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Full Length Research Paper

Investigating tenth grade Jordanian Students' thinking styles based on Herrmann's Whole Brain Model for the purpose of developing new teaching method in modifying science misconceptions

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The purpose of this study is to investigate tenth grade students' learning styles in Jordan based on Herrmann Whole Brain Model. As a result a teaching method has been developed (Herrmann Teaching Method: HTM) to be used to correct science misconceptions held by learners. The sample consisted of 558-students selected from three schools within Bani Kenana School District. The study sought to answer the following research question: *What learning styles are held by primary 10th grade students in Jordan by Herrmann's Model? Their respective percentages? Do such percentages vary statistically?* The results showed that no statistically significant differences in tenth grade student assignment to the four learning styles. In other word, tenth grade students proportionately distributed to the four learning styles based on Herrmann Model. This study, therefore, suggest that curriculum developers design their textbooks based on a teaching method that is derive from Herrmann Model and considers student's various learning styles and individual differences within classroom during a class time.

Keywords: Teaching method, Herrmann Model, thinking styles, learning styles, misconceptions, conceptual change.

INTRODUCTION

Despite the recognized importance of scientific concepts in one's cognitive construct, results from various recent studies refuted the common stereotype that students come to classroom with blank mind that need to be filled and molded by school. Studies revealed that students come to school with their own preconceptions. For example, Bruner (cited in Abu Jalal and Serian,1999) argued that everyone, even children, has his own worldview depending on which views and explains the world around him, which in many cases would be incompatible with the accurate scientific knowledge and known as alternative concepts or misconceptions.

The phenomenon of misconceptions has been widely studied by educators, particularly those interested in science teaching, and many educators and psychologists, like Bruner, Ausbel, Novak, Tyler and others (Ennenbach, 1983), thoroughly studied various misconceptions held by students of different ages (Gill-Pers and Carrascosa, 1990).

Results from conceptual change studies (Shipstone, 1988; Shipstone et al., 1988; Shipstone, 1989; Cepni and Keles, 2006; Baz and Bawaneh, 2008; Bawaneh et al., 2010; Bawaneh et al., 2010b) supported effectiveness of teaching methods that comply with the conceptual change theory in bringing about the intended conceptual changes in learners. Results were mostly in support of supremacy of untraditional teaching methods that complied with conceptual change steps, upon traditional ones.

Many theories have emerged as a result of intense concern with learners and increased interest in identifying the teaching-learning process. Two categories of schools of thought can be identified: the first group of theories was focused on the superficial behavior of learner known

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as the behavior theory. The other approach is concerned with mental operations happening in one's mind known as cognitive/ constructivism theory (Borger et al., 2000; Yitim, 2006).

Constructivism and Conceptual Change

Many educators (Najdi et al., 2005) argue for the need to look for prior learning acquired by students and to have it in mind while introducing new experiences and concepts. Learning scientific concepts relies upon a constellation of interrelated concepts linking prior and new concepts together. It is argued that much of strategies used in conceptual change processes are built around the constructivist approach (Habashi, 2006) that emphasizes on inquiry activities that help survey student responses and restructure concepts based on new cognitions (Trotedge et al., 2004).

Educators argue that there is no specific definition of *constructivism*, whereas others; Ritchie and Cook (1994), referred to *constructivism* as *epistemology* i.e. a cognitive paradigm which focuses on learner's role in self constructing of knowledge and views learning as an adaptation process in which learner would adapt processed data in response to new experiences that emerge out of active interaction with others. A constructivist classroom is characterized as a learning environment in which learner is encouraged to take responsibility on his own learning, taking the part of explorer in an attempt to give meaning to experiences to which he may be exposed by linking it to prior cognitive (Mustafa, 2004). Kattoula (2007) defines *constructivism* as a belief that new knowledge must be constructed out of existing knowledge, by establishment of new associations, transformation, and processing.

