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LEARNING ABOUT LEARNING STYLES: PEDAGOGICAL, CURRICULAR, AND MANAGERIAL IMPLICATIONS

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Abstract

The way students acquire knowledge is an interesting issue and an important research agendum. Better understanding of the learning styles and their characteristics is a necessity not only to educators but also to learners (Vincent and Ross, 2001) because of the benefits if offers to both parties. This paper looked into the learning styles of secondary school students in a science boarding school in the state of Kedah, Malaysia. Specifically, it sought to determine what are the learning styles of science-stream students as well as identify if are there significant differences in the students' learning styles grouped by gender, position in class, sibling order, father's occupation, mother's occupation, educational attainment of father, and educational attainment of mother.

A Personal Learning Style Inventory (Wyman, 1999) was utilized in determining the learning styles of Forms 1, 2, 3, 4, and 5 students. Data were analyzed via SPSS at .05 alpha.

Findings showed that generally, the respondents' learning styles was auditory. Learning styles differed significantly by gender and sibling order. Implications on curriculum, teaching, and educational management are discussed.

Keywords: Learning, Learning Styles, Pedagogy, Curriculum, Management

Introduction and Theoretical Groundwork

Learning styles have gained wide attention in the education arena. To teachers, knowledge of learning styles can help to structure their programs and teaching methods to maximize learning. They then can focus on the learning styles of learners to make learning more effective and efficient. The aim is to understand from the heterogeneous mix of students' learning styles and also the group learning style so that teachers can best adapt their teaching style and materials to suit the students' group learning style.

The elements of the learning style had been discussed in many literatures as early as 1892 (Fatt and Joo, 2001), with a prevailing view that different people acquire skills and knowledge and learn in many ways. However, some educators often think that everyone ought to learn the same way. But a growing body of research makes it clear that there are a number of different, yet equally valid, ways of people gaining knowledge and skills. Ideally the way teachers teach should match how students learn (Fatt, 2000). Therefore, the main concern of every educator in order for students to learn in an effective manner should be the learning styles of every student. Educators can then adapt their styles of teaching to match the learning styles of the students. Dunn and Giggs (2000) have convinced hundreds of administrators and teachers of the effectiveness of first identifying and the complementing how each student begins to concentrate on and retain new and difficult academic information and skills.

The notion of learning styles has been viewed in several angles. According to the National Association of Secondary School Principals (1979), learning styles are the cognitive characteristics of learners, their affective and psychological behaviors that indicate how learners perceive, interact with, and respond to the learning environment. Sadler-Smith (1996) defined learning styles as distinctive and habitual manners of acquiring knowledge, skills or attitudes through study or experience.

A more recent definition was given by Dunn and Griggs (2000), who defined learning style as the way students begin to concentrate on, process, internalize, and remember new and difficult academic information, comprising both biological and developmental environments, methods, and resources. Learning style indicates the tendency of a particular learner to adopt a particular learning strategy. It is a habitual manner whereas learning strategy is a conscious attempt to deal with a particular situation derived from the drawbacks of the style. Although many learners can master easy information in the wrong style for them, they do so more efficient and rapidly when they capitalize on their learning style strengths. Once learning styles have been identified, instructors then can estimate the processing approaches, methods and sequences of perceptual exposures to resources that are likely to make learning more comfortable and meaningful to each learner.

The literature shows that the learning style of individuals is determined by several factors. Price (1980), for example, argued that learning style varies with age while Milgram, Dunn and Price (1993) concluded that achievement levels of individuals also do have some influence in their learning styles. Other factors include culture (Dunn and Griggs, 1995) and physiological factors cited by Vincent and Ross (2001) such as visual (seeing/pictures), auditory (hearing) and kinesthetic (touching/physical).

Learning styles have also been categorized in various ways. Feldler (1996), Honey and Mumford (1992), Kolb (1984) and Senge (1992) shared views of the following learning styles: *activists* (people who like to try out new experiences, open-minded, innovative, and extrovert); *reflectors* (observe and ponder experiences and prefer to be left alone when working on any assignment); *theorists* (prefer logical explanation rather than facts in explaining something); *pragmatists* (tend to like putting theories into practice); *sensing* (tend to be patient and like detailed work and usually solve problems first by collecting facts before making any decision; *intuitive* (prefer non-routine calculations that require memorizing and are comfortable with new concepts); *visual* (absorb information more effectively from pictures, diagrams, charts or demonstrations); *verbal* (understand things better by talking and discussing matters with peers and groups); *sequential* (gain learning and understanding from logical explanations and steps and usually follow procedures that "work by the book"); and, *global* (solve complicated problems efficiently but find difficulty when asked to explain how).

