Digital Literacy in Malaysia: A Systematic Literature Review on Methodological Approaches

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ABSTRACT

Digital literacy can be simply defined as the skills required to achieve digital competence. Depending on the nature of studies, digital literacy has proliferated into many facets of skills, such as information literacy and computer literacy. We see that the studies of digital literacy are evolving in line with the predominated use of information technologies in learning, work, employability, and participation in society. Malaysia is also striving to ensure that digital literacy skills are bound to their citizens as a way of life, and thus, it is worthwhile to understand and investigate how well the research in digital literacy is progressing. This study has adapted the European Digital Competence Framework for Citizens 2.1 (DigComp) as our framework. The purpose of this study is to review digital literacy studies in Malaysia over the last decade using a systematic review in finding out the methodological approaches that are frequently used. A total of 37 studies were finally selected based on the inclusion and exclusion criteria, and they were categorized according to the year published, topics, research designs and data collection methods. The following findings were noted: (1) topics on information and data literacy, communication and collaboration, and digital content creation were frequently studied in Malaysia, (2) a quantitative research design predominated the studies by the Malaysian researchers, followed by qualitative and mixed methods (3) survey/question is the preferred data collection method for the quantitative research, and while the interview is for the qualitative research. We concluded that quantitative research studies were limited by the set answers on a survey and can be too dependent on the measurement scales. Therefore, we suggest the use of qualitative or mixed-methods designs to enrich the studies by exploring the attitudes, behaviours, and digital literacy experiences of respondents in-depth such as by using narrative inquiry and ethnography.

Keywords: Computer literacy; Digital competence; Digital literacy; Systematic review

INTRODUCTION

Since the idea of digital literacy was first conceptualised by Paul Gilster in 1997 (Bawden, 2001; Gilster, 1997), it had provided researchers with a powerful framework and design guidelines (Eshet-Alkalai, 2012). Digital literacy which is also understood as the development of competencies and skills necessary to make appropriate use of the information and communication technologies (ICTs) and Web 2.0 tools (Area & Pessoa, 2012), has attracted many theoretical approaches to the study (García-Martín & García-Sánchez, 2017) and it is no longer confined to the interaction with print text (Yang, Kuo, Ji, & McTigue, 2018).

Digital literacy as suggested by Paul Gilster in 1997 is "a person that should be able to find information online and evaluate it, where the skills of such person should include the use of emails and search engines, and the ability to evaluate a website, other online and information sources." (Leahy & Dolan, 2010). Boechler et al. (2015)

described that the digital literacy terminology inherited from computer literacy in the mid-1970s, information literacy

in 1970s and network literacy in the mid-1990s. The advancements of ICTs have eventually opened the study of digital literacy to exploring and applying different cognitive and learning theories, namely, e-literacy (Morris, 2007), digital competence (Ferrari, Punie, & Redecker, 2012) and multimodal literacies (McLoughlin, 2011). While e-literacy has a limited scope of combining traditional computer literacy skills and information literacy skills (Bawden, 2001), digital competence and multimodal literacies are much broader. Digital competence can be defined as the critical and creative use of ICT (Ala Mutka, 2011) which is seen as an attribute of information literacy (Ferrari et al., 2012). The convergence of different media elements such as print, visual images, social networking and even online games has pushed the traditional concept of digital literacy to a new complexity (McLoughlin, 2011). The proliferation of digital literacy is now evident with its multi-dimensional construct (Boechler et al., 2015; Jin, Reichert, Cagasan, de la Torre, & Law, 2020). To become digitally literate, a person needs more than just the ability to use software or to operate a digital device; it requires complex skills such as cognitive, motoric, sociological and emotional skills to operate effectively in the digital environments(Eshet-Alkalai, 2012).

Digital literacy has eventually turned into a sensational point of view among academicians and researchers for its "multi-literacies" nature, requiring a combination of skills and knowledge (Boechler et al., 2015). Ng's (2012) digital literacy framework has three intersecting dimensions; (i) technical (ii) cognitive and (iii) social-emotional dimensions. In the same year, Eshet-Alkalai (2012) revised his own model of the digital literacy framework he made in 2004 (Eshet-Alkalai, 2004) from five to six skills, namely; (a) photo-visual literacy; (b) reproduction literacy; (c) information literacy; (d) branching literacy; (e) socio-emotional literacy, and the new skill (f) real-time literacy. When "extending" to digital competence skills, more aspects can be mentioned. Ferrari et al., (2012) have summarised digital competence into seven areas that include information management, collaboration, communication and sharing, creation of content and knowledge, ethics and responsibility, evaluation and problem-solving, and technical operations. Further, the European Digital Competence Framework for Citizens 2.1 (DigComp) has outlined five competence areas for citizens that aims to support digital competencies as illustrated in Table 1 below (Carretero, Vuorikari, & Punie, 2017; Ferrari, Punie, & Brečko, 2013).

