RASCH HIERARCHICAL ANALYSIS ON CHALLENGES IN ACQUISITION OF MATHEMATICS LITERACY: A SURVEY ON MALAYSIAN SCHOOL STUDENTS

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Transformation in Malaysian education system has brings about different reactions among teachers, students, parents and also stakeholders. Changes in the aims of Mathematics education provide various challenges to the students' learning as well as to the teachers' teaching practice. This study is therefore aims to evaluate the students' challenges in mastering Mathematics subject. This survey was conducted to 132 secondary school students in Malaysia. Self-developed questionnaire which consist of 42 items and comprises of five main sources of challenges (self, teachers, parents, friends, nature of Mathematics factor) was used as the instruments of this study. Hierarchical analysis which applied Rasch Measurement Model was applied to determine the order of difficulties experienced by students in learning Mathematics. Findings showed that within the five sources of challenges in learning Mathematics, nature of Mathematics rank first while parents factor rank last. Findings of this study regarding the various sources of challenges in Mathematics learning could serve as guidelines to the teachers and school administrators in dealing students' difficulties in learning Mathematics.

Keywords: Nature of Mathematics, Assessment Pressure, Cognitive Pressure.

1. BACKGROUND OF STUDY

Mathematics performance has never been neglected in any education system, policies or plans. As good Mathematics literacy could give positive impacts on employment, any possible sources of challenges that could hinder students' Mathematics learning is therefore essentials to be explored. In addition to be perceived as a tough subject, the difficulties in learning Mathematics is also been associated to the poor level of students' self-regulation skills (Mohd Rustam and Azlina, 2016). Self-regulation is a fundamentals competency in 21th century learning which involved recurring of complex phases: planning, monitoring and reflection (Zimmerman, 2002). Yet, self-regulation is not a simple matter to be carried out by students (Wolters, 2010).

Changes of the curriculum aims, delivery method and learning content in Mathematics urge students to become a more effective self-directed learners (Winters, Greene and Costich, 2008). To achieve that, students need to have a good skills in developing learning objectives, choosing effective learning strategy and also assessing self-progress and performance from time to time (Azevedo and

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Cornley, 2004). Unfortunately, previous scientific report has mentioned lack of students' regulation skills in Mathematics learning (Hodges and Kim, 2010; Pape, Bell and Yetkin, 2003). Failure to regulate learning will definitely affects students' eagerness to learn Mathematics. Even worse, feeling demotivated will eventually lessen students' interest towards Mathematics as motivation acts as booster and determinant to successfully execute task given (Massali, 2007, Reeve, 2002).

For realizing national education agenda, teaching profession nowadays are facing great challenges. Teachers has to prepare themselves to be fully responsible in executing government educational plan by implementing teachers' teaching practices that could enhance students' learning. In line with the aims to produce students who are literate mathematically, Mathematics teachers need to be dynamic, creative and committed in their teaching (Noziati, 2016). However, it is undeniable facts that some teachers especially beginning teachers experiencing situation that require them to take time to adapt it (Goodwin, 2008). Low self-confidence in delivery learning content and poor stress management in dealing with students' negative behavior or weak achievement are the common challenges faced by some teachers (Goodwin, 2008) which eventually diminish their teaching quality.

Challenges, obstacles and difficulties faced by students in mastering Mathematics is attributed to a variety of sources. Teachers, parents, peers and other contextual factors are found to be the common sources of challenges and yet greatly affect the effectiveness of student learning outcomes in Mathematics. Based on this argument and preceding statements, this study is therefore intend to assess the challenges faced by students in their learning process in Mathematics. Specifically, the exploration will see the pattern of challenges that are more common and less common experience by the students while learning Mathematics. This study is an extension of previous study that has explored the sources of learning challenges in Mathematics through qualitative research approaches but does not establish a hierarchy of the explored challenges (Mohd Rustam and Azlina, 2016). By applying Rasch measurement model, this study aims to produce a valid hierarchy on sources of challenges in Mathematics learning in the context of Malaysian school students.

2. METHODOLOGY

The sample of this study were 132 secondary school students who aged 14 to 16 years old. As rasch measurement model was applied to this study, the sampling procedure is conducted by ensuring there is a sample representative for different students' ability. This has achieved by having person separation index 2.84 (3 different group of students abilities) which implied a good separation index (Fisher, 2007). Respondents were asked to complete a 42 items questionnaire

specifically measure five main sources of challenges namely self-factors, teachers factors, friends factors, parents factors and other factors including assessment pressure and nature of Mathematics. The self-develop questionnaire has undergone validation process by assessing its psychometric properties (item reliability, item separation and item dimensionality) (refer Table 1).