Vincent and Ross (2001) advanced these types of learners: *linguistic* (good at memorizing names, places, dates, and other detailed information), *logical-mathematical* (have the capacity to work with numbers and engage in higher order thinking), *visual-spatial* (think in terms of physical space), *musical* (show sensitivity to rhythm and sound), *body-kinesthetic* (use body movement in learning and expression), *interpersonal* (have the ability to understand and interact with other people), and, *intrapersonal* (have the ability to understand themselves, their interests, and goals). Reichmann and Grasha (in Sadler-Smith, 1996) identified three types of learning preferences: *dependent* (prefer teacher-directed, highly structured programs), *collaborative* (discussion-oriented and favor group projects and social interaction), and *independent* (exercise an influence on the content and structure of learning programs). Tickle (2001) also cited the *deep* (require access to semantic features) and *shallow* (analyze physical features of stimuli) processing styles.

Wyman's (1999) theory, which served as the framework of the present research, clustered learning styles into three modes: visual (seeing), kinesthetic (touching), and auditory (hearing). These learning modes are explained as follow:

Visual (Seeing)

According to Wyman (1999), when the visual style is preferred, the person is actually thinking in images or pictures. It is as if they have a movie camera in their mind. They take in what they hear or read and translate it into images in their brain. When the visual learners want to recall what they have learned, they simply glance upward and look at the image that they have stored on their "picture screen". This process is much like going to the movies and then recalling what one has seen, in order to tell a friend. The memory process is taking place by reviewing the pictures from the movie and then easily talking about the story line to someone else. Visual learners speak in terms of "I see, I get the picture".

In a classroom, the visual learner performs very well because all testing is conducted in a written "visual" format. This requires that visual images be made when recalling information. Good readers read the black and white text and then convert the information into pictures. This makes the memory process easier. The visual child will easily conform to most classroom standards, such as sitting quietly, writing neatly and organizing materials well. When choosing careers, the visual person selects those which fit the learning style: architect,

designer, decorator, engineer, surgeon, and those which require a "vision" of the future, such as CEOs and other executive positions.

Kinesthetic (Touching)

Kinesthetic learners prefer to learn through their body or feelings. If they can touch something and feel whatever they are learning about, they will process and remember the information quite well. As students in a classroom, these children are usually quite restless, have more difficulty paying attention, and cannot seem to get "focused" (a visual term). These learners like to speak about learning in terms of their feelings and say things like "I feel" or "I'd like to get a better handle on this information."

Wyman (1999) also stressed that kinesthetic learners do not have the internal pictures of neatness and organization that visual learners make so easily in their minds. This is one of the reasons that kinesthetic learners have a more difficult time demonstrating what they know in a traditional classroom. Children who prefer the kinesthetic learning style are not usually making pictures in their minds. If they do not make pictures, it follows that there are no pictures to either keep neat, or to "mess up". Therefore, it is normal for them not to be organized. A sense of time is also quite difficult for the child who prefers to learn kinesthetically. Often, there is little projection of consequences of actions, simply because this child does not "see" out into the future. They only understand the present moment. The kinesthetic child will excel in a classroom where book reports can be "acted out" and can choose assignments, which allow them to build projects. Careers of choice include the wonderful world of athletics, building, construction, dancing, among others, or those work that can involve the body and movement.

Auditory (Hearing)

Wyman (1999) pointed out that these individuals learn best by hearing or listening. These people do not necessarily make pictures in their minds, as do the visual learners, but rather filter incoming information through their listening and repeating skills. The auditory learners tell wonderful stories and solve problems by "talking" about them. The excellent hearing and listening skills of this type of learner are what make great musicians, disc jockeys, psychologists, to name a few. Speech patterns will represent exactly how the auditory person thinks, i.e., "I hear ya, that clicks, that sounds right, or, that rings a bell". In school, the auditory learner learns by listening and can easily repeat statements back to the teacher. The auditory child likes class discussions but can become easily distracted. Of the three styles, the auditory is the most talkative and has more difficulty writing.