Table 1: DigComp Framework

Competence Area	Competences
1. Information and data literacy	Browsing, searching, filtering data, information, and digital content Evaluating data, information, and digital content Managing data, information, and digital content
2. Communication and collaboration	Interacting through digital technologies Sharing through digital technologies Engaging in citizenship through digital technologies Collaborating through digital technologies Netiquette Managing digital identity
3. Digital content creation	Developing digital content Integrating and re-elaborating digital content Copyright and licences Programming
4. Safety	Protecting devices Protecting personal data and privacy Protecting health and well-being Protecting the environment
5. Problem-solving	Solving technical problems Identifying needs and technological responses Creatively using digital technologies Identifying digital competence gaps

We can conclude that the concept of digital literacy is plural by nature where it can be interpreted in various ways in academic literature, policy documents and practices. Digital competence and digital literacy are concepts that are increasingly used in public discourse but how the concepts are used and how they are defined remains unclear (Spante, Hashemi, Lundin, & Algers, 2018).

In the local context, many stakeholders especially academicians have already paid great concern to digital literacy, especially these days. In academia, for example, Gie and Fenn (2019) found that there was a high digital literacy among first-year students in the private higher learning institution notably those with home Internet connections. The Covid-19 outbreak and a series of lockdowns in Malaysia (Elengoe, 2020) which have caused millions to confine themselves at home, have amplified the use of the Internet and digital tools. Out of a sudden, teachers adopted the video conferencing tools such as Zoom and Google Meet to ensure learning continues (Arumugam, 2020; Kanyakumari, 2020). Employees had been working from home since then, to balance productivity with different modes of communication technologies (Mei & Jacob, 2021; Poo, 2021). In the midst of struggling with the war against Covid-19, Malaysia launched the Malaysia Digital Economy Blueprint (MyDigital) on 19th February 2021 which has ideas and plans to improve digital literacy, create high-income employment opportunities, make banking and finance business easier and more organised, and to provide virtual education access to children in the country ('Speech Text in Conjunction with MyDIGITAL and Malaysia Digital Economy Blueprint Launch Ceremony', 2021).

Based on a cursory review of existing literature, it seems that there is no article investigating the research trends of digital literacy in Malaysia although related topics in information and communication technologies (ICTs) are plenty. Hence, the purpose of this study is to review digital literacy studies in Malaysia over the last decade using a systematic review in finding out the methodological approaches that are frequently used. This can be achieved by addressing the following questions: (1) What are the topics studied based on the DigComp framework? (2) What are the research designs chosen? (3) What are the data collection methods used? For this review, we chose the DigComp framework over other frameworks because the DigComp framework is the most comprehensive and the latest. The outcomes of this paper are hoped to help new and existing researchers in bringing awareness and the importance of continued understanding in the field of digital literacy.

METHOD

We chose a systematic literature review to synthesize evidence with a detailed and comprehensive plan of study (Tawfik et al., 2019). According to Mohamed Shaffril et al. (2020), a systematic literature review has several advantages over a traditional review because of its unique procedures such as involving extensive searching methods, predefined search strings and standard inclusion and exclusion criteria. Also, unlike a narrative review, which is non-systematic and therefore cannot be considered a formal research process (Sánchez-Caballé, Gisbert-Cervera, & Esteve-Mon, 2020), a systematic review has been prominently developed within medical science, is a research method and also a process for systematically identifying and critically appraising relevant research (Liberati et al., 2009). A systematic review has the sole purpose to review relevant documents obtained from various relevant databases (Okoli, 2015).

A systematic literature review also requires research questions that are not only focused but facilitate an effective search strategy and provide a structure for the whole report. Lockwood et al. (2015) provide an impressive guideline on how to formulate questions based on the PICo (**P**opulation, the phenomena of **I**nterest and the **Co**ntext) approach. To illustrate the PICo approach with this study, the primary question is to review digital literacy (the phenomena of **I**nterest) studies in Malaysia (**P**opulation) over the last decade in finding out the methodological approaches (**Co**ntext) that are frequently used. We then created the research questions based on the primary question to make sure that we include only related studies and to generate synthesized findings that relate back to the primary question.

Among the recent digital literacy studies with a systematic review are Spante et al. (2018) that established a range of digital literacy definitions used in higher education research, Palmquist et al. (2019) that synthesized surgical education research trends over the last decade and Oh et al. (2021) that identified studies involved with the assessment of digital literacy among older adults.

