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Jing Jing, Ting; Tarmizi, Rohani Ahmad; Abu Bakar, Kamariah; Aralas, Dalia

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The Adoption of Variation Theory in the Classroom: Effect on Students' Algebraic Achievement and Motivation to Learn

Ting Jing Jing[1], Rohani Ahmad Tarmizi[1], Kamariah Abu Bakar[1], Dalia Aralas[2]

[1] Institute for Mathematical Research, Universiti Putra Malaysia, Serdang, Selangor
[2] Faculty of Educational Studies, Universiti Putra Malaysia, Serdang, Selangor

Malaysia

Correspondence: Ting, J.J. Institute for Mathematical Research, Universiti Putra Malaysia, 43000 Serdang, Selangor. Malaysia. E-mail: jtingmy@gmail.com

Abstract

Introduction. Analysis of lessons held in East Asia regions that perform well in Trends in International Mathematics and Science Studies such as; South Korea, Hong Kong and Japan, demonstrated teachers in mathematics classroom enacted features of the content systematically with consideration of variation within students' capabilities. Recent studies found that integration of variation theory in classroom instruction improve students' performance significantly. Considering the prior successes in integration of variation theory in classroom in other countries, it is imperative to examine the effect of variation theory based strategy in the teaching and learning of the algebra in schools in Malaysia.

Method. The study used quasi-experimental non-equivalent control group research design and involved 58 Form Two (Grade 8^{th}) students in two classes (30 in experimental group, 28 in control group) in Malaysia The first class of students went through algebra class taught with Variation Theory Based Strategy (VTBS) while the class of students experienced Conventional Teaching Strategy (CTS). The instruments used for the study were a 24-item Algebra Test and 46-item Instructional Materials Motivation Interest Survey.

Results. Result from Analysis of Covariance indicated that experimental group students achieved significantly better test scores than control group. However, result of Multivariate Analysis of Variance did not show evidence of significant effect of VTBS on experimental group students' overall motivation in all the five subscales; attention, relevance, confidence, satisfaction, and interest.

Discussion and Conclusion. These results suggested the adoption of VTBS in the algebra classroom is effective on students' algebraic performance but not on students' motivation to learn. Futher investigations of the impact of VTBS on students' affective outcomes are recommended.

Keywords: algebraic performance, motivation, urban, variation theory

Resumen

Introducción. Los análisis de las lecciones llevadas a cabo en las regiones de Asia Oriental que se desempeñan bien en Tendencias en Matemáticas y Estudios Científicos Internacionales en Corea del Sur, Hong Kong y Japón, demostraron a los maestros en el aula de matemáticas las características del contenido de forma sistemática, considerando la variación dentro de las capacidades de los estudiantes. Estudios recientes encontraron que la integración de la Teoría de la Variación en la Instrucción en el aula mejora significativamente el desempeño de los estudiantes. Teniendo en cuenta los éxitos anteriores en la integración de la teoría de la variación en el aula en otros países, es imperativo examinar el efecto de la teoría de la variación basada en la estrategia de enseñanza y aprendizaje del álgebra en las escuelas de Malasia.

Método. El estudio utilizó el diseño de investigación de grupo de control no equivalente equivalente y participó en dos clases (30 en el grupo experimental, 28 en el grupo de control) en Malasia Los estudiantes de la primera clase pasaron por la clase de álgebra enseñada con Variation Theory Based Strategy (VTBS) mientras que la clase de estudiantes experimentó la Estrategia de Enseñanza Convencional (CTS). Los instrumentos utilizados para el estudio fueron una Prueba de álgebra de 24 ítems y una encuesta de interés de motivación de 46 elementos.

Resultados. El resultado del Análisis de Covariancia indicó que los estudiantes del grupo experimental obtuvieron puntuaciones significativamente mejores que el grupo control. Sin embargo, el resultado del Análisis Multivariable de Varianza no mostró evidencia de efecto significativo de VTBS en la motivación general de los estudiantes del grupo experimental en todas las cinco subescalas; Atención, relevancia, confianza, satisfacción e interés.

Discusión y conclusión. Estos resultados sugieren que la adopción de VTBS en el aula de álgebra es eficaz en el rendimiento algebraico de los estudiantes, pero no en la motivación de los estudiantes para aprender. Se recomiendan más investigaciones sobre el impacto de VTBS en los resultados afectivos de los estudiantes.

