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Examining indigenous (Orang Asli) pupils' achievement in mathematics computation and word problem items

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Abstract

The purpose of this study is to examine the Indigenous pupils' achievement in mathematics with Bilingual (Bahasa Melayu and Temiar) versions of mathematics tests. Both tests, based on Mathematics computation and word problem, comprised of three main topics, namely Operation on Numbers, Money, and Time. This study involved eight Orang Asli (Indigenous) primary schools in the district of Sungai Siput, Perak. A total number of 230 Grade 5 (11 years old) pupils participated in the study. During the mathematics tests administration in schools, the students were randomly divided into two groups. Their selection into a particular group was randomly determined based on the classes name lists provided by the school administrator. Difficulty index was used to measure the pupils' achievement in the mathematics computation and word problem items in Bahasa Melayu and Temiar (the Orang Asli native language) languages. The test consists of 30 Multiple Choice Items (MCI) computation-based and 20 MCI word problem- based. The findings of this study show that the Orang Asli pupils face more difficulty in answering the topics of Operation on Numbers, Money, and Time in the Bahasa Melayu version compared to the Temiar version. The findings also show that the Bilingual version had improved the Orang Asli pupil's mathematics achievement in the topic of Money and Time in the mathematics computation and word problem items.

*Keywords***:** Mathematics Computation; Mathematics Word Problem; Bahasa Melayu Version; Bilingual Version; Operation on Numbers; Money; Time

1. Introduction

Primary schools for the Indigenous people (locally known as *Orang Asli*) children, has long been established in Malaysia. The term *Orang Asli* is used to refer to the original or first people from approximately 18 ethnic groups in the Peninsular Malaysia. The Malaysian Department of Orang Asli's Progress (JAKOA) has divided them into three categories, namely the Negrito, Senoi and Aboriginal Malay or Proto-Malays (Abd Ghani, 2015). From the language perspective, they are divided into the Mon-Khemer language family and the Austronesian language family. The former is

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comprised of the Temiar, Senoi and Negrito languages, which are spoken by the Negrito or Senoi, and the latter is spoken by the Proto-Malay. The *Orang Asli* at Sungai Siput in Perak state, Malaysia, use the Temiar language in their everyday life. Therefore, the Temiar language is used as a language support in testing the mathematical achievement among the Orang Asli pupils.

Indigenous pupils experience difficulties when learning mathematics (Bucknall, 1995; Howard, 1995) due to language, assessment, learning style, and the relevance of the mathematical activity (Warren, Cooper, & Baturo, 2004). Generally, Indigenous students' achievement is considered as 'abnormal' because their achievement in mathematics on standardised tests is not the same as that of non-Indigenous students (Meaney, McMurchy-Pilkington, & Trinick, 2012). The main contributing factor is their non-proficiency in the language of instruction. Therefore, with their limited linguistics proficiency in the Malay language or Bahasa Melayu (BM), assessing in their dominant native language may remove the secondary dimension introduced by the language of instruction.

When administering bilingual assessment, as proposed by the International Test Commission [ITC] Test Adaptations Guidelines, the pupil's language proficiency must be taken into account to ensure that they are equally tested in the language that they are more confident in (Coyne, 1999). Assessing pupils in their native language will help to reduce the cognitive load. Hence, a bilingual test is deemed as an appropriate action as it provides test items in the pupil's native language. Moreover, it removes the unnecessary language obstacle (American Educational Research Association, 1999). Besides the issue pertaining to language, another extra challenge to learn Mathematics among the *Orang Asli* pupils is their social background that is very different from what is being portrayed in the school syllabus (Hanafi, et al, 2014). Syllabi and curriculum are often designed with the general population in mind, but the learning capabilities of the *Orang Asli* pupils are very different from their peers in Malaysia.

The fact is the Indigenous pupils lag behind when compared to their peers and perform poorly in academics. This phenomenon is particularly evident in numerical-related subjects. The high dropout rate among the Indigenous pupils due to lack of sufficient support from their families further worsen this situation (Norlizah & Thava, 2017).

