Information Literacy Assessment: Rasch Analysis Approach

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ABSTRACT:

This study aimed to investigate the psychometric properties of adopted and modified the Tool for Real-time Assessment of Information Literacy Skills (TRAILS) using Rasch analysis. The TRAILS assessment is a 25 multiple choice items and was administered to the upper secondary school students. The analysis showed that all items are well-targeted for Malaysian students although some changes need to be done as to include some easier TRAILS. Analysis showed that majority of the students scored over 40% on the IL Assessment. The findings are useful to lead to a new paradigm in assessing competency of IL skills among students using Rasch analysis. The study is hoped to bring a new direction to the process of data analysis in library science research.

Keywords: Information Literacy Assessment, TRAILS, Rasch analysis, Secondary education

1. Introduction

Information literacy (IL) is one of the fundamental aspects of education for students today because of the rapid expansion of technology and the ever growing amount of complex information. Moreover, IL is a distinct and broader area of competence while showing significant overlap with information technology skills (American Library Association, 2000).

Thus, students, school staff and the general population need to review, select, evaluate and use it effectively (Herring, 2010). In the world of knowledge, students need to be educated to be more literate when searching, analyzing and using the information. Although schools are more specified on technical skills and research skills, they should teach the students to think and to prepare them to solve information – related problems as the goal of twenty-first century education in which IL and information technology (IT) become very crucial (Allen, 2007; S. K. W. Chu, Tse, & Chow, 2011; H. Yu, Noordin, Mokhtar, & Abrizah, 2010).

The birth of 'Internet' cause the volume of information flows worldwide unprecedented and disseminated so quickly (Gunter, Rowlands, & Nicholas, 2009). Hence, it becomes so crucial to educate this generations with IL skills as to survive in digital environment where possibility all the information will be soon available in electronic form. The

competitive of global marketplace require this gen to become competent lifelong learners as well as to fulfil their information needs (Edzan & Saad, 2005; Stowe, 2013).

2. Literature Review

2.1 Information Literacy Development

Since 1970s, the concept of IL had been interpreted in so many ways. In education field, the terms 'study skills', 'research skills' and 'library skills' are being used. For work environment and continued productivity, the terms 'lifelong learning' and 'creative thinking' are being used (Hepworth, 2000). IL is also linked to information technology (IT) skills with more implications for individual, educational system and society (American Library Association, 2000).

The importance of IL skills has been recognised in the 1989 Final Report of the American Library Association's Presidential Committee on Information Literacy as well as the definition of being information literate: a person must be able to recognize the need for information and effectively access, evaluate and creatively use information (American Library Association, 1989; Foo et al., 2013). All students including high-achieving and low-achieving students need to be information literate. Information literacy must be provided for all citizens regardless of social or economic status (Reichel, Rader, & Rader, 1991).

It is been known that there is a relationship between information literacy and media literacy due to the accessibility of the content via the Internet and mobile platforms, so UNESCO on the year 2011 views that information literacy and media literacy together as Information Literacy – Media Literacy or Media Information Literacy (MIL)(Moeller, Joseph, Lau, & Carbo, 2011).

2.2 Information Literacy in Malaysian Schools

Since the early nineties, the Malaysian government has been an enthusiastic supporter of ICT by developed a range of policies to encourage Malaysians to go online. The Ministry of Education (MOE) realized the importance of ICT in education by taken significant step to widen the usage of ICT among pupils by providing schools with ICT infrastructure (Krishnan, Nair, Rahim, Setia, & Farida, 2012). But, can technology supervise the development of information literacy skills? The answer is "yes" and "no" (McNaught, 2008).

It been showed that schools are embedding information literacy within its curriculum but it is not always obvious as noted by literature (Edzan, 2008). Educational Technology Division of Ministry of Education clarified that Information Literacy skills consists of thinking skills, learning how to learn skills, ICT skills, values and citizenship, multiple intelligences and knowledge acquisition. The Ministry of Education officials claim that Information Literacy Education (ILE) is integrated into the education system, but ILE does not appear to be implemented in most Malaysian schools (Ismail, Dorner, & Oliver, 2011).