Palabras clave: rendimiento algebraico, motivación, urbano, teoría de la variación

Introduction

Mathematics is one of the most influential mental tools to be used for a man's life over centuries (Skemp, 1985). Students need to acquire mathematical knowledge and skills to compete and survive in life. These skills include logical reasoning, problem solving skills, and the ability to think in abstract ways. The challenge in education today is to effectively teach students of diverse ability and different pace of learning so they are able to learn mathematics concepts with understanding and developing positive motivation and interest towards mathematics learning. Findings of some local studies suggested incomplete and poor mastery of related concepts as well as inability to apply the relevant prior knowledge among the students (Lim, 2010; Siti Aishah, 2010; Nadirah, Yusof, Siti Fatimah, Rahimah, & Ezrinda, 2012). Similar findings have been reported from Nordic countries; Finland, Sweden and South Africa (Tossavainen, Attorps & Väisänen, 2011; Viirman, Attorps & Tossavainen, 2011) which suggest students have similar difficulties in understanding structural concept of equality and function.

Malaysian teachers are urged to incorporate various teaching approaches in their teaching and learning, however reports from local studies have shown that drill and practice was still the most common teaching approach adopted by Malaysian mathematics teachers. A study led by Ministry of Education Malaysia in year 2011 report in Organisation for Economic Co-operation and Development (OECD, 2013) report discovered that half of the lessons in the classroom were concentrated on achieving superficial content understanding, instead of acquiring mathematical skills. Reports from Jamaliah (2001), Ruzlan (2007), and Lim and Hwa (2011), with twenty years apart, show teachers still compel the students to follow algorithms rigidly without a session for student to explore, experience and to understand concepts. Students often passively accept doctrines and techniques without any effort to explore the properties and relationships in numbers and operations.

Analysis of lessons held in Asian countries that perform well in TIMSS and PISA, such as China (Li, Peng & Soon, 2011) and Japan (Stigler & Hiebert, 1999), showed that the teachers enacted features of the content in a systematic way and took the variation in students' ability into account. Hiebert and Handa (2004) found that teachers in Hong Kong carefully choose a series of tasks, presented content of the lesson in repetition with variation deliberately to develop both concepts and procedures simultaneously. Park and Leong (2006) drew attention to one particular kind of variation – a "systematic" and "continuous" variation leading students to understand the concept.

Studies have evidence that the use of patterns of variation would uphold students' learning in various field: computer programming (Thune & Eckerdal, 2009); speeches in Cantonese Opera in Hong Kong primary school students (Tang & Leung, 2012); course design for a web based science e-learning system in Taiwan for fifth grade students (Hsu & Wang, 2014), and calculus (Attorps, Björk, Radic, & Tossavainen, 2013). However, there is limited number of accessible empirical data to substantiate the undertaking of teaching with variation (Cai & Nie, 2007). Most of the studies in Variation Theory have been conducted in the structure of Learning Studies (Holmqvist Olander & Nyberg, 2014; Wood, 2012), a hybrid of lesson study and design experiments research (Brown, 1992). There were only a handful of studies on the effect of variation theory teaching on students' outcomes (Al-Murani, 2006; Choy, 2006; Guo & Peng, 2011; Wong, Kong, Lam & Wong, 2010). Whilst these studies showed evidences of effectiveness of application of variation theory in various fields, it is still unknown to us if instructional strategy as a framework would have effects on cognitive and affective variables of students in Malaysia. Furthermore, a study done by Wong, et al. found that some students' interest in learning mathematics indeed declined after the experimental phase. The researcher attributed this affective reaction to difficulties of problem solving questions which created frustration among low performance students.

Variation Theory and Students' Outcomes

Variation theory was proposed and illustrated in the studies of Marton and Booth (1997) and Marton and Tsui (2004). They proposed that variation is epistemologically fundamental for all learning to occur. According to variation theory, learning means the advancement of a new way of experiencing something (Marton & Booth, 1997). This new way of experiencing a phenomenon can be described as "the structure of awareness at a particular moment" and qualitatively different ways of experiencing a phenomenon can be portrayed as "differences in the structure or organization of awareness at a particular moment or moments" (Marton & Booth, 1997, p.100).