The Identification Process

This systematic review was principally guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement, a document that consists of a set of items for reporting in systematic reviews and meta-analyses and a flow-diagram (Moher, Liberati, Tetzlaff, Altman, & The PRIMA Group, 2009). We started by identifying the studies in electronic databases. There must be at least two electronic databases to

get much yield and comprehensive results (Shea et al., 2017). For this paper, the electronic databases employed for the identification stage were SCOPUS, ScienceDirect, Emerald Insight, and ProQuest while Google Scholar was used as a supporting database (Mohamed Shaffril et al., 2020; Tober, 2011). To limit our search specifically targeted to answer the research questions, the keywords were combined with the BOOLEAN operators and the advanced search function available in each database during searching. The keywords used were conceptualised from the existing literature. They were "digital literacy", "digital competence", "digital skills", "information literacy", "computer literacy" (Boechler et al., 2015; Ferrari et al., 2012) and "Malaysia" to limit the search to this region. We also delimited the search to title, abstract and keywords in the databases to decrease the number of publications but to increase the precision of the information search (Savolainen, 2016; Spante et al., 2018). By using the refine options, only those articles that were published in 2010 and above are taken into account for a more recent conceptualisation of digital literacy (Oh et al., 2021). The combination of search keywords for each database was summarised in Table 2 below.

Table 2: Summary of Database Search Terms

Database	Keywords	Results	Search date
SCOPUS	(TITLE-ABS-KEY("digital literacy") OR TITLE-ABS-KEY("digital competence") OR TITLE-ABS-KEY("digital skills") OR TITLE-ABS-KEY("information literacy") OR TITLE-ABS-KEY("computer literacy")) AND TITLE-ABS-KEY("Malaysia")	62	19 March 2021
ScienceDirect	("digital literacy" OR "digital competence" OR "digital skills" OR "information literacy" OR "computer literacy") AND Malaysia	4	19 March 2021
Emerald Insight	((abstract:"digital literacy" OR (abstract:"digital competence") OR (abstract:"digital skills") OR (abstract:"information literacy") OR (abstract:"computer literacy")) AND (abstract:"Malaysia"))	3	19 March 2021
ProQuest	(ab("digital literacy") OR ab("digital competence") OR ab("digital skills") OR ab("information literacy") OR ab("computer literacy")) AND ab(Malaysia)	12	19 March 2021
IEEE Xplore	("Abstract":"digital literacy" OR "Abstract":"digital competence" OR "Abstract":"digital skills" OR "Abstract":"information literacy" OR "Abstract":"computer literacy") AND ("Abstract":Malaysia)	3	19 March 2021
Google Scholar	allintitle: Malaysia "digital literacy" OR "digital competence" OR "digital skills" OR "information literacy" OR "computer literacy"	11	19 March 2021
TOTAL		**95**	

The citations of identified studies or records were then exported to Zotero bibliographic reference manager (Zotero) in either BibTex or RIS format. By comparison, Zotero produces the lowest number of mistakes compared to other contenders, such as Mendeley, EndNote and RefWorks (Kratochvíl, 2017). The duplicates were removed if the records have the same title and author and were published in the same journal. The remaining records were exported into an Excel file along with the essential information captured from the databases for screening and coding purposes (Bree & Gallagher, 2016; Ose, 2016).

Screening of Titles and Abstracts
At this stage, we reviewed the titles and abstracts from each identified study that had been moved from the previous stage, the Identification Process (Peters, 2017). Screening of the identified studies is an integral part of the systematic review process. This is to minimise deficiencies made by the database, and this process focuses on reading the title, and the abstracts as indicated by Mohamed Shaffril et al. (2020) and Tawfik et al. (2019).

An interrater agreement for the title and abstract screens was calculated using both the agreement rate and Cohen's kappa. All authors participated both in the screening process and conflicts were resolved based on a consensus basis. The quality of three reviewers would be better than two, especially when two would have different opinions from each other, the third opinion is considered (Xiao & Watson, 2017). Studies included at this stage were subject to further screening using the full texts which are usually in PDF documents (Belur, Tompson, Thornton, & Simon, 2018). The decision for each article during the title and abstract screening was made based on the following rules:

Yes: This article appeared to meet the inclusion criteria and should be included in the systematic review.

No: The article did not meet the inclusion criteria and should not be included in the systematic review.

Maybe: There was not enough information in the title/abstract to decide, thus move to full-text screening stage.

Any articles that were not agreed upon among the authors, were moved to the full-text screening stage.

Eligibility Criteria
The articles were selected based on the following inclusion criteria: (1) related to digital literacy, (2) used descriptive, qualitative, experimental, or mixed-methods research design, (3) conducted in Malaysia, and (4) published in English or Malay. These inclusion criteria were important to refrain the researchers from bias.

Therefore, articles were excluded if the studies were (1) not related to digital literacy, (2) were review, conceptual, or opinion papers, or another non-empirical type of publication, (3) studies conducted in other countries other than Malaysia, and (4) used other languages other than English and Malay. Articles were also excluded if the issues discussed were unrelated, unavailable full texts, or abstract-only articles.

Included Studies
The decisions to select the identified studies for further assessment are based on the eligibility criteria. This is to minimise the chance of including non-relevant articles (Tawfik et al., 2019). The decision for each article was made based on the following rules:

Include: The article met the inclusion criteria and should be included in the systematic review.
Exclude: The article did not meet the inclusion criteria and should not be included in the systematic review.

