

MEASURING RESEARCH LITERACY: DEVELOPMENT OF RESEARCH LITERACY TEST

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ABSTRACT

Postgraduate students required to read large amounts of information compared to undergraduate students. Reading and digesting research reports is unavoidable for postgraduate students as this is how they will be able to gain inputs and information to inform their theses and research articles. Thus, this study developed a valid and reliable research literacy test (RLT) that can be used to assess students' research literacy in the future. The results from this study suggested that research literacy can be assessed based on three sub-domains; information literacy, knowledge of research methodology and statistical literacy. Fleiss kappa value for each sub-domain was 0.88, 0.73, and 0.86 respectively. The residual and fit analysis also indicated that RLT has fulfilled the requirement of unidimensionality of an instrument. Both of person and item reliability indices also are appropriate with 0.70 and 0.85 respectively. The findings indicate that the validity and reliability of RLT is good and appropriate to assess students' research literacy.

Keywords: *Research Literacy, Instrument Development, Validity, Reliability, Rasch Analysis*

INTRODUCTION

Universities in Malaysia are continuously challenged by the government to increase the number of postgraduate students as they are seen as important contributors to research and journal publications (Mazhisham et al., 2015; Chapman & Chien, 2015). Other than completing their thesis, some universities include journal publication as part of the postgraduate program requirements to be fulfilled prior to graduation. However, higher education is faced with issues such as an increase of student dismissal from completing their study (Anbuselvan, 2014) and postgraduate students takes longer than normal duration to complete their research study (Nurhazani et al., 2015; Hasnan et al., 2015; Mazhisham et al., 2015). Necessarily, several studies were conducted by previous researchers to identify factors or difficulties encountered by postgraduate students which may influence the delay in completing thesis (Ngozi & Kayode, 2013; Anbuselvan, 2014; Norhazani et al., 2015; Gaffner & Wilson, 2015; King & William, 2014). One of the factors cited was students' difficulty in reading research, which eventually lead to the delay of their research writing or academic writing (Lim et al., 2016; Rosales et al., 2012; Itua et al., 2014).

Research writing specifically thesis writing requires postgraduates to read vast amount of empirical literatures which consist of a lots of terminology, jargons, statistical data and as well as information displayed in figures and tables. However, to some postgraduates, reading empirical literatures (research reports, research articles) is frustrating and challenging and subsequently reducing their motivation to read empirical articles. Many studies reported barriers towards reading research articles. For instance, Wao et al. (2012) identified barriers towards reading research articles among doctoral students such as lack of time, psychological physical factors, lack of relevancy, lack of statistical background, language style and accessibility. Similarly, Waller and Knight (2012) identified barriers towards reading research articles such as the complex content, the difficulty of finding relevant articles, the time commitment, and access problems. Bengue et al., (2010) classified reading barriers into three themes as follows:

- (i) Research Characteristics: Lack of understanding of research design, methods, and analysis and also their view about the research significance and relevance.

- (ii) Comprehension: Lack of prior knowledge, vocabulary and reader attributes which reducing their abilities to construct meaning from text.
- (iii) Text Characteristics: Text coherence and volume of reading

This study however would like to focus on examining postgraduates' ability to identify, access, interpret and evaluate empirical literatures. The term used for this ability is referred as research literacy (RL). Briefly, ability to RL can be defined as ability to read, access, interpret and evaluate research reports (thesis, research articles) (Shank & Brown, 2007; Brody et al., 2012; Jakubec & Astel, 2015; Olola et al., 2016; Beaudry & Miller, 2016; Jakubec & Astel, 2017; Senders et al., 2017).

The importance of RL has been mentioned by few authors as the requirement for professional developments and societal development (Senders et al., 2017; Brody et al., 2017). However, most of studies regarding association between professional and societal development and RL were conducted in the context of health and community practice. The concerns about RL from health practitioners' perspectives is that how understanding a research will motivate individuals to participate in clinical research (e.g.: parents allowing their young children or they themselves participate in clinical research), motivate health practitioners to conduct their own research (small scale or large scale research) and help health practitioners apply findings from relevant research articles in their daily practice, subsequently develop their professional skills (Brody et al., 2012; Jakubec & Astel, 2015; Olola et al., 2016; Jakubec & Astel, 2017; Senders et al., 2014)

The importance of RL is also mentioned in the context of higher education (HE) especially in German. This is due to that most of universities in German are regarded as research universities. Thus, RL is included in the general definitions of standard and objectives for German Higher Education degrees (Ophoff et al., 2017). RL also can be found or has been suggested as the requirement course in degree programs as to prepare students for their research journey (Ophoff et al., 2017; Down & Sutton, 2016; Down & Sutton, 2014; Mackey & Ho, 2005; Tuñón, 2008). These indicated the importance of RL in preparing students for their own development. However, the number of study about RL in educational field is still lower compared to the studies conducted by health practitioners and most of articles available only focused on the development of RL course for postgraduate or degree students (see Down & Sutton, 2016; Down & Sutton, 2014; Mackey & Ho, 2005, Tuñón 2008).

