International Journal of Doctoral Studies

An Official Publication of the Informing Science Institute
InformingScience.org

IJDS.org

Volume 19, 2024

INFLUENCES OF LEARNING EXPERIENCES ON RESEARCH LITERACY AMONG POSTGRADUATE STUDENTS AT MALAYSIAN RESEARCH UNIVERSITIES

Ibnatul Jalilah Yusof*	Universiti Teknologi Malaysia, Skudai, Johor, Malaysia	ijalilah@utm.my
Siti Khadijah Mohamad	Universiti Sains Malaysia, Pulau Pinang, Malaysia	sitikhadijahmohamad@usm.my
Lukman Hakim Ismail	Universiti Teknologi Malaysia, Skudai, Johor, Malaysia	lukman@utm.my

ABSTRACT

Aim/Purpose	Given the limited research on assessing research literacy among postgraduate students in the education field, this study aims to explore the association between research literacy scores and learning experiences. These experiences include reading intensity, participation in formal research-related courses, and engagement in presenting and publishing articles.
Background	Postgraduate students are required to master essential skills such as reading, evaluating, interpreting, and synthesizing information from primary research articles, as they are expected to be both consumers and producers of scholarly work like theses and research articles. Developing research literacy, which encompasses these skills, is crucial. Without adequate research literacy, students may misinterpret research findings, compromising the quality of their studies. This not only affects their own work but also negatively impacts other researchers who reference their research outputs.
Methodology	This study utilized a survey method with a sample of 236 postgraduate research students in education. The participants were selected through stratified sampling, dividing them into two strata: master's students and doctoral students. The survey data were analyzed using multiple regression for inferential purposes.

Accepting Editor Emin Taner Elmas | Received: January 8, 2024 | Revised: July 15, 2024 | Accepted: July 31, 2024.
Cite as: Yusof, I. J., Mohamad, S. K., & Ismail, L. H. (2024). influences of learning experiences on research literacy among postgraduate students at Malaysian research universities. *International Journal of Doctoral Studies, 19,* Article 11. https://doi.org/10.28945/5345

Contribution	This study offers guidance on designing supportive programs based on the examined factors influencing research literacy among postgraduate students. Understanding these factors will enable more targeted and effective program development to foster students' research abilities.
Findings	Findings revealed that all five predictors predict the research literacy of postgraduate students in education. Nevertheless, further analysis shows that three of the five predictors significantly predicted research literacy scores. These include the total number of courses attended, $t\ (230) = 2.62$, $p < .05$; the total number of papers published, $t\ (230) = 4.05$, $p < .05$; and the number of articles read monthly. Among these, the total number of articles published emerged as the strongest predictor, followed by the total number of courses attended and the number of articles read monthly.
Recommendations for Practitioners	Practitioners in education should focus on enhancing research literacy within formal research courses provided for postgraduate research students. These courses should be tailored to improve research literacy skills and align with evolving needs and expectations, especially in the context of academic publication. Additionally, practitioners should implement interventions that cultivate reading habits, as staying informed directly affects students' academic publication endeavors.
Recommendations for Researchers	Researchers should investigate additional learning experiences that could impact research literacy. This includes exploring the role of mentorship, collaborative projects, and the use of digital resources in research education. Furthermore, engaging in longitudinal studies to track the development of research literacy over time is recommended. This would provide insights into how research skills evolve throughout the course of postgraduate studies.
Impact on Society	This study aims to empower research students by providing them with essential skills and knowledge for critical assessment, engagement, and contribution to research findings. Enhancing research literacy leads to a more informed, problem-solving, and evidence-based research community. Ultimately, this effort can significantly improve the quality of research education.
Future Research	Future studies may examine other factors, such as the barriers and challenges that students face in acquiring research literacy skills, including motivational, psychological, and socio-economic factors.

Keywords	research literacy, postgraduate students, formal research courses, immersion in research, reading intensity

BACKGROUND

Higher education institutions 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, thereby enhancing Malaysia's economic competitiveness (Shariff et al., 2015). Therefore, Malaysian research universities provide support for students by offering courses or modules that include research methods, data analysis, critical writing, and presentation skills during their first year of postgraduate studies (Md Kasim et al., 2021; Yusof, 2019).

Nevertheless, the criteria for passing or failing these courses vary widely (Yusof, 2019). Some courses only require attendance, while others might require a mini proposal presentation (Jeyaraj, 2020; Md Kasim et al., 2021; Yusof, 2019). After the first year, postgraduate students are often left to manage

their research independently. This means that, beyond the initial year, there is typically no formal assessment of their research skills or ability to conduct research except for evaluations by their supervisors, proposal defenses, and, ultimately, the viva voce examination.

In order to complete their studies, postgraduate students in Malaysia are also required to publish at least two articles in journals, necessitating them to read, write, and publish. This presents a significant issue, as reading research articles is fundamentally different from reading reports or textbooks. Reading research articles requires students to understand, interpret, and make sense of the methods used and correlate them with the data and discussion presented (Varnhagen & Digdon, 2002). The ability to understand and interpret research articles is referred to as research literacy (Groß Ophoff et al., 2017; Senders et al., 2014; Yusof, 2019).

Generally, research literacy is defined as the ability to search, identify, interpret, and evaluate relevant research articles from appropriate resources (Senders et al., 2014). Jakubec and Astle (2017) stated that research literacy is arguably just as important for students as research capacity. A lack of research literacy not only hinders the progress of writing research articles but also compromises the quality of research by leading to misunderstandings of findings (Cleary et al., 2016).

It is often assumed that postgraduate students, especially doctoral students, have little or no difficulty reading research articles (Burgess et al., 2012; Singh, 2014). However, Hubbard and Dunbar (2017) found that both postgraduate and postdoctoral students struggle to read research articles, especially when interpreting figures and statistical data. This difficulty likely stems from a lack of personal research context and prior knowledge. Furthermore, the findings of Yusof et al. (2019) revealed that the literacy level of postgraduate research students in education in Malaysia is moderately low. This study also indicated that their knowledge of research methodology is similarly at a moderate low level. Additionally, postgraduate students demonstrated poor performance in statistical literacy.

To date, there is limited research measuring research literacy among Malaysian postgraduate students and identifying the factors that might contribute to it (Yusof, 2019; Yusof et al., 2019). Therefore, this study aims to investigate to what extent experiences such as the frequency of daily reading, the number of articles read monthly, the number of formal courses attended, the number of research presentations, and the number of research publications influence the research literacy of postgraduate students in education. Additionally, this study seeks to identify the most significant contributor to research literacy among these factors.

LITERATURE REVIEW

CONCEPT OF RESEARCH LITERACY

The definition of literacy is continually evolving, and there is no consensual agreement among scholars regarding its exact meaning. Definitions of literacy often vary depending on the values and rationales of specific subjects, such as mathematics or computer literacy (Jablonka, 2003) or multidimensional concepts (Brody et al., 2012; Powell, 2016). Research literacy, being a relatively new term, is similarly evolving, with limited studies available on the topic. According to Besseah et al. (2017), research literacy is "currently generic and needs to be interpreted in relation to one's disciplinary practices and assessment demands" (p. 558).

In the context of medical research development, Senders et al. (2014) define research literacy as "the ability to access, interpret, and critically evaluate medical literature" (p. 1). They suggest that research literacy is essential for practitioners to make informed decisions based on research evidence regarding their patients. They also propose that research literacy involves a set of skills that can be systematically taught, practiced, and refined to help practitioners effectively utilize available medical literature. According to Senders et al. (2014), a research-literate practitioner should (i) be familiar with the abundance of available research databases, (ii) be able to search and retrieve literature, (iii) understand

the purpose of the research and its questions, and (iv) determine whether the research design and analysis are appropriate for answering the questions.

Olola et al. (2016) simply define research literacy as familiarity with research concepts, including the ability to differentiate between quantitative and qualitative research and knowledge of research designs and processes. Powell (2016) defines research literacy as "the capacity to obtain, process, and understand basic information needed to make informed decisions about research participation" (p. vii). Powell is particularly concerned with racial and ethnic minorities who are underrepresented in health-related research due to a lack of understanding of the research process, especially regarding informed consent.

