Talismans of Digital Literacy: A Statistical Overview

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Abstract: The individuals living in the 21st century have become the consumers of digital innovations and have to adapt, adopt and adapt to the new norm of surviving and thriving in the digital society. Familiarity with the latest technologies is not the only requirement for survival. One also needs to have relevant digital competencies to complete tasks with optimized outputs and efficiently deal with the chain of digital changes. The current study introduces the South Pacific digital literacy framework (SPDLF) driven by 6 essential literacies and sixty attributes. The study intends to provide a three-stage statistical validation for the South Pacific digital literacy framework. The three stages of validation include;(1) evaluating the strongest predictors of digital literacy from the six literacies in the SPDLF, (2) evaluating the significant predictors of each of the six literacies and (3) evaluating the significant attributes from a total of sixty attributes in the SPDLF. The results show that all attributes in the SPDLF are statistically significant, therefore, all attributes are significant contributors to digital literacy in the South Pacific digital literacy framework.

Keywords: Digital literacy, digital literacy framework, south pacific, digital age, 21st-century education

1.   Introduction

The third millennium witnessed the involvement of new technologies, which transformed the ways society functioned. The livelihood of people has changed through the increasing inclusion and usage of ICT resources and tools. Industries such as agriculture, transportation, communication and education have been automated to improve efficiency and productivity. The education sector has seen technology as a powerful catalyst for extensive changes in the education system and the stakeholders experiencing the evolution of education from Education 1.0 to Education 4.0(Himmetoglu Aydug & Bayrak., 2020; Tejedor et al., 2020; Feerrar, 2019).To elaborate further, Himmetoglu Aydug & Bayrak. (2020) define Education 1.0 as the downloading education, Education 2.0 as open access education, Education 3.0 as knowledge-producing education and Education 4.0 as innovation-producing education. Maphosa and Bhebhe (2019) add that Education 3.0 advanced the facilitation processes; thus, the students were learning virtually and the access to education was from anywhere at any time. On the other hand, Education 4.0 focuses on the use of smart technology, artificial intelligence, big data, and robotics in the teaching and learning processes (Tejedor et al., 2020, Feerrar, 2019). Education 4.0 reflects the innovations in teaching and learning practices, such as the use of digital technology and digital platforms for lifelong learning (Himmetoglu Aydug & Bayrak., 2020).

Student attributes in Education 4.0, as described by Himmetoglu et al. (2020), include cybersecurity knowledge, producing new information and using appropriate technologies, using technology effectively, the ability to differentiate between right and wrong information and distributing information safely using various online platforms. With Education 4.0 in place, there is a demand for higher education institutes (HEI) to graduate students with the relevant competencies to adapt to the technology-enabled work environment (Tejedor et al., 2020). Hence, many HEI worldwide is developing and expanding programmes to ensure that their graduates are well equipped with the required skills for digital workplaces (Feerrar, 2019). The collective shaping of individuals is referred to as digital literacy, which has become one of the essential surviving skills in the 21st century.

The term digital literacy has been defined as skills or competencies, or abilities of an individual to use digital technologies and knowledge of norms and practices that revolve around the appropriate use of relevant digital technologies (Reddy, Chaudhary & Sharma., 2020b; Feerrar, 2019; Maphosa & Bhebhe, 2019). There are several global definitions and frameworks developed for digital literacy; however, the emphasis range from the baseline knowledge about technology or computer literacy, and critical thinking to online engagement and ethics (Feerrar, 2019). These definitions and frameworks assist in measuring digital competencies and can help strategize the implementation of appropriate digital literacy programmes. Researchers believe that the digital competencies of students need to be measured so that the existing digital divide can be narrowed, particularly

in developing countries (Tejedor et al., 2020; Maphosa & Bhebhe, 2019). According to Tejedor et al. (2020), introducing educational technology itself does not improve teaching and learning outcomes. It needs to be used effectively and that is achievable through proper training. Dashtestani & Hojatpanah (2020), add that it is often assumed that the "Net Generation" learners are digitally literate and know how to use educational technologies presented to them effectively. However, this has been proved wrong by the many studies conducted, which showed that students who were above 30 years exhibited characteristics of digital natives (Tejedor et al., 2020). This means that although the "Net Generation" users are well versed in the use of new digital technology, there is a gap between personal and academic use of technology. The supposed digital natives are consumers of the digital content available to them rather than content creators for academic learning (Dashtestani & Hojatpanah, 2020; Reddy, Chaudhary & Sharma., 2020b; Tejedor et al., 2020).