Moreover, there is limited number of instrument that assess students' RL. Additionally, available instruments that have been used in assessing RL were limited to measuring the knowledge of research concepts and used self-perceived questionnaire to measure the knowledge (see Olola et al., 2016; Brody et al., 2012). The used of questionnaire to measure what the respondents know about research concepts may be invalid as it measures what the respondents believe they know not what they actually know (Boynnton & Greenhalgh, 2004). Thus, the purpose of this study is to develop a test to measure postgraduate students' research literacy.

The development of research literacy test (RLT) was based on instrument development framework outlined in 1999 Standards for Psychological and Educational which also has been discussed in and Linn (2006), Adam and Wiemen (2010). There four major phases in the development of RLT are as follows; (i) outlined the purpose and scope of domain to be measured, (ii) development and evaluation of the test specifications, (iii) field testing, evaluation, items selection, and scoring, (iv) assembly and evaluation of the test for operational use. This paper however is limited only to the third phase of RLT development.

METHODOLOGY

The first phase of this study involved of outlining the purpose of the test and scope of domain to be measured. The sub-domains of research literacy were defined based on literature review and meta-data analysis.

The second phase involved of assessing validity of the sub-domains using Fleiss Kappa analysis. Fleiss Kappa analysis produced kappa value (k) indicating experts' rating agreement whether the items in RLT are relevant or irrelevant. Items review by the experts is essential to determine if the test items

match or measure the achievement target, the representativeness of the test items, if there any bias and stereotyping, technical adequacy (Linn, 2006; McCowan & McCowan, 1999; Osterlind, 1998). The study involved of four experts who have more than 10 years of experience in teaching research methodology, educational statistics, and measurement and evaluation subjects. Each expert was provided with rating form to evaluate each items. k value that is less than 0.40 is considered unacceptable and value between 0.40 to 0.75 is considered acceptable and more than 0.75 is regarded excellent (Fleiss, 1981).

Other than Fleiss Kappa analysis, the validity of RLT was also examined using Rasch Analysis. The software used in this study is Winsteps. Rasch Analysis provided information about unidimensionality. The examination of unidimensionality is to make sure that the test measures one attribute at a time. Unidimensionality was examined based on standardized residuals (PCA residuals) and fit statistics. As for PCA residuals, it is advisable that the expected (modeled) value of variance explained should be close to the observed percentage (Linacre, 2015) while the eigenvalue of the first contrast should be between 1.4 to 2.0 (Linacre, 2008). Tanaka (2016) suggested that the value should not exceed 3.0. If it is larger than acceptable value, it indicates some kind of secondary effect in the data (e.g. item format, type of participants or dimension, etc.) (Tanaka, 2016, Linacre, 2015). While for fit statistics, outfit (outlier sensitive) analysis was examined based on its mean square (MNSQ) value along with standardized fit statistic (ZSTD) value. MNSQ should be between 0.5 to 1.5 (Linacre, 2002), while ZSTD value should be between -2.0 to +2.0 to indicate reasonable predictability.

As for the third phase (field testing), the RLT was administered to 45 postgraduate students from Faculty of Education from one of the five research universities in Malaysia. Reliability of RLT was examined using Rasch Analysis. Rasch Analysis provided two reliabilities; person reliability and items reliability. Acceptable value of reliability is between 0.6 and 0.8 (Linacre, 2011; Bond & Fox, 2007). Noted that person reliability is independent of sample size while item reliability is independent of test length, however both of them are largely not influenced by model fit.

RESULTS AND DISCUSSION

As a result of the literature reviews and meta-data analysis, research literacy test (RLT) consists of three domains; information literacy, knowledge of research methodology and statistical literacy as shown in Table 1.