2. Literature Review

2.1 Operation on Numbers

Mathematical operations undeniably involve knowledge about numbers. Young children are expected to acquire numeracy skills and *Orang Asli* children are no exception. Acquiring numeracy skills is indeed important because the children need these knowledge and basic operations skills to solve problems that they encounter in their everyday life (Sabidin, et al, 2017). Grade 5 *Orang Asli* pupils have been found to have adequate numeracy skills. Nevertheless, they still face problems in solving sums involving multiplication, division, and word problems. In fact, these pupils are weak in word problem items across all topics, which could have stemmed from their inability to read and understand the problems. Interestingly, this study notes that these *Orang Asli* pupils record a high-level of performance in the oral test of numeracy competency compared to their performance in written test. The researchers conjectured that language and assessment are essential factors that affect pupils' mathematical knowledge and understanding (Ismail, et al, 2020). In relation to assessing pupils' mathematical knowledge whether orally or in written forms, study suggests that pupils need to be given the opportunity to show their mathematical knowledge in oral examination because they can perform better orally when compared to their performance in written examination (Videnovic, 2017).

As a start, to avoid misunderstanding the given questions, students must carefully read and understand the tasks to be solved. They also need to correctly select the numbers to ensure that their procedures of calculating is accurate. In doing so, they must always consider the use of basic mathematical skills, which are addition, subtraction, multiplication, and division. However, mastering these basic operations skills alone is insufficient if they are not able to provide proper and clear steps of working procedures when solving the questions. Additionally, there is certainly a need for these students to understand all the topics and not merely focus on certain topics only. Interestingly, students find that mathematical symbols help students to understand mathematics better because they find it easier to use symbols compared to words when attempting to solve mathematical word problems. Students are always inclined to make errors in mathematics, especially in the mathematical concepts and word problem-solving. Students who are not able to acquire mathematical concepts may view mathematics as a very challenging subject (Veloo, et al, 2015). Thus, these students are more inclined to resort to memorizing the facts and are less creative to expanding their cognitive abilities in Mathematics. All these obstacles contribute to their low commitment to learn mathematics and thus influence their poor achievement in Mathematics (Witherell, & Plattsmouth, 2010).

2.2 Concepts of Time and Money in Mathematics

While there is not much literature on the topic of *Time*, *Money* is one of the popular concepts often used in the teaching of Mathematics, and to a great success (Engel, et al, 2013). Findings on mathematics instructional content and student knowledge highlight that time spent on *Basic Counting*, *Addition* and *Subtraction* have a negative association with mathematics achievement for those students who have mastered the proficiency level 1. However, the topics *Time* and *Money* have been reported to have positive association in the same assessment. Studies conducted on pupils with higher proficiency levels (Level 2 and Level 3) also yielded similar results. The pupils gained the most benefit from additional exposure to the topic *Money*, while *Addition* and *Subtraction* also played a role in increasing the pupils' mathematics achievement. Interestingly, this study uncovered a very important finding, which is students benefit more from exposure to advanced content rather than repetition with basic skills (Engel, et al, 2013).

2.3 Language in Mathematics Test

The notion that Mathematics involves minimal language skills is fallacious, especially within the context of problem solving whereby logic and real-world applications are involved (Hatfield, et al, 2007). In word problems, language is able to support or hinder pupils' performance because Mathematics is not only context-based but is also bound by language (Bernardo, 2005). With regards to language, native language support, especially for word problems, affect bilingual pupils' Mathematics achievement. Their speed, efficiency or accuracy in solving problems may be affected by the language used. Vocabulary can be a barrier to success in mathematical problem solving. This challenge to understand the mathematical vocabulary and expressions of the items lead to the failure to solve problems (Fletcher, & Santoli, 2003). Researches show that lack of understanding to mathematics vocabulary can be an obstacle to success in mathematics word problem solving. On a similar note, pupils with less proficiency in the language of assessment may not show favorable achievement (Abedi, et al, 2006). There is a tendency among native language teachers to engage in cultural translation for the purpose of overcoming this linguistics and cultural differences (Kramsch, 2020). Hence, ample opportunity must be given to ascertain that pupils with less proficiency in the language of assessment stand a fair chance to exhibit their true performance in Mathematics assessments (Abedi, et al, 2006), perhaps by providing tests in native language.