In addition to the learning styles categorized by Wyman (1999), the researchers have also attempted to explore possibilities of any dual or multiple modes of learning, hence, the following additional learning styles examined in the study: visual-auditory, visual-kinesthetic, auditory-kinesthetic, and visual-auditory-kinesthetic.

It is hoped that the study would benefit the educators, curriculum planners, key decision-makers, and parents in terms of providing a teaching and learning environment that can accommodate students' learning styles. More importantly, the findings also hope to the better understanding of learning dynamics among secondary school students in a science school in the Malaysian context.

Objectives of the Paper

This paper looked into the learning styles of secondary school students in a science boarding school in the state of Kedah, Malaysia. Specifically, it sought to determine what are the learning styles of science-stream students as well as identify if are there significant differences in the students' learning styles grouped by (a) gender, (b) position in class, (c) sibling order, (d) father's occupation, (e) mother's occupation, (f) educational attainment of father, and (g) educational attainment of mother.

Hypothesis of the Study

The study advanced the null hypothesis that there are no significant differences in the students' learning styles grouped by gender, position in class, sibling order, father's occupation, mother's occupation, educational attainment of father, and educational attainment of mother.

Methodology

Research Design and Respondents

This was a descriptive study employing the survey-correlational approach. It attempted to determine the learning styles of 585 secondary school students in a science school in the state of Kedah, Malaysia.

Instrument

In assessing learning styles, the Personal Learning Style Inventory developed and validated by Wyman (1999) of the Center for New Discoveries in Learning, California, USA was used in this study. This questionnaire comprised of 36 items that assessed students' learning styles across three modes: visual (picture style), kinesthetic (physical state), and auditory (hearing style). The questionnaire is well structured, uses simple and easily understood language, and scoring is facilitated through an automated computer analysis after access to the website of the Center. To determine its suitability in the local setting, it was administered to a class of first year students (n = 30) in the same school. The resulting Cronbach alpha was 0.903.

Data Collection and Analysis

Permission to gather the data was first obtained from the School Principal. Discussions on the need for the study, its importance to teaching, curriculum, and educational administration, were done. After permission was granted, the guidance counselor of the school agreed to administer the research questionnaires among all the classes, except the one which was used for pilot study. Gathering of data took about two weeks. The data were anlayzed using the SPSS computer software at 0.05 level of significance.

Findings

Profile of Respondents

A good proportion of male and female respondents was observed, where there were 52% females (n = 304) and 48.0% males (n = 281). The mean age of respondents was 15.2 years, the youngest being 12 while the oldest, 17. Of the 585 respondents, 51.4% were in their lower secondary education (Forms 1, 2, and 3) while the remaining 49.6% were in their upper secondary education (Forms 4 and 5). The most number of students was in Form 4 (155 or 26.5%), followed by Form 2 (138 or 23.6%), Form 5 (129 or 22.1%), Form 3 (89 or 15.2%), and Form 1 (74 or 12.6%).

The respondents were either in the top ten (193 or 33%) or between 11^{th}-20^{th} (204 or 34.9%) places in their class, with only 39 (6.7%) in the lowest rank scale (31^{st}-40^{th}). One-third of them (180 or 30.8%) were first-born children, while almost one-fourth (137 or 23.4%) were second in the family. The rest were third in the family or so.

Both the fathers' and mothers' occupations of respondents varied widely, with each parental group having more than one-third (208 or 35.6%) of them working in the public sector and only 71 (12.1%) involved in the private sector. A number of their parents were teachers/lecturers (111 or 19%) or self-employed (72 or 12.3%), while a few of their fathers were working as farmers (51 or 8.7%), and their mothers as housewives (51 or 8.7%). Other parental occupations include doing business (22 or 3.8%) and working as professionals (18 or 3.1%) such medical doctors, accountants, and engineers.

In terms of the educational attainment of the respondents' fathers, more than half (322 or 55%) had high school education, while more than one-third (215 or 36.8%) had university degrees. Forty-four (7.5%) of the respondents' fathers had primary or elementary education, while only four (0.7%) had no formal schooling at all. A similar trend was also noted in the educational attainment of the respondents' mothers, where two-thirds (387 or 66.2%) finished high school, and about one-fourth (144 or 24.6%), university education. Some had either primary or elementary education (45 or 7.7%) or no formal education (9 or 1.5%).