In the educational research context, Shank and Brown (2007) associate research literacy with critical reading, defining it as the "ability to read many types of research reports and articles and benefit in a variety of ways from the practice" (p. 22). Similar to Senders et al. (2014), they suggest that research literacy can be developed through practice and experience. They emphasize that familiarity with the terms and concepts of educational research strengthens the ability to read and understand research.

Groß Ophoff et al. (2017) define research literacy as "the ability to purposefully access, comprehend, and reflect on scientific information, as well as apply the resulting conclusions to educational decisions" (p. 39). They conceptualize research literacy based on five steps of the research cycle: "(i) posing answerable questions, (ii) searching for relevant information, (iii) reading and critically appraising evidence, (iv) evaluating, and (v) applying conclusions according to educational needs" (p. 40).

Beaudry and Miller (2016) define research literacy as "the ability to locate, understand, discuss, and evaluate different types of research; to communicate accurately about them; and to use findings for academic and professional purposes" (p. 4). They argue that research literacy should be integrated with other literacies, empowering educational practitioners to access, understand, and apply research findings to their academic and professional development. They map research literacy as an integration of four components: (i) information literacy, (ii) verbal literacy, (iii) numerical literacy, and (iv) visual literacy.

Based on the definitions discussed, two common themes emerge: (i) the ability to search and locate articles, and (ii) the ability to interpret research articles. These abilities enable research consumers to make informed decisions about their practices, whether for professional or academic purposes. Therefore, in this paper, research literacy is defined as the ability to identify, access, interpret, and evaluate research articles, encompassing multidimensional components such as information literacy, knowledge of research methodology, and statistical literacy.

Theoretical Underpinning

Vygotsky's (1978) concept of the Zone of Proximal Development (ZPD) posits that the ZPD represents the difference between what learners can do independently and what they can achieve with guidance from a More Knowledgeable Other (MKO). Vygotsky's ZPD emphasizes that learners can reach higher levels of understanding and skill with the support of an MKO, such as a teacher or peer, than they would be able to achieve on their own. Furthermore, ZPD is always changing. This means that as individuals learn, practice, and gain experience, their ZPD shifts, reflecting ongoing cognitive development (Doolittle, 1996, 1997).

Figure 1 illustrates Vygotsky's concept of the ZPD and how the need for assistance changes during the learning process (Doolittle, 1996, 1997). In the early stages of learning, students require much assistance to perform tasks, as their independent performance is low. As they progress and gain more knowledge, they move through the ZPD, needing less assistance while their ability to perform tasks independently increases. By the late stages of learning, students can perform tasks with little to no assistance, having internalized the necessary skills and knowledge. This progression emphasizes the importance of guided learning and gradually reducing support as learners develop their abilities.

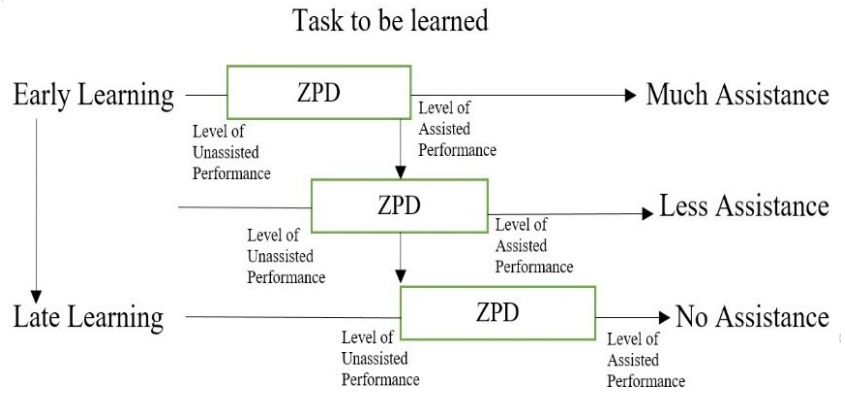

Figure 1. Vygotsky's Zone of Proximal Development (based on Doolittle, 1996)

This dynamic nature of the ZPD aligns with the development of research literacy, which can be continuously honed through repeated practice and varied experiences (Senders et al., 2014; Shank & Brown, 2007). As postgraduate students engage in research activities, guided learning, and collaborative projects, their research literacy skills expand, allowing them to tackle increasingly complex research tasks. Reis-Jorge (2007) further argued that teachers' perceptions and understanding of research progressively improve through learning experiences, demonstrating that teachers improve more effectively when they operate within their ZPD with appropriate guidance. Independent reading alone may not significantly improve research literacy until students immerse themselves in research activities. This immersion provides the necessary guidance and support, enabling students to fully develop their research skills within their ZPD. This study, therefore, examines the impact of three learning modes – reading, formal courses, and immersion in research – on research literacy.

The first potential factor influencing research literacy is reading. Erdem (2015) highlighted the close relationship between reading and critical literacy. This idea is reinforced by Round and Campbell (2013), who found that frequent exposure to primary articles, coupled with guided reading, enhances students' attitudes and confidence in data interpretation. Olola et al. (2016) also proposed that the quantity of research articles read could impact research literacy. Lie et al. (2016) discovered a negative correlation between the difficulty experienced in reading research articles and the number of articles read. Similarly, Hubbard and Dunbar (2017) indicated that perceptions of research articles might be influenced by the volume of articles read. While they did not directly explore the link between reading volume and comprehension, they suggested that students at research-intensive universities, who likely read a substantial number of articles, would become more familiar with research articles through this increased exposure.

The second potential factor affecting research literacy is participation in formal courses. These are categorized as research interventions by Brody et al. (2012), Olola et al. (2016), and Powell (2016) or as mandatory courses for research students, as noted by Groß Ophoff et al. (2015, 2017). However, the outcomes reported in these studies are inconsistent, likely due to variations in how research literacy is defined and the focus of the courses or interventions. For example, some studies, such as those by Brody et al. (2012), Olola et al. (2016), and Powell (2016), concentrate mainly on research methods knowledge, aiming to enhance understanding in this specific area. On the other hand, Groß Ophoff et al. (2017) adopt a broader definition of research literacy, including information literacy, statistical literacy, and evidence-based reasoning. Yet, their post-course results primarily show significant improvements only in information literacy. This discrepancy might be attributed to a general tendency within faculties to favor courses that emphasize information literacy and qualitative methodologies.

The third potential factor is immersion in research. As delineated by Reis-Jorge (2007), immersion in research encompasses the final submission of a small-scale research project, which can take various forms. This might include a materials design project with a justification or academic defense, the creation of a publishable article or a series of such articles or conducting a seminar akin to what students might typically be asked to perform. Lundwall et al. (2019) emphasize that participation in activities like research publications reflects students' interest in research, along with their persistence and writing skills. Naragund et al. (2015) further support this, noting that activities such as research presentations and publications enhance students' confidence, communication, presentation, and article organization skills. Similarly, Walkington (2015) argues that participating in research conferences and publications is crucial for student progression, as it provides opportunities for feedback exchange and learning.

In the context of research publications, the process of giving and receiving feedback plays a vital role in enhancing the quality and rigor of academic work. The feedback mechanism is particularly pronounced in the peer-review process, which is a central and critical component of scholarly publishing. Importantly, this process also serves as a learning opportunity for researchers, particularly emerging scholars, to understand the standards and expectations of high-quality academic work (Campbell et al., 2021). Interactions such as giving and receiving feedback from others on their research outputs provide an additional learning opportunity (Kneale et al., 2016). From the study, students valued feedback from other academicians and participants as it influenced the progression of their current research. In other words, if students do not appreciate or consider the feedback provided by others in the academic and research community, it may lead to stagnation or a slower pace of progress in their research projects. Other benefits of research publications and conferences include enhancing students' learning, increasing retention, and providing adequate career preparation (Campbell et al., 2021).

