	38.63	6.10	2.33* (p=.001)	-.71 (p=.767)	-3.04* (p=.000)
Intra	34.82	4.63	31.43	4.33	34.99	5.38	3.39* (p=.000)	-.17 (p=1.00)	-3.56* (p=.000)
Naturalist	33.12	4.81	30.93	4.78	34.45	5.75	2.19* (p=.001)	-1.33 (p=0.107)	-3.52* (p=.000)

As shown in Table 3, the post hoc tests revealed the followings:-

In terms of Verbal-Linguistics Intelligence, Malay and Indian students self-estimated themselves significantly higher than Chinese students with their corresponding mean differences of 2.89 (p < .001) and 3.45 (p < .001), while there was no significant difference between the self-estimated mean between Malay and Indian students.

In terms of Visual-Spatial Intelligence, Malay students self-estimated themselves significantly higher than Chinese students with a mean difference of 2.83 (p < .001), while there were no significant differences in self-estimated means between Chinese and Indian students, and between Malay and Indian students.

In terms of Bodily-Kinesthetic Intelligence, Malay students self-estimated themselves significantly higher than Chinese students with a mean difference of 2.75 (p < .001), while there were no significant differences in self-estimated means between Chinese and Indian students, and between Malay and Indian students.

In terms of Interpersonal Intelligence, Malay and Indian students self-estimated themselves significantly higher than Chinese students with their corresponding mean

differences of 2.33 ($p < .001$) and 3.04 ($p < .001$), while there was no significant difference between the self-estimated mean between Malay and Indian students.

In terms of Intrapersonal Intelligence, Malay and Indian students self-estimated themselves significantly higher than Chinese students with their corresponding mean differences of 3.39 ($p < .001$) and 3.56 ($p < .001$), while there was no significant difference between the self-estimated mean between Malay and Indian students.

In terms of Naturalist Intelligence, Malay and Indian students self-estimated themselves significantly higher than Chinese students with their corresponding mean differences of 2.19 ($p < .001$) and 3.52 ($p < .001$), while there was no significant difference between the self-estimated mean between Malay and Indian students.

Conclusion And Discussions

In summary, significant gender differences in self-estimation of multiple intelligences were observed between male and female students on verbal-linguistic, visual-spatial, interpersonal and intrapersonal intelligences, favouring the female students. Significant ethnicity differences in self-estimation of multiple intelligences were observed among Malay, Chinese and Indian students. By ethnicity, Malay students as well as Indian students self-estimated themselves higher than their Chinese counterparts in Verbal-Linguistics, Interpersonal, Intrapersonal, and Naturalist Intelligences, while only Malay students self-estimated themselves higher than their Chinese counterparts in Visual-Spatial and Bodily-Kinesthetic. However, there were no significant differences in self-estimated multiple intelligences between Malay and Indian students across the 8 multiple intelligences.

Findings in which female students self-rated themselves higher than male students in verbal-linguistic, visual-spatial, interpersonal and intrapersonal intelligences dimensions lend support to the findings of Uysal (2004) where female tenth grade students in Turkey perceived themselves higher than male students of the same grade level in verbal-linguistics, visual-spatial and interpersonal intelligence dimensions. Another study that yielded similar results was the findings from Wehrwein, Lujan and DiCarlo (2007) in which 86 undergraduates enrolled in a physiology laboratory course at Michigan State University participated. It was found that 16.7% females preferred learning through reading and writing (verbal-linguistics) compared to only 4.2% males. It could be hypothesised that generally females have higher verbal-linguistics intelligence than males because females tend to read more books than males. According to a survey done by Associated Press (AP), a typical woman reads nine books in a year, compared with only five for men (Weiner, 2007). Brizendine (as cited in Weiner, 2007), author of *The Female Brain* claims that girls have an easier time with reading or written work and adult women talk more in social settings and use more words than men. This difference can be explained in terms of structure of the brain where it was found that language centres are more tightly located in male brains and more widely dispersed in female brains (Smith, 2004); hence, females perform better than males

in skills that require language, inclusive of verbal fluency, speed of articulation and grammar.

Kimura, in *Sex and Cognition* (1999) claims that women are better than men in human relations (interpersonal), emotional and artistic expressiveness, aesthetic appreciation, and verbal language whilst men are better than women in independence, dominance, spatial and mathematical skills (Wilson, 1992). Another study that supports the present study was a research done by Yuen and Furnham (2006) on 378 adolescents in Hong Kong. They found that females rated themselves significantly higher than males in verbal-linguistics and interpersonal intelligences while there were no significant differences in other multiple intelligence dimensions. Noorzalina Mohd Noor (undated) found that there was a significant difference between Form One and Four males and females from sixteen MARA Junior Science Colleges in Malaysia where females are more dominant in verbal-linguistics and musical-rhythmic intelligences while males are more dominant in bodily-kinesthetic, naturalist, and visual-spatial abilities.