Table 1. Domain to be measured

Domain	Sub-Domain
Information Literacy	-Ability to locate and retrieved research articles -Recognize different types of academic documents -Search for relevant information
Knowledge of Research Methodology	-Difference between quantitative and qualitative research in terms of research variables, research design, sampling data collection.
Statistical Literacy	-Familiarity of basic statistical concepts and terminologies -Statistical test (inferential and descriptive analysis) -Interpret statistical analyses based on data and chart or graphs

The research literacy domains were assessed using multiple choice question with 3-options format. The distribution of 40 items is shown in Table of Specification (Table 2) which Information Literacy has 10 items, Knowledge of Research Methodology and Statistical Literacy has 15 items respectively.

Table 2. Table of specification for research literacy components

	Educational Research Literacy Components	No of Items

		Information Literacy	Research Methodology	Statistical Literacy	
Cognitive Level	Remember	2	5	x	20
	Understand	3	5	5	
	Apply	4	4	1	14
	Analyse	1		4	
	Evaluate			5	6
	Create	x	1	x	
No of Items		10	15	15	Total Items: 40

All 40 items then were evaluated according to their respective domains. The kappa value of each domain is shown in Table 3. The k value for information literacy is 0.88, knowledge of research methodology is 0.73 and statistical literacy is 0.86. All of k value for each domain is more than 0.7, which indicated that all of items are somewhat valid and relevant to be used in RLT.

Table 3. Kappa value (k) for research literacy domains

Research Literacy Domains	Number of Items	Kappa Value (k)
Information Literacy	10	0.88
Research Methodology	15	0.73
Statistical Literacy	15	0.86

The unidimensionality results obtained from Rasch Analysis is shown in Table 4. The value of expected variance is 31.7%, which is close to the value of observed variance that is 31.5%. According to Linacre (2015), the instrument indicates unidimensionality if the expected value is close to observed value. As for eigenvalue, Tanaka (2016) stated that the value should be less than 3.0 to indicate unidimensionality. As for MNSQ and ZSTD, the range indices of MNSQ is between 0.80 to 1.44 while ZSTD obtained is ranged from -1.7 to 1.2. Based on Table 4, all of the values reported by Winsteps were in the range of acceptable value. Thus, RLT was considered appropriate and was proceed to field testing.

Table 4. Unidimensionality results

Analysis	Value	
PCA Residuals	Expected (modeled) variance	31.7%
	Observed variance	31.5%
	Eigenvalue	2.2
Item Fit Statistics	Range Value Indices	
	Outfit MNSQ	0.80 to 1.44
	Outfit ZSTD	-1.7 to 1.2

The data obtained from field testing was analyzed to examine reliability. Table 5 shows the reliability value of person reliability and items reliability as reported in Winsteps. Person reliability obtained is 0.70 and item reliability obtained is 0.85. Both of reliabilities are within the acceptable value which is

more than 0.60 as suggested. This indicated that, the RLT is ready to be assembled for the operational use.

Table 5. Reliability value

Reliability	Reliability Indices
Person	0.70
Items	0.85

CONCLUSION

The purpose of this study is to develop a valid and reliable test to measure research literacy of postgraduate students of Faculty of Education. Research literacy test (RLT) was systematically developed based on instrument development framework suggested by Adam and Wiemen (2010). Based from the findings, RLT has a good validity and reliability which can be used to assess postgraduate students' research literacy in future. However, there are some limitation of this study.

Firstly, considering postgraduates' time to participate in this study and also the advantages of multiple-choice (MC) format such as can include large amount items and afford a more representative sample of targeted domain to be measured (Haladyna, 2004), the study chose to develop MC format for RLT. However, the used of MC format may be inappropriate to assess higher cognitive ability such as problem-solving, reasoning and judgement (Palmer & Devitt, 2007; Couch et al., 2018). Thus, in future, research literacy test may be developed using open-ended format to assess higher cognitive ability.

Secondly, research literacy in this study consists only three domains, information literacy, knowledge of research methodology and statistical literacy. It did not measure students' other variable such as motivation to read research reports or reading skills. Additionally, RLT offers a snapshot of students' research literacy at the time of testing and should not be used to predict students' success in completing their research.

Thirdly, RLT was developed purposely for postgraduate students' in educational field. However, it was expected that the postgraduate-level education programs in other institutions of higher learning would be able to adopt and adapt this test to improve their programs that are related to research literacy based on their students' results. The results from RLT also can give a necessary feedback to help students acknowledge their own literacy and may help them increasing their own motivation to read more research articles at the same time would guide faculty in planning supportive programs that facilitate students' ability to evaluate and conducting quality research. In considering both the attrition rate among postgraduate students and the growing number of graduate students, the need for intervention is imperative.

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