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Mathematical Learning Attributes Impacting Students' Performance in Sarawak

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ABSTRACT

The purpose of the study is to examine the mathematics learning attributes in mathematics classroom at the secondary school level in Malaysia. Students' responses related to mathematics learning attributes were sought.A survey was conducted using a set of questionnaire (62 items) among rural secondary school students in the state of Sarawak, Malaysia. Four hundred and fifteen responses were collected. Self-reported students' achievement in school based assessment was used as the measurement of mathematics performance which later was collapsed into categorical variables. Logistics Regressions was used to examine the significant predictors contributed to mathematics performance. The study indicates Learning Styles and Teaching Practices are predictors of students' higher achievement in mathematics while other learning attributes are in place. This finding concurred with other studies which stressed the importance of teaching strategies and practices in mathematics learning class. Mathematics teacher must adapt their teaching technique according to their students' learning style preferences and beliefs on mathematics to improve learning.This study will contribute to rural school educational research. The findings in this study would expand the current body of knowledge and data about the importance of learning attributes in pedagogical context. The study provides valuable information to teachers and school administrative to create effective learning program matching the needs of the students.

Keywords: mathematical beliefs, self-regulated, teaching practices, parents, spiritual practices.

1. Introduction

Education assumes a critical part in a nation's quest for national advancement and economic development. The goal of education system is always aim to provide students opportunity to learn and to grasp knowledge and ability which are essential for success in future life. What is going on in the classroom at the present days would predict a nation's future.

Education has been one of sector that received high level of investment in Malaysia compare to neighbouring countries. In recent years national budget, the education sector continues to receive the largest allocation with a significant 22 percent of federal budget (RM54.6 billion in year 2014 and RM56 billion in year 2015). However, the educational outcomes are not matched with the amount of federal spending. Malaysian students' achievement in mathematics is not as excellent as educators or society in general would like to see. Trends in International Mathematics and Science Study (TIMSS) reported our students scored poorly. In 2011, it is reported Malaysian students' performance in TIMSS continued to plunge with average score from 519 in 1999) to 440 in year 2011, the recent assessment, which is 60 points below international average Mullis et al. (2012). The same report indicates thirty-five percent (35%) of the Malaysia participants failed to achieve the least competency in Mathematics.

Malaysia is a nation state with geographical diversity. It is consists of Peninsular Malaysia and the two states of Sabah and Sarawak, northern part of Borneo Island. The growth of population and socio-economic status were at a different pace thus it leads to distinction of urban and rural areas. The two eastern states have greater number of rural schools in compare to their counterparts in Peninsula Malaysia Federal governments have directed on these areas to raise the socio-economic status by providing special assistance however the disparities among urban and rural area specifically in students' performance are remained as critical concern. The outcomes of the efforts were not as high as desired.

The issue of less well performance of rural students compared to their urban counterparts in has been highly debated among scholars in academic field. Studies have shown that rural students are lagged behind in the achievement in mathematics, in both primary and secondary schools (Sidin (1994),Singh et al. (2010)). Cox (2000) stated the weak academic achievement is generally

connected with factors such as learning cultures, deprived background, short of teachers and other affective factors confronted students. Bishop (1988) proposes the culture plays a pivotal role in the teaching and learning of mathematics. Kline (2002) identifies that teacher support is the most critical element contribute to a success school. In which aspect does the culture being a factor to success in mathematics? There are possibilities that students' mathematical belief, culture, activities in the classroom might lead to more engagement and enjoyment in mathematics learning. However, there are much evidence prove that some students do not like mathematics subject and yet still pass the test with flying colours.

For a long time, beliefs and values in pertinent culture have been greatly embedded in a population's history and traditions. The cultural of people include language and religion (Kline (2002)). Bishop (1988) proposes that mathematics is "a cultural product which has developed as a result of various activities" and that calculating, positioning, measuring, designing, evaluating, and explaining are all part of that cultural. Cultural establish values which affect the nature of mathematics teaching, and learning in the classroom. Student habits in mathematics are shaped by culture. In general, researchers have identified several cultural factors; popular media, parent, teachers, students' own beliefs and language that might contribute to the disparity in mathematics performance cross nations, origins, ethnicity, and gender (Barton (1996)).