Krishnan, Nair, Rahim, Setia, & Farida also stated that the majority of the students who use the Internet do so, to search for information. They also mentioned that these students no longer have to go to libraries to find materials or sources because they can use Internet to get the latest, current and up to date information. Therefore, as they can be recognized as 'Google generation', thus, it is important for them to be taught information literacy skills. Google generation is popular phrase that refers to a generation of young people, born after 1993, growing up in a world dominated by the internet (Rowlands et al., 2008). And according to Godwin & Parker (2008), the Google generation or web generation dates from 1981.

2.3 Information Literacy Assessment

Measuring the IL competency is important for the teachers and the students as one of the alternatives in determining the effects of IL competency towards their academic performance although they encounter limited opportunities for teaching and learning IL skills except for competency which is adopted as a normal concern for educational institution (Gross & Latham, 2013). As the world are moving fast with the technology that seem to enable the information been distributed as quickly as it all around us, the need of IL been implemented in student's daily life become more urgent. IL is concerned with student's ability to collect, analyze and utilize information gathered by using the information technology and using that information to make effective decisions (Hignite, Margavio, & Margavio, 2009).

Using assessment, questions about which student learn, what they learn, and how well they learn as well as explore pedagogical practices and educational experiences can be answered to foster student learning (Maki, 2002). Assessment have the idea to see the educational process of learning that been captured by the students. By assessing student IL skills, it allows librarians to know what students have learned and what they will need to do to improve their teaching and also to measure institutional effectiveness and the quality of education (Beile, 2008b; Seeber, 2013).

Walsh (2009) stated there are a lot of assessment methods used in information literacy skills such as analysis of bibliographies (F. Yu, Sullivan, & Woodall, 2011), essay (Nutefall, 2004), multiple-choice questionnaire (Chang et al., 2012; S. K. W. Chu, 2012; Fain, 2011; Foo et al., 2013; Kovalik, Yutzey, & Piazza, 2012), observation (Novotny & Cahoy, 2006), portfolio (Sonley, Turner, Myer, & Cotton, 2007), simulation (Newell, 2004), self-assessment (Kurbanoglu, Akkoyunlu, & Umay, 2006) and quiz/test (Emmett, Emde, Emmett, & Emde, 2007). He stated that multiple-choice questions were the most popular method used as assessment tool (Walsh, 2009).

There are many IL assessment that been developed by libraries, colleges, and universities to cater the need of assessing the IL skills such as Information Literacy Test, James Madison University (JMU), iSkills, SAILS (Standardized Assessment of Information Literacy Skills), Assessment Primer, University of Connecticut, Bay Area Community Colleges Information Competency Assessment Project, TRAILS (Tool for Real-time Assessment of Information Literacy Skills) and many more.

Even though TRAILS is US based, one study from Hong Kong did use it to evaluate students' skills in information literacy (S. K. W. Chu, 2012). There is still no national assessment for IL competency for schools in Malaysia as IT literacy places more importance (Krishnan et al., 2012).

3. Research Objective

The objectives of this study are:

a. To examine the psychometric properties of the adopted and modified TRAILS using the Rasch Analysis.
b. To access the students' level of information literacy.

4. Method

This case study was conducted using a quantitative survey approach (Phase 1) and qualitative analyses (Phase 2). For the Phase 1, the population was Form Four students (16 years old) in a single secondary school. Only 165 respondents (86 males and 79 female students) participated in this study. In this study, Ninth Grade General Assessment from the Tool for Real-time Assessment of Information Literacy Skills (TRAILS), a project of Kent State University Library was adopted and modified to assess IL skills of secondary school children, regardless of their academic achievement. TRAILS is an online tool that freely available created to measure the information literacy skills of high school students and based on Ohio Academic Content Standards and Information Power: Building Partnerships for Learning (C. B. L. Chu, Yeung, Alice, & Chu, 2012; Schloman & Gedeon, 2007).