This study addresses gaps in previous research on factors contributing to research literacy by focusing on three specific learning experiences: reading, formal courses, and immersion in research. In the reading category, we measure the frequency of daily article readings and the total number of articles read per month. Since research literacy in this study encompasses information literacy, knowledge of research methodology, and statistical literacy, we include all courses pertinent to these domains, such as academic reading courses, information literacy courses, research methodology courses, and data analysis or statistics courses. For the immersion in research factor, we consider both the number of research presentations and publications by the students. Additionally, this study fills a gap in the existing literature, as there are limited studies assessing research literacy and examining its contributing factors among postgraduate research students in the field of education, in contrast to the more extensively researched medical and health fields (Jakubec & Astle, 2017; Senders et al., 2014).

RESEARCH METHODOLOGY

RESEARCH OVERVIEW

This study primarily used a quantitative survey design, employing the Research Literacy Test (RLT) to answer the following research questions:

RQ1: To what extent do the frequency of daily reading, the number of articles read monthly, the number of formal courses attended, the number of research presentations, and the number of research publications influence the research literacy of postgraduate students in education?

RQ2: Which factors contribute the most to the research literacy of postgraduate students in education?

RESEARCH INSTRUMENT

The research instrument used in this study is the Research Literacy Test (RLT), which is divided into two sections. Section 1 consists of 40 multiple-choice questions (Table 1), and Section 2 assesses the factors contributing to research literacy (Table 2).

The RLT questions were validated by five experts in the education field who have experience supervising postgraduate students. Furthermore, a total of 72 respondents were involved in the pilot study, 38 of whom were master students and 34 of them were doctoral students. The Cronbach's alpha value is 0.86 (good) (Cronbach, 1951).

Table 1. Research literacy components

Cognitive level	Educational research literacy components			No. of items	Total items
	Information literacy	Research methodology	Statistical literacy		
Remember	2 (1,2)	1 (19)		3	15
Understand	3 (6,7,8)	5 (12,18,21,23,25)	4 (28,32,33,35)	12	
Apply	4 (3,4,9,10)	4 (13,14,15,16)	3 (27,34,37)	11	17
Analyze	1 (5)	3 (17,22,24)	2 (29,38)	6	
Evaluate		2 (11,20)	4 (26,31,39,40)	6	8
Create			2 (30, 36)	2	
No of Items	10	15	15	**40**	

As shown in Table 1, the Research Literacy Test (RLT) consists of 40 questions, with 10 items focused on information literacy, 15 items on research methodology knowledge, and 15 items on statistical literacy. The questions range from the remembering level to the creating level.

The information literacy questions assess the ability to access and locate research articles, recognize different types of academic documents (such as references and citations), and search for relevant information. The research methodology questions evaluate the understanding of the elements of quantitative and qualitative research articles, basic data-gathering tools and procedures, and methods used, as well as the basic types of quantitative and qualitative research articles. The statistical literacy questions assess familiarity with basic statistical concepts and terminologies, understanding of statistical tests (including correlation, t-test, ANOVA, and regression), and the ability to interpret statistical analyses based on data and charts or graphs.

Table 2. Learning experience components

Learning experience construct	Items
Formal research courses	Have you attended any research methodologies courses? Yes [ ] No [ ] If yes, how many classes have you attended?
	Have you attended any statistics (data analysis) courses? Yes [ ] No [ ] If yes, how many classes have you attended?

Learning experience construct	Items
	Have you attended any academic reading courses? (e.g., how to read research articles class, how to evaluate research articles) Yes [ ] No [ ] If yes, how many classes have you attended?
	Have you attended any information literacy courses? (e.g., how to search and retrieve research articles) Yes [ ] No [ ] If yes, how many classes have you attended?
Immersion in research	Have you presented your research at international conferences? Yes [ ] No [ ] If yes, in how many conferences have you participated?
	Have you presented your research at national conferences? Yes [ ] No [ ] If yes, in how many conferences have you participated?
	Have you presented your research on other platforms? (e.g., 3 minutes thesis competition; proposal defense) Yes [ ] No [ ] If yes, in how many activities have you participated?
	Have you published your research in indexed journals? (e.g., Scopus, WOS, ERA) Yes [ ] No [ ] If yes, how many papers have been published?
	Have you published your research in a non-indexed journal? Yes [ ] No [ ] If yes, how many papers have been published?
	Have you published your research on other platforms? (e.g., proceeding, technical report, book chapter) Yes [ ] No [ ] If yes, how many papers have been published?
Reading intensity	How frequently do you read research articles a day? Never [ ] Rarely [ ] Occasionally [ ] Frequently [ ] Very frequent [ ]
	How many research articles have you read monthly? None [ ] 1-3 articles [ ] 4-6 articles [ ] 7-9 articles [ ] More than 10 [ ]
Postgraduate level	Masters [ ] Doctoral [ ]

The second section of the Research Literacy Test (RLT) is designed to measure independent variables, specifically focusing on learning experiences. These are evaluated based on three primary constructs, as detailed in Table 2. The formal research course components include research methodology, statistical/data analysis, information literacy, and academic reading courses, which were selected for their relevance to research literacy. The immersion in the research component encompasses research presentations and research publications. The reading intensity component includes the frequency of daily reading and the number of articles read monthly. Additionally, for demographic purposes, the RLT requires students to specify whether they are master's or doctoral students.

POPULATION AND SAMPLING

The main population for this study is postgraduate research students from five research universities (RU) in the education field. The rationale for choosing RU is that these universities focus more on research activities, and their education is based on research and development (Malaysian Ministry of Higher Education, MOHE). Those five education-based faculties include the Faculty of Education, Universiti Malaya; School of Educational Studies, Universiti Sains Malaysia; Faculty of Education, Universiti Kebangsaan Malaysia; School of Education, Universiti Teknologi Malaysia; and Faculty of Educational Studies, Universiti Putra Malaysia.

To ensure ethical conduct, a list of active postgraduate students (both master's and PhD) was requested from each faculty. However, some faculties were reluctant to provide a complete list, making it impossible to establish a comprehensive sampling frame. Consequently, due to the unknown population size, random sampling could not be employed, and the sample size could not be determined using conventional methods such as the Krejcie and Morgan (1970) sample size table.

The sampling technique used in this study was stratified purposeful sampling. The purpose of stratification is to have a relatively homogenous sample in each stratum (Patton, 2002). The stratification of respondents was first based on the faculty of education in five research universities, followed by the postgraduate level, which included doctoral and master's students. The number of samples for the field study was determined using G*Power 3.1 software. G*Power is an analysis software that computes adequate sample size for any statistical test (Faul et al., 2009). The determination of the sample size is based on three power parameters, that is, (i) power value, (1-β), (ii) alpha level, (α), (iii) effect size, (f^2), and the number of predictors.

The summary of the sample size for running multiple regression, as generated by G*Power, is shown in Figure 2. Using α = .05, (1- β) = .95 and f^2 = .10, and the number of predictors = 5, sample size required is 204. As stratified purposive sampling was used, the sample selection was based on the availability of students to sit for the test, whether online or face-to-face. To ensure a balanced representation between master's and doctoral students, the number of participants from each group was carefully managed to avoid a significant gap. However, the data collection did not cease at 204 respondents. To account for potential missing data or insufficiently completed responses, an additional ±15% of respondents were included. Consequently, after removing outliers, the total number of valid respondents was 236, as shown in Table 3.