TABLE 1: FINDINGS OF PSYCHOMETRIC ANALYSIS

No.	Psychometric Properties	Findings	Remarks
1.	Rasch item reliability	0.98	Excellent (Fisher, 2007)
2.	Cronbach alpha reliability	0.90	Acceptable (Bruin, 2006)
3.	Item separation	6.75	Excellent (Fisher, 2007)
4.	Item dimensionality	40%	Acceptable (Fisher, 2007)

3. RESULT

To identify the hierarchy of the sources of challenges in learning Mathematics, the measure value and the rank for each items in each of the sources of challenges was determined first (Table 2 to Table 6). Item with higher measure value imply the higher difficulty of the items. In the context of this study, higher measure items indicate that the particular challenges is rarely happen and vice versa.

TABLE 2: RANK OF CHALLENGES IN LEARNING MATHEMATICS IN THE ASPECT OF NATURE OF MATH AND ASSESSMENT PRESSURE FACTORS

Rank	Source of Challenge	Subconstruct	Measure
1	Need to know the usage of various Mathematics tools (protractor, calculator)	AP2	–2.23
2	Need to master different Mathematics solving steps	AP3	–2.02
3	Need to answer Mathematics higher-order thinking skills questions	AP1	-1.83
4	Need to master in answering difficult Mathematics questions	AP4	–1.54
5	Too much Mathematics topics to be mastered	NM3	–1.01
6	Too much Mathematics concepts to be understand	NM2	–0.98
7	Too much Mathematics formulae to be memorized	NM1	–0.78
8	Too much Mathematics symbols to be memorized	NM4	–0.72
	Average Measure		–1.39

AP = Assessment Pressure; NM = Nature of Mathematics

Suprisingly, all the eight items measuring students' challenges in mastering nature of Mathematics and also assessment pressure have negative measure value (measure = −2.23 to −0.72). The result implies that challenges in learning mathematics in the aspect of nature of math and assessment pressure were very commonly happen among students.

TABLE 3: RANK OF CHALLENGES IN LEARNING MATHEMATICS IN THE ASPECT OF
SELF FACTORS

Rank	Source of Challenge	Subconstruct	Measure
1	Perceived Mathematics as a tough subject	NP2	–0.20
2	Lack of ability to manage time to study Mathematics	LSR1	–0.19
3	Perceived Mathematics as a confusing subject	NP1	–0.06
4	Could not get assistance from others in solving Mathematics questions	LSR2	0.32
5	Could not give focus/pay attention in Mathematics class (boring, sleepy etc)	LSR3	0.32
6	Do not have interest to execute Mathematical tasks	NP3	0.47
	Average Measure		0.11
	NP = Negative Perception; LSR = Low Self-Regulation		

Out of six items measuring challenges in learning Mathematics in the aspect of self-factor, three of them have negative measure value while the rest three have positive measure value with less than 0.5. This indicates that low self-regulation and negative perception were also the challenges that frequently occur among students.

TABLE 4: RANK OF CHALLENGES IN LEARNING MATHEMATICS IN THE ASPECT OF
FRIENDS FACTOR

Rank	Source of Challenge	Subconstruct	Measure
1	Friends who like to compete in Mathematics assessment	LOS2	–0.64
2	Surrounded by friends who perceived Mathematics as tough subject	NA2	–0.06
3	Surrounded by friends who like to disturb while learning Mathematics in class	NB1	0.35
4	Surrounded by friends who dislike/no interest in Mathematics	NA1	0.51
5	Friends could not assist in solving Mathematics questions	LOS1	0.54
6	Friends who arrogant and do not want to share their Mathematics knowledge	NB2	0.57
7	Friends who like to tease my poor performance in Mathematics	NB3	0.71
8	Influence by friends to not completing Mathematical tasks	NB4	0.95
	Average Measure		0.37
	LOS = Lack of Support; NA = Negative Attitude; NB = Negative Behavior		

Interestingly, the top three rank were represent by each of the three sub constructs (lack of support, negative attitude and negative behaviour). Besides, the three subsequent items were also represent by the three sub constructs (NA1 = rank 3; LOS1 = rank 4; NB2 = rank 5) with measure value slightly above 0.5. In contrast, challenges related to be teased or influenced by friends to not completing task were occur sometimes.