There are five categories in TRAILS; (1) develop topic; (2) identify potential sources; (3) develop, use, and revise search strategies; (4) evaluate sources and information; and (5) recognize how to use information responsibly, ethically, and legally. The test items were modified to make them specifically relevant to local students. Content validity was evaluated by four Malaysian school teachers, two librarians and two experts in IL field. To ensure that all the students could understand the items properly, the questions were translated into Malay language by the certified translator and been verified by language teacher.

The dichotomous data were analyzed based on the Rasch measurement model with the aid of computer application software, WINSTEPS version 3.68.2, a Rasch based item analysis program. The Rasch measurement model is used in this study to assess students' achievement on IL skills as it gives more significant analysis, allowing for better inference to be made (Azrilah, Mohd Saidfudin, Faridah, & Mohd Zaidi, 2013). It would scale the students' ability estimation according to the portion of correct responses and give the depth in the understanding of the ability for each student in relation to every item difficulty (Karim, Shah, Din, & Osman, 2014). Rasch measurement model basically tells that students with high ability should be able to answer all questions; meanwhile the less able students may have some problems with the difficult questions (Azrilah, Mohd Saidfudin, & Azami, 2013; Bond & Fox, 2007). It gives a complete solution to almost every measurement on problems faced in science as well as suitable for social science

whereas the raw data is so unruly (Wright & Mok, 2004).In this study, we evaluate Reliability, Item-Person Map and Differential Item Functioning (DIF).

4.1 Measures and Scoring

The study used adapted and modified Tool for Real-time Assessment of Information Literacy Skills (TRAILS) which contains of 25 multiple-choice questions. Table 1 shows the constructs and their respective test items.

Table 1: IL Assessment constructs and their respective items

No	Constructs	Items
1	Develop, use, and revise search strategies (DU)	1 - 6
2	Develop topic (DT)	7 - 11
3	Identify potential sources (IP)	12 - 15
4	Evaluate sources and information (ES)	16 - 20
5	Recognize how to use information responsibly, ethically, and legally (RH)	21 - 25

4.2 Procedures

The assessment is in the format of multiple-choice questions. It would have only one "completely correct" or the best answer that would receive the score of 1 for that item (question) and score of 0 for other answers. The dichotomous data then will be analysed and the difficulty items are mapped to the respondent ability to show the arrangement of difficulty level for those matched items with person's distribution of capabilities on a logits scale.

5. Discussion

5.1 Respondents' Profile

The male respondents were 86 (52.1%), whereas females were 79 (47.9%). There were 48 (29.1%) science students who were from two classes. Next, there were 117 (70.9%) non-Science students which are from four classes. All of them were form 4 students. However, Table 2 shows that 19 respondents were dropped from the analysis for being misfit persons, leaving 73 males and 73 females. Consequently, it reduced the number of Science students to 44(30.1%) and Non-Science 102 (69.9%).

Table 2: Profile of Respondents

Demography Factor	N	Factor	Frequency	Percentage
Gender	146	Male (1)	73	52.1%
		Female (2)	73	47.9%
Streams	146	Science*(Class S, E)*	44	30.1%
		Non-Science*(Class K, O, L, A)*	102	69.9%

5.2 Reliability

Using the Winsteps version 3.68.2, the data were analysed to determine the validity and reliability of the Information Literacy Assessment (ILA). Item and person reliability also shows the extent to which the items are compatible with the Rasch Model and the item and person separation index.