Once included, data were extracted from the studies according to a predesigned coding instrument and were appraised for the quality of evidence. Excluded studies were noted with reasons in the PRISMA flow diagram (Peters, 2017).

Quality Assessment
The included studies were assessed using the Crowe Critical Appraisal Tool (CCAT). It is a validated quality assessment tool developed to rate empirical papers in systematic reviews according to eight categories that include Preliminaries, Introduction, Design, Sampling, Data collection, Ethical matters, Results and Discussion where each has a 6-point scale of 0 to 5. The maximum amount of scores that can be achieved is 40 (Crowe, 2013). The CCAT can be used for both quantitative and qualitative studies (Akinla, Hagan, & Atiomo, 2018). In addition, the included studies were also assessed according to the DigComp framework: (1) information and data literacy (browsing, searching, filtering data), (2) communication and collaboration (interacting, sharing, engaging in citizenship, collaborating), (3) digital content creation (developing, integrating, and re-elaborating digital content; copyright; licenses; programming), (4) safety (protecting devices, protecting personal data and privacy, protecting health and well-being), and (5) problem-solving (solving technical problems, identifying needs and technological responses, creatively using digital technologies, identifying digital competence gaps) (Carretero et al., 2017; Ferrari et al., 2013).

RESULTS
The PRISMA flow diagram in Figure 1 below summarizes the search results and selection process of all studies included in our systematic review. Initially, the number of records identified from the electronic database was 95 (SCOPUS: 62; ScienceDirect: 4; Emerald Insight: 3; ProQuest: 12; IEEE Xplore: 3; Google Scholar: 4). Of these records, 17 articles were duplicates and had been removed, leaving 78 articles for the title and abstract screening. During the title and abstract screening, two reviewers achieved 60.8% percentage agreement with Cohen's Kappa,

K=0.364, p<.001). There is a remarkable difference between the percentage agreement and Cohen's Kappa because the latter has corrected for chance.
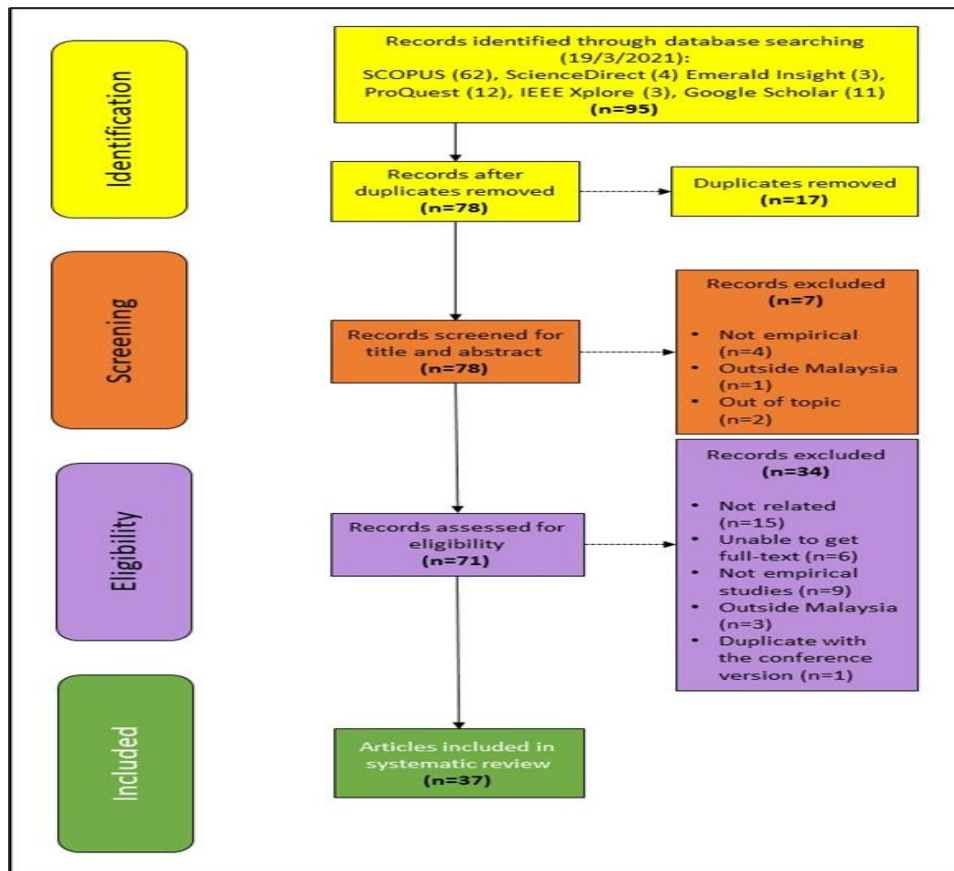

Figure 1: The PRISMA Diagram

Study Characteristics

After the screening, seventy-one (71) articles were assessed for eligibility. Thirty-four (34) articles were excluded for the following reasons: not related (n=15); unable to get full-text articles (n=6); not empirical studies (n=9); outside Malaysia (n=3); and duplicated with the conference version (n=1). There was at least one study in each year from 2010 to 2021, except none in 2013. The highest number occurred in 2020 with nine (9) studies. Most population groups studied were university students, lecturers, and staff which made up 45.9% of total studies, as well as school students and teachers with 29.7% of total studies. The remaining population groups stood up at 24.3% of total studies comprised of urban and household respondents, youths (marginalized & rural), native people, pharmacists and business owners and managers. A total of thirty-seven (37) articles were included in our review. Table 3 below provides a summary of the included studies.