It is quite surprising to know from the findings of this study that there was no significant difference between males and females on logical-mathematical intelligence and that females rated themselves higher than males on visual-spatial intelligence. These findings are contrary to previous studies which found that males were better than females in logical-mathematical and visual-spatial abilities (Gutierrez et al., 2006; Neto & Furnham, 2006; Swami et al., 2006). Such discordance may be explained by the experiences these students have gained at home or in their own schools. The females might have been better exposed to situations which require more participation in logical and mathematical applications. Female students possessing higher visual-spatial intelligence than male students might be contextually explained. Robichaux and Guarino (as cited in Jernagan, 2000) proposed that spatial visualisation (visual-spatial) abilities might be influenced by childhood experiences, parents' occupations, family income, model building, musical experience, playing with blocks, playing sports and drawing three dimensional objects. He even suggested that parental income can influence the visual-spatial abilities of the child. Highly paid parents can provide their children with more toys, building blocks, games, computers, and other three-dimensional objects around the house. Exposure to this sort of experience at an early age can enhance the child's ability in visual-spatial intelligence regardless of the gender of the child. As such, it is sensible to explain that in the District of Manjung and within the population from which the students were selected, female students are more exposed to the visual-spatial activities than boys at home and in schools.

Different findings were found in a survey done by Neto and Furnham (2006) among 160 Portuguese students where males rated themselves higher than females in logical-mathematical, visual-spatial and naturalist intelligences. According to MENSA (as cited in Smith, 2004), boys are more likely to be highly talented in mathematics and tasks that are spatial in nature (i.e., maze performance, picture assembly, block design, mental rotation, and certain mechanical skills) than girls. Similar findings were reported by Wilson (1992) where men tended to be higher in independence, dominance, spatial and mathematical skills, and rank-related aggression. Loori (2005) found that there was a significant difference between males and females in logical-mathematical

intelligence where males rated themselves higher than females contrary to the present study which found that there was no significant difference between males and females in logical-mathematical intelligence. A study done by Furnham, Neto, and Ruiz (2008) amongst 242 secondary students in Portugal found that there were significant gender differences in some multiple intelligence dimensions. Males rated themselves higher than females in logical-mathematical ($t = 3.5$, $p < .01$), visual-spatial ($t = 2.94$, $p < .01$), intrapersonal ($t = 2.65$, $p < .01$), spiritual ($t = 2.83$, $p < .01$), and naturalistic ($t = 3.01$, $p < .01$) intelligences. Again, these findings which are incongruent with the findings of the present study may be explained by the differential learning environment and educational policy.

The present study also suggested that there are significant differences among Malay, Chinese and Indian students in verbal-linguistic, visual-spatial, bodily-kinesthetic, interpersonal, intrapersonal and naturalist intelligences. Malay students seem to rate themselves higher than Chinese students on verbal-linguistics, visual-spatial, bodily-kinesthetic, interpersonal, intrapersonal and naturalist intelligences. Indian students seem to rate themselves higher than Chinese students on verbal-linguistics, interpersonal, intrapersonal and naturalist intelligences dimensions. There is no study found in the literature that examine the differences among these ethnicities in their self-estimation of multiple intelligences in Malaysia to which the findings of this study could be compared, hence rendering the findings from this study to be novel.

Meanwhile, one of the components in verbal-linguistic intelligence is the interest for poetry. Suggestion for the inclusion of the Malay Literature component into the teaching and learning of the Malay Language across secondary schools in Malaysia was approved on June 11, 1999 (Nuruddin, 2010). While exposing the students to Malay literature such as classic stories, poems, limericks, rhymes, and Malay epics is laudable and might have generated students' interest in poetry, the boosting of interest, nevertheless, confines to Malay students as evident in the high self-estimation mean in verbal-linguistic. This could perhaps be explained by the fact that Malay language is the mother tongue of the Malay students and that the Malay students could make sense of the meaning of classic Malay words better than Chinese and Indian students do.

Recommendations

Based on the findings of the present study, there are few important recommendations that could be made so as to enhance the learning and teaching, in general, and the teaching and learning of science, in particular. Firstly, the results of the present study and some of the past findings as suggested by Gardner (1999) indicate that different students do possess different combinations of multiple intelligence dimensions. In other words, every students has all multiple intelligence dimensions but with varying degree of preference. Therefore, teachers should recognise these differences so as to give every student the opportunity to learn in many different ways that suit them best.

