

Building Educational/Academic Resilience through Digital Literacy

Abstract

The ongoing digitization of the education systems has introduced a new pedagogical approach to teaching and learning – Education 4.0 that aligns the fourth industrial revolution. Education 4.0 has improved the effectiveness and efficiency of learning globally. However, the issues and challenges associated with Education 4.0 or technology-enabled technology teaching and learning emerged when the global education system was mandated to technology-enabled learning during the pandemic. Both the educators and the learners were found to lack relevant digital skills to successfully facilitate the learning process. This study introduces the concept of digital literacy, a digital literacy framework and a digital literacy tool that can be used to effectively champion digital literacy skills to both the educators and the learners. The digital literacy tool has been successfully used in the South Pacific to evaluate digital literacy competencies and further improve the digital literacy competencies of the selected sample. As such, the digital literacy tool can be used to improve digital literacy of individuals in the developed and developing economies hence promoting educational resilience for all in the technology-enabled environment.

Keywords: digital literacy, digital literacy tool, digital literacy intervention, education 4.0

Introduction

In recent years the global education system has witnessed major reforms due to the sustained increase in usage and assimilation of digital technologies. The strong nourishment from the digital technologies has also induced the evolution of the education system, going from Education 1.0 (face-face and teacher centered) to Education 4.0 (technology-enhanced and student-centered). The recognition for providing quality education to its citizens under the sustainable development goals (SDGs) has been clearly visible from a majority of nations (Rahmaniah et al., 2021; Drossel et al., 2020; Martzoukou, 2020). As such newer digital technologies are continuously assimilated into the education system to provide flexible and improved educational delivery globally. However, there are also diverse challenges that the learners face when trying to learn online and these challenges amplified during the pandemic when the education system opted for online learning. According to Nedungadi et al. (2018), although learners are used to online environment, they are still required to have certain digital competencies for effective online learning. Therefore, improving digital literacy skills will build education resilience for learners hence preparing them for the technology-enabled society (Rahmaniah et al., 2021). The facilitators also need to develop digital characteristics to classroom success and to combat the challenges of technology-enhanced education (Soulen & Wine, 2018). Moreover, educationists state that if the facilitators do not have appropriate digital skills, they might have a negative attitude towards technology-enhanced, therefore, affecting the course design, course delivery and their students' performance (Potyrala & Tomczyk, 2021; Tomczyk, 2021). The authors (Potyrala & Tomczyk, 2021) further state from their studies that in general the teachers are not adequately trained to use new digital technologies for effective and efficient teaching. Therefore, appropriate and targeted interventions are needed to improve the digital skills of both the teachers and the learners in order to have a well-driven, productive and resilient education system

For technologies to act as a catalyst and promote effective learning, stakeholders need to design and deliver appropriate interventions and trainings so that learners' digital skills can be shaped and developed appropriately (Tejedor et al., 2020). Digital literacy is the acquisition of inter-related skills or competencies needed to survive and thrive in the digital society.

The definition of digital literacy has continually evolved using different dimensions in various models created by researchers of different countries (Ayyildizi et al., 2021; Reddy et al., 2021b; Avakare & Nikou, 2020; Perdana et al., 2019; UNESCO, 2018; Dios et al., 2016). The impacts of Covid-19 on the education sector have sparked the necessity of developing digital skills of both the learners and facilitators to promote education resilience henceforward. Motivated from the growing importance of improving digital literacy skills of the learners, the facilitators and eventually every individual in this digital society, researchers from the South Pacific have designed the following: (1) digital literacy framework, and (2) digital literacy tool that consists of a digital literacy scale (DLS) and a digital literacy intervention program (DLIP). The contributions of this research paper are as follows:

- i. Contributes of a newly developed digital literacy framework to literature. Although there have been many frameworks developed globally, research showed that relevant digital literacy skills needed for the 21st century were still missing that led to a digital skills gap (Ayyildiz et al., 2021; Perdana et al.,

2019; Dios et al., 2016). The new digital literacy framework intends to fill the existing digital skills gap in the South Pacific and beyond.

- ii. Introduces a new and unique digital literacy tool- DLS and DLIP. The digital literacy scale (DLS) is unique in its nature and tests individuals for their digital literacy skills from six dimensions stated in the literature section. The methodology used to design the DLS and measure digital literacy of individuals is the first of its kind. The digital literacy intervention program (DLIP) is also unique in its nature. To the best of the authors' the methodology used to improve the digital literacy skills of individual is a first of its kind as well. There have been separate modules developed to improve information literacy, computer and technical skills; however, such a holistic intervention program has not been found in the literature.