2.4 Instrumental and Relational Theory

When learners confront new learning contexts, new schemata would be constructed based on their existing knowledge (Skemp, 1986). Skemp asserts that within mathematics education, learners learn mathematics either instrumentally or relationally. Instrumental learning, which is rote, will result in instrumental understanding of mathematics. Though this type of understanding may give quicker results, nevertheless, it is short term in nature. Skemp argues that, on the other hand, relational understanding is rich in relationships among concepts in mathematics, it is long term in nature, and it can motivate the students to learn mathematics. Nevertheless, both types of learning and understanding of mathematics is needed when learning mathematics.

In the long run, the aim of mathematics education is not only to produce high achievers but also pupils who can survive in real-life situations and solve real problems. If students just meet minimum pass in assessments, then they are not ready to face the challenges that occur in their life. Hence, it is the responsibility of all parties especially educators to enhance pupils' learning significantly (Veloo, Krishnasamy, & Harun, 2015). Therefore the aim of this study is to examine the Grade 5 Indigenous pupil's achievement in Bahasa Melayu and Bilingual (Bahasa Melayu and Bahasa Temiar) mathematics test for computation and word problem items. This study also compared the *Orang Asli* pupil's achievement in Mathematics computation and word problem in the three topics of *Operations on Numbers*, *Time* and *Money*.

3. Method

3.1 Population and sampling

This quantitative study involved eight *Orang Asli* primary school pupils in the district of Sungai Siput, Perak. The total number of pupils in Grade 5 was 287, who were enrolled eight schools, namely SKKK (35), SKPL (48), SKPP (18), SKC (32), SKPPI (38), SKPKM (28), and SKPPE (28) and SKKB (60). Nevertheless, for this study only 230 Grade 5 pupils participated during the administrations of the Mathematics test at these schools.

3.2 Mathematics Grade-5 Competency Test

The blueprint for the Mathematics Grade-5 Competency Test (MGCT) was constructed based on semester one Mathematics Year 5 topics to establish the content validity for the test. Hence, only the syllabus until the month of July was considered, which included seven topics (Computation, Addition, Subtraction, Multiplication, Division, Decimal and Fraction). For this research purpose, only five topics were considered, namely Computation, Addition, Subtraction, Multiplication, Division and Combined Basic Operations. Two topics were excluded, which were Decimal and Fraction, but two topics such as Money and Time from Grade 4 were added. The rational was that these topics were taught in the second semester for Grades 4 and 5 and they are related to their daily life. The Mathematics test consisted of 30 Multiple Choice Items (MCI) on mathematics computation and 20 MCI on mathematics word problems (Table 1). The Cronbach Alpha indices for the computation test was 0.77, while for the word problem test was 0.76, which suggest both tests have acceptable reliability.

Table 1. Mathematics Computation and Word Problem based on Grade 5 Mathematics Topics

No	Topics	Mathematics items		Total
		Computation (Paper 1)	Word Problem (Paper 2)	
1	Addition (+)	4	3	7
2	Subtract (-)	6	3	9
3	Multiplication (X)	3	5	8
4	Divide (/)	3	2	5
5	Mixed operation (+/-/X//)	3	-	3
	Operation on Numbers	**19**	**13**	**32**
6	Money	7	4	11
7	Time	4	3	7
	Total	30	20	50

3.3 Analysis of Item

All the Mathematics computation and word problem items were initially constructed in Bahasa Melayu based on the topics from the Standard Document of Curriculum and Assessment (DSKP) (Ministry of Education, Malaysia, 2012). Test specification table was also constructed to justify the inclusion of all the items for the purpose of validity as well as for the review and evaluation of the Mathematics items by the selected expert teachers at the district level. Subsequently, all the items were translated to the Temiar language before they were audio recorded for the Bilingual test by a Temiar native speaker. Back-translation method was adopted to verify the native language translation (Brislin, 1980).