Numerous studies have been conducted on learning attributes impacting on students' achievement such as age, gender, family structure, ethnicity, parents' educational level, socio-economic status, instructional practices, student beliefs and attitudes toward school, and parent involvement(Ma and Klinger (2000); Abu Bakar et al. (2009); Hui (2014)). Gathering from present research, three major group of factors or predictors for mathematics performance are classified: Demographic context (gender, socio-economic status, parent's educational level, spoken language, religion), Pedagogical/Instructional context (teacher competency, instructional strategies and techniques, curriculum, school context and facilities), and Cultural context (confidence, previous achievement, interest, self-concept, peers, learning style, arithmetic ability, mathematics beliefs, attitudes, religion practices).

Fagan (2006) suggests that cultural values; discipline and persistence in certain religious community are one of the significant factors for students to academic. Studies confirm direct influence of the students' spiritual activities in improving academic achievement. Jeynes (2003) examines the effects of religious practice among urban and non-urban students on the academic achievement. The results indicate urban children those committed to religious

practice performed better on most academic compare to their less religious peers after controlling for socio-economic status, race, and gender. Regnerus (2000),Regnerus (2001) in two studies confirms that educational accomplishment, mathematics and reading scores are related positively with more frequent spiritual practice.

Students have varying beliefs about mathematics as a subject and about themselves as learners of mathematics. Some of these beliefs make students so interested in learning mathematics, whereas other beliefs hinder their interest and understanding of mathematics. McLeod (1992) has suggested four categories of students' beliefs; beliefs about mathematics, beliefs about self, beliefs about teaching, beliefs about social context. Suthar and Tarmizi (2010) indicated positive relationship among students' belief and mathematics achievement and others overseas studies such as House and Telese (2008) and Garcia (2012) indicated the same tendency of outcomes. In contrast, there are other studies that revealed that attitudes and beliefs were not associated with mathematics achievement Papanastasio (2000).

Self-regulated learning is closely related to processes skills such as thinking, action taking, behaving and engaging in intended activities Zimmerman (1989). Mousoulides and Philippou (2005) examined association between motivational beliefs, use of self-regulated strategy, and mathematics achievement. They found that self-efficacy was a strong predictor of mathematics performance and use of self-regulated strategies have negative effect on mathematics achievement. Contrary, Altun and Erden (2013) found self regulated based learning was one of the significant factors in mathematics achievement. Self-regulated was also studied by Loong (2012) in Malaysian context and Rabab'h and Veloo (2015) in Jordan. These two studies demonstrated that subscales of self-regulated learning have significantly contributed to mathematics achievement.

What happens in the classroom has an impact on students' opportunity to learn. Instructional practices are usually associated with mathematics achievement, including various types or methods of instructional delivery. In literature, teacher practices are usually delineated into "best practices" and teachers' actual practices to determine its impact on achievement. Fidler (2002) demonstrated teaching strategies and techniques used in the teaching and learning activities were significant predictors of students' mathematics performance after a number of other factors were controlled. Granstrom (2006) stress that different teaching methods would produce different outcomes in classrooms. Clements et al. (2013) suggest aspects of mathematics instructional environments such as; teacher, student, and peers variable which are statistically associated to

student achievement. Several local studies; Ismail and Awang (2009) , Yamat et al. (2011), and Al-Agili et al. (2013) have elaborated that teaching method and teaching practices are the one of the factor which has positive significant relationship with mathematics achievement; mathematics teachers matter in Malaysia.

Students develop their own style of learning through variety of ways and their learning process varies independently (Dunn and Dunn (1972)). A learning style is a preferred method of acquiring information and knowledge in students' optimal environment. It influences students think, act and approaches to learn. Several studies have shown that academic performance of students is related to their learning styles. In Malaysia, studies show ambiguous results. A study was carried out in High Performance School in Malaysia with a sample of 362 (Adnan et al. (2013)) indicated weak relationship in contrast to no relationship between all dimensions of learning style and mathematics achievement (Umar & Senin, 2008) in regular secondary school.

Home was documented as groundwork of education advancement since long time ago. The role of parents in their children's learning persists to be recognised even until present day. Numerous literatures highlighted the essential of parental involvement in their children education (Sui-Chu and Willms (1996)). Research indicates parent plays major roles in discussions with the children about school-related topics, attending school activities, getting homework complete. In a cross national study, Cai (2003) compares the roles parents in the United States of America (US) and in the People's Republic of China play in their children's mathematics learning. Results show that parent factor is a significant predictor of their children's mathematics performance.