Literature Review

Advances in technology has transformed the education sector from Education 1.0 to Education 4.0, where education is accompanied by innovative pedagogical technologies and procedures, while the role of the teacher is that of mentor, reference, and collaborator. Facilitators and learners both require competencies such as digital literacy, critical thinking and problem- solving to function in the 21st- century educational ecosystems (Montoya et al., 2021). Moreover, during the Covid-19 pandemic, the global education institutes had to move to the online teaching and learning. Scholars identified that many facilitators all over the world were not competent to guide the learners in the technology-driven environment. Redesigning of courses and out of classroom activities for learning in the Covid era is entirely the facilitators' responsibility, therefore digital skills and inter-related competencies became necessary (Alakrash et al., 2021). The notions of Education 4.0 and learning in the post Covid-era are driven by digital platforms and digital technologies, therefore, there needs to be endorsement of appropriate transformation strategies and development of digital skills so that individuals can function effectively and efficiently in their schools and colleges, workforce and the digital society (Qureshi et al., 2021).

In addition, the government and education institutes worldwide are reviewing policies to map the job skills requirements with student graduation attributes and realigning the dimensions of learning with the job skills requirements (Perez & Montonya, 2022). Drawing from the critical research on digital literacy, incorporating digital literacy practices seemed to be the best approach to narrow the digital skills gap in any society. While many countries had mandated the digital literacy education, there were countries who were still in the process of understanding the dimensions of digital literacy, the uptake of digital literacy education being at its foundation stages. The government, stakeholders, scholars and educationist were still trying various means to narrow the digital skills gap through various initiatives when the pandemic happened and functioning of the society was totally leveraged on technology (Alakrash et al., 2021; Montoya et al., 2021). Citizens were forced to utilize their digital skills to perform the required tasks from personal to work to learning, therefore the need for digital skills gained urgency in all areas of life (Shilcock, 2020). As such, the acquirement of digital literacy skills magnified after the birth of Covid-19 pandemic.

The education sector had varied impacts of the pandemic and the stakeholders, parents, facilitators and learners faced unique challenges worldwide. The prominent issue was digital competency, which stressed out the learners making them fail to complete their assessments and even dropping out of their courses (Montoya et al., 2021; Reddy et al., 2021b). Experts stated that both the facilitators and the learners needed digital resilience to sustain quality course delivery, motivation, achievement and performance (Eri et al., 2021; Shilcock, 2021). Within the context of this study, digital resilience is defined as the ability of an individual to overcome the barriers related to the use of digital platforms and digital technologies for learning during any pandemics or endemics. To make the facilitators and learners digital resilient, targeted digital literacy interventions should be administered.

The current research explores the use of a newly designed framework and a digital literacy tool to promote educational resilience in the South Pacific. The authors define the characteristics of a digitally literate individual as having:

a comprehensive knowledge of current and emerging digital technologies, skills to locate, evaluate, create and disseminate information using digital technologies and platforms ethically and legally, understanding the relationship between digital technologies and life-long journey, and participating in the civic society (Reddy et al., 2021a).

Digital literacy in this study comprises of six dimensions defined as follows:

1. *media literacy*- ability to use digital technologies to access, analyse, evaluate and communicate information in a variety of digital platforms.
2. *information literacy*- ability to use digital technology to find, locate, analyse and synthesise resources, evaluating the credibility of these resources appropriate citation techniques, abiding the legal and ethical issues surrounding the use of these resources and formulating research questions in an accurate, effective and efficient manner
3. *visual literacy*- ability to use digital technology to ‘read,’ interpret, and understand information presented in pictorial or graphic images communicate this information and convert the information into visual representations.
4. *communication literacy*- ability to use digital technologies to communicate effectively as individuals and work collaboratively in groups, using publishing technologies, the Internet and Web 2.0 tools and technologies
5. *technology literacy*- ability to use digital technology to improve learning, productivity and performance.
6. *computer literacy* – ability to understand how to use computers, digital technologies and their applications for practical use.

Using the above definitions and dimensions of digital literacy, a new digital literacy framework and a digital literacy tool were designed.

Methodology

The methodology for the research had three phases that is design and development of : (1) a digital literacy framework, (2) a digital literacy scale and (3) a digital literacy intervention program. The digital literacy framework and the digital literacy tool were validated using exploratory factor analysis and validation tests using the “Statistical Package for the Social Sciences” (SPSS) software. The research utilized an integrative literature review approach to understand the theoretical background of digital literacy and work carried out on the development of digital literacy scales and suitable intervention programs.