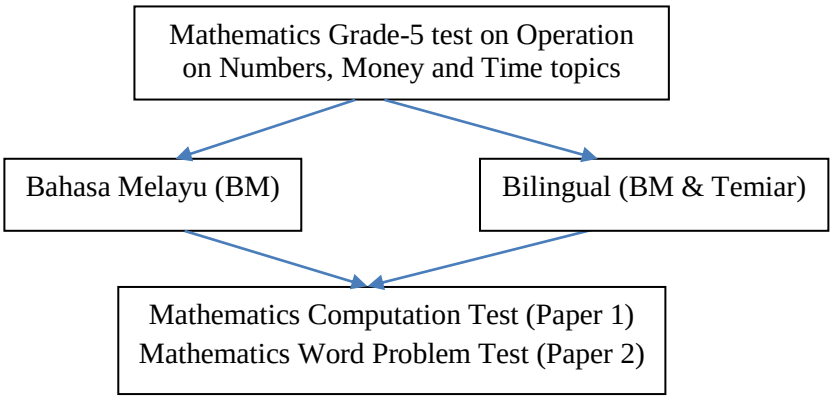

Figure 1. *Orang Asli* Pupils' Mathematics Achievement based on Bahasa Melayu and Bilingual Tests for Computation and Word Problem Items

Figure 1 shows the framework for assessing the *Orang Asli* pupils' Mathematics performance using Bahasa Melayu and Bilingual version tests for Computation and Word Problem Tests in this study. For item analysis purposes, this study used the difficulty index based on Classical Test Theory. Items with difficulty index below 0.30 were classified as more difficult items and items with difficulty index above 0.70 were considered as easier items. Items that have difficulty index between 0.30 and 0.70

were considered to have moderate level of difficulty, which is applicable for validity (Kaplan, & Saccuzzo, 2001). The focus of this paper is concentrated on quantitative item analysis and as such, triangulation was deemed not necessary, within this context of elaborative discussion on item difficulty index.

4. Results

4.1 Mathematics Computations Test: BM and Bilingual Versions.

4.1.1. Operation on Numbers

Table 2 shows the difficulty index for mathematics computation test comprising of three main topics, namely *Operation on Numbers*, *Money* and *Time*. For the topic on *Operation on Numbers*, which has five sub-topics (add any two to five numbers, subtract any two numbers, multiply any two numbers, divide a number and mixed operation), the results indicate that the difficulty index in BM version of the test was 0.32 whereas the difficulty index in bilingual version was 0.39. Although both versions of the tests were very difficult for the pupils, the Bilingual version was easier for the pupils. For the topic *Operation on Numbers*, the pupils' test performance on the Bilingual version of the test had increased by 21.9% compared to their performance on the BM version of the test. Among the five subtopics for the *Operation on Numbers*, the sub-topic *subtract any two numbers* showed the greatest increase, which was 48.3%, in the pupil's performance in the bilingual version when compared to the BM version. This is followed by the topic *Divide a Number* (42.1%), *Mixed Operations* (23.1%), *Multiply any two numbers* (8.6%), and *Add any two to five numbers* (5.8%). The Grade 5 pupils found it more difficult to answer items on *Operation on Numbers* when the test was in Bahasa Melayu compared to when the test was given in their native language.