Learning Styles

This section reports the findings on the overall learning styles of respondents and when they were classified according to (a) gender, (b) position in class, (c) sibling order, (d) father's occupation, (e) mother's occupation, (f) educational attainment of father, and (g) educational attainment of mother.

Overall Learning Styles of Respondents

Seven learning styles surfaced in the study, namely (a) visual, (b) kinesthetic, (c) audio, (d) visual and kinesthetic, (e) visual and audio, (f) kinesthetic and audio, and (g) visual, kinesthetic, and audio. Of these learning styles, the findings showed that more than one-third (213 or 36.4%) of the respondents displayed "audio" style. More than one-fourth (149 or 25.5%) of them tended to be "kinesthetic" learners, while a number of them (131 or 22.5%) were "visual" learners. A few others tended to be bi-modal in their learning styles, with only three (0.5%) as poly-modal (visual, kinesthetic, and audio). Table 1 shows the data.

Table 1
Distribution of Respondents by Learning Styles

Learning Styles	Frequency	Percentage
Visual	131	22.4
Kinesthetic	149	25.5
Audio	213	36.4
Visual & Kinesthetic	25	4.3
Visual & Audio	37	6.3
Kinesthetic & Audio	27	4.6
Visual, Kinesthetic & Audio	3	0.5
Total	585	100.0

Differences in Learning Styles of Respondents by Independent Variables

The seven learning styles identified were also observed across the independent variables of the study. In terms of gender, a number of the males (102 out of 281) preferred a "kinesthetic" learning style while many of the females (133 out of 304) preferred an "audio" learning style.

The chi-square analyses showed that males differed significantly in their learning styles than the females. The null hypothesis that there are no significant differences in the learning styles of respondents grouped by gender is thus, not supported. A summary of the data is shown in Table 2.

Table 2
Learning Styles of Respondents by Gender

Learning Styles	Gender (Frequency)		Total
	Male	Female	
Visual	58	73	131
Kinesthetic	102	41	149
Audio	80	133	213
Visual & Kinesthetic	15	10	25
Visual & Audio	14	23	37
Kinesthetic & Audio	11	16	27
Visual, Kinesthetic & Audio	1	2	3
Total	281	304	585
Chi-square = 35.445; df = 3; p = 0.001**			

*** Significant at 0.01 significance level (p<0.01)*

With regard to academic position in the class, it appears that "audio" style dominated across the four categories identified. In the 11^{th}-20^{th} categories, however, the respondents may tend to be "audio" (60 out of 204) and "kinesthetic" (57 out of 204) in certain situations due to the narrow difference in frequencies. Some respondents also tended to be bi-modal and poly-modal learners. Table 3 presents the findings.

Table 3
Learning Styles of Respondents by Position in Class

Learning Styles	Position in Class (Frequency)				Total
	1 - 10	11 - 20	21 - 30	31 - 40	
Visual	49	44	30	8	131
Kinesthetic	47	57	40	5	149
Audio	73	60	60	20	213
Visual & Kinesthetic	8	11	4	2	25
Visual & Audio	10	17	7	3	37
Kinesthetic & Audio	5	15	6	1	27
Visual, Kinesthetic & Audio	1	0	2	0	3
Total	193	204	149	39	585
Chi-square = 16.095; df = 9; p = 0.065 ^{ns}					

^{ns}*Not significant at 0.05 significance level (p> 0.05)*

When the chi-square analysis was done, however, no significant differences were found. This indicates that learning styles of respondents grouped by position in class did not vary regardless of the respondents' academic rank in the class. This finding led to the acceptance of the null hypothesis that there are no significant differences in learning styles of respondents when classified according to their position in class.

In terms of sibling order, the eldest, second, third, and fifth children in the respondents' families were "audio" in their learning style. Those who were fourth in the family tended to be "visual" (32 out of 87), although they tended to be "audio" (28 out of 87) in certain learning situations. The data are shown in Table 4.