TABLE 5: RANK OF CHALLENGES IN LEARNING MATHEMATICS IN THE ASPECT OF TEACHER FACTORS

Rank	Source of Challenge	Subconstruct	Measure
1	Mathematics teacher set a high expectation on my Mathematics achievement	TP2	–0.19
2	Mathematics teacher scold when I got poor examination result	TB1	–0.13
3	Mathematics teacher teach very fast	TP6	–0.12
4	Mathematics teacher give too much tasks	TP5	0.06
5	Mathematics teacher not using interesting teaching aids	TP4	0.11
6	Mathematics teacher could not make me understand the solving steps of Math questions	TP1	0.34
7	Mathematics teacher teach in boring ways	TP3	0.50
8	Mathematics teacher like to punish	TB2	0.68
9	Mathematics teacher do not discuss difficult Math questions	TP7	0.75
10	Mathematics teachers do not pay attention to low achiever students	TB4	0.80
11	Mathematics teacher always not enter to the class	TB3	1.23
	Average Measure		0.37

TP = Teaching Practice; TB = Teaching Behaviour

Result in Table 5 showed that the 11 items measuring challenges in the aspect of teacher factor could be classified into two main groups which were items with measure value less or equal to 0.5 (rank 1 to rank 7; measure = –0.19 to 0.50) and items with measure value greater than 0.5 (rank 8 to rank 11; measure = 0.68 to 1.23). Based on that indicator, it seems that teachers' negative behaviour are not commonly experience by students yet it still happen sometimes. In contrast, students more commonly experience challenges regarding Mathematics teacher who teach in boring ways, very fast, could not make students understand, giving too much homework and set too high expectation.

TABLE 6: RANK OF CHALLENGES IN LEARNING MATHEMATICS IN THE ASPECT PARENTS FACTORS

Rank	Source of Challenge	Subconstruct	Measure
1	Parents set a high expectation on my Mathematics achievement	CP3	–0.52
2	Always being scolded by parents when got poor Mathematics examination result	EP2	–0.30
3	Parents do not provide allocation to buy Mathematics reference books	LFS1	–0.21
4	Parents do not provide allocation to buy Mathematics exercise books	LFS3	0.02
5	Parents do not send me to Mathematics tuition class	LFS2	0.49
6	Family members could not assist in solving Mathematics questions	CP4	0.61
7	Parents compare my Mathematics ability to others family members	CP2	0.68
8	Family members do not take care of my problems in learning Mathematics	CP1	1.30
9	Family members like to tease my Mathematics performance	EP1	1.40
	Average Measure		0.39

CP = Cognitive Pressure; EP = Emotional Pressure; LFS = lack of Financial Support

For the aspect of parents' factor, setting high expectation on children Mathematics achievement (rank 1; measure = –0.52) is align with the result of teachers' factor that was also set a high expectation to their students. Besides, it is surprise that three items measuring lack of financial support were ranked on the top position (LFS1: rank 3 measure = –0.21; LFS3: rank 4 measure = 0.02; LFS2: rank 5 measure = 0.49). Meanwhile, three items measuring cognitive pressure regarding family members could not assist in solving Mathematics questions, comparing Mathematics ability with others and teasing on Mathematics performance were not commonly happen but still experience by students.

The distribution of each measuring items illustrated in the item-person map in Figure 1.

4. DISCUSSION

Acquisition of Mathematics literacy required students to master the basic Mathematical knowledge. However, findings in this study showed that students facing difficulties in knowing, memorizing and understanding all the Mathematics formulae, concepts and symbols. What is more, the too many topics to be learnt add the students' difficulties. Ho and Hyun (2011) in their study found that, lack of ability to understand well the Mathematics formulae, concepts, symbols and representation was the students obstacle to master Mathematics which eventually induce negative anxious feeling to engage in Mathematics activities. The results on the most commonly challenges experience by students in relation to lack of Mathematics skills could be best explain due to the lack of mastery on basic Mathematics knowledge. There are empirical evidence confirmed that students weak in solving Mathematics higher-order thinking skills, complex and word problem was due to the poor content and basic knowledge (Abdul Halim, Nur Liyana and Marlina, 2015; Najua Syuhada, Mohd Salleh and Abdul Halim, 2016; Parmjit, Arba and Teoh, 2010). Moreover, the poor students' performance in international Mathematics assessment ie TIMSS and PISA align with the result of this study which indicates challenges for students in solving higher-order thinking skills and complex questions which need them to apply various solving steps and mathematics tools were very common to happen.