The HEI is responsible for providing structured learning experiences. With Education 4.0, digital literacy can be used as the basis to prepare the graduates with the relevant skills needed for technology-enabled workplaces. Since the framework for digital literacy at higher education differs per individual, professional organizations, government and country, the current paper works on a digital literacy framework developed for the South Pacific. The reader is referred to the work of Reddy, Chaudhary & Sharma.(2020a). The developed framework, namely the South Pacific digital literacy framework (SPDLF) consists of 6 inter-related literacies, namely media literacy (M), information literacy (Info), visual literacy (V), communication literacy (Comm), computer literacy (C) and technology literacy (T). The SPDLF has been adopted from Covello's digital literacy framework and the definition for each literacy has been modified to meet the digital literacy requirements of the 21st century. Each literacy in the SPDLF has a number of attributes as shown in Figure 3. In total, sixty attributes will be used to measure the digital competencies of students. The sixty attributes have been developed to meet the requirements for the 21st century and the literacies in the SPDLF. This paper is a continuing work on digital literacy in the South Pacific by Reddy et al. (2020a, 2020b, 2020c). While the authors have conducted studies on measuring digital competencies of students at a regional university, this sequel aims (1) to provide a statistical validation of SPDLF, (2) to determine the strongest predictors of digital literacy from the SPDLF, (3) to determine the significant predictors of each literacy and (4) to evaluate the significant predictors of digital literacy from the sixty attributes that are part of the SPDLF.

Globally, studies on digital literacy have shown the digital literacy competencies of individuals, the frameworks of digital literacy, the contributions of digital literacy in education, the importance of digital literacy in the 4th industrial revolution, digital literacy as predictors of other literacies etc. The current study is the first of its kind in literature that evaluates each literacy's significant predictors/contributors in the digital literacy framework. This study also evaluates the significant predictors/contributors to overall digital literacy. Moreover, the paper provides a statistical validation of the South Pacific digital literacy framework developed to measure individuals' digital literacy competencies in the South Pacific and beyond. Digital literacy plays an important role in Education 4.0, thus knowing the significant contributors to digital literacy is important. Since the studied attributes for digital literacy are aligned to the 21st century required skills, the results of the study can be used by relevant stakeholders in the education sector and other interested organisations to revise and improve their digital literacy education curriculum and programmes.

The content of the paper is distributed as the following; contribution to the field of digital literacy by researchers including South Pacific in the literature review section, the description of the instruments to collect and measure digital competencies in the methodology section and the analysis of the data in the results and discussion section. Finally, the paper essays recommendations on ways digital literacy programmes can be aligned to improve the digital literacy of individuals in the South Pacific.

2. Literature Review

2.1 Digital literacy and its components

The theoretical understanding of digital literacy is extensive. While some researchers incorporate skills and competencies, others harness multi-literacies. The ideas and initiatives around digital literacy keep changing due to two reasons; technology keeps evolving, and new frameworks are continuously designed as per individual, organization, and country needs (Hamaguchi, Nematollahi & Minter, 2020; Radovanovic et al., 2020; Durak, 2019). The standard and global definition for digital literacy given by UNESCO (2018) are:

> *Digital literacy is the ability to define, access, manage, integrate, communicate, evaluate and create information safely and appropriately through digital technologies and networked devices for*

participation in economic and social life. It includes competencies that are variously referred to as computer literacy, ICT literacy, information literacy, data literacy and media literacy.

The above definition addresses the various dynamics and forms of digital literacy competencies needed for survival in the digital age. Although frameworks are being developed using the global definition from UNESCO, the dimensions in the country-based frameworks differ and reflect the sustainable development and progress of the country. For example, UK uses 7 elements of digital literacy (Radovanovic et al., 2020), Singapore uses 5 elements (Government of Singapore, 2020), the US uses the TPACK framework (digitalliteracy.US, 2020), Malaysia uses 3 element framework (Saubari & Baharuddin, 2016) while in the South Pacific a 6 element digital literacy has been designed (Reddy, Chaudhary & Sharma., 2020b). As stated above, the digital literacy framework developed by Reddy et al.(2020a, 2020b) is referred to as the South Pacific digital literacy framework (SPDLF). The SPDLF consists of 6 elements- media literacy, information literacy, visual literacy, communication literacy, computer literacy and technology literacy. As such, the definition of digital literacy in the South Pacific context is (Reddy, Chaudhary & Sharma., 2020b):

Digital literacy is an individual's ability to find and evaluate information, use this information effectively, create new content using this information and share and communicate this newly created information safely using appropriate digital technologies.