Difficulties faced by constructivist delivery of science content

However, success attributed to the constructivism argument is greatly debated regarding using the constructivism approach in science education both epistemologically and pedagogically (Harding and Hare, 2000). Despite many related research studies and important programs were developed (study describing Australian Constructivist View, instructional projects developed in British and American universities such as $(SI)^2$ program in British Colombia University), science teachers, even most expert were incompletely using the constructivism approach. Tobin (cited in Ritchie and Cook, 1994) criticized the constructivism arguing that reforming approaches calling for a changing role of science teacher were unsuccessful, and failed to consider the basic components of change process in teacher education and training. Such basic components include; self-reflection in beliefs, develop private vision of classroom practice, and commitment to personal change.

Although constructivism would appear theoretically simple, many teachers, however, encounter difficulties in their attempts to create their constructivist classrooms (Mckeown and Beck, 1999), the result supported by Haney et al (2002). While teacher uses the constructivism approach in his teaching, students, on the other hand, would urge on returning to the most conventional teaching method that responds to their deeply-rooted beliefs. The constructivism approach is also challenged by many difficulties that have counter-effects. In order to obtain high scores on the high-stake state assessment, students would carry out various activities that do not reinforce meaningful learning (Brook and Brook, 1999).

Along the same lines, Matthews (1998) asserted that the difficulties faced by constructivist delivery of science content not only practical, but also theoretical. The argument is that if cognitive as a single construct was not transmissible, then how could students be receptive to cognitive with complex conceptual schemas which took long years from creative people to develop?

The concern of many educators is to identify by which teaching method cognitive content could be delivered based on principles of the constructivist approach. The question is that in case of abstract knowledge, for example concepts such as velocity, acceleration, force or gene, or experience-free knowledge, for instance a proposition about atomic structure or algorithm operations; unrelated with prior knowledge of concepts, for example perceptions regarding virus, antibodies, or evolution; knowledge alien to commonsense, experience or daily expectation of learner, then how all of this knowledge could be taught without being delivered to students by teacher, given that teaching cognitive body not only learning concepts, but also includes a methodology or theory of method (Matthews, 1998).

Zaitoun and Zaitoun (2003) criticized constructivism arguing that student can't construct every kind of knowledge, as there are cognitive fields that couldn't be represented by a constructivist model (e.g: The exchange of gases in the air vesicles). They, however, emphasize on the existence of cognitive complexity in the instructional tasks, time needed to construct, assessment, social receptivity of the constructivist model of learning, and reluctance by teachers.

Against criticisms, brain research report that the constructivist approach is the best to represent brain functionality (Abbot and Ryan, 1999). The conclusion then is that constructivist teaching strategies are meaningful and should be adopted, but to what extent?

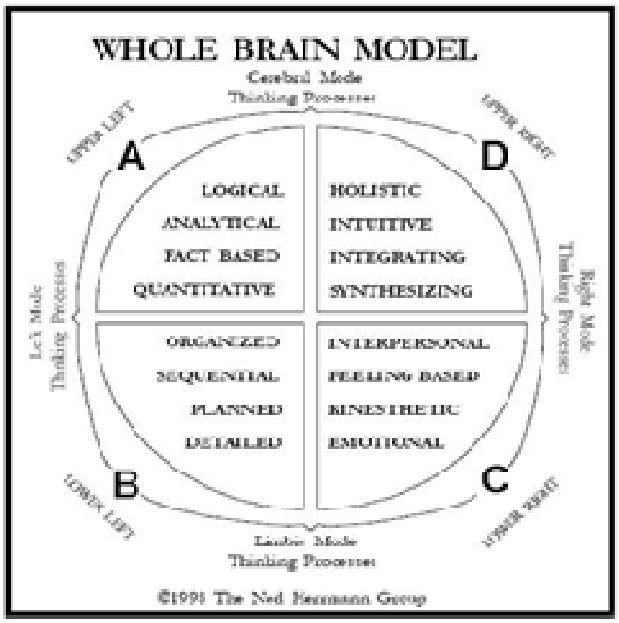

Figure 1. Illustration of Hermann's Brain Model (Herrmann, 2000)