Table 3: Person Reliability

	RAW SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	11.1	25.0	-.29	.45	1.00	.0	1.00	.1
S.D.	3.7	.0	.73	.04	.11	.7	.18	.8
MAX	22.0	25.0	2.20	.75	1.26	1.8	1.70	1.7
MIN	2.0	25.0	-2.65	.43	.67	-2.7	.62	-2.6

REAL RMSE	.46	ADJ.SD	.57	SEPARATION	1.24	Person RELIABILITY .61
MODEL RMSE	.45	ADJ.SD	.58	SEPARATION	1.28	Person RELIABILITY .62

Person RAW SCORE-TO-MEASURE CORRELATION = 1.00
CRONBACH ALPHA (KR-20) Person RAW SCORE RELIABILITY = .61

The summary statistics (Table 3) shows that the Cronbach-α value was 0.61, which is acceptable (Bland & Altman, 1997; Nunnally, 1967). Cronbach-α value implies that the data are more likely to be latent variable if the value is closer to 1 than 0 but it does not show if there is problem with the person or the item. By using Rasch analysis, it allows more investigation as to check the reliability of the person and item (Bond & Fox, 2007; Chan, Ismail, & Sumintono, 2014). The Summary Statistics from Table 4discloses that person separation is 1.24, indicating that there were nearly two groups of the students (Sumintono & Widhiarso, 2014). The person reliability estimated in Rasch model is 0.61 meanwhile the item reliability is 0.93. The reliability values of more than 0.8 are acceptable values, while values between 0.6 – 0.8 are less acceptable and values less than 0.6 are not acceptable (Bond & Fox, 2007). The low person reliability indicated that the sample range of the students' abilities is small (Linacre, 2012).

Table 4: Item Reliability

	RAW SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	64.6	146.0	.00	.19	1.00	- .1	1.00	- .1
S.D.	22.1	.0	.74	.01	.09	1.2	.12	1.1
MAX	105.0	146.0	1.50	.23	1.28	2.9	1.37	2.7
MIN	24.0	146.0	-1.33	.17	.88	-2.2	.85	-2.2

REAL RMSE	.19	ADJ.SD	.72	SEPARATION	3.79	Item RELIABILITY .93
MODEL RMSE	.19	ADJ.SD	.72	SEPARATION	3.86	Item RELIABILITY .94
S.E OF Item MEAN =	.13					

Table 4 reveals that item reliability index shows the replicability of item placements is along the pathway if the same items were given to one more sample of the same size that behaved the same way (Bond & Fox, 2007). As item reliability is 0.93, it indicates "very good" reliability value (Fisher, 2007). It also means that the item is stable. There are items which are difficult, easy and some items in between, which indicated that items were spread with ranges of difficulty (Azrilah, Mohd Saidfudin, Faridah, et al., 2013; Bond & Fox, 2007).

Table 5 shows the summary of the item separation index. The findings show that the items (questions) for the five constructs have reliability ranging from 0.83 to 0.96. The indices show that the items were very good as the values are close to 1.0 (Bond & Fox, 2007).The measurement becomes better as the higher the value of the separation index of the items because the items were separated by levels of varying difficulty (Kamis, Bakar, Hamzah, Asimiran, & Halim, 2013). Item separation index is the separation of item

difficulty level (Kamis et al., 2013). From the result, it revealed that the item separation index was between the values of 2.19 to 5.15. These items can be divided into 2 to 5 strata or levels of agreement

Table 5: The reliability of IL skills constructs

No	Construct	Total Items	Item Reliability	
			Item	Separation
1.	Develop, use and revise search strategies (DU)	6	0.88	2.74
2.	Develop topic (DT)	5	0.92	3.34
3.	Identify potential source (IP)	4	0.96	5.15
4.	Evaluate sources and information (ES)	5	0.83	2.19
5.	Recognize how to use information responsibly, ethically and legally (RH)	5	0.89	2.86