Marton and Pang (2006) proposed that in order for a learner to discern a particular aspect of an object, he or she must experience variations in features of the object. For instance, a learner would not be able to discern the concept of 'male' and 'female' if there was only 'male' in the universe. A learner would not be able to discern the aspect of 'colour' if the learner has never been exposed to other colours. Critical aspects are those crucial features that students ought to focus on in order to see the object of learning appropriately. Critical aspects are described as necessary conditions to make it possible for the content to be learned. By consciously varying certain critical aspects of the phenomenon while keeping other aspects invariant, a space of variation is created that can bring the learner's focal awareness toward the critical aspects, which makes it possible for the learner to experience the object of learning (Pang & Marton, 2005).

Human awareness is made up of two tiers, the structural aspect and the referential (meaning) aspect. The structural aspect refers to the consolidation of features discerned and focused on by the subject and the referential aspect refers to a specific connotation of an individual object (Pang & Marton, 2005). Under the cognitive theories, surface aspects are aspects that are irrelevant to the knowledge while structural aspects are underlying principles or rules that define the knowledge. In Variation Theory, aspects of an example are not analyzed as surface or structural to the knowledge, but as critical or uncritical to students' understanding and learning; critical aspects might be superficial or structural. These critical aspects must be practical for every specific object of learning. Critical aspects are identified according to the disciplinary knowledge to be learned and students' understanding. The disciplinary knowledge refers to the knowledge of concept that are accepted by people or the community (Marton & Tsui, 2004; Guo & Pang, 2011).

Critical aspects are described as necessary conditions to make it possible for the content to be learned. By consciously varying certain critical aspects of the phenomenon while keeping other aspects invariant, a space of variation is created that can bring the learner's focal awareness toward the critical aspects, which makes it possible for the learner to experience the object of learning (Pang & Marton, 2005). The patterns of separation and contrast can be utilized in examples designed for structural and values discernment (Guo & Pang, 2011). Separation is awareness of a feature (value) from the object of learning as a whole while contrast is awareness of differences in variation among features of an object of learning (Marton, 2009). Cognitive theorists have shown that the human brain is only capable of processing a limited amount of information at any given time (Sweller, 1988). The most effective learning occurs when the working memory load is small to facilitate the changes in long term memory. Individuals are unable to be aware of all aspects of the phenomenon at the same time. Instead, they are only able to attend to certain aspects of the phenomenon. During the separation process, some of the aspects will come to the forefront whereas others will withdraw into the background, which forms a figure-ground structure (Marton & Booth, 1997).

The information presented in classroom can often be given in different approaches. Some approaches are easier for most learners than others because the information is presented in a lighter cognitive load (Tossavainen, 2009). Since intrinsic cognitive load directly relates to the nature of tasks, the interactivity of elements, and the expertise of learners, instructional designers cannot modify it directly but appropriate instructional designs can be used to control extraneous cognitive load.

In this study, to assert ‘what is varying and what is not?’ in students’ learning, the critical aspects of the object of learning should be varied against its background and a possible obvious contrast revealed. The use of variation is to assist students to discern the critical aspects corresponding to the feature of the object of learning. Therefore, Variation Theory Approach includes notions of previous knowledge of students, critical aspects of the object of learning, and features of variant and invariant as conditions of learning in this study.

Students’ motivation has always been a significant factor in many learning events. If teachers want the learning to be successful, they should consider motivation as one of the major factors while designing instruction. Nevertheless, Variation Theory embraced a different notion of motivation from social motivational theory. It is centred on the association of the object of learning and this enables students in establishing relevance structure for the learning so that it can be seen as significant for students. In a learning situation, if students can see the relationship between the object of learning and their daily life experience, it will promote their understanding and invoke favourable reaction to the object of learning (Lo, 2012). The relevance structure is the key feature that connects the student’s experience to the object of learning and explains how the learning experience influences students’ way of seeing and thinking. Learning activities with relevance structure for students will assist students to learn. The focus of activities should always be on the critical features of the object of learning (Lo, 2012). What is varying and what is not should be enacted through each activity to ensure the activity will serve for students to discern the relevant critical features of the object of learning. The object of learning is not learnt if students are unable to discern the object from its context. It is impossible for us to be equally aware of all objects and its features simultaneously when we see different objects every day. However, our attention will be focussed on the feature that was varied and its relationship with invariant features. Lo (2012) suggested that learning activities related to motivation strategies should not distract students' attention from the object of learning. To become aware of something, the students have to discern it from its background. There are necessary conditions for this discernment to occur. For example, to separate the 'Like Terms' and 'Unlike Terms', the students must be exposed to 'Unlike Terms'. The concept of 'same unknowns' are separated from 'different unknowns'. Premeditated trials to methodically change certain features and keep certain other features unchanged may assist a person to separate new features of an object of learning and develop new concepts.