Table 4
Learning Styles of Respondents by Sibling Order

Learning Styles	Sibling Order (Frequency)					Total
	Eldest	Second	Third	Fourth	Fifth & Others	
Visual	41	27	20	32	11	131
Kinesthetic	47	38	29	10	25	149
Audio	59	50	48	28	28	213
Visual & Kinesthetic	6	7	4	4	4	25
Visual & Audio	16	8	3	6	4	37
Kinesthetic & Audio	9	6	3	7	2	27
Visual, Kinesthetic & Audio	2	1	0	0	0	3
Total	180	137	107	87	74	585
Chi-square = 27.933; df = 12; p = 0.006**						

*** Significant at 0.01 significance level (p<0.01)*

When the chi-square test was carried out, it was found out that the differences observed were significant at 0.05 alpha. This finding lends support to the rejection of the null hypothesis that there are no significant differences in the learning styles of respondents grouped by sibling order.

The respondents, when grouped by occupation of the father, tended to be kinesthetic and audio learners. Those who showed kinesthetic learning style were those who fathers were farmers, were working in the private sector, and were doing business. The "audio" learners are those whose fathers were working in the public sector, were self-employed, were teachers/lecturers, were doctors, accountants, or engineers, and were deceased.

The differences observed, however, were not significant at the 0.05 alpha. The null hypothesis that there are no significant differences in the learning styles of respondents when grouped by father's occupation is thus, accepted. Table 5 presents the data.

Table 5
Learning Styles of Respondents by Father's Occupation

Father's Occupation	Learning Styles							Total
	Visual	Kinesthetic	Audio	Visual & Kinesthetic	Visual & Audio	Kinesthetic & Audio	Visual, Kinesthetic & Audio	
Farmer	14	16	13	4	3	1	0	51
Public Sector	44	57	80	7	13	7	0	208
Private Sector	15	21	19	3	3	7	1	71
Self Employed	16	13	32	3	5	5	0	72
Teacher/ Lecturer	30	22	45	4	4	5	1	111
Business	6	8	6	0	2	0	0	22
Doctor/ Acc'tant/ Engineer	0	5	6	3	3	0	1	18
Deceased	5	7	10	1	3	1	0	27
Others	1	0	2	0	1	1	0	5
Total	131	149	213	25	37	27	3	585
Chi-square = 31.699; df = 24; p = 0.135 [ns]								

[ns] *Not significant at 0.05 significance level (p> 0.05)*

When the mother's occupation was examined, the findings showed that the respondents tended to be generally audio learners, especially those whose mothers were housewives, were working in the public and private sectors, were self-employed, were teachers/lecturers, and were doing business. Those whose mothers were doctors, accountants, or engineers were either kinesthetic or audio in learning style, while those whose mothers were deceased tended to be visual learners.

To determine whether the observed differences were significant, the chi-square test was performed. Results showed that the differences were not significant at the 0.05 alpha, suggesting that the null hypothesis is accepted. The data are presented in Table 6.

Table 6
Learning Styles of Respondents by Mother's Occupation

Father's Occupation	Learning Styles							Total
	Visual	Kinesthetic	Audio	Visual & Kinesthetic	Visual & Audio	Kinesthetic & Audio	Visual, Kinesthetic & Audio	
Housewife	69	81	102	13	19	17	2	303
Public Sector	15	25	36	3	6	4	0	89
Private Sector	5	11	15	2	5	0	0	38
Self Employed	2	4	13	1	0	2	0	22
Teacher/ Lecturer	35	24	41	3	6	3	1	113
Business	1	2	3	1	0	1	0	8
Doctor/ Acc'tant/ Engineer	1	2	2	1	0	0	0	6
Deceased	3	0	1	1	1	0	0	6
Total	131	149	213	25	37	27	3	585

Chi-square = 22.498; df = 21; p = 0.371 [ns]

[ns] *Not significant at 0.05 significance level (p> 0.05)*

Whether the highest educational attainment of the respondents' father was secondary or university education, or no formal schooling at all, the most dominant learning style demonstrated was "audio". However, those with primary education were neither kinesthetic nor audio in learning styles. Table 7 summarizes the data.

Table 7
Learning Styles of Respondents by Father's Educational Attainment

Learning Styles	Father's Educational Attainment (Frequency)				Total
	Without Schooling	Primary School	Secondary School	University	
Visual	0	12	69	50	131
Kinesthetic	1	13	97	38	149
Audio	2	13	104	94	213
Visual & Kinesthetic	0	5	12	8	25
Visual & Audio	1	0	20	16	37
Kinesthetic & Audio	0	1	19	7	27
Visual, Kinesthetic& Audio	0	0	1	2	3
Total	4	44	322	215	585

Chi-square = 15.545; df = 9; p = 0.077 [ns]

[ns] *Not significant at 0.05 significance level (p> 0.05)*

The observed differences were tested using a chi-square to find out statistical significance. Based on the findings, it was found out that there were no significant differences in learning styles of respondents when classified according to father's educational attainment.