Phase 1 –Digital literacy framework

After an in-depth and critical literature review, Covello’s (2010) framework was adopted to be used for the current research. His framework illustrated digital literacy as an umbrella of six other literacies, which to the authors’ knowledge explicitly defined the digital skills required for this digital age. The definitions of digital literacy and its composites – media literacy, information literacy, visual literacy, communication literacy, technological literacy and computer literacy were revised to reflect the appropriate skills needed in the digital era. Furthermore, to complete the framework, relevant skills were allotted to each literacy; the skills being unique to avoid repetition and overlapping of the skills. The skills set defined competencies for each literacy henceforth defined the digital literacy competencies of the individuals. For the purpose of this study, skills will be referred to as specific ability of individuals while competency as the combination of learned skills. The skills were adopted from prior work done in the field of digital literacy and the six composites of digital literacy ((Arneson & Offerdahi, 2018; Dincer, 2018; Holladay, 2018; Coklar et al., 2017; Ejikeme & Okpala, 2017; Jin & Ming, 2017; Sas et al., 2017; Sorgo et al., 2017; Rizi et al., 2014; Riesmeyer et al., 2012, Covello, 2010). There were 60 items in total.

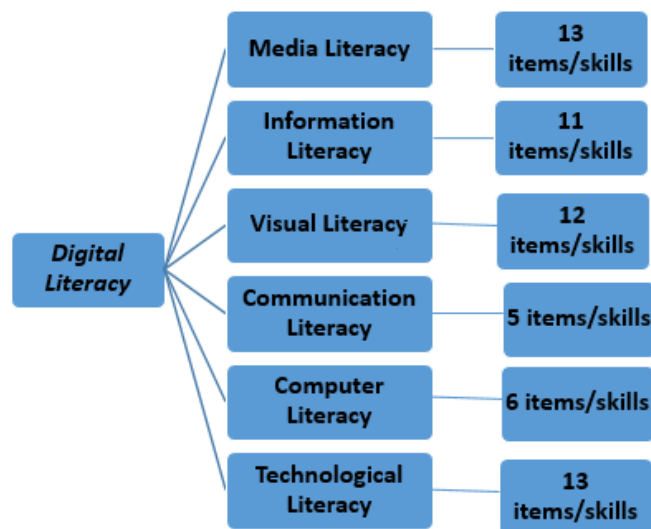


Figure 1: Visual representation of the digital literacy framework.

Using the digital literacy framework that included the skills set for digital literacy, a questionnaire was designed and administered to a sample of randomly selected participants. The validity and reliability of the questionnaire was evaluated using the Cronbach alpha test. The Cronbach alpha value for the questionnaire was 0.90 and the participants faced no issues in attempting the questions thus the questionnaire was deemed valid and reliable. Furthermore, to evaluate the contribution and significance of each skills, an exploratory factor analysis (EFA) was carried out. The data for EFA were collected from a sample of 2755 senior high schools in Fiji which comprised of 33 urban and rural schools from the two main islands..

The following tests were performed:

- i. Kaiser-Meyer-Olkin (KMO) test – to determine the sample adequacy. The results for this test was 0.984, indicating that the sample was sufficient to evaluate the factor loadings. According to Dios et al.(2016), any value greater than 0.8 and close 1 is acceptable.
- ii. Bartlett’s Test of Sphericity- to evaluate if the data is suitable for factor analysis. Researchers state that p-value should be less than 0.05 so that factor analysis can be carried out (Dios et al., 2016; Young & Pierce, 2013). For this data set the p-value was 0.00 thus the data was suitable to carry out the factor analysis.
- iii. For the factor analysis, there were six relevant factors with eigenvalues over 1.0. The total variance of the data set was 66.7% hence validating the data and data collection process.
- iv. Varimax rotation was chosen as it is a popular test for social science research. The factor loadings before varimax rotation for the sixty attribute were greater than 0.66 and all loaded well in component. After the varimax rotation was performed, the factor loadings ranged from 0.401 to 0.777. According to Samuels(2017) and Chang et al.(2011), factor loadings above 0.5 indicate a significant contribution of the item to the study and can be kept. Theseauthors also state that items with factors 0.3 and 0.4 can also be kept depending on the nature and importance of the item to the study. Therefore, all the sixty items were retained for the study.
- v. The six composites were tested for their validity using the Cronbach alpha test. The Cronbach alpha values for all six components were greater than 0.9, approving the internal validity of the digital literacy framework.