There are studies indicate cultural factors that can cause ineffective involvement of parents in their children's learning. The recent analysis done by Z. et al. (2007) based on TIMSS Data 2007 on fourth grade Iran students demonstrated there was no significant relationship among variable of parental involvement and mathematics performance. Research study showed that African American parents not familiar with standard-based mathematics instruction (Jackson and Remillard (2005)) therefore provided limited or no help to their children. Findings from research also indicated that low-income parents provide significantly few or less support compared to middle and upper class parent (Starkey and Klein (2008)). Parents with low socio-economic status may have very little knowledge to support their children's school related learning (Gorinski and Fraser (2006)).

To date, none of research examines mathematical learning attributes among

rural students in Malaysia. This study intended to fill the gap and provide empirical data from Sarawak perspective on the impact of mathematical learning attributes on students' performance. In this study, the cultural context was examined in terms of mathematical beliefs and, learning style, Self-regulated learning, spiritual practices and parent involvement whereby teaching practices which includes activities carried in the classroom was examined as pedagogical context.

This study embarks on the following objectives:

(i) To investigate mathematics learning attributes at secondary school level in Malaysia, Sarawak state

(ii) To determine mathematics learning attributes as predictors of mathematics achievement

2. Materials and Methods

The study sample was obtained by means of cluster sampling procedure. In the main study, a purposive cluster random sampling was employed. The cluster was the "divisions" in the state of Sarawak and these divisions constituted the intact groups (that were) randomly selected, while purposive was incorporated into the cluster random sampling on the basis that the sole criterion for selection within the intact groups was Form 2 and Form 4 students. Note that in other states in Malaysia, "districts" were used instead of "divisions". Table 1 shows the actual number of students by region that participated in this study. Schools were categorized by Ministry of Education Malaysia as Rural School (*Sekolah Luar Bandar*) from three different division; Samarahan, Sri Aman and Sibu. According to State Education Department of Sarawak (Jabatan Pendidikan Negeri Sarawak), there are 185 secondary schools whereby 107 (57.84%) are categorized as *Sekolah Luar Bandar*. Initially, one school each from these three divisions was selected. Due to poor turnout on the week of survey conducted in Sri Aman division, another two schools were involved for this study. The total schools involved amounted five instead of three. As a result, four hundred and fifteen set of responses were collected. Table 1 reveals division and total number of schools and students respectively.

A quantitative survey method was conducted. A self-report questionnaire consists of two parts; demographic information and questionnaires. The questionnaire was based on the related literature review. It consisted of 71 items; 9 items on mathematics belief, 7 items on self-regulated, 9 items on teaching

Table 1: Selected Divisions and Total Number of Schools and Students.

Selected Division	Number of Schools	Number of Students
Samarahan	1	129
Sri Aman	3	130
Sibu	1	156
Total	5	415

practices, 11 items on spiritual practices, and 8 items on parent involvement. The participants rated the questionnaire items using 5-point Likert Scale ranging from 1 (strongly disagree) to 5 (strongly agree).

To measure mathematics achievement, respondents were asked to reply to this item: "How many marks do you often get?" To quantify their responses, categorical variable was used which grouped 80% to 100% as grade A, 65% to 79% as grade B, 50% to 64% as grade C,40% to 49% as grade D and 0% to 39% as grade E. The categories were based on school level grading system. Generally, the school based grading systems were varied across the school. To standardized it, the aforementioned categorical was used. For methodological considerations, we collapsed these grades into two dichotomous groups; grade A and grade B for higher achievement outcomes, and grade C and grade D for lower achievement outcomes. Grade E is not considered in binary logistic regression. However, when we explored further with multinomial logistic regression, the grade groups were retained.

Data screening procedures were conducted at the preliminary data analysis to inspect data set for entry errors, missing, and examining cases with well above or below the majority of other cases. In this study, missing were replaced with the mean of the corresponding item since descriptive analyses revealed relatively small percentage (the highest 2.7%) of missing data. There were also missing in gender and students' self-reported score/grade. In order not to distort the result of the analysis, these missing data were left as missing without doing any replacement.