Herrmann Whole Brain Model

Thorndike (cited in Hergenhahn, and Olson, 1993) indicated to individual differences that can be explained by the differing cultural, personal, biological, and emotional variables among individuals. This paper follows this approach by emphasizing on the individual differences among students, and student-centered learning considering student as the hub of the teaching-learning process by taking the learning style most preferable to students into account, then proposition teaching method based on Herrmann's Whole Brain Model in modifying science misconceptions. The study relied on Herrmann Whole Brain Model in classifying students depending on their learning styles (She, 2005 ; Steyn & Maree, 2003 ; Bawaneh, Ahmad Nurulazam, and Salmiza, 2010a):

❖ **External learning Style:** Students under this category are described as logical, factual, theoretical, analytical, and realistic. This pattern represents the upper left quadrant of the brain (QA). The preferable learning style happens in traditional classroom with aid of lecture, discussion and textbook. Teacher, who serves as the knowledge dispenser, and answerer of question.

❖ **Procedural Learning Style:** This pattern is characterized as sequential, regulated, elaborated, planned, procedural, controlled, conservative, and timely. This pattern describes the lower left quadrant of brain (QB). Student under this category prefer individual learning by handwork in which individual students are provided with already prepared manual showing experimentation step by step and tools and instruments needed, hands-on activities, abstract cognition, and commonsense are most emphasized.

❖ **Interactive Learning:** This pattern is characterized as interpersonal, emotional, intuitive, sensory, spiritual, expressive, verbal, literacy. This pattern is represented by the lower right quadrant of brain (QC). Students with interactive learning style prefer work in groups with each group being provided with manual showing experiment procedures and duties of each group members. Learning context itself is created by experience, feedback, listening, physical experimentation, and shared thinking.

❖ **Internal Learning:** This pattern is characterized as being inclusive, innovative, imaginative, integrative, conceptual, synthetic, simultaneous, self-exploratory, imitative, and creative. This pattern is represented by the upper right quadrant of brain (QD). Visual displays on computer or practically in labs are the most preferable learning style for learners under this category.

From Herrmann's view, as already discussed-brain consists of four areas of preferences (A, B, C, and D). Herrmann, as a result, developed his internationally accepted scale for purpose of classifying individuals relying on their preferences of thinking (preferable learning styles). Figure 1 shows brain divisions depending on Herrmann's classification.

Teaching Approaches and Learning Styles

Herrmann (cited in Bull, Montgomery, and Kimball, 2000) explains that preferring what to learn by one relates to his learning style, so mismatch between learning style and teaching approach would possibly result in learner's

helplessness, thereby greater effort and money to bring about learning, in addition to feeling dullness and boring. Preference of one learning style, however, doesn't necessarily mean effective learning as inappropriate teaching, which mismatch one's learning style is being received. Herrmann (2000) also argued that learning would take place even in separate of one's learning style, which requires strong extrinsic and intrinsic motivation. Teacher, therefore, is advised to explore learning capacities and to consider their various learning styles when deliver the teaching which should be effective and challenging. Teachers, therefore, encouraged not teaching based one learning style; otherwise they have to meet the various learning styles.

The teacher's role is to identifying students' learning styles before delivery their teaching in order to develop teaching strategies that match student's learning styles (Cuthbert, 2005). Doing so will lead to increase academic achievement, scientific fact retention and application more positively for developing positive attitudes in learners (Loo, 2002; Dunn and Dunn, 2002; Lister, 2004; Minotti, 2005; She, 2003; She, 2005; Beasley et al., 1997).

Dunn and Griggs (1989) suggested that when student learn with his preferred learning style, he will be more integrated and retention of facts will be longer, enjoy learning more than those who learn with less preferred learning style. Similarly, Hilgersom (1987) called teachers to be aware to student's preferred learning styles, teaching methods, as well as instructional activities that foster effectiveness of learning styles most preferred to students. Hilgersom (1987) called for conducting further empirical studies to identify whether students would achieve higher taught depending on their learning styles.