Table 3: Summary characteristics of included studies

Category	Result	
	n	%
DigComp framework		
Information and data literacy	36	32.1
Communication and collaboration	31	27.7
Digital content creation	24	21.4
Safety	7	6.3
Problem solving	14	12.5
Year of study publication		
2010	1	2.7
2011	2	5.4
2012	4	10.8
2013	0	0.0
2014	3	8.1
2015	2	5.4
2016	4	10.8
2017	3	8.1
2018	3	8.1
2019	4	10.8
2020	9	24.3
2021	2	5.4
Research design		
Quantitative	23	62.2
Qualitative	9	24.3
Mixed methods	5	13.5
Population		
Urban communities	1	2.7
Households	1	2.7
Youths (Marginalised & Rural)	2	5.4
Native people	2	5.4
Pharmacists	1	2.7
Business owners/managers	2	5.4
University lecturers	3	8.1
University lecturers, librarians, and students	1	2.7
University staff	1	2.7
University students	10	27.0
Teacher trainees	2	5.4
School librarians	1	2.7
School students	4	10.8
School teachers	2	5.4
School teachers-librarians	2	5.4
School teachers and students	2	5.4
Data Collection Methods		
Survey/Questionnaire	22	59.5
Posttest	1	2.7
Interview	7	18.9
Interview and Document Analysis	2	5.4
Survey/Questionnaire and Interview	5	13.5

Below, we have arranged our results based on our three questions in this study:

Question 1: What are the topics studied based on the DigComp framework?
It was found that information and data literacy is the most studied topic at 32.1%, followed by communication and collaboration at 27.7%, digital content creation at 21.4%, problem-solving at 12.5% and the least studied, safety at 12.5%.

Question 2: What are the research designs chosen?
Most studies were based on the quantitative research design (23/37, 64.9%), the qualitative research design came in second place (9/37, 24.3%), and then the mixed methods research design (5/37, 13.5%).

Question 3: What are the data collection methods used?
A total of twenty-two (22) studies from the quantitative research were cross-sectional surveys and one (1) study was a post-test experimental study. An interview was the most preferred main data collection method for the qualitative research with seven (7) studies while two (2) studies had both interview and document analysis. While five (5) mixed methods research studies were found to use surveys and interviews to collect data.

Table 4 below presents the detailed characteristics of all thirty-seven (37) included studies. The CCAT average score achieved was 37/40 (93%) as most studies fulfilled almost perfectly all the eight categories. The total score should be written to the nearest full percent as there is no need for decimal places because they do not add anything to the accuracy of the score obtained (Crowe, 2013) and there are 40 distinct percentage scores that none of which overlap (Crowe & Sheppard, 2011). However, there are some variations that existed among the studies reviewed. Studies that reported from surveys or questionnaires but without charts, with only tables lose slight marks. Studies also lost marks in the 'Ethical matters' category if there is no clear remark on the consent from the participants they surveyed. In addition, studies with charts scored better in the 'Result' category as they give more understanding of the targeted issue faster to the readers rather than tables with numeric data. The largest population came from a quantitative study by Pandian et al. (2020), with 1200 school students that examined their digital media skills while the lowest number was a qualitative study by Ramdan et al. (2020), with only 4 business owners or managers that explored the factors that can influence the use of digital platforms in micro or small enterprises.

Table 4: Detailed characteristics of included studies (n=37)

Author	Year	Research Design	Sample size, n	Study aim	CCAT score, (% of total)
Abdul Karim and Mohd Noor	2020	QUAL	31	To examine the interplay of affective domain in students' information literacy development in higher learning	37 (93%)
Anthonysamy et al	2020	QUAN	563	To examine how self-regulated learning strategies (SRLS) can foster the enhancement of digital literacy in digital learning to increase efficiencies in human capital for sustainable development in lifelong learning	37 (93%)