Gagné and Driscoll (1988) claimed satisfaction is considered as the most uncomplicated element of Keller's ARCS (Attention, Relevance, Confidence, and Satisfaction) Model to comply with. With a provision of emphases on critical features connected to the object of learning, students are able to comprehend the intended object of learning (content). Students feel more appreciated and satisfied because the learning activities match their abilities. The same experience would trigger situational interests and lead to individual interest in the long run.

A systematic variation instruction in the teaching and learning will improve students' mastering in knowledge and skills in algebra. To address above problem, a study to investigate how effective is Variation Theory in promoting algebra learning. This study is crucial because it is focused on finding out whether the teaching and learning of a classroom by using the variation theory which learning can be improved, on how better learning outcomes can be achieved in algebra in secondary schools in Malaysia which will help teachers develop relevant teaching practices in future.

Objectives and hypothesis

The purpose of the study is to examine the effectiveness of learning algebra using Variation Teaching Strategy (VTBS) compare to Conventional Teaching Strategy (CTS) on algebraic achievement and motivation of mathematics learning among Form Two (Grade 8th) students Malaysia. The effectiveness of VTBS was examined based on students' algebraic

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achievement, motivation and subscales (attention, relevance, confidence, satisfaction, and interest). The *objectives* of this study are:

1. To compare the effects of Variation Teaching Strategy (VTBS) and Conventional Teaching Strategy (CTS) on algebraic achievement among Form Two students.
2. To examine the effects of Variation Teaching Strategy (VTBS) and Conventional Teaching Strategy (CTS) on motivation its five subscales (attention, relevance, confidence, satisfaction and interest) among Form Two students.

Six *hypotheses* were derived based on the above research objectives:

$H_0$1: There is no significant difference in the means of students' algebraic achievement test between VTBS and CTS groups while controlling for the scores on the test before the treatment (Pretest).

$H_0$2: There is no significant difference in the means of students' overall motivation and its five subscales between VTBS and CTS groups.

$H_0$3: There is no significant difference in the means of students' relevance subscale between VTBS and CTS groups.

$H_0$4: There is no significant difference in the means of students' confidence subscale between VTBS and CTS groups.

$H_0$5: There is no significant difference in the means of students' satisfaction subscale between VTBS and CTS groups

$H_0$6: There is no significant difference in the means of students' interest subscale between VTBS and CTS groups

Method

Participants

This study employed quasi-experimental pretest-posttest non-equivalent control group design (Campbell & Stanley, 1963). It was conducted at secondary school in Kuching, capital city in the state of Sarawak, Malaysia. A total of 58 participants were involved in the study; one group with 30 participants and another group with 28 participants. These two intact classes were selected and assigned randomly as control group and experiment group.

Instruments

The instrument used for the study was a 24-item *Algebra Test (AT)* and 46-item Instructional Materials Motivation Interest Survey (IMMIS). The researcher located Algebra Diagnostic Test (Chow, 2011) matches the Form Two algebra content, and research question established earlier. As a result, the Algebra Diagnostic Test (Chow, 2011) were adapted and renamed as Algebra Test. The questions consist of problems in two algebra topics in Form Two syllabus namely: algebraic expressions, and equation. The assessments on content and skills were: understanding and use of letters and symbols, solving equations, translating words into algebraic expressions, analyzing and generalizing number pattern, relationship between variables. Students obtain 1 score for each accurate answer with a total score of 24. The score was then converted into percentage.

In this study, students' motivation to learn was measured in terms of five dimensions. The IMMIS instrument was a combination of Keller's Instructional Materials Motivation Survey (IMMS) and self-developed interest subscale, which made up of 46 items. The questionnaire adopted from IMMS has been modified to adapt to algebra lessons in Malaysian school context, and rated by a four-point Likert scale, ranging from 1 (Strongly disagree) to 4 (Strongly agree). The first dimension, attention (A), measured the degree to which the method used in the two groups could initiate and sustain learner motivation during the experiment process. The second scale, relevance (R), examined whether the students could perceive the value and utility of what was taught. The third scale, confidence (C), measured the degree to which students felt they could successfully accomplish the goals and tasks laid out during the class. The fourth scale, Satisfaction (S), measured feelings of accomplishment and intrinsic appeal by the respondents during the lesson, and Interest (I), measured affective reaction to instructional mode. This instrument has been validated by two lecturers who are experts in this field. A pilot study has been conducted before the actual test to test the reliability of the instrument. The Cronbach's alpha obtained for overall motivation scale was 0.924 and values of each subscale were as follows: attention (.747), relevance (.823), confidence (.708), satisfaction (.859), and Interests (.871).