Research shows that essential components of digital literacy have been drawn by observing the requirements and demands of the digital society. As such the framework developed by (Reddy et al., 2020c) targets the essential digital competencies needed to bridge the persisting issue of the digital divide in the South Pacific. Although the framework has been piloted in the education sector, the authors believe that it can be applied to any context in the South Pacific and beyond. Moreover, the 6 elements or literacies that are part of the framework have been individually or inter-relatably researched upon. The next few paragraphs reflect prior research on the 6 literacies that are part of the study.

Reddy, Chaudhary & Sharma. (2020b), in their comprehensive review on digital literacy, state that the first literacy associated with digital literacy is visual literacy, which is seeing, interpreting, and communicating information to others. Researchers have defined visual literacy as a set of abilities that enables an individual to effectively find, interpret, evaluate, use, and create images and visual media (Kedra, 2018; Meeks, 2017). To add on, Hamaguchi, Nematollahi & Minter.(2020), Pem (2019) and Kedra (2018) state that an individual is visually literate if he/she has the knowledge and skills to interpret and understand visual messages, knows visual grammar and can use the visuals to communicate. The scholars, in their view, also state that there is no one definition of visual literacy since new technologies develop much faster and individuals deeply immerse themselves into using these new technologies. Learners are passive consumers of visual culture, they receive visual messages in the classroom, but to what extent they can derive meaning from them is another question (Kędra & Zakeviciute, 2019). Considering the above ideas, visual literacy has been reconceptualized as the ability to use digital technology to read, interpret and understand the information presented in pictorial or graphic images, communicate this information and convert it into visual representations.

Next, technology literacy has been defined as having the ability to use digital technology to improve learning, productivity, and performance (Reddy et al., 2020a; Durak, 2019). Many researchers have integrated technology literacy with computer literacy or information communication literacy but the authors of the current paper believe that technology literacy in the 21st century has separate competencies and needs to be separately learnt and measured as technology literacy involves a lot more than just knowing how to use technological devices. The notion is also supported by the work of (Durak, 2019; Julia & Isrokatun, 2019) which shows that technology literacy is beyond the ability to collect, manage, produce and transfer information and must not be mixed with computer or information literacy of individuals. Literature shows that the studies of technology literacy are now expanding their horizon from education and STEM fields to human resource management, from people with disabilities to facilitating elections (Jibia et al., 2020; Susanti et al., 2019; DeCoito & Richardson, 2018; Allison et al., 2017).

Next, computer literacy is an individual's understanding of how to use computers, digital technologies and their applications for practical use (Reddy et al., 2020a; Tsai et al., 2020; Fraillon et al., 2018). Recently, computer literacy has been classified as one of the fundamental and educational goals in many countries as its competencies consist of the use of computers, information gathering, evaluation and management, information production transformation and creation, digital communication, information sharing and responsible and safe

use of digital technologies (Tsai et al., 2020; Makhmudov, Shorakhmetov & Murodhosimov., 2020). Studies on computer literacy are now ranging from early childhood education to the older generation because there is a growing need for individuals to be computer literate (Tsai et al., 2020; Makhmudov, Shorakhmetov & Murodhosimov., 2020). Additionally, digital platforms being the medium of information distribution, is putting more emphasis on individuals to be computer literate. Therefore, computer literacy becomes an integral part of all spheres of 21st-century life.

The next literacy is information literacy, which is the ability to reflect on the nature of the information, its technical and social infrastructure and philosophical context and impact (Library, 2020). Since information literacy enables people to find relevant and credible information particularly using websites frequently to look for resources, it has become an integral part of educational institutes in the 21st century (Guo & Huang, 2020; Reddy, Chaudhary & Sharma.,2020b). The work of Aharony and Gazit (2020) and Konovalenkco and Nadolska (2020) add that information literacy makes teaching and learning effective irrespective of the level of education. Information literacy has also been marked as an important determinant of online information search capabilities and a significant competency that impacts an individual's acceptance of technology (Aavakare & Nikou, 2020; Coklar, Yaman & Yurdakul., 2017).