Anuar et al	2019	QUAN	30	To examine the role of attitude, subjective normative and perceived behavioural as intermediaries on the relationship between individual skills and intentions to use the Internet among the schoolteachers in Malaysia	37 (93%)
Baharuddin et al	2011	QUAN	157	To study the teachers' perception on information literacy practices by teacher-librarians or library media teachers	37 (93%)
Erfanmanesh et al	2014	QUAN	1100	To determine the prevalence and correlates of information seeking anxiety among a group of postgraduate students at a research-intensive university in Kuala Lumpur, Malaysia	36 (90%)
Gie and Fenn	2019	QUAN	127	To investigate the relationship between TAM and digital literacy among the first-year students in a private institution of higher learning in Malaysia	37 (93%)
Hamid et al	2014	QUAL	14	To examine and assess the quality and effectiveness of information literacy training employed by teacher trainees in their follow-on research process	37 (93%)
Hashim et al	2011	QUAN	39	To assess the level of computer literacy among the Semai tribe in Kampung Bukit Terang, Kampar, Perak	36 (90%)
Hashim et al	2012	QUAN	39	To assess the level of literacy and computer literacy amongst the indigenous people or natives living in a rural area or Perak, Malaysia	36 (90%)

Ismail et al	2018	QUAN	150	To investigate the effects of WebOPAC Self Training Tool with Guided Exploration, non-guided and tradition on information literacy skills standards among first year degree students in Malaysian public university	38 (95%)
Kassim et al	2020	QUAN	244	To explore digital competencies among gen Z in two countries: Malaysia and Bangladesh	37 (93%)
Kaur et al	2015	MIXED	40	To investigate the supervisory and digital literacy practices among 40 supervisors in two public universities in Malaysia in the following four aspects: ethics, personal commitment, climate and use of digital tools	37 (93%)
Kee	2020	QUAL	14	To find out how adult learner learn in this digital age, especially for those who had learned and developed their digital skills through experience and by self-exploring at their workplace	37 (93%)
Masud et al	2021	QUAN	547	To identify the role of education in promoting the awareness on the use of ICT-based infrastructure among the public to enhance their socioeconomic status	38 (95%)
Mohamad et al	2019	QUAN	143	To model the relationship between passion, attitude Internet usage and age in nurturing digital literacy and narrowing the knowledge gaps between urban and rural settings	36 (90%)
Murugan et al	2017	QUAN	50	To determine the technological readiness of the students by measuring their digital skills using the Digital Competence Framework (EU)	36 (90%)

Naim and Abdul Razak	2020	QUAN	233	To examine the relationship of ESL lecturers' personal and professional characteristics towards their digital competence	36 (90%)
Ojo et al	2018	QUAN	270	To examine Internet usage as the outcome of choice made by an individual to use the Internet	38 (95%)
Omar and Phung	2018	MIXED	10	To develop an e-assessment prototype as a digital transformation towards the usual assessment practices among communication lectures	38 (95%)
Pandian et al	2020	MIXED	191	To explore how secondary school students participating in a digital storytelling project	37 (93%)
Pandian et al	2020	QUAN	1200	To examine the digital media skills of Malaysian students in selected schools in Malaysia	37 (93%)
Rahman et al	2019	QUAN	76	To identify the relationship between computer literacy in UTHM: computer, email and internet to job satisfaction	36 (90%)
Ramdan et al	2020	QUAL	4	To explore the factors that can influence the use of digital platforms by micro and small enterprises	36 (90%)
Samsudin et al	2016	MIXED	395	to study how 15- to 25-year-old Malaysian youths in marginalised communities engage with the Internet in performing various activities in their everyday lives	37 (93%)
See Wan et al	2017	QUAL	11	To explore the attitudes of Malaysian CPs towards online health-related information	36 (90%)

Shariman et al	2012	QUAL	24	To analyse the digital literacy competence of Malaysian students which is needed to access and use digital contents for finding information required in academic tasks	38 (95%)
Shariman et al	2014	QUAN	420	To analyse the digital literacy competence of Malaysian students which is needed to access and use digital contents for finding information	36 (90%)
Shyh-Mee et al	2015	QUAN	710	To investigate how school librarians perceive their readiness in implementing information literacy (IL) education in schools.	37 (93%)
Sidhu et al	2016	MIXED	132	To identify the digital literacy competencies of students for application in e-learning	36 (90%)
Sintian et al	2021	QUAN	256	To investigate how school librarians perceive their readiness in implementing information literacy (IL) education in schools.	36 (90%)
Tan et al	2012	QUAN	120	To examine postgraduate students' perceptions of their level of dependence on supervisors in relation to the use of digital tools and academic matters pertaining to motivational support, writing a proposal, collecting, and analysing data and writing the final report	37 (93%)
Vong et al	2017	QUAN	41	To identify the students' attitude towards digital literacy in learning Kadazandusun language at secondary school, Sabah state	37 (93%)