Table 2. Difficulty Index for Mathematics Computations Test

No	Topics	Mathematics Computation Test		Increase in performance (%)
		BM version	Bilingual version	
1	Add any two to five numbers	0.52	0.55	5.8
2	Subtract any two numbers	0.29	0.43	48.3
3	Multiply any two numbers	0.35	0.38	8.6
4	Divide a number	0.19	0.27	42.1
5	Mixed operation	0.26	0.32	23.1
	Operation on Numbers	**0.32**	**0.39**	**21.9**
6	Money	0.32	0.41	28.1
7	Time	0.27	0.27	-
	Mathematics Computation	0.32	0.39	21.9

4.1.2. Money and Time

For the topic on *Money*, the results indicate that the difficulty index of the BM version of the test was 0.32 whereas in the Bilingual test, the difficulty index was 0.41. This shows that the Mathematics Computation Test for the Bilingual version was easier compared to the BM version. However, both the BM and Bilingual versions of the test were equally difficult for the pupils for the topic on *Time*. Hence, it can be seen that for the topic on *Money*, the BM version of the test was more difficult for the *Orang Asli* pupils. Nevertheless, the bilingual version of the test improved Grade 5 pupils' achievement in the computation test for the topic on *Money*.

4.2 Mathematics Word Problem Test: BM and Bilingual versions.

4.2.1. Operations on Numbers

Table 3 shows that the difficulty index for mathematics word problem items comprised of three main topics, namely *Operation on Numbers*, *Money* and *Time*. For the topic on *Operation on Numbers*, which has four sub-topics (Addition, Subtraction, Multiplication and Division), the results indicated that the difficulty index in the BM version of the test was 0.30 whereas the difficulty index for the Bilingual version was 0.36. Although both versions of the test were very difficult for the pupils, the bilingual version was easier for the pupils. For the word problem items from the topic *Operation on Numbers*, the pupils' performance on the Bilingual version of the test had increased by 20% compared to their performance on the BM version of the test. Among the four sub-topics of the topic on *Operation on Numbers*, the sub-topic *Addition* showed the greatest increase, which is 30%, in the pupil's performance for the Bilingual version compared to the BM version. This is followed by the topic *Division* (15%), *Subtraction* (14.7%), and *Multiplication* (12%). The Grade 5 *Orang Asli* pupils found it more difficult to answer word problem items on *Operation on Numbers* when the test was in Bahasa Melayu compared to when the test was given in their native language.

4.2.2. Money and Time

For the topic on *Time*, the results indicated that the difficulty index in the BM version of the test was 0.25 whereas, in the bilingual version the difficulty index was 0.31. This shows that the word problem items in the Bilingual version was easier for the pupils compared to the BM version. However, for the word problems from the sub-topic *Money*, the difficulty index for both versions of the test were found to be about similar. This indicates that the BM version of the test was more difficult for the *Orang Asli* pupils. Overall, the bilingual version of the test improved the Grade 5 pupils' achievement on the mathematics word problem items.

Indigenous pupil's performance in the Bahasa Melayu version and Bilingual version of the mathematics competency test for the word problem items recorded different achievement. *Orang Asli* pupils face more difficulty in answering the topics *Operation on Numbers*, *Money* and *Time* in the Bahasa Melayu version for computation items compared to their Bilingual version. Interestingly, the Bilingual version for the word problem items had improved their achievement in the word problem items for the topic *Money*. The result of this study also highlights that the Bilingual version for the computation items was easier for the pupils and this version had also improved Grade 5 *Orang Asli* pupil's achievement for the word problem items in mathematics.

Table 3. Difficulty Index for Mathematics Word Problem Items

No	**Topics**	**Mathematics Word Problem**		
		BM version	**Bilingual version**	**%**
1	Addition	0.40	0.52	30.0
2	Subtraction	0.34	0.39	14.7
3	Multiplication	0.25	0.28	12.0
4	Division	0.20	0.23	15.0
	Operation on Numbers	**0.30**	**0.36**	**20.0**
5	Time	0.25	0.31	24.0
6	Money	0.31	0.32	3.2
	Mathematics Word Problem	0.29	0.34	17.2