IMMS was chosen because it is capable of measuring motivation of class instruction**.** Keller's ARCS Model does support that variability is needed to keep the learners from getting bored. One of the relevance strategies is to provide familiarity experience to connect material with the learners' beliefs and experiences which is concurred to Variation Theory's – learning by experience it. Therefore, the IMMIS test the effectiveness of instructional material on motivation to learn by assessing the degree of stimulations perceived by students on instructional material or presentation in response to attention, relevance, confidence, satisfaction and interest (Nair, Yusof & Hong, 2014).

Procedure

The experimental study was completed in six weeks (1000 contact hours). In the first week, a pre-algebra test was given to the students, who were subsequently given a post-test and survey after completion of the experimental process. Teachers used instructional material; Teacher's Module and Students' Module developed by researcher as main guidelines in conducting VTBS algebra lessons. Two algebra topics selected for this study were Algebraic Expressions and Linear Equation. An example of algebra learning task is presented in Figure 1. The example of VTBS activity is as follows:

On the other hand, participants in the control group were taught using conventional teaching and learning approach: 'explain-practice-memorize' technique. They used textbook and workbook (algebra topics) in the lessons. An example of CTS learning activity is shown in Figure 2.

LEARNING AREA:
ALGEBRAIC EXPRESSIONS II

Object of learning: evaluate expressions by substituting numbers for letters

Given y = 2, find

a) $5y$
b) $5y - 3$
c) $5y^2 - 3$
d) $(5y^2)^2 - 3$

Varied	Not Varied	Critical aspects
Step (a) Basic expression : $5y$ Step (b) $5y$ subtract 3 Step (c) Increase the degree of unknown, y to power of 2: $5y^2 - 3$ Step (d) The square of $5y^2$	$5y$ (basic expression) Coefficient and subtraction $5y^2$ and subtraction	• Substitute 2 with y by using bracket • Multiply 5 with 2 • Order of operation • Substitute y in the power of 2 with number, 2 • Order of operation • Expansion of $(5y^2)^2$ • Order of operation

Figure 1. An Example of VTBS Learning Activity

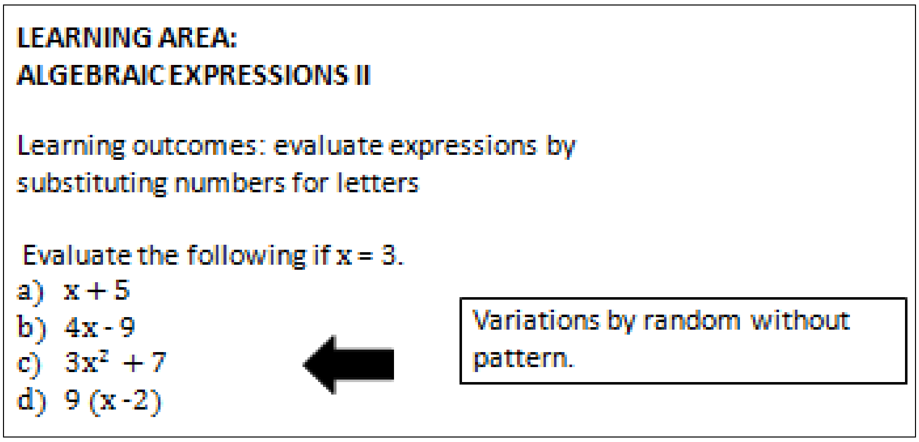

Figure 2. An Example of CTS Learning Activity

Datal Analysis

In order for results to be utilized and generalized to the population of interest, several assumptions were verified before using appropriate statistical analyses in IBM SPSS version 20.0. First, descriptive analysis was used to analyze the participants' background information. Second, ANCOVA) and MANOVA were used to test the hypotheses. The level of statistical significance for all procedures was set at $p \leq .05$.