Yu et al	2016	QUAL	5	To examine the level of self-assessed information literacy skills among school librarians and the perceived need for these school librarians to have information literacy skills	37 (93%)
Yu et al	2010	QUAL	9	To evaluate the impacts of knowledge management practices on empowering rural youth who have participated in a six-month ICT training	38 (95%)
Yu et al	2016	QUAL	23	To examine how secondary school teachers in Malaysia conceptualise information literacy, and how this understanding leads to information literacy practices through resource-based learning	38 (95%)
Yusof et al	2012	QUAN	120	To explore information literacy instruction through resource-based projects	37 (93%)
Ziden et al	2020	QUAN	256	To investigate the implementation of a resource-based school history project in Malaysian secondary schools and to understand how the project contributes towards students' information literacy development	38 (95%)

Table 5 below shows the elements of the DigComp framework: information and data, communication and collaboration, digital content creation, safety and problem-solving, with the research designs and data collection methods. The result shows that all elements had been studied using quantitative, qualitative, and mixed-methods research designs. The quantitative research design was the most popular, followed by the qualitative and mixed methods. This can explain why the survey/questionnaire is the most preferred data collection method. The interview method had also been used in all qualitative studies and mixed methods to study all the DigComp elements. It is also found that both the safety and problem-solving elements had not been studied using posttest the posttest data collection method.

Table 5: DigComp Framework, Research Designs and Data Collection Methods (n=37)

Research Design	DigComp Framework									
	Information and data literacy		Communication and collaboration		Digital content creation		Safety		Problem solving	
Quantitative	23	63.9%	20	64.5%	14	58.3%	5	71.4%	10	71.4%
Qualitative	8	22.2%	6	19.4%	6	25.0%	1	14.3%	3	21.4%
Mixed Methods	5	13.9%	5	16.1%	4	16.7%	1	14.3%	1	7.1%
Data Collection Method										
Survey/Questionnaire	22	31.9%	19	27.5%	13	18.8%	5	7.2%	10	14.5%
Posttest	1	33.3%	1	33.3%	1	33.3%				
Interview	6	33.3%	5	27.8%	4	22.2%	1	5.6%	2	11.1%
Interview and Document Analysis	2	33.3%	1	16.7%	2	33.3%			1	16.7%
Survey/Questionnaire and Interview	5	31.3%	5	31.3%	4	25.0%	1	6.3%	1	6.3%

DISCUSSION

In this systematic review, we emphasised our study to find out what are the topics frequently studied based on the DigComp framework. We also highlighted what are the research designs frequently chosen and what are the data collection methods frequently used. To the best of our knowledge, only handful numbers of systematic reviews on digital literacy issues in Malaysia.

At this time of writing, Malaysia is in the full Movement Control Order 3.0 (MCO 3.0) since 1st Jun 2021 where only essential services are allowed to operate (Ayamany, 2021). Other than the said essential services are not allowed to open, and this includes non-essential government agencies, higher learning institutes and schools. It is important to highlight that higher learning institutes and schools suffer so much that all parties involved such as students, teachers, and lecturers, as well as parents must adapt with the online learning and digital skills in full scale. Therefore, we can contemplate that the number of studies in 2020 jumped to 9 of 37, or 24.3% of the total studies, which is the highest since 2010 because of this pandemic and its consequences. It shows that digital literacy may have attracted quite substantial number of researchers into this field, especially in Malaysia.

On finding out the topics that were frequently studied, the results showed that the first three DigComp framework elements, information and data literacy, communication and collaboration and digital content creation had been intensively investigated by Malaysian researchers. Among them were studies on the information seeking anxiety by postgraduate students in Malaysia, (Erfanmanesh, Abrizah, & Abdul Karim, 2014), comparison of digital competencies among generation Z in Malaysia and Bangladesh (Kassim, Hairuddin, Chowdhury, Al-Din, & Azhar, 2020) and the digital media skills of Malaysian students in selected schools in Malaysia (Pandian et al., 2020). All these studies were conducted mainly in the schools and university settings.

It is also important to note that majority of the population came from the academic settings, both from schools and higher education (75.6%). The digital competence areas assessed in the selected studies include the browsing and searching for digital contents from the Internet, interacting and sharing information using digital technologies and creating digital contents. The last two DigComp framework elements, namely safety and problem solving were not well investigated in most studies, which include areas such as protecting devices, personal data and privacy as well as solving technical problems and identifying needs of information technologies.

Regarding the research designs, it was found that quantitative studies predominated within digital literacy research in Malaysia (23/37, 62.2%). When looking the quantitative studies in detail, it was evident that the majority employed non-experimental research designs and covering all the elements of the DigComp framework. The qualitative and mixed-methods designs were employed in the remaining studies (14/37, 37.8%) for all elements, but showed little focus on the safety and problem-solving elements.

Malaysian digital literacy researchers commonly used survey/questionnaire as their main quantitative data collection, only one study was found to use a posttest. This is expected as DigComp framework is designed primarily for self-assessment reporting tools (Carretero et al., 2017). For qualitative data collection method, an interview was the most preferred. The mixed methods used both survey/questionnaire and interview for integration and corroboration of data. There is a need for comparative mixed methods research designs as they combine both qualitative and quantitative for enriching data while improving validity and reliability (Creswell, 2003, p. 207). The mixed methods design is strongly considerable as it is the combination of two methods that follow different philosophical and methodological orientations which can present a greater diversity of divergent views compared with quantitative or qualitative methods alone (Schoonenboom & Johnson, 2017; Taguchi, 2018).