Students self-factors which include negative perception and low self-regulation seems to be the sources of challenges to the students in learning Mathematics. Align with the previous study conducted on the local and international education context, perceiving Mathematics as too difficult and confusing subject are the two attributions to students failure in Mathematics (Gomez-Chacon, 2000; Mohd Rustam and Azlina, 2016). Emergence of negative perception will results the decreasing of interest to completing Mathematical tasks. Even worse, there were students who believe that disliking Mathematics was their inborn characteristic which disrupt their Mathematics learning (Arem, 2010; Marzita, 2002).

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PERSON - MAP - ITEM

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                      |
                    . |T                                   ④
                      |
                    . T|                           ③              CP1
                    . |                                   TB3     EP1
    1               .#  +              ②        ND4
                     # |S                                 TB4     CP2
                   .### |                        NB3      TP7     CP4
                  #### S|             NP3        LOS1     TB2     FS2
                 ###### |             LSR2       NA1      TP3     NA2
                 ###### |             LSR3       NB2      TP1     NB2
    0           ####### +M            NP1        NB1      TP4     FS3
                ####### M|    ①       NP2        NA2      TP5     FS1
                  ##### |             LSR1                TB1     EP2
                  .#### |                                 TP2     CP3
                .###### |     NM4                LOS2     TPG
                  .## S|S     NM1
   -1             #### +      NM2
                   .## |      NM3
                    # |
                  .# T|       AP4
                      |T
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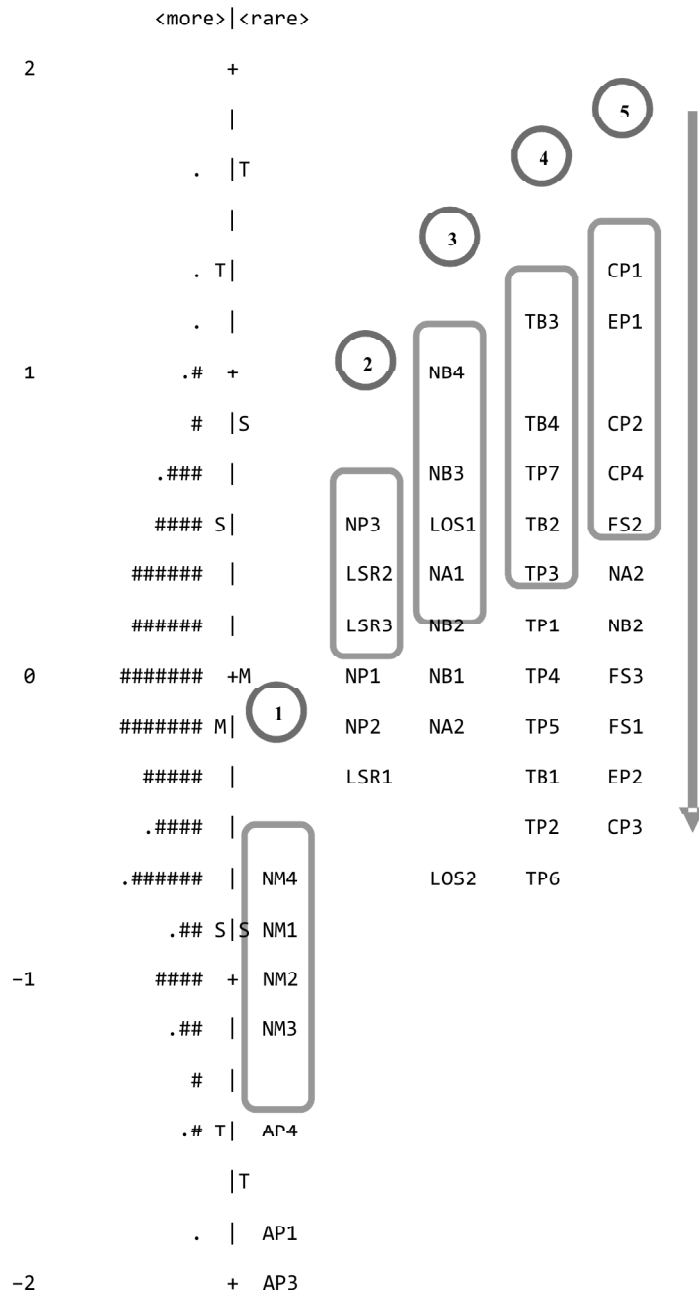
Figure 1: Item Difficulty Distribution