Using the validated digital literacy framework, a digital literacy tool was developed which consisted of a digital literacy scale and a digital literacy intervention program.

Phase 2 – Digital literacy tool

Part 1- Digital Literacy Scale (DLS)

The digital literacy framework was used to design the Digital literacy scale (DLS). Each of the six literacies defined and mentioned in previous sections has a number of defined items where each is allotted points “1-5” representing the response “strongly disagree to strongly agree”. Figure 2 shows the distribution of the points for each literacy and the total score for digital literacy.

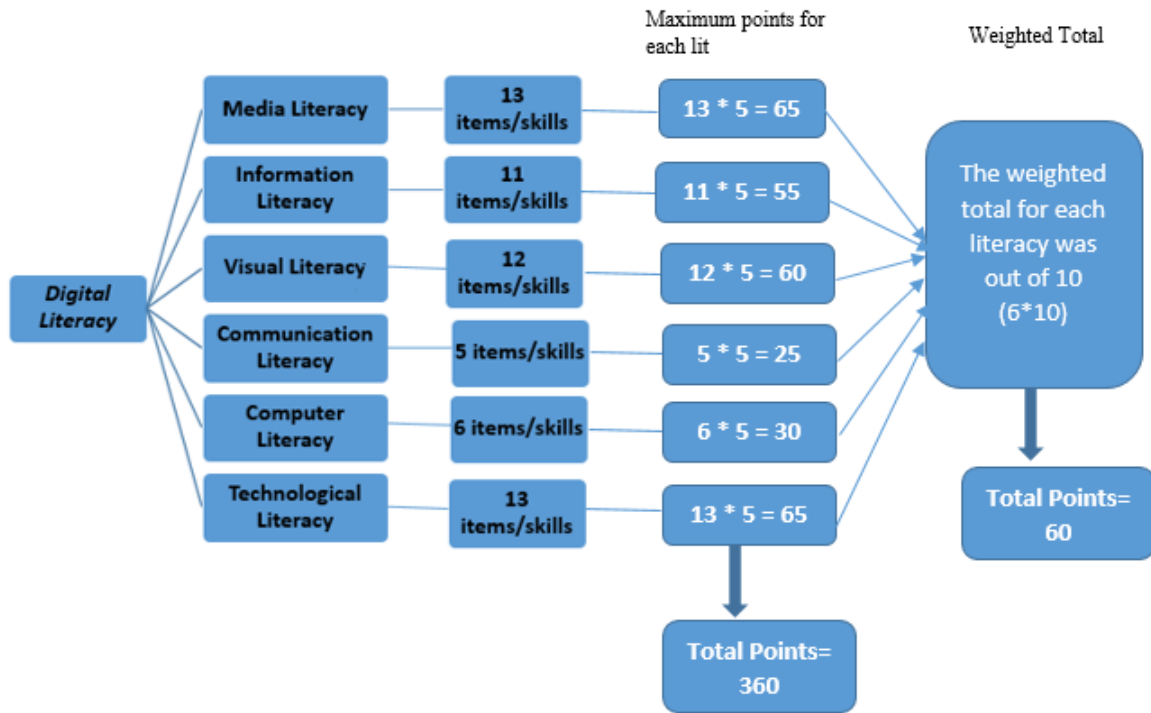


Figure 2: Design and development of the digital literacy scale.

As per Figure 2, each of the literacies has an associated skills set that garners points. The participants have to self-evaluate themselves using Likert scale of “strongly disagree to strongly agree”; points allotted respectively are 1-5. As such, for each question the maximum points is five and minimum is one. The total points for each literacy is calculated as shown in Figure 2, resulting in a total score maximum score of the participant of 360. Since, the number of skills/items were different for each literacy a weighted total out of 10 was evaluated for each literacy. Hence, the maximum weighted total was 60. Subsequently, using the class interval method, the levels for DLS were formulated. The DLS has six levels with associated points and description of the digital literacy competencies. The details are presented in Table 1.

| <i>Levels</i> | <i>Points</i> | <i>Description</i> |
|---------------|---------------|--------------------|
| L1 | 0-10 | No Understanding |
| L2 | 11-20 | Very Low |
| L3 | 21-30 | Low |
| L4 | 31-40 | Average |
| L5 | 41-50 | High |
| L6 | 51-60 | Very high (Expert) |

Table 1: Description of the digital literacy scale.