5.3 Person Item Map

Figure 1 shows a hierarchy of the person's ability and item difficulty in a straight line which are also known as variable map or Wright Map. A variable map gives an organizing concept for viewing the outcomes of a measurement process (George Engelhard, 2013). Moreover, it represents the revolutionary technique to display very complex rating scale data and test data (Boone, Staver, & Yale, 2014).Person with high ability stays at the top scale meanwhile person with low ability stays in the lower part of the scale. Person estimates are distributed on the left side while item estimates are on the right based on their ability and difficulty estimates (Tee, Law, Soojin, Kim, & Ki, 2013).The person mean estimate is -.29 and the item mean is .00, with no wide divergence. The items and persons spread evenly along the standardized scale and clustered opposite to each other. It reveals good targeting of items to the sampled students. However, about 4.7% of the sampled students reported ability estimates lower than the least difficult item.

By comparing both person's ability and item difficulty on the same interval scale, Figure 1 reveals that a student (S20), from the Science class has the highest ability logit unit (2.20) and is located at the highest level on the scale. Meanwhile, a student from Non-Science class (A2) has a lowest ability logit unit (-2.65) and thus, located at the lowest level on the scale. It also shows that students with higher grades made greater improvements in IL skills compared to lower grades due to their higher motivational and self-regulation level (S. K. W. Chu et al., 2011), as S20 got 8A's while A2 only got 1C in Lower Secondary Certificate.

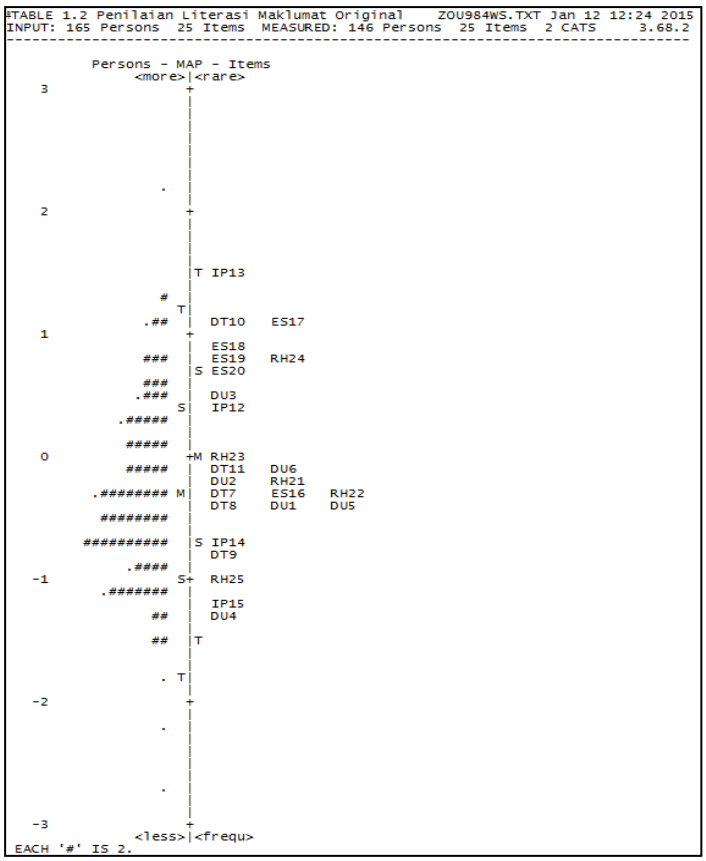

Fig.1. Item map

The variable map also reveals that the spread of item measure ranges from a maximum logit at 1.50 and minimum logit value of -1.33 respectively. The most difficult item (IP13) stays at the top scale while the easy item (DU4) stays in the lower part of the scale. Difficult items were able to be answered by the highly capable students meanwhile the less ability students may have some difficulty with it (Azrilah, Mohd Saidfudin, & Azami, 2013; Bond & Fox, 2007; Kamis et al., 2013; Linacre, 2012) .The results also revealed that the Science students score more that the Non-Science students although majority of the students are from the Non-Science class.