Lack of regulation skills in the other hand will add the difficulties of students to master Mathematics literacy and skills. Many students could not manage or allocate time effectively to study Mathematics, get assistance when unable to solve Mathematics problem or could not keep focus on teacher's teaching (Mohd Rustam and Azlina, 2016; Perry, Philips and Dowler, 2004; Winne, 2005). Lack of regulation skills is said to be experienced by many students as it is a higher-order skills which need good cognitive planning and judgement (Zimmerman, 2002). As the respondents of this study was secondary school students, the lack of regulation skills could be related to the facts that students tend to form low efficacy in regulating their learning (Corpus, McClintic-Gilbert and Haynega, 2009) despite the importance to acquire regulation skills from primary level to secondary level of education (Annevirta and Vauras, 2006).

The low average measure of the friends' factor indicates that lack of support, friends' negative attitude and behaviour were common hindering elements in their Mathematics learning. This results support the previous findings from the literature. Study by Berndt's (1992) reflect that negative attitude or behaviour of friends are exist in the learning process and will give maladaptive effects on students' learning motivation. Additionally, friends' negative attitude and behaviour towards Mathematics were exist in the learning environment in the classroom, supporting findings of Arem (2010) and Marzita (2002) claim. This is also support Nelson and deBacker (2008) study that friends could influence one's performance, goals orientation and belief system.

Being teach by a decisive and boring teacher who like to scold, punish, applying dull teaching were also the common challenges for students in learning Mathematics. Students inability to master Mathematics literacy are also stem from the unpleasant teaching practices and behaviour that trigger students anxious, restless and the feeling of low self-confidence (Marzita, 2002, Mohd Rustam and Azlina, 2016). In the Malaysian education context, students' performance is still based on the examination score especially for Form Four and Form Five (Upper Secondary) students. Meanwhile, for the lower secondary students, most of schools still carrying out continuous assessment thus pushing teacher to set a high expectation to the students as an excellent students and school grade are the aims for most of the schools.

Another big concern on the challenges in learning Mathematics is related to teachers' lack of content knowledge. Teachers who unable to make students understand Mathematics learning is supported by claim by Briggs (1993) and Briggs and Crook (1991) where there were Mathematics teachers who do not have solid foundation in Mathematics. This situation was also reflected in the statement by Arem (2010) which explains the shortcomings of Mathematics teachers includes not interested in Mathematics, do not get proper training and poor in presenting

teaching aids in a way that is understood., Emphasizing of higher-order thinking skills element In the current education system contribute to other challenge for teacher to deliver the learning content well. Even worse, teachers who prefer their students to only memorize the solving steps of Mathematics question will definitely inhibit students development in higher-order thinking skills (Saad, Nagappan, Ratnavadinel, Yasin and Hin, 2009).

Parents or family members could also be the sources of challenges in students' Mathematics learning despite of other social force from teachers and peers (Kober, 1991; Sells, 1980). Lacking of support and being push to get excellent result in Mathematics also the common difficulties experienced by students. The undeniable facts regarding the importance of mastering Mathematics literacy (Siti Hamad and Rohani, 2010) often led to parents worries on their children Mathematics performance and tend to express their frustration on their children weak achievement. The cognitive pressure and emotional pressure shown by the parents will eventually trigger anxious feeling of their children (Arem, 2010; Lazarus, 1974; Wilhem and Brooks, 1980). Besides, students are trying to fulfil their parents' high expectation unsincerely or just because feel scared to their fierce and firm parents (Mohd Rustam and Azlina, 2016). However, results indicates that students' family members do take care of their problems in learning Mathematics.

5. CONCLUSION

Acquisition of Mathematics literacy required students' persistent, commitment and willingness to engage not only in the aspects of cognitive but also emotional and physical. Findings of this study give a clear picture yet alarming the significant concern to consider students' Mathematics learning process. In facing current global challenges, teachers especially, must have innovative and dynamic ideas to create a conducive Mathematics learning environment to cater the demand of 21st century education. Students are also need to be trained a proper regulation skills to become a good self-directed learner. Finally, this study is expected to give empirical evidence on students' challenges in mastery Mathematics and provide information to the related parties to consider to assist students' learning in Mathematics.

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