Results

Effect of VTBS on Students' Algebraic Performance

A preliminary test on pre-algebraic performance was conducted to detect differences in algebraic knowledge and skills among the experimental and control groups in urban and rural school prior to the treatment. Independent t-tests were conducted to ensure the independency of covariate across the independent variable groups (VTBS, CTS). The means and standard deviations of students' algebraic achievement in Algebra Test are shown in Table 1 for VTBS and CTS group. Before the treatment, VTBS group (M = 27.400, SD = 11.30) performed slightly better than VTBS group (M = 25.15, SD = 10.25). Both groups progressed after the treatment with VTBS group scored better (M = 58.13, SD = 12.90) than CTS group (M = 42.32, SD = 11.44) (Table 1).

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Table 1. *Descriptive Statistics of Students' Algebraic Achievement*

Test	Group	N	M	SD
Pre	VTBS	30	27.40	11.30
	CTS	28	25.14	10.25
Post	VTBS	30	58.13	12.90
	CTS	28	42.32	11.44

Analysis of Covariance (ANCOVA) was conducted to explore the impact of instructional strategy on algebraic achievement, as measured by AT (Table 2). Scores on AT administered prior to the commencement of the program were used as a covariate to control individual differences. Analysis also showed that there was a significant difference on post-test scores between the control group and the experimental group [F (1, 55) = 24.163, p < .001; partial eta squared = .305] (Table 2). This result suggests, after controlling the pre-test scores, students who had been went through classes using VTBS achieved significantly better scores as compared with those who had been taught using the conventional method.

Table 2. *ANCOVA of Students' Algebraic Achievement*

Source	Type III Sum of Squares	Df	Mean Square	*F*	Sig.	Partial Eta Squared
Corrected Model	4787.727[a]	2	2393.863	18.295	.000	.399
Intercept	12466.645	1	12466.645	95.274	.000	.634
Pre	1166.801	1	1166.801	8.917	.004	.140
Group	3161.718	1	3161.718	24.163	.000	.305
Error	7196.773	55	130.850			
Total	159899.000	58				
Corrected Total	11984.500	57				

Table 3. *Mean and Standard Deviations of Students' Motivation of Learning Subscales*

	Group	M	SD	N
Attention	VTBS	2.60	0.38	30
	CTS	2.70	0.41	28
Relevance	VTBS	2.60	0.42	30
	CTS	2.73	0.44	28
Confidence	VTBS	2.43	0.34	30
	CTS	2.62	0.50	28
Satisfaction	VTBS	2.68	0.50	30
	CTS	2.87	0.52	28
Interest	VTBS	2.77	0.36	30
	CTS	2.82	0.42	28

Effect of VTBS on Students' Motivation to Learn

From the descriptive statistics in Table 3, it is obvious that CTS students have slightly higher motivation mean scores than VTBS for all five subscales: attention (M = 2.70), relevance (M = 2.73), confidence (M = 2.62), satisfaction (M = 2.87), and interest (M = 2.82). A multivariate analysis of variance (MANOVA) was conducted to explore the impact of instructional strategy on students' overall motivation and its five subscales. Table 4 indicates there was no statistically difference between groups Students' Overall Motivation to Learn: F (5, 50) = .966, p = .447; Wilks' Lambda = .915; partial eta squared = .085. When the results for the dependent variables were considered separately, there were no statistical significant difference between experimental and control groups in respect of attention subscale, F (1, 56) = .083, p = .774, partial eta squared = .001 ; relevance, F (1, 56) = .452, p = .504, partial eta squared = .008 ; confidence, F (1, 56) = 1.585, p = .001, partial eta squared = .028; satisfaction, F (1, 56) = .394, p = .533, partial eta squared = .007, and interest, F (1, 56) = ,002 p = .964, partial eta squared =.000 (Table 5). In summary, students' in experimental group did not showed significant positive responses to the VTBS treatment.

Table 4. *Multivariate Analysis of Variance for Students' Motivation and Subscales*

Effect		**Value**	**F**	**Hypothesis df**	**Error df**	**Sig.**	**Partial Eta Squared**
Intercept	Pillai's Trace	.979	481.882[b]	5.000	52.000	.000	.979
	Wilks' Lambda	.021	481.882[b]	5.000	52.000	.000	.979
	Hotelling's Trace	46.335	481.882[b]	5.000	52.000	.000	.979
	Roy's Largest Root	46.335	481.882[b]	5.000	52.000	.000	.979
Group	Pillai's Trace	.085	.966[b]	5.000	52.000	.447	.085
	Wilks' Lambda	.915	.966[b]	5.000	52.000	.447	.085
	Hotelling's Trace	.093	.966[b]	5.000	52.000	.447	.085
	Roy's Largest Root	.093	.966[b]	5.000	52.000	.447	.085