In general, there is more distribution of students below the item mean at 0.00 logit. It can be concluded as IL which can also be known subject under the field of Library and Information Science (LIS) which is not a 'teaching subject' in school (Tan, Gorman, & Singh, 2012). Moreover, the findings are also comparable with Smith et al. (2013) who revealed that the secondary school students are lacking the IL skills. Hence, this result is expected although it will be interesting to find out more why there are students who managed to be located above the item mean.

All items are well-targeted for Malaysian students although some changes need to be done as to include some easier items. The assessment also included both difficult and easy items as evident in the spread of items along the standardized linear scale.

5.4 Differential Item Functioning (DIF)

Differential Item Functioning (DIF) looks at a psychometric difference for item functions as a group compared to the others (Aryadoust, Goh, & Kim, 2011; Mokhtar & Jailani, 2011; Suah & Ong, 2012).Item estimation should remain stable across the relevant subsamples if the variance property holds (Bond & Fox, 2007). Rasch measurements for the gender were calculated as to investigate whether the items use to measure the IL Assessment function are in the same way for the subsamples.

DIF contrast is the difference in measurement for an item between male students and female students. To be noticeable, it should be at least .50 logits (Linacre, 2012). To analyse GDIF, Winsteps performs two-tailed t-test to test the significance of the differences between two index difficulties. The level of t critical value rests with value 2.0 for all DIF analysis. A negative index of GDIF Contrast means that the item is easier to be confirmed by males while a positive index item is easier to be confirmed by female respondents.

Table 6 displays results of GDIF analysis on 25 studied items. The analysis demonstrates that 4 items (DU5, IP12, ES17 and ES20) from 25 items show the significance of GDIF in value t ≥ 2.0 logit. The GDIF contrast (≥- 0.5 logit) shows that these 4 items also show more than 0.5 logit. Thus, these 4 items are suggested to be deleted. Analysis also revealed that 2more items (DU3 and IP14) showed significant GDIF but the significance of GDIF in value t ≤ 2.0.

Table 6: Differential Item Functioning for Female and Male students

Group	DIF Measure (Difficulty measure)	Group	DIF Measure (Difficulty measure)	GDIF Contrast (DIF size)	t	Df	Item Label
M	-0.50	F	-0.39	-0.12	-.34	143	DU1
M	-0.38	F	-0.08	-0.30	-.86	143	DU2
M	0.88	F	0.16	0.72	1.88	142	DU3
M	-1.54	F	-1.11	-0.43	-1.12	143	DU4
M	0.13	F	-0.90	1.02	2.79	143	DU5
M	-0.20	F	-0.08	-0.11	-.32	143	DU6
M	-0.13	F	-0.51	0.38	1.06	143	DT7
M	-0.44	F	-0.26	-0.18	-.52	143	DT8
M	-0.87	F	-0.70	-0.18	-.49	143	DT9
M	1.39	F	0.94	0.45	1.04	142	DT10
M	-0.14	F	-0.14	.00	.00	143	DT11
M	0.79	F	0.04	0.76	2.00	143	IP12
M	1.39	F	1.60	-0.22	-.47	143	IP13
M	-0.44	F	-1.04	0.59	1.63	143	IP14
M	-1.13	F	-1.18	0.06	.15	143	IP15
M	-0.20	F	-0.39	0.19	.54	143	ES16
M	0.55	F	1.70	-1.15	-2.76	143	ES17
M	0.71	F	1.08	-0.37	-.94	143	ES18
M	0.71	F	0.94	-0.22	-.57	143	ES19
M	0.13	F	1.33	-1.20	-3.11	143	ES20
M	-0.44	F	-0.02	-0.42	-1.21	143	RH21
M	-0.32	F	-0.26	-0.06	-.16	143	RH22
M	0.19	F	-0.20	0.40	1.11	143	RH23
M	0.63	F	0.86	-0.23	-.60	143	RH24
M	-0.87	F	-1.04	0.16	.45	143	RH25

Figure 2 shows the results DIF analysis of all test items. The grey line drawn between square plot points represents item difficulty in the male subgroup (M), and the black line drawn between diamond-shaped plot points represents item difficulty in the female subgroup (F).