The reliability and validity of the measurements used are justified before the further data analysis. Some items were deleted which prompted all corrected item-total correlation of all constructs were above the cut off of .30 [6]. After correction, the Cronbach's α for each construct was higher than cut off of .80 except construct on Learning Styles (.783) and Parent Involvement (.754) which

demonstrate good internal consistency reliability [7]. The total items remained for data analysis is 66.

3. Result and Discussion

Descriptive analyses were performed in order to provide preliminary insights into the nature of responses obtained. Table 2 summarizes the descriptive analyses of each construct used in the instrument. The results revealed students perceived more on Parent Involvement (M=3.96, SD=0.65) than Mathematical beliefs on Mathematics (M=3.92, SD=0.48), Spiritual Practices (M=3.81, SD=0.65). For other attributes; and Teaching practices carried out in the classroom (M= 3.45, SD=0.62) followed by Learning Styles (M=3.49, SD=.59). Students perceived the least in Self-regulated (M=3.42, SD=.75). The results also revealed that all the constructs had negative skewness which indicated scores clustered at the high end ranging between -0.67 and -1.47. In addition, all of the kurtosis was positive, ranging between 1.20 and 2.87 indicating moderate high.

Table 2: Descriptive Statistics on Responses.

	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statisti	Statistic	Std. Error	Statistic	Std. Error
Mathematical Beliefs	415	3.9209	.48033	-.898	.120	2.871	.239
Learning Styles	415	3.4948	.58812	-.666	.120	1.335	.239
Teaching Practices	415	3.4531	.62315	-1.050	.120	1.828	.239
Self-regulated	415	3.4240	.75139	-.905	.120	1.204	.239
Spiritual Practices	415	3.8116	.65268	-.840	.120	1.518	.239
Parent Involvement	415	3.9598	.64911	-.820	.120	1.355	.239

Table 3 summarizes the frequency of grades according students' self-reported grades. The table shows 40.8% students get grade A and B which is considered as higher achievement outcome and 38.7% get grade C and D which is considered as lower achievement outcomes. There are 20.5% students always failed in school-based examination. Logistic regression was conducted to assess whether six variables significantly predicted whether or not a student achieved higher outcomes. When all six predictor variables are considered together,

Table 3: Descriptive Statistics on Responses.

Grade		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	69	16.6	16.7	16.7
	B	100	24.1	24.2	40.8
	C	88	21.2	21.3	62.1
	D	72	17.3	17.4	79.5
	E	85	20.5	20.5	100.0
	Total	414	99.8	100.0	
Missing	System	1	.2		
Total		415	100.0		

they significantly predict whether or not a student achieved higher outcome $(X^2 = 31.14, df = 6, N = 414, p < .001)$.

Table 4: Omnibus Tests of Model Coefficients.

		Chi-square	df	Sig.
Step 1	Step	31.085	6	.000
	Block	31.085	6	.000
	Model	31.085	6	.000

To examine the Goodness of Fit, Omnibus Tests shows it support the model. Table 4 shows value, $p < .001$, so the model is better than SPSS's original guess in Block 0, which assumed that everyone get lower outcome achievement. The chi-square value is at 31.09 with 6 degrees of freedom. Table 5 also indicates good-fit of our model by a significant value $> .05$. The Chi-square value for the Hosmer-Lemeshow Test is 15.448 with a significant level of .051.

Table 5: Hosmer and Lemeshow Test.

Step 1	Chi-square	df	Sig.
	15.448	8	.051

Cox & Snell R Square and Nagelkerke R Square values (Table 6) indicate between 7.2% and 9.8% of the variability is explained by this set of variables.

Table 6: Summary of Model.

Step 1	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
	528.810[a]	.072	.098

From the Table 7, we were able to correctly classify 87.7% of the students who are lower achiever.

Table 7: Classification Table.

Observed			Predicted outcomes		
			Not Achieved	Achieved	Percentage Correct
Step 1	Outcomes	Not Achieved	213	30	87.7
		Achieved	107	62	36.7
	Overall Percentage				66.9

From the Table 8 and 9, we can conclude that; three of the six variables (Mathematical Beliefs, Learning Practices and Teaching Practices) are, individually, significant predictors of students' performance. Self-regulated Learning, Spiritual Practices and Parent Involvement variables failed to predict students' performance whether used alone or with other predictors. Learning Styles and Teaching Practices are significant predictors when all six are considered together.