Likewise, media literacy which had been integrated with information literacy in many studies from literature, will be treated as a separate component in this study. Media literacy has become a lifelong process and is defined as the ability to access and create communication signals and recognize the property, wealth, and values underlying the messages (Reddy, Chaudhary & Sharma ., 2019; Ainura et al., 2018). Researchers add that media literacy has become a lifelong process as the use of the Internet for various purposes evolved in the 21st century (Simons et al., 2017; Sas, Meeus & Simons., 2017). Media literacy has been remarked in health care, particularly food communication, news reporting and online social behaviour (Festl, 2019; Austin et al., 2018; McGlinn & Casey,2018). The current authors believe that with the growth of technology and the media industry, individuals in the 21st-century must be media literate to be well-versed and comprehensive media users.

The final component of digital literacy is communication literacy which only a few researchers have separately studied (Ghasemi & Rasekh, 2020; Reddy, Chaudhary & Sharma., 2020b). Communication literacy has always been considered part of information literacy or media literacy (Zoubi, 2021; Lofthus & Silseth, 2019; Simon et al., 2017). The work of Ghasemi and Rasekh(2020) and Reddy, Chaudhary & Sharma. (2020b) define communication literacy as using digital technologies to communicate effectively as individuals and work collaboratively in groups, using publishing technologies, the Internet and the Web 2.0 tools and technologies. Communication literacy has been listed as an important literacy in the 21st century by only a few authors (Author et al., 2020b; Keskin, Ozata & Banar, 2015) and was adopted from Covello (2010). Since digital technologies and digital platforms have created and increased social interaction, one needs to have the ability to use these safely and effectively. Although individuals practise the act of communication literacy, there has not been any study done on communication literacy or the attributes of communication literacy. Through this study, the authors of the paper will highlight the attributes of communication literacy and their importance for 21st-century individuals.

The studies conducted on the above-discussed literacies vary amongst researchers. The characteristics of the attributes or features that define each literacy differ from one study to the other. For the current study, the characteristics selected to define each literacy are presented in Table 10 in the appendix. From the given characteristics/attributes of digital literacy, the strong predictors of digital literacy are evaluated.

2.2 Education 4.0 and Digital Literacy

The 4th Industrial Revolution (4th IR) brought changes in the education setting, making Education 4.0 the desired approach to learning. Education 4.0 harnesses the potential of digital technology and provides open education resources for lifelong learning (Chaka, 2020; Lestari & Santoso, 2019). On the contrary, Hariharasudan and Kot (2018) state that although Education 4.0 promotes an abundance amount of information and increases dynamic learning processes, it is often hindered due to weak alliance in adapting technology-enabled learning and lack of digital literacy skills. The work industry in the third millennium requires digital literacy skills to be productive and efficient; therefore the need for graduates to have digital literacy skills has become a requirement (Lestari & Santoso, 2019; Hariharasudan & Kot, 2018). As such, in collaboration with industries, HEI needs to come up with new programs to develop relevant digital literacy skills for its graduates. The idea of upskilling the digital competencies of graduates will transcend them to thrive in a digitally enabled work environment (Lestari &

Santoso, 2019; Abel et al., 2018). All in all, many scholars and researchers in the literature have invariably classified digital literacy as the gateway to Education 4.0.