She (2005) demonstrated that since 1960's through 1980's the issue of whether compatibility between learning style most preferred to students and teacher's teaching approach would really benefit students has been greatly debated. In this context many studies (for example, Traver and Dawson, 1978) which are interested in teaching visual learners by seeing words, and auditory learners by listening to word sounds. Reviewing fifteen studies in this field resulted in thirteen studies found no positive effect of compatibility between learning style most preferred to students and teacher's teaching approach. Another 24 studies were also concerned with inquiring the effect of compatibility between learning style most preferred to students and reading teaching approach failed to find a positive effect (Kampwirth and Bates, 1980). Additionally, Kavale and Forness (1987) conducted meta-analysis of 39 prior studies and found out no positive effect of achievement on reading style in children. In summary, the literature reviewed did not support the finding that compatibility between learning styles preferred to students and teaching approach has effective effect on an improved reading. However, studies in Special Education field open the door for little hope.

Martini (1986) conducted a study aimed at investigate the effect of science teaching to middle school learner depending on learning styles most preferred to students. Findings indicated that:

1. Visual Students best learn by viewing films and reading.
2. Auditory Students best learn science content by cassette recordings.
3. Kinesthetic (Motor-sensory) Learners best learn via microcomputers and electronic gaming.

Tarver (1996) and Stahl (1999) contended that today's learning styles approach should be known as a modality preference approach. Stahl and Tarver investigated the result of there is no effect of compatibility between teaching approach with the learning styles, most preferred to students suggesting a hypothesized relationship (effect) between compatibility teaching approach and learning styles most preferred to students. Results from other studies emphasized improvement of student learning when teaching approach is compatible with learning styles most preferred to them (Jerkins, 1991; Martini, 1986); and Packins and Bain (1978) (cited in She, 2005).

The debate still exists among educators about the effect of compatible teaching approach with learning styles most preferred to students in science and other subjects learning as a result of varied complexities and structure of learning styles (Herrmann, 2000; She, 2005). There is a need, therefore, to fill the gap in empirical studies concerned with compatibility between teaching approach and learning styles most preferred to students. Most importantly, such studies expected to provided elaborate information about how students (children) learn with varied learning styles if were compatible or incompatible with teacher's teaching approach, mainly learning difficult scientific concepts in science subject.

Statement of the Problem

Many studies (Demirci, 2004; Baser, 2006; Cepni and Keles, 2006; Massad et al., 2002; Jaber, 2004; Baz, and Bawaneh, 2008) reported a very serious problem when entry-level students come to school with many concepts that are inconsistent with the acceptable scientific knowledge; such concepts are called alternative concepts or misconceptions. This problems was also reported by the American Association for the Advancement of Science (AAAS, 1989), and supported by the National Research Council which found that students have shallow understanding of science and scientific concepts. Publication of the Jordanian Ministry of Education has clearly shown that misconceptions are widely held by Jordanian students (Massad et al., 2002), the same result was supported by many studies (Shorman, 2000, Jaber,

2004; Baz and Bawaneh, 2008; Bawaneh et al., 2010; Bawaneh et al., 2010b). Results from many international studies; Second International Assessment of Educational Progress IAEP (1991) report Abulibdeh (2008). Replicated Third International Mathematics and Science Study (TIMSS-R, 1999) report (Michael et al., 2000), (TIMSS, 2003) report (Michael et al., 2004), (TIMSS, 2007) report (Michael et al., 2008), and the Program for International Student Assessment, PISA (2006) report (Ryo and Barbara, 2009) revealed commonly held misconceptions in science, basically physical concepts in many countries including Jordan.

In general, results from this study clearly demonstrate that the Jordanian Educational System was ineffective in gearing Jordanian students to the targeted performance levels, despite the curriculum reforms adopted by the Jordanian Ministry of Education (Abulibdeh, 2008), which, in light of earlier outcome, justifies revisiting, and reconsideration of teacher qualifying and training programs and the scholastic environment in general.

On the other hand, it is important to indicate that science teaching approaches are teacher-centered where student is passive learner, and lecture is the main teaching method to deliver content (Mestre, 2001). This approach posits that all students have the same level of ability to acquire scientific content, with little attention being given to student individual differences, dispositions, and preferable learning methods (Fuqaha, 2002; McCarthy, 1990; Kolb, 1984). For purpose of identifying best teaching methods, improving student's understanding of scientific concepts, science curriculum developers and educators are thus interested in acquiring students right scientific concepts, find our and eliminate alternative concepts, using appropriate remedial strategies, and taking into account learning styles that students have, and deliver teaching accordingly (Cuthbert, 2005; Bell, 1998).