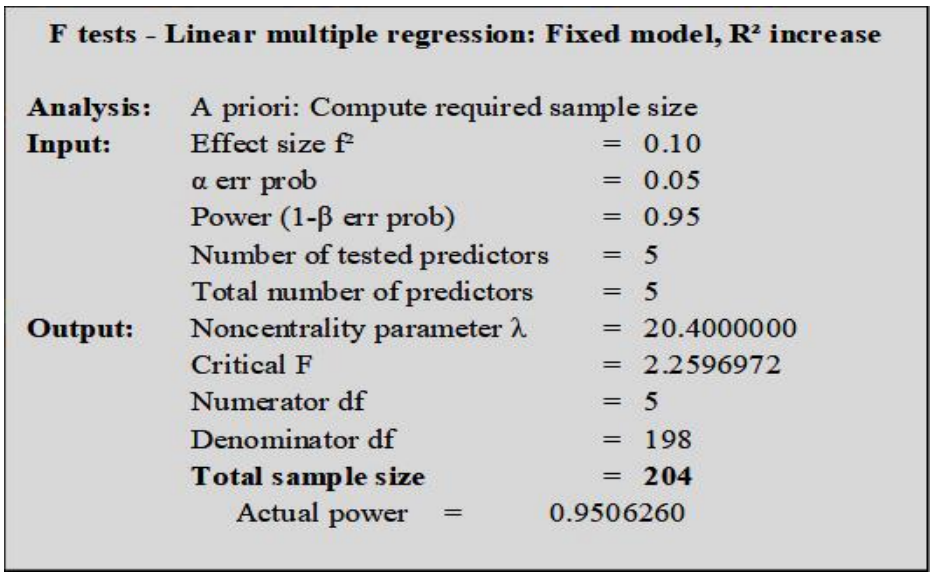

Figure 2. Required sample for multiple regression

Table 3. Sample size for field study

Universities	Faculty sample size	Postgraduate level sample size	
		Doctoral	Masters
Universiti Malaya	39	23	16
Universiti Sains Malaysia	37	21	16
Universiti Kebangsaan Malaysia	55	25	30
Universiti Teknologi Malaysia	55	31	24
Universiti Putra Malaysia	50	26	24
Total sample size	236	126	110

Initially, all data were to be collected in a specific setting since the RLT is a test. However, due to limitations such as participants' and lecturers' time, different faculties proposed and allowed various methods for administering the test. Some lecturers permitted the test to be administered during their class, while other data were collected online. There was no time limit for completing the test, and it was assumed that all students were honest when taking it. Participation in the test was voluntary, and students were not compelled to participate, ensuring that ethical considerations were met.

Data Analysis

There are five learning experience variables in this study (Table 4). First, reading frequency (daily) and the number of articles read (monthly) were both ordinal data. The number of courses attended, research presentations, and research publications were initially continuous data (frequency); however, they were converted into ordinal data for this analysis. This study employed standard multiple regression, treating all predictor variables equally by inserting them into the analysis simultaneously, thereby estimating only one regression equation (Warner, 2012). For the dependent variable, instead of using the number of correct answers, the research literacy score was summed based on the probability scores, which were calculated using each item's difficulty logit and the individual's ability logit.

Table 4. Data for multiple regression analysis

Learning experience	Measured in survey	Measured in analysis
Reading frequency daily	Ranked	Ranked: Never, Rarely, Occasionally, Frequently, Very Frequent
Number of articles read monthly	Ranked	Ranked: None, 1 to 3 articles, 4 to 6 articles, 7 to 9 articles, more than 10 articles
Number of courses attended	Frequency	Ranked: Never, 1 to 4, 5 to 8, 9 to 12, 13 to 16, and 17 to 20
Number of research presentations	Frequency	Ranked: Never, 1 to 3, 4 to 6, and 7 to 9
Number of research publications	Frequency	Ranked:S Never, 1 to 2, 3 to 4, and 5 to 6

Prior to evaluating regression results, assumptions analyses such as linearity, multicollinearity, normality, and outliers were performed. The first assumption tested was non-linearity. Non-linearity testing examines whether the relationship between the independent variables and the dependent variable is linear or curvilinear. The bivariate plot of standardized predicted (ZPRED) values against standardized residual (ZRESID) values, with the addition of the Loess curve, is shown in Figure 3. The Loess curve indicates that the relationship between ZPRED and ZRESID is roughly linear, around zero. Thus, the linearity assumption is met.

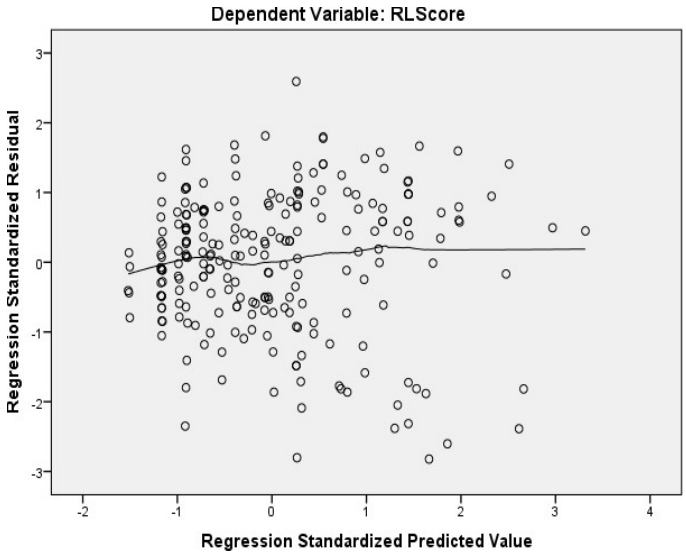

Figure 3. Scatterplot

The second assumption tested was homoscedasticity. Similar to linearity testing, homoscedasticity can be examined using the same scatterplot shown in Figure 3. Based on the scatterplot, there is no sign of heteroscedasticity, such as a bowtie or fan shape of scattered residuals. Therefore, the homoscedasticity assumption is met.

Normality is the assumption that the residuals are normally distributed and can be checked by a visual examination of the normal P-P plot, as shown in Figure 4. The plot compares the observed cumulative standardized residual and the expected cumulative of the normal distribution. The plot shows that observations clustered around the horizontal line indicate that the distribution is normal.

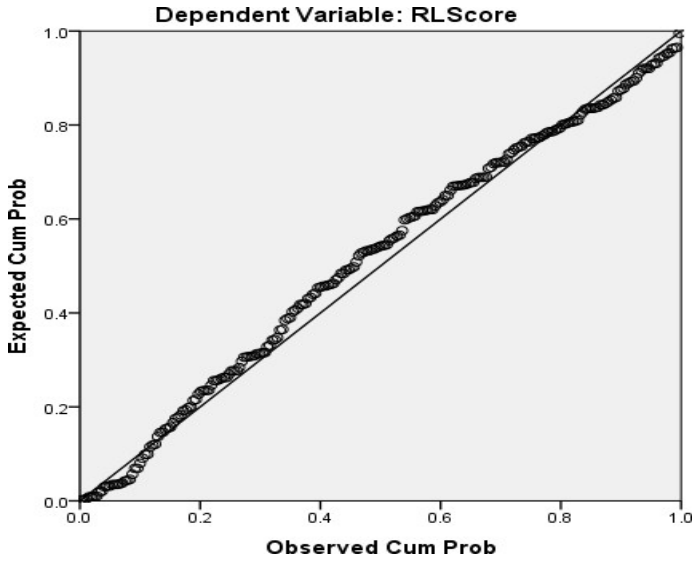

Figure 4. Normal P-P plot of regression standardized residual

The next assumption is multicollinearity, which refers to the correlation between variables within a study. The correlation between independent variables should not exceed 0.70 (Pallant, 2007). Pearson's correlation coefficients for all variables of the study are presented in Table 5. The results indicate that none of the independent variables have a correlation value greater than 0.70 with any other independent variable.

Table 5. Pearson's correlation

Variables	Research literacy score	Reading frequency/ day	Number of articles monthly	Total research presented	Total research published	Total course attended
Research literacy score	1.000	.294	.373	.453	.405	.514
Reading frequency /day	.294	1.000	.630	.335	.235	.339
Number of articles read monthly	.373	.630	1.000	.385	.265	.358
Total course Attended	.514	.339	.358	.548	.631	1.000
Total research presented	.453	.335	.385	1.000	.508	.548
Total research published	.405	.235	.265	.508	1.000	.631

The second means of checking collinearity is by examining tolerance and variance inflation factors (VIF). The tolerance value should not be less than 0.10, and the VIF value should not exceed 10 (Pallant, 2007). As shown in Table 6, each variable shows an acceptable value for both tolerance and VIF. Thus, based on an examination of correlation and collinearity statistics, it can be said that all variables are free from multicollinearity.