Table 5. *Analysis of Variance for Students' Motivation and Subscales*

Source	**Dependent Variable**	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	Attention	.016[a]	1	.016	.083	.774	.001
	Relevance	.098[b]	1	.098	.452	.504	.008
	Confidence	.331[c]	1	.331	1.585	.213	.028

	Satisfaction	.139[d]	1	.139	.394	.533	.007
	Interest	.000[e]	1	.000	.002	.964	.000
Intercept	Attention	416.210	1	416.210	2189.385	.000	.975
	Relevance	403.261	1	403.261	1858.002	.000	.971
	Confidence	375.633	1	375.633	1800.449	.000	.970
	Satisfaction	427.873	1	427.873	1214.359	.000	.956
	Interest	447.913	1	447.913	1949.903	.000	.972
Group	Attention	.016	1	.016	.083	.774	.001
	Relevance	.098	1	.098	.452	.504	.008
	Confidence	.331	1	.331	1.585	.213	.028
	Satisfaction	.139	1	.139	.394	.533	.007
	Interest	.000	1	.000	.002	.964	.000
Error	Attention	10.646	56	.190			
	Relevance	12.154	56	.217			
	Confidence	11.683	56	.209			
	Satisfaction	19.731	56	.352			
	Interest	12.864	56	.230			
Total	Attention	427.190	58				
	Relevance	415.559	58				
	Confidence	387.325	58				
	Satisfaction	448.785	58				
	Interest	461.278	58				
Corrected Total	Attention	10.662	57				
	Relevance	12.252	57				
	Confidence	12.014	57				
	Satisfaction	19.870	57				
	Interest	12.864	57				

Discussion and Conclusion

This study imparts additional empirical evidence that support the use of Variation Theory as pedagogical guide to design algebra lessons in the classroom. This result concurs with findings of Al-Murani (2006); Choy (2006); Guo & Pang (2011) in their studies which investigated effect of using variation theory in mathematics. This study confirmed the effectiveness of variation theory framework which made use of variance and invariance in evaluating the effectiveness of algebra lessons conducted in algebra mathematics classroom. The research does not claim that teaching with variation is the best instructional strategy in teaching algebra, as clearly students in the control group were also learning. Nevertheless, if the teachers did not provide their students with opportunities or learning experience in discerning the critical features of the object of learning through variation, there is no telling whether students will be able to discern the critical features by themselves or not. This elucidates the difference in students' learning outcomes which in this study is about learning

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algebra. A good lesson always starts with good instructional designed. Undoubtedly, it has facilitated students in experimental group to learn through variation and achieved the learning outcomes.

Another aspect in this study examined the students' motivation when exposed to VTBS in the classroom. This result concurred to Wong et al. (2010) which found that students in Hong Kong (urban region) did not yield positive motivational reaction toward VTBS treatment. There were many factors which affected students' motivation to learn mathematics (Keller, 2010). Furthermore, there are large diversity in cultural and economic background in school location thus the learning environment may affect students' motivational goals. VTBS is not a motivational instructional strategy. The researcher did not specifically use Keller's model of instructional design in this study. However, there are features in VTBS which existed in Keller's Model such as interest but has positively impacted the motivation to learn among experiment group of students.

In general, Malaysian schools tend to attribute academic outcomes to hard working than innate ability. Many schools are organized to assure high expectations on students. The system was designed likely to develop cognitive potential but the affective aspects are given less attention. This might have affected motivation of to learn by making urban students to live up to expectations (Graham & Hudley, 2005). Another factor could be students were more exposed to technology devices. They were constantly connected to internet and smart phones might have resulted lost interest and motivation in classroom instructions without technology in compare to rural students whom the exposure to gadgets and social-media tools were least (Prensky, 2008).

The current research design does not allow us to make causal statements about the classroom settings in relation to the students' affective outcome, however the pattern of findings suggest culture and social factors in regard to school location might have impacted students' motivation. Further studies on affective domains specifically the effects of VTBS on students' motivation in relation to school location are needed in order to explain contradictory results. The use of Variation Theory Based Strategy in teaching and learning algebra for this study is only a starting point. It is necessary for future similar research to adjust strengths and flaws of this study to improve the research findings.

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