When the mothers' educational attainment was examined, the findings showed that those with no formal schooling were neither visual nor audio, while those with primary education were kinesthetic learners. Those with secondary and university education tended to be audio learners. However, the differences observed were not significantly different based on the 0.05 alpha. This led to the acceptance of the null hypothesis that there were no significant differences in learning of respondents grouped by mother's educational attainment. Table 8 presents the data.

Table 8
Learning Styles of Respondents by Mother's Educational Attainment

Learning Styles	Mother's Educational Attainment (Frequency)				Total
	Without Schooling	Primary School	Secondary School	University	
Visual	3	9	82	37	131
Kinesthetic	1	19	106	23	149
Audio	3	12	138	60	213
Visual & Kinesthetic	0	4	14	7	25
Visual & Audio	1	0	26	10	37
Kinesthetic & Audio	1	1	19	6	27
Visual, Kinesthetic & Audio	0	0	2	1	3
Total	4	44	322	215	585
Chi-square = 16.177; df = 9; p = 0.063 ^{ns}					

^{ns}*Not significant at 0.05 significance level (p> 0.05)*

Discussion, Implications, and Recommendations

The findings of the study provided some platforms for discussions and avenues for educational attention. One of the striking results is the "audio" learning style that prevailed among the respondents in the study. Learners who are auditory in learning are described as those who like talking, have difficulties with written instructions, enjoy listening, and outgoing and sociable. These learners must hear something in order to understand and learn best by listening to an explanation, and that they tend to be distracted in the class although they may like class discussions (Kanar, 1995, in Vincent and Ross, 2001). However, the respondents, as science-stream students, need to do more in class than just mere listening. They must actively engage themselves in hands-on activities both within and outside the classrooms. Likewise, the respondents need to be more aggressive in exchanging views and ideas as well as challenging existing knowledge and concepts.

One of the pedagogical and curricular implications is that school teachers, especially those teaching secondary school science like biology, physics, and chemistry, need to craft teaching-learning activities and programs that encourage or require non-passive individual contributions and engagement in class and peer discussions, group work, and experiments. There needs to be a practical curriculum that focuses on activities that elicit logical and critical thinking, appreciation of the roles of science in nation-building and personal development, and functional knowledge useful to day-to-day routines. Nevertheless, Fatt (2000) points out that teaching should provide students with the opportunity to learn in a way that suits their learning styles so that they can learn better and feel more comfortable in their own learning styles instead of having themselves to adapt to the various teaching styles of teachers. This statement, however, may not apply well to the present research considering that the respondents were science students and as such, "learning by listening" solely seems to be an unproductive way of uncovering the frontiers of secondary school science. Perhaps, the insight in the statement espoused by Fatt (2000) implies that, for instance, auditory students may prefer oral examinations while visual students may do well in tests that require visual interpretation of diagrams or models, and that kinesthetic students may prefer task-oriented activities. The bottom line of course, is to make teaching effective, in particular science-oriented instruction. For educational managers such as the school principals, the need to provide unconditional administrative, organizational, and personal support is imperative, in particular the implementation of pedagogical and curricular programs that suit learners' styles.

Although auditory learning style was the prevailing learning style, it was also interesting to note that a couple of the respondents tended to be kinesthetic (26 percent) and visual (22 percent). A few others also had the tendency to be bi-modal and poly-modal in their learning styles – they were visual and audio (6 percent), kinesthetic and audio (5 percent), and visual and kinesthetic (4 percent), and a negligible proportion (0.5 percent) tended to be visual, kinesthetic, and auditory. The spread in the learning styles is understandable because learners use their (five) senses to gather information and then channel these information through representational systems (visual, auditory, and kinesthetic) to make sense of their environment. Those with a visual preference see the world by constructing or remembering mental images while those with an auditory preference like sounds and can make decisions based on what is being heard. Kinesthetic learners relate to the world through feelings (Madonik, 1990, in Fatt and Ng, 2001). The implication, thus, is that when educators, curriculum planners, and school principals design, develop, and facilitate teaching and learning experiences, factors such as the organizational and environmental context, the learner characteristics, and their learning styles should be taken into account. Interplay of individual differences (with regard to ability, age, among others), the organizational context (school culture and climate, resources, learning methods, to name a few), and the environmental context (e.g., social factors, technological changes) results in a wide range of learning needs at individual or group levels (Smith, 1996).