In expectation of best teaching method, and given that teaching strategies that are fine-tuned with student' learning styles create better learning in students (references), and considering that Herrmann Whole Brain Model is systematic and inclusive that is focused on learner development, this study, therefore, recommends preparation of the instructional material so that to consider the different learning styles of students in classroom (during one class), and support learners to develop their own preferred learning styles to reach the end goal from Herrmann Model that is for a learner to acquire all learning styles equivalently and becomes Whole Brain Learner.

Teaching method that was developed based on Herrmann Model and thus designated as Herrmann Method so that to be responsive to each learning style (brain four quadrants) within one classroom. In other words, events take place in classroom should include various activities and skills, consider individual differences among students, and take into account student's learning styles as described by Herrmann Model: Extrinsic learning style (QA) that prefers learning through lecturing, discussion, and textbook; procedural learning style (QB) prefer learning with individual manual work; interactive learning style (QC) prefer experimentation and cooperative learning in groups; and intrinsic learning style prefer learning with practical display by teacher (QD).

Purpose of the study

The major purpose of the present study was:

1. To identify students' learning style based on Herrmann Whole Brain Model.
2. To Propose Teaching Method Based on Herrmann's Whole Brain Model in Modifying Science Misconceptions by answering the study question.

Study question: What learning styles are held by primary 10^{th} grade students in Jordan by Herrmann's Model? Their respective percentages? Do such percentages vary statistically?

Significance of the Study

The significance of the present study resides in many aspects that relate with the teaching-learning process, most importantly is that identification of the learning styles among tenth grade learners in Jordan based on Herrmann Whole Brain Model for the purpose of developing new teaching method in modifying science misconceptions. Through designing the instructional material with a teaching method that is derive from Herrmann Model (Herrmann Teaching Method) which is inclusive and systematic and considers individual differences among students during a class time.

This will guide students to develop their own preferred learning styles in order to reach the final end from Herrmann Theory that is for a learner to acquire all learning styles equally (Whole Brain). It is expected that this study will benefit wide stakeholders in the teaching-learning process including curriculum developers, teachers and students the hub of the teaching-learning process itself.

MATERIALS AND METHODS

Population and Sample

Population consists of all boy schools, which include primary 10^{th} grade level within Bani Kenana Provincial Directorate of Education, Irbid Governorate in Jordan during the academic year 2008/2009. The sample was randomly selected. Table 1 shows these schools and respective student numbers.

Table 1. Schools and respective student numbers

School Building	Students
Harima Comprehensive Boy Secondary School	201
Kharja Comprehensive Boy Secondary School	164
Al-Hussein Comprehensive Boy Secondary School	193
Total	558

Instruments

Learning Preference Questionnaire (LPQ)

This study employed questionnaire version revised by Nawafleh (2008) to suite the Jordanian environment, which classify students depending on the preferred learning styles. Nawafleh (2008) developed a questionnaire based on She (2003), which included 60-items originally modified from HBDI: Herrmann Brain Dominance Instrument consisting of 120-items based on Herrmann's Whole Brain Dominance Model. Nawafleh (2008) employed the unique Chinese version of She's instrument, which initially was built on Herrmann Whole Brain Model (HBDI) consisting of 60-items measuring a sequence of learning activities that are most preferable to students, divided into four quadrants based on Herrmann Whole Brain Model. Each quadrant is assigned 15-items. To verify reliability, the instrument was administered to primary 10th graders in Jordan and re-administered two weeks later. Chronbach alpha coefficients for the first test were (QA: 0.78 , QB: 0.79 , QC: 0.76 , QD: 0.77). Relying upon these coefficients Nawafleh adopted the instrument as appropriate to the Jordanian environment (O'deh, 1993).

Identifying Student's Learning Style by the Instrument

Students' learning style was identified by student's response to questionnaire items when option the learning activity that is easy to use and enjoyable. The aggregate response will be calculated for each respondent. The percentage of each quadrant will be reached by dividing the items number selected within one quadrant by total items selected in all quadrants. Students then will be classified into four learning styles depending on the quadrant, which had the higher percentage. If two or three quadrants had the same percentage, student would be of two or three learning styles. However, all students with two learning styles or more will be excluded from the study.