For example, students who are high in verbal-linguistic and logical-mathematical intelligences, could easily make sense of the definition of Boyle's Law (i.e., for a fixed mass and temperature of gas, the pressure is inversely proportional to the volume)

and comprehend PV=k, where P is pressure, V is volume, and k denotes constant. Nevertheless, for the average and low-achievers who may not be high in verbal-linguistic and logical-mathematical intelligences, may have difficulties in making sense of Boyle's Law through such traditional teaching in which definition of terms and expression in formula is prevalent. Alternative pedagogical approach, such as simulation, could be judiciously employed. In this case, a group of students may be blind-folded and told to walk at random (i.e., signifying the random movement of molecules) within a confined space, while other students record the number of collisions between the "molecules" (i.e., signifying pressure in that it may be defined as the number of collisions amongst the molecules). As the space is reduced (i.e., signifying a reduction in volume), students are able to observe from the physical activities that there are more collisions (i.e., increase in pressure). This simulation exercise which capitalizes on bodily-kinesthetic intelligence, will serve as an anchor to understanding the definition and formula of Boyle's Law. As Kagan and Kagan (1998) have rightfully phrased it, "the more ways we teach, the more students you reach" (p. 26), calling teachers to match, stretch, and celebrate. Matching implies matching instructional strategies to students' intelligences to maximize academic success, stretching means using instructional strategies and curriculum that develop or stretch all intelligences in all students so as to maximize the development of all intelligences, and celebrating entails students discovering MI theory through metacognition and sharing so as to understand and celebrate our own uniqueness and that of others.

The educators can use suitable multiple intelligence inventory of their choice to estimate the students' preference towards the multiple intelligence domains. Identifying student learning preferences is one method for ensuring that students can learn optimally. Teachers cannot expect to use the same traditional method of teaching, instructional practices, or old pedagogical approach that were used in the past but instead they need to become innovators in the quest to meet students' learning needs (Foriska, 1992). We can no longer depend on old paradigms since they do not generate the academic potential of all students.

Educators themselves should be exposed to multiple intelligences theory through staff development trainings or relevant courses related to pedagogical approach. Since many educators are still unfamiliar with this theory, school principals and other administrators of educational institutions are encouraged to organise in-service trainings to provide teachers with necessary knowledge regarding the multiple intelligences theory and its application. If the educators understand this theory well enough, they can definitely apply the theory significantly in classrooms so as to bring out the hidden potentials in every student.

Students are encouraged to know their own MI profile so that they would know their preference pattern in learning method using multiple intelligences approach. Students can choose the way they can learn best by knowing their own profiles in multiple intelligences dimensions. If they think that they are good at interpersonal intelligence, they can choose to study in groups which emphasises discussion activities. Likewise, they can use a lot of mind-mappings and diagrams if they know that they are good at visual-spatial intelligence.

The present findings indicated that in general, students in the Manjung District perceived themselves highest in interpersonal intelligence dimension. There are many different possible methods and techniques that can be applied in classroom setting which are appropriate for the teaching and learning of science. Teachers can construct learning activities that emphasise group or team learning which enable active participation among students such as group discussion, problem-based learning, cooperative learning and other student-centred activities.

As the findings showed that female students in Manjung District rated themselves higher than male students on verbal-linguistic, visual-spatial, interpersonal, and intrapersonal intelligences, educators or teachers in this district are recommended to find ways on how to increase the males' self-estimates on these multiple intelligences dimensions. Male students should be encouraged to participate more in activities involving these intelligence dimensions.

Finally, given that the Malay and Indian students rated themselves higher than Chinese on verbal-linguistic, visual-spatial, bodily-kinesthetic, interpersonal, intrapersonal, and naturalist intelligences, teachers can find the reasons that contribute to this situation and take the necessary actions thereafter. We have to investigate why Chinese students rated themselves lower than Malays and Indians in most of the multiple intelligences. As reported by Ghazali and McPherson (2009), Malay children spend more time than the other ethnic groups watching TV, playing computer games, playing with friends and playing sports, while Chinese children spend less time on social activities. These findings suggest why Chinese students perceived themselves low in most of the multiple intelligences. Another factor which might explain for such low estimates in multiple intelligences amongst the Chinese students is the low number of Chinese participating in this survey (i.e., only 20.2% compared to the Malay students). As such, it is recommended in future research that looks at ethnicity differences in Malaysia, the use of a more representative samples of Chinese students is warranted.

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