Vincent and Ross (2001) recommend that for kinesthetic or tactile students, educators and the academic community should provide hands-on activities, provide for physical movement within the classroom, and encourage note taking. There should be "learning by doing", touching, writing notes to help remember things, underlining important concepts or information in textbooks, taking frequent stretch breaks, drawing pictures or diagrams of what has been learned, and building projects to help explain ideas. In science classes, the conduct of laboratory work and experiments can motivate and help kinesthetic students to enjoy learning. This will allow the learners to satisfy their curiosity, move about to gather

information, and make and record observations, among others. For visual learners, Vincent and Ross (2001) suggest that teachers of visual students should provide as many visual clues as possible, such as by using video equipment, providing assignments in writing, and using charts and pictures. Teachers, add these authors, should use bright colors, encourage students to take notes, and draw pictures in their notes to associate with facts. Visual students need to visualize new ideas or knowledge presented, read the class topic before it is discussed in class, and visualize the details of what is read. Since the curriculum of the students involved in the present study is putting a premium in science and allied sciences (e.g., mathematics), the lectures must be accompanied with concrete illustrations and real-life situations. For instance, talking about the human system will be more meaningful when students see a video or detailed pictures of the systems involved. In other words, the theories and concepts must be associated with pictorial representations.

In addition, gender differences in learning style were also observed in this study. Females were generally auditory in their learning style, while the males were generally kinesthetic. Across other learning styles, it was found that more females were more visual, more visual and auditory, and more auditory and kinesthetic than their male counterparts. A similar finding was found in a research done by Heffler (20001) of Stockholm University, Sweden, where the females appeared to be more experience-based approach to learning, feeling-based judgments, people-oriented, concrete role-play simulation learning, and feeling comfortable with ambiguity. The learning categorization used was not the same for the present investigation, but the findings support this study and point out that the females acquired knowledge and skills in ways that were statistically and significantly different from the males.

In another related study, Segumpan and Mohamad Zainol Abidin (2002) also found in their study of MBA students in a Malaysian university that the males were kinesthetic while the females were auditory in their learning styles. Although the respondents involved university students, it was interesting to note that the secondary school science students in the present study also showed the same learning styles in terms of gender. The researchers feel that the similarity may be attributed to cultural underpinnings and to some extent, the national policy of a standardized curriculum in the educational system. The implication for teaching, then, is to provide instruction that tries to balance between stimulating the auditory sensation and accommodating the tactile tendencies of both female and male students. The curriculum should be attuned to students' learning modes, without sacrificing the objective of the science school to develop learners who are curious, inquisitive, logical, analytical, creative, and reflective as well as able to apply what are learned in the classrooms to what are happening in the external environment. The curriculum should see to it that the students will not be mainstreamed or segregated in instruction based on their gender because the school might lose its mission of producing individuals, whether males or females, who should love science and go for future science careers.

Learning styles also varied statistically and significantly according to sibling order. While the eldest, second, third, and fifth child showed a preference for auditory learning style, the fourth child tended to be visual. This finding seems unexpected, and because of the scarcity of studies that have examined sibling order differences in learning styles, the present researchers could not be certain to make a conclusive statement about learning styles based on sibling order. Besides, no sophisticated statistical analyses like regression were carried out, thus, the findings could only say the least that there were significant differences in the students' learning styles based on sibling order, and could provide definite explanation for the

differences. This is one limitation of the study, and perhaps, this can be an interesting topic for future researches along this line. Longitudinal studies, including the possible bearing of culture and national educational policies, are also recommended.

Concluding Remarks

In any educational setting, learning style issues and challenges will prevail. Educators and researchers alike will continue to address pedagogical, curricular, and managerial implications of these learning styles, especially on effective instruction. While the writers of this paper have attempted to provide some insights on learning styles in the context of a science school environment, it appears that more researches and empirical work need to be done to understand better the intricacies of student learning. As aptly put by Caple and Martin (1994), students do learn in different ways and that uniform approaches to education and training, whether they be based on talk and chalk, experiential exercises, or distance learning will not be suitable for every individual.

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