Table 6. Collinearity statistics

Variables	Collinearity statistics	
	Tolerance	VIF
Reading frequency/day	.586	1.707
Number of articles read monthly	.564	1.773
Total course attended	.511	1.955
Total research presented	.617	1.621
Total research published	.564	1.772

The fourth assumption tested was the presence of outliers. Outliers were identified using the Mahalanobis Distance value and Cook's Distance value. According to Pallant (2007), the Mahalanobis Distance value should not exceed a critical value based on the number of independent variables. In this case, with five independent variables, the critical value is 20.52. As shown in Table 7, the maximum Mahalanobis Distance value is 24.531, which slightly exceeds the critical value of 20.52.

Table 7. Residual statistics

Residual statistics				
	Minimum	Maximum	Mean	Std. deviation
Mahal. Distance	1.083	24.531	4.979	3.651
Cook's Distance	.000	.154	.006	.015

After reviewing the Mahalanobis values, respondent 156 was identified with a maximum value of 24.531. However, respondent 156 will not be omitted from further analysis, as their Cook's Distance

value is not larger than 1. According to Tabachnick and Fidell (2019), a Cook's Distance value exceeding 1 indicates a significant problem, warranting the removal of the case. In this analysis, the Cook's Distance value for respondent 156 is 0.154, suggesting no major problem. Additionally, the Casewise Diagnostics table, which appears only if there is an extremely unusual case, was not produced for this analysis, indicating no cases were extreme enough to influence the regression results significantly. Therefore, after the assumptions analysis, none of the cases was dropped, and the final sample size remained at N = 236.

RESULTS

DEMOGRAPHICS

The largest participation came from Universiti Kebangsaan Malaysia and Universiti Teknologi Malaysia, each contributing 23.3% (n = 55) of the respondents. This was followed by Universiti Putra Malaysia with 21.2% (n = 50) of the respondents. Universiti Malaya and Universiti Sains Malaysia had the least participation, with 16.5% (n = 39) and 15.7% (n = 37) of respondents, respectively. The study included both doctoral students (n = 126, 53.4%) and master's students (n = 110, 46.6%).

Influence of reading, attending formal courses, presentations, and publications on research literacy in postgraduate education students

The influence of the variables was measured using multiple regression analysis in SPSS. The overall regression (Table 8), including all of the predictor variables, was statistically significant with R = .58, R^2 = .33, adjusted R^2 = .32, F(5, 230) = 23.07, p < .05. Research literacy scores were significantly influenced by these five predictor variables, with approximately 33% of the variance in research literacy scores accounted for by the regression.

Table 8. Model summary and ANOVA

Model		R	R^2	Adjusted R^2	Std. error of the estimate
1		0.5786[a]	0.334	0.320	5.174
		Df	F	Sig	
	Regression	5	23.071	.000[a]	
	Residual	230			
	Total	235			

a. Predictors: (Constant), total course attend, total presented, total published, reading frequency, articles read monthly

Main contributors to research literacy scores

The further output shows the contributions of each predictor where the *t* ratios for each regression slope were examined. Based on Table 9, three of the five predictors were significantly predictive of research literacy scores: the total number of courses attended, t(230) = 2.62, p < .05; the total number of papers published, t(230) = 4.05, p < .05; and the number of articles read monthly, t(230) = 2.40, p < .05. The other two predictors, reading frequency and research presentations, were not significantly predictive of research literacy scores in this regression.

Among the three significant predictors, the total number of papers published was the strongest predictor (β = .304), followed by the total number of courses attended (β = .180) and the number of articles read monthly (β = .172). The proportions of variance uniquely explained by each of these three predictors (sr^2 unique) were: sr^2 = .04 for the total number of papers published, sr^2 = .02 for the total number of courses attended, and sr^2 = .02 for the number of articles read monthly. Therefore, in this sample and context, the total number of articles published was the strongest predictor of research

literacy scores, followed by the total number of courses attended and the number of articles read monthly.

Table 9. Coefficients of multiple regression

Coefficients									
Model		Unstandardized coefficients		Standardized coefficients	t	Sig.	Correlations		
		B	STD Error	BETA			Zero-order	Partial	Part
1	(CONSTANT)	12.928	.913		14.155	.000			
	ReadDaily	.030	.454	.05	.067	.947	.294	.004	.004
	ArtReadMontlhy	.929	.387	.172	2.401	.017	.373	.156	.129
	CourseAttended	1.259	.480	.180	2.624	.009	.453	.171	.141
	ResearchPresented	.672	.638	.075	1.054	.293	.405	.069	.057
	ResearchPublished	2.340	.578	.304	4.046	.000	.514	.258	.218

DISCUSSION

Postgraduate research students often find themselves, as described by Garner et al. (2009), "flying in the dark," as they must acquire all the necessary skills on their own during the research process. This challenge has been highlighted in previous studies by Hubbard and Dunbar (2017) and Conway (2011). Similar issues have also been highlighted by Jeyaraj (2018) and Yusof (2019) in the context of Malaysian postgraduate students. Despite their advanced level, postgraduate students still require some assistance, as cognitive development at any given age, including adult learners, is limited to a particular range (Vygotsky, 1978). Hence, this study attempted to identify whether five independent variables (frequency of daily reading, number of articles read monthly, formal research courses attended, and presenting and publishing articles) can predict the dependent variable (research literacy).

INFLUENCE OF READING ON RESEARCH LITERACY IN POSTGRADUATE EDUCATION STUDENTS

Reading has long been associated with literacy and is recognized as a significant predictor in literature (Hubbard & Dunbar, 2017; Lie et al., 2016). In this study, the reading variable encompassed both the frequency of reading and the number of articles read monthly. Shank and Brown (2007) assert that repeated exposure to research articles enhances research literacy among readers. This perspective is corroborated by Round and Campbell (2013), who found that frequent exposure to research articles, combined with guided reading, can improve students' attitudes and confidence in their ability to interpret data. Furthermore, Yusof (2019) highlighted the importance of critical reading, identifying it as a foundational element of research literacy.

In this study, while the frequency of daily reading of research articles was found to be a predictor of research literacy, it was not a significant predictor. Conversely, the number of articles read monthly was identified as a significant factor. This distinction can be attributed to the cumulative knowledge and depth gained from reading multiple articles over a month, leading to better retention and a more comprehensive understanding of research concepts.

This aligns with Vygotsky's idea that learning occurs most effectively when learners are exposed to challenging material with appropriate support. By reading multiple articles over a month, learners can build upon their existing knowledge, gradually moving through their ZPD as they acquire new skills and understandings (Doolittle, 1996, 1997). Although the direct presence of an MKO is not always necessary, the structure and content of research articles themselves can serve as a form of guidance.

Repeated and varied exposure to complex texts over a month can help students internalize advanced research concepts, much like an MKO would guide them through their ZPD.

One of the ways to increase research literacy is through meaningful engagement with research articles, regardless of the frequency of daily reading. Engaging with research articles involves critically questioning the research claims made by the authors (Wallace & Wray, 2021). By posing questions about the content, readers are likely to find some answers within the text itself. However, some questions may remain unanswered, prompting readers to conduct further research or consider the potential risks of accepting the findings without addressing these questions (Eriksen, 2022; Wallace & Wray, 2021).

This study also acknowledges limitations in how the scale is used for reading variables. The scale for the number of articles read monthly (None, 1 to 3 Articles, 4 to 6 Articles, 7 to 9 Articles, more than 10 Articles) provides a clear and measurable indication of reading volume, which directly correlates with research literacy. In contrast, the scale for daily reading frequency (Never, Rarely, Occasionally, Frequently, Very Frequently) is more subjective and might not capture the actual volume and depth of reading as effectively as the monthly measure.

Future research should consider refining the scales used for measuring reading variables to better capture the volume and depth of reading. One approach could be to combine both daily and monthly reading measures to provide a more comprehensive assessment. Additionally, incorporating qualitative measures, such as reading logs or detailed surveys, could help capture the nature and quality of engagement with research articles. By using a combination of quantitative and qualitative measures, future studies can gain a more nuanced understanding of how reading behaviors influence research literacy.