Table 8: Variables Not in the Equation.

			Score	df	Sig.
Step 0	Variables	Mathematical Beliefs	5.531	1	.019
		Learning Styles	9.829	1	.002
		Teaching Practices	4.456	1	.035
		Self-regulated	.041	1	.840
		Spiritual Practices	.098	1	.754
		Parent Involvement	.757	1	.384
	Overall Statistics		29.933	6	.000

Table 9 presents the odds ratios, which suggest that the odds of estimating

Table 9: Variables in the Equation.

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1	Mathematical Beliefs	.513	.281	3.346	1	.067	1.671	.964	2.897
	Learning Styles	.821	.249	10.827	1	.001	2.272	1.394	3.705
	Teaching Practices	-.731	.205	12.656	1	.000	.481	.322	.720
	Self-regulated	-.122	.178	.474	1	.491	.885	.625	1.254
	Spiritual Practices	.235	.183	1.644	1	.200	1.265	.883	1.811
	Parent Involvement	-.338	.193	3.061	1	.080	.713	.489	1.041
	Constant	-1.891	1.051	3.234	1	.072	.151		

students achievement improve by 2.3 times if one knows their perceived on Learning Styles, 1.7 times if students' beliefs on mathematics, however would have decrease the amount of estimation by 0.9 times if one knows their perceived Teaching Practices.

4. Conclusion

Learning Styles and Teaching Practices are learning attributes which are impacting the performance of students in Sarawak with other attributes in cultural context; Mathematical Beliefs, Self-regulated Learning, Spiritual Practices and Parent Involvement, in place. Self-regulated, Spiritual Practices and Parent Involvement did not have impacts on students' mathematics performance when acts individually. Despite literature implies culture do have some influences on students performance.

This result reinforces the importance of teaching strategies and practices into mathematics instruction. Teacher must assess individual learning style preferences and then adapt their delivery technique to improve the pace of learning according to learning styles of their students. The result concurred with multiple studies held in Malaysia (Ismail and Awang (2009) ; Yamat et al. (2011) ; Al-Agili et al. (2013)) and other countries (Fidler (2002); Granstrom (2006)).

The mathematical beliefs of the rural students do have influences students' performance in mathematics which is concurred with the results demonstrated by House and Telese (2008) , Suthar and Tarmizi (2010) and Garcia (2012) . How do students perceived about mathematics and themselves as learners of mathematics are essential to teachers to plan for their instructional activities.

Otts (2010) reported the use of self-regulated strategies would affect students' performance. Nonetheless, current study unsuccessfully to predict students' performance. It is possible that students are not trained to use self-regulated strategies during regular classes. Consequently, the students are less motivated and less persistent to achieve their tasks related to mathematics subject.

There was high percentage of students were not staying with their parent but in school hostel. Limited time together with their parents during weekend did not provide sufficient time for parent to give support and involve with their children's school related learning. Furthermore, low-income parents (Starkey and Klein (2008)) and low socio-economic status parents may have limited knowledge to assist mathematics learning of their children (Gorinski and Fraser (2006)).

Home also a ground work for any religious or spiritual practices. Even though studies reported religious practices do has effects on academic of children however Jeynes (2003) assessed the effects for religiosity were usually greater for urban children than they were for non-urban children which is in this case, rural students. There is possible other background variables such as gender, social-economic status, parent education, may be influential to students' religious practices and performance in mathematic.

The results of this study suggest it is imperative to have more effectual and feasible polices to retain quality teachers in rural schools. World Bank cited in Marwan et al. (2012) reported some evidence about real scenario in Malaysian rural schools. The percentage of turnover in rural schools is high. Schools are shortage of teachers trained in English, Mathematics and Science subjects. In the same report, it also indicates unfavourable students' performance due to low retention of quality teachers in rural schools.

Educational policies could be designed that specifically take into account program of in-service professional development of the mathematics teachers. These policies are vital for a young developing country like Malaysia that has been putting effort to diminish the gap in education among rural and urban schools. At the same times, it is equally important to inculcate positive learning styles towards mathematics students. Hopefully the results of this study will help the Ministry of Education, schools, teachers, and parents to identify ways to improve student's achievement in mathematics and allocate more resource to improve in mathematics.

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