Study Design

This is a survey study, employing correlation technique to administer inclusively for participants.
The following variables were studied:

- *Independent Variable: Student's Preferable Learning Styles:* including four levels: style [A] Externalized (upper left), style [B] Procedural (lower left), style [C] Interactive (lower right), and style [D] Internalized upper right].
- *Dependent Variable*: Proposition Teaching Method Based on Herrmann's Whole Brain Model in Modifying Science Misconceptions

Statistical Treatment

Perceived frequencies, percentages, and respective cumulative percentages, and expected frequencies and respective percentages, in addition to X2 value based on fit-of-goodness technique to test the normality sample. Standardized residual for interactive cells were also computed.

RESULTS

The major purpose of the present study was to Propose Teaching Method Based on Herrmann's Whole Brain Model in Modifying Science Misconceptions.

To answer the study question "What learning styles are held by primary 10th grade students in Jordan by Herrmann's Model? Their respective percentages? Do such percentages vary statistically? For simplicity, the researcher divided this question into two parts:

A. Regarding learning styles held by primary 10th grade students in Jordan depending on Herrmann's Model

Frequencies related to individual learning styles held by primary 10th grade students in Jordan were tabulated to find out the relative sizes as percentages to the total sample (N=558), in addition to the cumulative percentages as shown by table 2.

Table 2 shows results as follows:

1. Style QA Externalized was placed top representing 22.6% of the overall learning styles held by primary 10th graders.
2. Style QC Interactive was ranked next representing 21.5% of the overall learning styles held by primary 10th grade students.
3. Style QB Procedural was placed third accounting for 18.3% of the overall learning styles of the primary 10th grade students.
4. Style QD was placed in the fourth rank accounting for 16.1% of the overall learning styles of primary 10th grade students.

Taking into account that the aforementioned learning styles accounted for 78.5% of the overall learning styles held by 10th grade students, it is evident from results that the remaining learning styles resulting from interaction of the four major learning styles relying on Herrmann Model (externalized, procedural, interactive, internalized) represent 21.5% of the overall learning styles held by primary 10th graders.

Table 2. Frequencies, percentages, and cumulative percentages of learning styles held by the primary 10th graders in Jordan by Herrmann's Model

Rank	Dominant Learning Style	Frequency	Percentage	Cumulative Percentage
1	QA Externalized	126	22.6	22.6
2	QC Interactive	120	21.5	44.1
3	QB Procedural	102	18.3	62.4
4	QD Internalized	90	16.1	78.5
5	QAQD Externalized+Internalized	30	5.4	83.9
6	QBQC Procedural+Interactive	18	3.1	87.2
7	QAQCQD Externalized+Interactive+Internalized	18	3.1	90.3
8	QBQD Procedural+Internalized	12	2.2	92.5
9	QAQBQD Externalized+Interactive+Internalized	12	2.2	94.7
10	QBQCQD Procedural+Interactive+Internalized	12	2.2	96.9
11	QAQC Externalized+Interactive	6	1.1	0.98
12	QCQD Interactive+Internalized	6	1.1	0.99
13	QAQBQC Externalized+Procedural+Interactive	6	1.1	100.0
	Overall	558	100.0	

Table 3. Results from (X^2) of fit-of-goodness to reveal substantial differences in perceived and expected frequencies of major learning styles of primary 10th graders graders

Dominant Learning Style	F	Percentage %	Expected F	Remaining	K^2	Freedom Degree	A
QA Externalized	126	28.767	109.5	16.5	7.479	3	0.058
QB Procedural	102	23.288	109.5	-7.5			
QC Interactive	120	27.397	109.5	10.5			
QD Internalized	90	20.548	109.5	-19.5			
Overall	438	100.000					

B. Results related to substantial percentages learning styles held by Primary 10th grade students

Learning styles of primary 10th grade students resulting from interaction of the four major learning styles based on Herrmann model were excluded. The targeted sample (N=438). Perceived frequencies of learning styles found in primary 10th grade students and their respective percentages were computed. In addition, expected frequencies and residuals (Residual=the subtractive product of expected frequency from the perceived frequency. So, when positive product obtained the perceived frequency, it will be superficially greater than the expected frequency and vice versa.