Influence of Attending Formal Courses on Research Literacy in Postgraduate Education Students

Research intervention or participation in formal courses was measured as the second factor. Previous studies, such as those by Brody et al. (2012), Olola et al. (2016), and Groß Ophoff et al. (2017), have reported varying results. These variations are likely due to differences in the definitions of research literacy and the specific focus of the courses or interventions. Nevertheless, this study attempted to reduce the gap by including related courses such as research methodology, data analysis, critical academic reading, and information literacy to align with our definition of research literacy.

This study demonstrated that the number of formal courses attended by participants significantly enhances their research literacy. It can be assumed that when students enroll in courses related to research methods, data analysis, or their specific field of study, they receive systematic instruction and guidance, thereby improving their understanding of research concepts and practices. Additionally, attending formal courses offers opportunities for students to interact with peers and experts in their field, leading to discussions, collaborations, and exposure to diverse perspectives. These interactions contribute to a richer research literacy (Long et al., 2014). Therefore, it is crucial to enhance academic ability and practice in critically teaching these research courses to postgraduate students.

Vygotsky (1978) emphasized the importance of structured learning activities and formal courses in cognitive development. He posited that engaging in relevant and challenging activities within a structured educational framework, guided by knowledgeable instructors, facilitates significant cognitive growth (Doolittle, 1996, 1997). These formal courses provide the scaffolding necessary for students to progress through their ZPD, enabling them to develop new skills and knowledge that they might not be able to achieve independently. By participating in these structured learning experiences, students can attain higher levels of understanding and competency in research literacy.

However, this study has limitations regarding how interaction and engagement occur during classes. The quality and effectiveness of interactions between students and instructors and among peers can vary significantly. Factors such as class size, teaching methods, and the level of instructor engagement

can influence how well students absorb and apply the material. Additionally, the extent to which students actively participate and engage in discussions can impact their learning outcomes. Hence, future research should consider examining these aspects more closely, potentially through qualitative methods such as classroom observations or interviews with students and instructors, to better understand the dynamics of interaction and engagement in formal courses and their impact on research literacy.

Influence of Research Presentation on Research Literacy in Postgraduate Education Students

Walkington (2015) suggested that research presentations in conferences and research publications are opportunities to allow student progression. In a study by Naragund et al. (2015), presentations and publications are highlighted as pedagogical activities that can enhance research proficiency alongside research method workshops and industry visits. In the context of this study, it is assumed that interaction occurs during the question-and-answer sessions following presentations. Research presentations, particularly those given during research defenses or at conferences, serve as opportunities for students to receive feedback from the professional community (Corwin et al., 2018).

During research presentations, students are often pushed to the edge of their current knowledge and skills, requiring them to articulate and defend their research. This process places them within their ZPD, where learning is most effective (Doolittle, 1996, 1997). The feedback provided by peers, instructors, and experts (the MKOs) during these presentations serves as the scaffolding that Vygotsky emphasized. This guidance helps students to refine their understanding, correct misconceptions, and improve their research methodologies. The interaction with MKOs allows students to develop new skills and knowledge that they might not achieve independently, thereby facilitating significant cognitive growth and enhancing their research literacy.

However, this study found that presentations were not a significant contributor to research literacy. In this study, presentations were measured based on the number of presentations in which students participated. While feedback is generally recognized as having a significant impact on student learning, its effectiveness depends on students' ability to utilize and make sense of the feedback (Henderson et al., 2021; Winstone & Boud, 2022). This study did not address the extent to which students could effectively process and apply the feedback received, which could explain why presentations did not emerge as a significant factor in enhancing research literacy.

Future research should explore the quality and utilization of feedback received during presentations. It would be beneficial to investigate how students interpret and apply the feedback to their research work. Qualitative methods such as interviews, focus groups, and detailed case studies could provide deeper insights into these processes. Additionally, examining the role of feedback training for students could help determine whether structured guidance on how to effectively use feedback enhances research literacy. Furthermore, future studies could also explore other dimensions of presentations, such as the content and delivery quality, audience engagement, and the nature of the questions and feedback received. This comprehensive approach could better illuminate the impact of research presentations on students' research literacy development.

Influence of Research Publication on Research Literacy in Postgraduate Education Students

As research and writing are difficult, Lundwall et al. (2019) suggested that if students have published their articles, it shows that students, to some extent, have mastered data collection and research methodology. Similarly, Reis-Jorge (2007) suggested that after research presentation and publications, positive improvement can be observed from his respondents: (1) they become more literate and can understand professional literature, and (2) the experience equips respondents with academic skills.

Publishing research in reputable journals allows researchers to gain recognition and validation from their peers, which can boost their confidence in their research abilities (Lundwall et al., 2019; Naragund et al., 2015). Moreover, engaging with the peer review process and receiving audience feedback helps postgraduate students develop resilience and confidence in handling criticism constructively. In order to get published, students often use the feedback they receive to make necessary changes and improvements to their work.

Not surprisingly, the results of this study showed that the total number of research publications was the strongest contributor to research literacy scores, followed by the total number of courses attended and the number of articles read monthly. While attending courses and reading articles are undoubtedly important components of research literacy, the number of research publications remains the most influential contributor due to its depth, originality, and ability to foster critical thinking and specialization.

This process aligns with Vygotsky's concept of the ZPD, as described by Doolittle (1997). Vygotsky emphasized that learning is most effective when students engage in complex, real-world tasks with appropriate guidance. Therefore, Doolittle (1997) specifically proposes instead of teaching research design in isolated components, assigning comprehensive research projects helps students experience the entire research process, including crucial and authentic activities like topic creation, data collection, analysis, and publication. This approach provides scaffolding, where instructors and peers act as MKO, guiding students through their ZPD. By gradually reducing assistance, students move from requiring significant guidance to performing tasks independently, thereby achieving higher levels of understanding and proficiency in research literacy.

Future Directions and Methodological Recommendations

The primary limitation of this study is its reliance on a quantitative approach. While quantitative methods provide valuable numerical data and enable statistical analysis, they may not capture the full depth and complexity of participants' experiences and perceptions, such as the interactions and engagement that occur during classes and how students use feedback. Quantitative data can miss the detailed, subjective aspects of research literacy that qualitative methods, such as interviews and focus groups, can reveal. Future research should incorporate qualitative methods to complement quantitative data. This mixed-methods approach would provide a richer, more comprehensive understanding of research literacy by capturing the subjective experiences of participants.

Additionally, the study utilized a non-random sampling method due to the privacy and confidentiality policies of some faculties, which restricted access to information such as the total number of active master's and doctoral students, their names, and email addresses. This limitation prevented the use of a random sampling frame, which affects the generalizability of the findings. As a result, the conclusions drawn from this study may not be applicable to the entire population of postgraduate research students in education at research universities. Therefore, future studies should seek to use random sampling methods to enhance the generalizability of their findings. Researchers could work on developing agreements with faculties to access necessary data while ensuring the privacy and confidentiality of participants.

Furthermore, the study focused on specific variables, such as the frequency of daily reading, the number of articles read monthly, and the number of formal courses attended, without exploring other potentially significant factors like research motivation and orientation. Future research should consider a broader range of variables, including motivation and orientation, to provide a more holistic understanding of research literacy. Including these additional factors can help identify other significant contributors to research literacy.

CONCLUSION

Based on the discussions that had been justified in this study, this study concluded that reading, formal courses, and immersion in research play an important role in research literacy, as summarized in Figure 5. First, while daily reading helps stay current with research trends, reading multiple articles monthly fosters a more comprehensive and informed approach to research literacy. It allows students to develop a broader knowledge base, explore specific areas deeply, and build critical analysis and synthesis skills. This combination of breadth and depth, achieved through monthly reading, contributes to a more holistic understanding of their field.