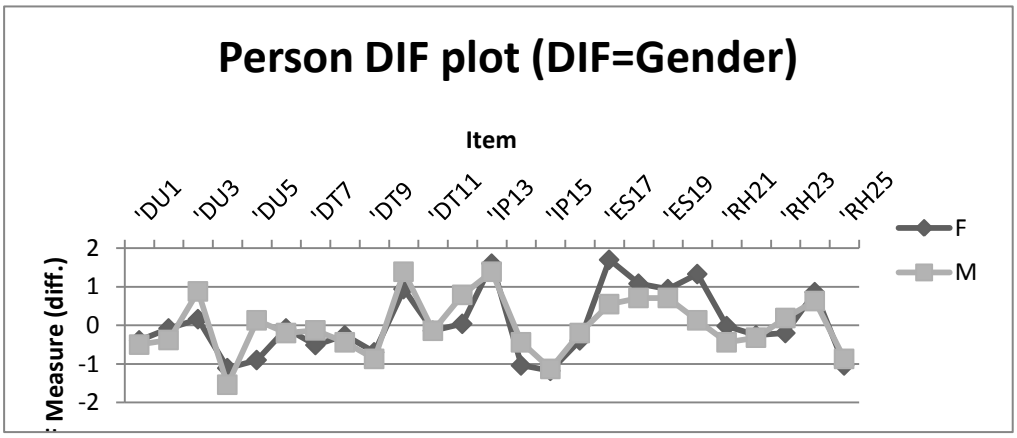

Fig.2. Plot of item estimates between Female and Male students from Differential Item Functioning analysis

All items are well-targeted for Malaysian students although some changes need to be done as to include some easier items. The assessment also included both difficult and easy items as evident in the spread of items along the standardized linear scale. From the analysis, it also shown that students with higher grades made greater improvements in IL skills compared to lower grades due to their higher motivational and self-regulation level (S. K. W. Chu et al., 2011). However, in general, there is more distribution of students below the item mean at 0.00 logit. It can be concluded as IL which can also be known subject under the field of Library and Information Science (LIS) which is not a 'teaching subject' in school (Tan et al., 2012).An independent t-test revealed that the stream does have relationship on IL skills. As students with better grades were likely to enrol in science stream, hence shown that those who have IL skills probably from those who were also high achieving students.

Similar to previous study (Kovalik et al., 2012), the students were score poorly for the sub-category *Evaluate Sources and Information* (M=30.55, SD=20.637). It suggested that the students are weak in evaluating the sources and information properly. As other researchers found out that the young people tend to speed the searching especially via web searching hence spent less time in evaluating information (Rowlands et al., 2008) and became liberal when explaining the sources such as from mobile phones, Facebook, Google, books and people (Smith & Hepworth, 2012).

6. Limitation

The sample of this study came only from one secondary school. They might not be used to generalize and represent other schools and students in Malaysia. A further research to cover more secondary schools and students is recommended. In this study, the data was collected through the survey and assessment only.

7. Conclusions

The findings from the study showed that the items target particularly well on Malaysian students with different IL level. However, results indicated that easier items could be added in order to examine students with lower IL skills. It also shown that majority of the students has basic IL skills such as develop and search for the information.The assessment results revealed that the students' best performing IL skills is *Develop, use and revise search strategies*. Meanwhile there is also a need to investigate why these students seem to have lack of evaluating skill as the scores on the assessment also indicated these students encounter difficulties when dealing with the evaluating resources and information. We also can conclude that students with higher PMR (Lower Secondary Evaluation) scores did have significantly higher IL Assessment scores as well.

Future studies can be done to investigate the various ways to integrate the IL skills by studying the students' information behaviour. It is also useful to investigate how the students that scores in IL Assessment managed to grasp the IL skills without formally taught.

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