The digital literacy tool is hosted via an online platform, and the participants are given its URL to self-evaluate their skills for each literacy. Upon clicking the submit button, a results page, as shown in Figure 3, appears that gives the total scores for each literacy and the overall digital literacy competency of the participant. The results page also advises the participants the targeted remedial they can take to improve their digital literacy skills.



Figure 3: Results page of the DLS.

Part 2 - Digital Literacy Intervention Program (DLIP)

The digital literacy intervention program was developed to improve the digital literacy skills of individuals especially in the South Pacific. The digital literacy intervention program has six modules that represents each literacy. The modules are enhanced with gamification so the participants' interest and engagement is maintained throughout the program. The DLIP has two components; (1) theory that consists of explanatory notes and videos about each literacy, and (2) game- based quiz. The reader is referred to the paper titled "*Contextualized game-based intervention for digital literacy for the Pacific Islands*" for a detailed account of DLIP. Once the participants complete all the modules, they can view their "badges" and the "stars" for each module. Badges are rewarded for their scores in the quiz while "stars" are rewarded for the number of coins collected in the theoretical section. The aforementioned incentives are to motivate the participants to complete the modules. The participants can also print their certificate once all the modules are completed. The certificate *inter alia* has the digital literacy level of the participants printed.

Results and Discussion

The digital literacy tool was piloted to 100 first year university students in Fiji to test for its effectiveness, validity and internal consistency. Given below are the tests performed and their results:

- i. A Kuder-Richardson-20 (KR-20) test was carried out to test the internal consistency. The KR-20 value obtained was 0.869 that indicated that the digital literacy tool was reliable and can be used for a greater audience. The work of Berame (2017) and Quaigran & Arhin (2017) was referred to understand the tests carried out for internal consistency of the digital literacy tool.
- ii. The spearman's correlation test was performed to test the validity of DLIP. Correlation values greater than 0.3 meant that the intervention is valid (Brien et al., 2019; Incebacak & Ersoy, 2017). For DLIP, the correlation values for each literacy were as follows: media literacy – 0.5, communication literacy – 0.6, information literacy- 0.6, visual literacy – 0.7, technological literacy – 0.8, and computer literacy – 0.8.

The correlation values indicate that each module was valid and had significant impact in improving the literacy of the individual's.

- iii. Cohen's d value was used to evaluate effectiveness of the digital literacy tool. According to McLeod (2019), the Cohen's d value measures the effect size of the intervention. He described the d values as such- d=0.2 be considered a 'small' effect size, 0.5 represents a 'medium' effect size and 0.8 a 'large' effect size. For the DLIP, the d value for overall digital literacy was 0.47 ~ 0.5, indicating a medium impact of the intervention in improving the digital literacy skills of the participants. For each literacy the d values were as follows:
- media literacy – the value is 0.51- medium effect
 - communication literacy- the value is 0.96- large effect
 - information literacy – the value is 0.08- small effect
 - visual literacy – the value is 0.37, small effect
 - technology literacy – the value is 0.32- small effect
 - computer literacy- the value is 0.55- medium effect

From the results, overall it can be stated that the digital literacy tool was valid, reliable and effective. Although the impact size is varying for each literacy, there is an impact /contribution of each module in improving the digital literacy competencies of individuals.

Conclusion

Establishing digital literacy competencies amongst people in the 21st-century has become utmost important particularly after the pandemic. There are expectations from stakeholders, industries and educationists for individuals to perform effectively and efficiently using digital technologies and platforms. Digital literacy skills need to be appropriately taught so that the individuals become resilient members of our workforce and societies, absorbing perturbations, uncertainties and emergencies with sustainable use of digital technology.

This research introduced validated digital literacy framework and digital literacy tool that can be used to promote educational resilience and foster life- long learning amongst the 21st-century individuals. The digital literacy framework and the digital literacy tool- digital literacy scale and the digital literacy intervention program are validated and have proven to be significantly effective amongst the piloted sample. Furthermore, it is recommended that the new digital literacy framework be used to develop targeted interventions so that digital skills gap can be narrowed. Also, the digital literacy tool to be used to evaluate the digital literacy competencies of individuals so that relevant strategies can be devised to improve the digital literacy competencies of the individuals. The study has also introduced a one-stop-shop intervention program to improve digital literacy skills of individuals. As such, the authors offer a feasible solution to measure, remediate and hence narrow the existing digital skills gap in the South Pacific. While the tool has been contextualized for the Pacific setting, it can easily be extended beyond Pacific. .

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