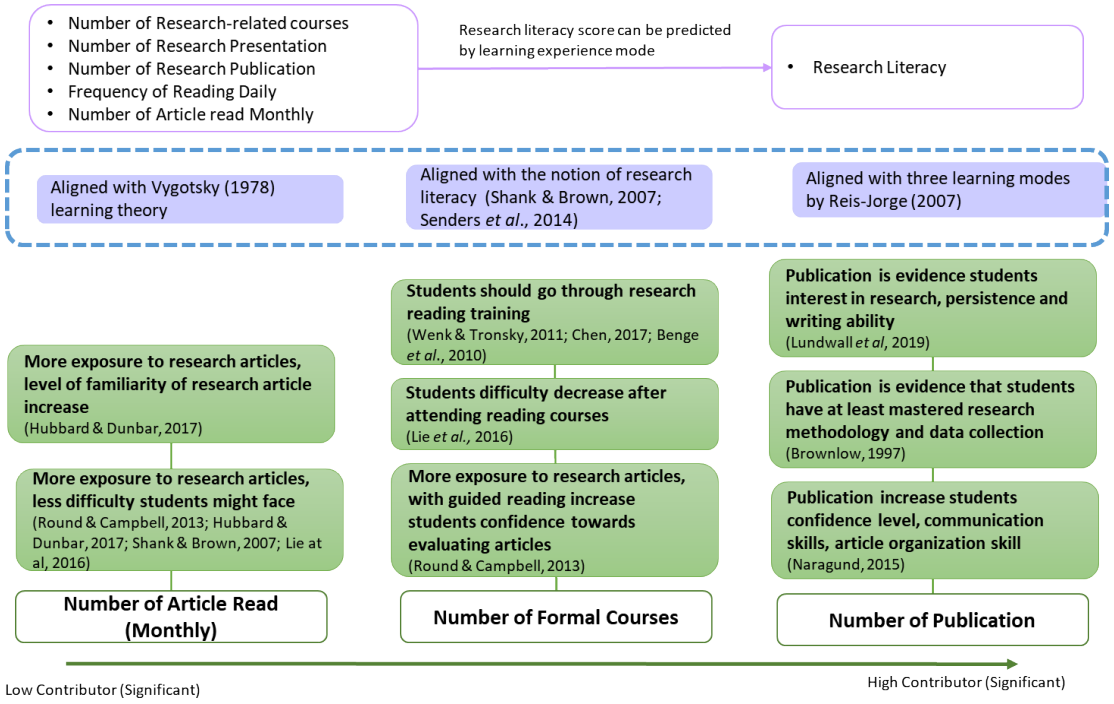

Figure 5. Summary of the contribution of learning modes on research literacy

However, for postgraduate students, it is important to adopt a systematic approach when selecting articles or books to avoid outdated or unreliable information that could hinder research literacy. Reading skills develop progressively and should be nurtured throughout postgraduate studies. Round and Campbell (2013) suggested that repeated exposure to primary articles, combined with guided reading, enhances students' attitudes and confidence in data interpretation. Therefore, research reading training is essential for improving understanding (Benge et al., 2010; Chen, 2017; Wenk & Tronsky, 2011).

Second, although reading exposes individuals to diverse ideas and perspectives, it may not provide the same depth and specificity as formal research courses. In Malaysia, most of the time, research courses are provided by universities. Additionally, workshops are available to help postgraduate students. Although some courses may have fees, they offer structured learning opportunities that facilitate social interaction and cooperative learning.

The structure of these courses, as suggested by Doolittle (1997), could be improved by assigning student teams to comprehensive research design projects that cover all phases of research. These projects should culminate in submitting their completed work for presentation and publication, providing a real-world application of their efforts. This approach not only enhances the learning experience

but also prepares students for the demands of professional research by encouraging collaboration, critical thinking, and practical application of their skills.

Lastly, Malaysia's goals to significantly increase the number of doctoral graduates and expert practitioners are ambitious and crucial for the nation's advancement. To realize these aspirations, Jeyaraj (2018) highlights the necessity of a more systematic approach to supporting research writing and researcher development in higher education. This study emphasizes the importance of structured and comprehensive support systems for postgraduate students, particularly in enhancing research literacy. By integrating formal courses, collaborative projects, and authentic experience, students can manage the complexities of academic research more effectively and contribute meaningfully to their fields. Implementing a systematic approach that includes these elements will not only help achieve Malaysia's goals but also ensure the production of high-quality research and the development of proficient researchers.

REFERENCES

Beaudry, J. F., & Miller, L. (2016). *Research literacy: A primer for understanding and using research*. Guilford Press

Benge, C. L., Onwuegbuzie, A. J., Mallette, M. H., & Burgess, M. L. (2010). Doctoral students' perceptions of barriers to reading empirical literature: A mixed analysis. *International Journal of Doctoral Studies*, *5*, 55-77. https://doi.org/10.28945/1331

Besseah, B., Achiro, D., Mhando, J., & Salau, S. A. (2017). Embedding digital and research-literacy support program into postgraduate studies curriculum: A proposed program for sub-Saharan African postgraduate schools. *Library Review*, *66*(8/9), 586-594. https://doi.org/10.1108/LR-02-2017-0012

Brody, J. L., Dalen, J., Annett, R. D., Scherer, D. G., & Turner, C. W. (2012). Conceptualizing the role of research literacy in advancing societal health. *Journal of Health Psychology*, *17*(5), 724-730. https://doi.org/10.1177/1359105311425273

Burgess, M. L., Benge, C., Onwuegbuzie, A. J., & Mallette, M. H. (2012). Doctoral students' reasons for reading empirical research articles: A mixed analysis. *Journal of Effective Teaching*, *12*(3), 5-33.

Campbell, K. M., Kaur-Walker, K., Singh, S., Braxton, M. M., Acheampong, C., White, C. D., & Tumin, D. (2021). Institutional and faculty partnerships to promote learner preparedness for health professions education. *Journal of Racial and Ethnic Health Disparities*, *8*, 1315-1321. https://doi.org/10.1007/s40615-020-00893-6

Chen, K. T.-C. (2017). An exploratory study of NNES graduate students' reading comprehension of English journal articles. *Reading in a Foreign Language*, *29*(1), 20-35. http://hdl.handle.net/10125/66726

Cleary, M., Sayers, J., Walter, G., & Nicoll, L. H. (2016). "Did I really say that?" quoting, misquoting, and misinterpretation: academic integrity in writing for publication. *Nurse Author & Editor*, *26*(2), 1-12. https://doi.org/10.1111/j.1750-4910.2016.tb00215.x

Conway, K. (2011). How prepared are students for postgraduate study? A comparison of the information literacy skills of commencing undergraduate and postgraduate information studies students at Curtin University. *Australian Academic & Research Libraries*, *42*(2), 121-135. https://doi.org/10.1080/00048623.2011.10722218

Corwin, L. A., Prunuske, A., & Seidel, S. B. (2018). Scientific presenting: using evidence-based classroom practices to deliver effective conference presentations. *CBE – Life Sciences Education*, *17*(1), 1-8. https://doi.org/10.1187/cbe.17-07-0146

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, *16*(3), 297-334. https://doi.org/10.1007/BF02310555

Doolittle, P. E. (1996). Vygotskian vocabulary development in the secondary classroom. *Reading, Exploration and Discovery*, *17*(1), 31-39.

Doolittle, P. E. (1997). Vygotsky's zone of proximal development as a theoretical foundation for cooperative learning. *Journal on Excellence in College Teaching*, *8*(1), 83-103.

Erdem, A. (2015). A research on reading habits of university students: (Sample of Ankara University and Erciyes University). *Procedia – Social and Behavioral Sciences*, *174*, 3983-3990. https://doi.org/10.1016/j.sbspro.2015.01.1145

Eriksen, A. (2022). The research literacy of professionals: reconciling evidence-based practice and practical wisdom. *Professions and Professionalism*, *12*(3), e4852. https://doi.org/10.7577/pp.4852

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2009). Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, *41*(4), 1149-1160. https://doi.org/10.3758/BRM.41.4.1149

Garner, M., Wagner, C., & Kawulich, B. (Eds.). (2009). *Teaching research methods in the social sciences*. Routledge.