5. Discussion

5.1. Mathematics Grade-5 Computations Test: BM and Bilingual Versions

Mathematics Grade-5 Computation Test in BM and Bilingual versions were very difficult for the Grade 5 *Orang Asli* pupils, yet the Bilingual version of the computation test was easier for them for the topic on *Operation on Numbers*. This finding is coherent with the finding in the study done by (Videnovic, 2017) whereby it was reported that when the pupils were given the opportunity to be assessed oral mode, they could perform better compared to the written examination. Overall, the Grade 5 *Orang Asli* pupils performed better in numeracy skills of the computation items such as *addition, subtraction, multiplication, division* and *combined basic operation* when the items were given in their native language compared to the items in Bahasa Melayu. This finding is also consistent with the finding of (Ismail, et al, 2020) whereby they found that the Indigenous pupils' achievement in numeracy proficiency in the oral test was higher compared to the written test. The study also showed that mathematical register can be a hindrance to successful word problem solving. The lack of understanding of mathematical vocabulary leads to failure in solving word problems items (Schoenberger, & Liming, 2001).

For the topic on *Money*, the BM version of the test was more difficult for these *Orang Asli* pupils. However, the Bilingual version of the test improved their achievement in computation test for the topic on *Money*. This finding is consistent with the finding of (Engel, et al 2003), where the pupils in their study had gained the most benefits from the additional exposure on *Money*, while *Addition* and *Subtraction* also played a role in increasing the pupils' mathematics achievement. However, in the current study, both the BM and Bilingual versions of the test were equally difficult for the pupils for the topic on *Time*. This indicates a positive relationship between the topics *Time* and *Money* in mathematics (Engel, et al 2003).

5.2. Mathematics Word Problem Test: BM and Bilingual Versions

For the *Operation on Numbers* in word problem items, the *Orang Asli* pupils found both the Bilingual and BM versions very difficult for them, yet the word problem items became easier when they were tested in the pupils' native language. They faced difficulty to answer the mathematics test in BM compared to when the items were in their native language. This result is in line with the finding of (Hanafi, 2004), who conjectured that Indigenous pupils in Malaysia face an extra challenge of learning Mathematics due to having a background that is very different from the mainstream students and their learning capabilities are very different from their counterparts. Furthermore, the study also described the IQ and capability of Indigenous pupils as lower when compared to mainstream pupils (Hanafi, 2004). On a similar note, it was also reported that students with less proficiency in the language of assessment may not show favorable achievement (Abedi, 2006), which explains the overriding tendency among native language teachers to engage in cultural translation for the purpose of overcoming language differences (Kramsch, 2020).

For the topic on *Time* for word problem items, the results indicated that the difficulty in the BM version of the test as greater for the pupils compared to the Bilingual version. This shows that the word problem items in the Bilingual version was easier for the pupils compared to the BM version. However, for the sub-topic on *Money*, the difficulty index for both versions of the test was found to be about similar. This finding is not consistent with the finding within the study whereby the assimilation of concepts of *Time* is similar among the pupils but not for the topic on *Money*. However, the study reported that *Time* and *Money* have a positive relationship within the same assessment in mathematics (Engel, 2013).

6. Conclusion

This finding shows that there is no difference in the *Orang Asli* pupils' performance in topic of *Time* for computation items in both languages. For the word problem items from the topic of Money, the finding also indicates similar results in both languages. Notably, these two topics, *Time* and *Money*, are related to their daily life and they are more aware and can relate better to them compared to the topics on *Operation on Numbers* for computation and word problems. Thus, it is conjectured that the *Orang Asli* pupils' performance in the computation test is better than their performance in the word problem test. This research finding has become a stepping stone in solving mathematics problems faced by the Indigenous community. The mathematics educators can take initiative in enhancing the level of the mathematics achievement among Malaysian Indigenous pupils with the use of code switching between the native language and the language of instruction. For future study, this study suggests the need to conduct content analysis and error analysis on the topics on *Time* and *Money* to further examine issues such as misconceptions on these two topics.

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