in addition to finding out computed (X2) ((X2) is computed by this equation: ($\chi^2 = \sum_{i=1}^{n} \frac{(o_i - e_i)^2}{e_i}$) using Goodness of Fit technique was revealed and compared with critical (X2) at freedom degree (3), and assigning the respective statistical significance as in table 3.

indicated priority of the learning style QA in the upper left quadrant of brain (22.6%), the result which finds support from Shelnutt et al)1996) and Abdullah et al (2004). Next is the learning style QC in the lower right quadrant of brain (21.5%), whereas learning style QB come in the third place (18.3%), and finally in the upper right quadrant of brain (16.1%) is the learning style QD. The later result is consistent with results from De Boer and Steyn (1999). On the other hand, results indicate that all learning styles are proportionately represented in the sample. Callan (1996) noticed that students in the same classroom have differing learning styles. I think this is good for community to strike social balance in terms of diversifying jobs and employment opportunities depending on mental abilities and interests of individual job seekers.

These results can be accounted for by ongoing update and developing process taking place on curriculum level and the diversified teaching methods. Used, though

traditional teaching methods of lecturing and classroom discussion dominate education levels and courses. Which if continued would negatively affect creative thinking and scientific fiction abilities in students and encourages analytical, logical and rational thinking.

CONCLUSION

The purpose of the present study was to find out best teaching methods For the purpose of developing new teaching method in modifying science misconceptions. To that end, this study suggested that the instructional material should be designed in a way to take student's preferred learning styles into account as specified in Herrmann Whole Brain Model. Results indicated no statistically significant differences among the four learning styles (QA, QB, QC and QD), and studies (Loo, 2002; Lister, 2004; Minotti, 2005; She, 2003; She, 2005) support that the best learning results from teaching strategies that comply with student's learning styles, and considering that Herrmann Model is inclusive and systematic that is focused on learner development given that a learning styles is not constant, but rather changeable and could be developed, the researchers are of the view that curriculum developers should design textbooks that are responsive to all students in the classroom that consider individual differences among learners during class time. It also urged to build comprehensive skills in students that encourage them develop their own learning styles in order to reach the final end of Herrmann Theory which underlies his model, that is for students to acquire all learning styles proportionately (Whole Brain), which, of course, will increase flexibility and creativity in learners (Herrmann, 1989). The four alternatives of preferable learning styles (QA, QB, QC and QD) developed based on Herrmann Model, other four teaching methods that comply with the learning styles should be developed. Along the same lines, Nawafleh (2008), She (2005), and She (2003) investigated the effect that compliance between teaching method and preferable learning style based on Herrmann Model and interaction between both would have on the immediate and deferred achievement and concept acquisition and retention. Herrmann (2000) defended for a strong and relevant association between one's preferable learning style and teaching method that students who are taught with methods comply with their preferred learning styles will have greater motivation to learning and experience lesser effort exerted. Bull, Montgomery, and Kimball (2000) advise greater attention to student's preferable learning styles and considerate individual differences by guiding teachers to provide students with a teaching that complies with various learning styles; i.e. preparation of the instructional material (content) based on Herrmann Model considering peculiar characteristics of each of brain parts. In other words, to take the four learning styles into account during classroom time, so that there will be more than one learning style that are integrated in one teaching method to deliver the lesson content based on Herrmann Model referred to in this study as Herrmann Method (HM).

RECOMMENDATIONS

In light of the results reached to by the current study the following is recommended:

1. Urge curriculum designers in the Jordan Ministry of Education to take diversified approach when presenting the instructional content and related activities and experiments and to consider individual differences in the textbooks.
2. Teachers need good training on how to recognize and consider the individual differences among students which should contain varied teaching methods in classroom and address different topics.
3. Identifying student's thinking styles; let them learn about them, and characteristics of each style in order to develop skills subsumed under each learning style while caring the other learning style. Herrmann (1989) argued that thinking styles can be developed so that for learner to acquire more than one thinking style.

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