IMPLICATIONS FOR FUTURE RESEARCH

This study has selected digital literacy studies in Malaysia using a systematic literature review in finding out the methodological approaches that are frequently used. Based on the findings, we implied that Malaysian digital literacy researchers were enthusiastic to use a quantitative research design over qualitative and mixed-methods designs. The quantitative research involves statistics and mathematics, and it might not be influenced by personal feelings or opinions (Basias & Pollalis, 2018). It is mainly used to investigate multiple variables from surveys and experiments (Creswell, 2003). The qualitative design, on the other hand is dealing with experiences, behaviours and relations without the use of statistics and mathematics, or the processing of numerical data (Merriam, 2009, pp. 3–5). With mixed-methods designs, all data have both an objective and a subjective component. In other words, the number can be assigned to qualitative data such as open-ended questions in surveys and any number obtained can be interpreted using a subjective judgment (Abusabha & Woelfel, 2003; Creswell, 2003).

It is not the objective of this paper to debate the superior justifications of one another. Research is about knowing, understanding and exploring the world and there is no one privileged way of doing this (Walsh, 2011), but the authors feel that it is necessary to also look at the "softer" part of the data using a qualitative design instead of merely looking at numbers and statistics. Therefore, when a problem or issue needs to be explored, a qualitative research is appropriate because we need to study a group or population that cannot be easily measured such as stories, voices and perceptions (Creswell, 2013). Digital literacy researchers in Malaysia can replicate the foreign studies such as exploring the student perception of digital literacy (Tham et al., 2021), defining digital literacy according to beliefs (List, 2019) and understanding the development and retention of digital skills over time (Léger & Freiman, 2016). Researchers can also explore the last two DigComp elements, safety and problem-solving elements using either a qualitative or mixed-methods design.

The findings also indicated that majority of the population groups came from the academic settings such as schools and higher education institutions. The most frequently studied subjects were undergraduate students and teachers. This showed that such groups provide an easy to reach sample population and convenient sampling procedures. In effect, other groups such as adults, families, and rural communities seem neglected as less studies made on them. Therefore, Malaysian digital literacy researchers should now divert their focus to these population groups so that more contextual issues such as digital divide (Lo et al., 2012; Sheikh Dawood, Ghazali, & Samat, 2019) and digital inclusion (Malek, Razak, Salman, Nor, & Abdullah, 2012) can be uncovered and make them relevant.

CONCLUSION

A total of thirty-seven (37) studies were selected in this systematic review. Three authors, or so-called reviewers were involved, where each took part in his or her own respective roles. With a systematic literature review, we can select and evaluate the available published literature with detailed steps as prescribed by the PRISMA flow diagram. Further, by using the PICo approach, a clear, logical, and well-defined research question can be formulated. However, some limitations exist in our study. First, the initial literature search in selected databases was limited to publications from Malaysia only, which does not capture the entire body of digital literacy research outside Malaysia. Second, although there was the involvement of co-researchers when selecting the studies based on the criteria, there could still be some inter-rater issues and own beliefs towards certain articles which could deviate given the large number of articles over a period. Third, we clearly focused on methodological aspects and not primarily on the content of the instruments. We decided to do so because judgment of the content was difficult since the digital literacy definition is proliferated, and this may add complexity to systematic review.

It was evident that most digital literacy research in Malaysia were focusing on the first three elements of DigComp framework, information and data literacy, communication and collaboration and digital content creation, with students from schools and higher learning institutions comprised most of the subject population. The reason for the predominance of these elements would be the fact that Malaysian digital literacy researchers were taking a convenient approach in selecting the sample populations, as these researchers were affiliated to education institutions. Digital literacy skills may have been embedded in Malaysian curriculum particular and practiced by the educators, making the contextual issues are deeply related. Digital literacy research in Malaysia is becoming trendy nowadays, especially during the Covid-19 pandemic where everybody especially those in the education sector are facing tremendous and sudden changes in teaching and learning.

The general population such as business owners in small and medium, marginalized, or rural youths, and including indigenous people need more attention as they can be digitally disadvantaged. Malaysian digital literacy researchers should go beyond the comfortable zones, beyond their geographical boundaries by employing qualitative and mixed-methods as these can capture the insights, experiences and in-depth persona of the participants and their social surroundings. Digital literacy is evolving in all aspects be it the definition, the competence areas as well as the research methodological approaches. It is now imperative for educational authorities and policy makers to promote digital literacy to all layers of societies so that the said agenda can be uphold and related initiatives can be implemented.

DECLARATION STATEMENT
The lead author* affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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CONFLICT OF INTEREST
The authors declare no self-interest in the study conducted.

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