Groß Ophoff, J., Schladitz, S., Leuders, J., Leuders, T., & Wirtz, M. A. (2015). Assessing the development of educational research literacy: The effect of courses on research methods in studies of educational science. *Peabody Journal of Education*, *90*(4), 560-573. https://doi.org/10.1080/0161956X.2015.1068085

Groß Ophoff, J., Schladitz, S., & Wirtz, M. (2017). Differences in research literacy in educational science depending on study program and university. *Proceedings of the 3rd International Conference on Higher Education Advances* (pp. 1193-1202). Universitat Politècnica de València. https://doi.org/10.4995/HEAD17.2017.5556

Henderson, M., Ryan, T., Boud, D., Dawson, P., Phillips, M., Molloy, E., & Mahoney, P. (2021). The usefulness of feedback. *Active Learning in Higher Education*, *22*(3), 229-243. https://doi.org/10.1177/1469787419872393

Hubbard, K. E., & Dunbar, S. D. (2017). Perceptions of scientific research literature and strategies for reading papers depend on academic career stage. *PLoS One*, *12*(12), e0189753. https://doi.org/10.1371/journal.pone.0189753

Jablonka, E. (2003). Mathematical literacy. In A. J. Bishop, M. A. Clements, C. Keitel, J. Kilpatrick, F. K. S. Leung (Eds.), *Second international handbook of mathematics education* (pp. 75-102). Springer. https://doi.org/10.1007/978-94-010-0273-8_4

Jakubec, S., & Astle, B. J. (2017). *Research literacy for health and community practice*. Canadian Scholars' Press.

Jeyaraj, J. J. (2018). It's a jungle out there: Challenges in postgraduate research writing. *GEMA Online Journal of Language Studies*, *18*(1), 22-37. https://doi.org/10.17576/gema-2018-1801-02

Jeyaraj, J. J. (2020). Academic writing needs of postgraduate research students in Malaysia: Identifying writing needs of postgraduate research students in an international branch campus. *Malaysian Journal of Learning and Instruction*, *17*(2), 1-23. https://doi.org/10.32890/mjli2020.17.2.1

Kneale, P., Edwards-Jones, A., Walkington, H., & Hill, J. (2016). Evaluating undergraduate research conferences as vehicles for novice researcher development. *International Journal for Researcher Development*, *7*(2), 159-177. https://doi.org/10.1108/IJRD-10-2015-0026

Krejcie, R. V., & Morgan, D. W. (1970). Sample size determination table. *Educational and Psychological Measurement*, *30*, 607-610. https://doi.org/10.1177/001316447003000308

Lie, R., Abdullah, C., He, W., & Tour, E. (2016). Perceived challenges in primary literature in a master's class: Effects of experience and instruction. *CBE – Life Sciences Education*, *15*(4), 1-12. https://doi.org/10.1187/cbe.15-09-0198

Long, C. R., Ackerman, D. L., Hammerschlag, R., Delagran, L., Peterson, D. H., Berlin, M., & Evans, R. L. (2014). Faculty development initiatives to advance research literacy and evidence-based practice at CAM academic institutions. *The Journal of Alternative and Complementary Medicine*, *20*(7), 563-570. https://doi.org/10.1089/acm.2013.0385

Lundwall, R. A., Hodges, C. B., & Kotter, A. D. (2019). Balancing needs in publishing with undergraduate and graduate students at doctoral degree-granting universities. *Frontiers in Psychology*, *10*, 295. https://doi.org/10.3389/fpsyg.2019.00295

Md Kasim, A., Chang, L. W., Mohamad Norpi, N., Abu Kasim, N. H., & Hashim, A. (2021). Enhancing research mechanisms and institutional processes in Malaysia: A case study of Universiti Malaya (UM). *Journal of Research Management and Governance*, *4*(1), 10-23. https://doi.org/10.22452/JRMG.vol4no1.2

Naragund, J. G., Kanakaraddi, S. G., Handur, V. S., & Sujatha, C. (2015). Enhancing research proficiency in postgraduate engineering students. *Proceedings of the 3rd International Conference on MOOCs, Innovation and Technology in Education, Amritsar, India*, 441-445. https://doi.org/10.1109/MITE.2015.7375361

Olola, C., Scott, G., Gardett, S., Downs, H., Stockman, B., & Clawson, J. (2016). Research literacy among emergency dispatchers at an emergency communication center: Developing capacity for evidence-based practice at dispatch (a pilot report). *Annals of Emergency Dispatch and Response*, *4*(1), 22-26.

Pallant, J. (2007). *SPSS survival manual* (3rd ed.). McGraw Hill.

Patton, M. Q. (2002). *Qualitative research and evaluation methods* (3rd ed.). Sage.

Powell, L. R. (2016). *Conceptualizing, understanding, and assessing research literacy in a diverse population* [Doctoral dissertation, University of Massachusetts].

Reis-Jorge, J. (2007). Teachers' conceptions of teacher-research and self- perceptions as enquiring practitioners-A longitudinal case study. *Teaching and Teacher Education*, *23*(4), 402-417. https://doi.org/10.1016/j.tate.2006.12.007

Round, J. E., & Campbell, A. M. (2013). Figure facts: Encouraging undergraduates to take a data-centered approach to reading primary literature. *CBE – Life Sciences Education*, *12*(1), 39-46. https://doi.org/10.1187/cbe.11-07-0057

Senders, A., Erlandsen, A., & Zwickey, H. (2014). The importance of research literacy developing the critical skill of interpreting medical research. *Natural Medicine Journal*, *6*(4).

Shank, G., & Brown, L. (2007). *Exploring educational research literacy*. Routledge

Shariff, N. M., Ramli, K. I., Ahmad, R., & Abidin, A. Z. (2015). Factors contributing to the timely completion of PhD at the Malaysian public higher educational institutions. *International Journal of Humanities Social Sciences and Education*, *2*(1), 256-263.

Singh, M. K. M. (2014). Challenges in academic reading and overcoming strategies in taught Master programmes: A case study of international graduate students in Malaysia. *Higher Education Studies*, *4*(4), 76. https://doi.org/10.5539/hes.v4n4p76

Tabachnick, B. G., & Fidell, L. S. (2019). *Using multivariate statistics*. Pearson.

Varnhagen, C. K., & Digdon, N. (2002). Helping students read reports of empirical research. *Teaching of Psychology*, *29*(2), 160-165. https://doi.org/10.1207/S15328023TOP2902_14

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Walkington, H. (2015). *Students as researchers: Supporting undergraduate research in the disciplines in higher education*. The Higher Education Academy.

Wallace, M., & Wray, A. (2021). *Critical reading and writing for postgraduates*. Sage.

Warner, R. C. (2012). *Applied statistics: From bivariate through multivariate techniques* (2nd ed.). Sage.

Wenk, L., & Tronsky, L. (2011). First-year students benefit from reading primary research articles. *Journal of College Science Teaching*, *40*(4), 60-67.

Winstone, N. E., & Boud, D. (2022). The need to disentangle assessment and feedback in higher education. *Studies in Higher Education*, 47(3), 656-667. https://doi.org/10.1080/03075079.2020.1779687

Yusof, I. J. (2019). *Psychometric evaluation of research literacy test for postgraduate education research students in Malaysian research universities*. [Doctoral dissertation, Universiti Teknologi Malaysia, Skudai, Johor].

Yusof, I. J., Latif, A. A., Derasid, N. A. C., & Jani, M. D. M. (2019). Research literacy level of education postgraduate research students using rasch measurement model. *International Journal of Recent Technology and Engineering*, *8*, 791-796. https://doi.org/10.35940/ijrte.C1242.1083S219

AUTHORS

Ibnatul Jalilah Yusof is a senior lecturer and the Program Coordinator for Measurement and Evaluation in Education at the School of Education, Universiti Teknologi Malaysia (UTM). She holds both a Ph.D. and a Master of Education in Measurement and Evaluation in Education. Her research interests and areas of expertise focus on educational assessment, research literacy, and quantitative research methodology.

Siti Khadijah Mohamad received a Ph.D. in educational technology from the Universiti Teknologi Malaysia. She is currently working as a senior lecturer at Universiti Sains Malaysia. Her research interests include educational technology, educational data mining, and learning analytics.

Lukman Hakim Ismail is a senior lecturer in the Department of Biomedical Science at the Faculty of Electrical Engineering, Universiti Teknologi Malaysia (UTM). He holds a master's degree in technology management and a Ph.D. in Biomedical Engineering. His areas of expertise encompass human factors engineering, healthcare management, and patient safety.