Education 4.0 is best described as promoting life coping skills such as leadership, collaboration, creativity and innovation using digital technology, information and media literacy, knowledge about cyber-physical systems, artificial intelligence, Internet of Things (IoT), cloud computing, mobile technologies, open and smart education and blockchain (Tejedor et al., 2020, Feerrar, 2019; Lestari & Santoso, 2019; Hariharasudan & Kot, 2018). Figure 1 shows a summary of Education 4.0 which has been gathered from literature (Chaka, 2020; Lestari & Santoso, 2019; Hariharasudan & Kot, 2018; Abel et al., 2018). Education 4.0 for the current study has been categorised into four categories of life-coping skills, smart learning modes, transformation technologies and smart education tools.
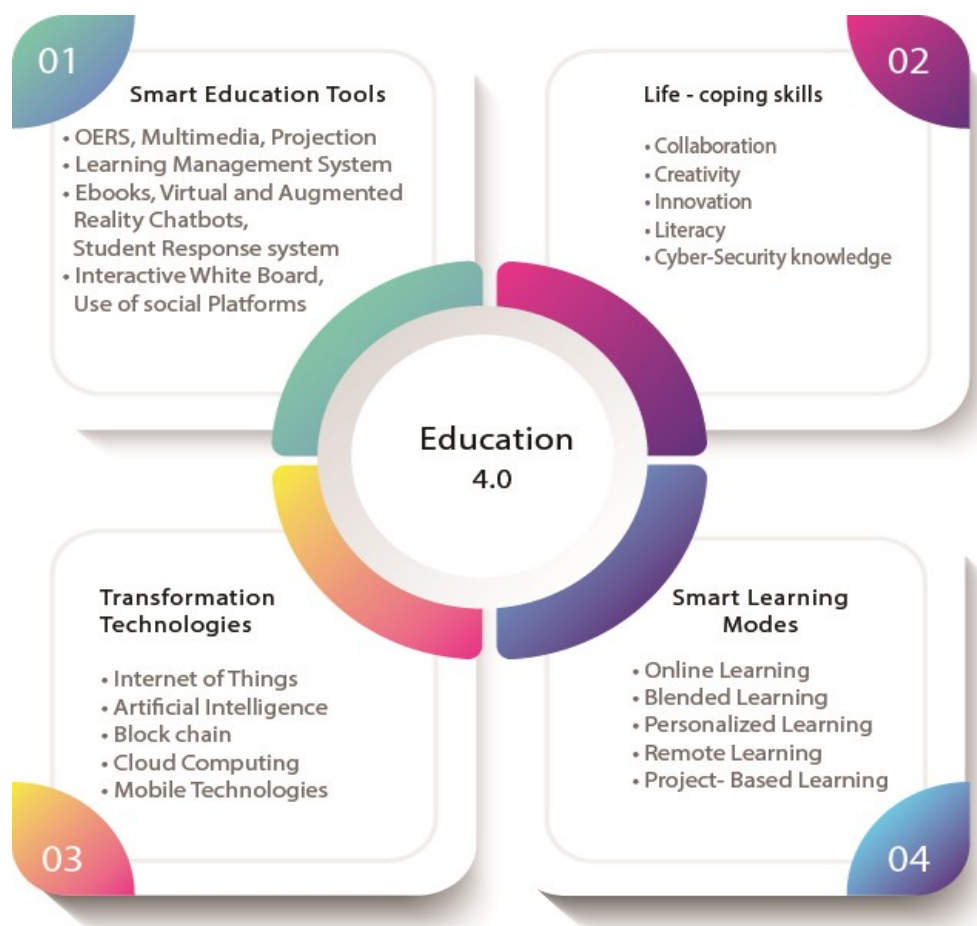

Figure 1: Education 4.0 summarised

Based on the characteristics of Education 4.0 listed by prior researchers and the characteristics of digital literacy discussed under "Digital literacy and its components", the authors of this paper have come to a conclusion that digital literacy and Education 4.0 have a strong relationship. Figure 2 describes the relationship between Education 4.0 and digital literacy. Figure 2 shows that the goals of Education 4.0 and the characteristics of digital literacy are similar; hence, it can be stated that digital literacy complements Education 4.0. Digital literacy enhances students' skills and enables them to successfully use technology-enabled systems (Abel et al., 2018). Digital literacy is also a manifestation of classroom performance, staff and student readiness for technology-enabled learning and lifelong learning (Makhmudov, Shorakhmetov & Murodhosimov, 2020). If a student has relevant characteristics of digital literacy, then he/she will accomplish the goals set by education institutes in the 21st century.

Figure 2: Relationship between Education 4.0 and digital literacy

2.3 Education 4.0 and Digital Literacy in the South Pacific

The impact of the 4th industrial revolution on the South Pacific region is similar when compared to the rest of the world. In the third- millennium, the South Pacific region is standing on the cusp of a digital revolution due to the permeation of digital technologies, the Internet and improved network infrastructure (GSMA,2019; Vula,2019; Raturi,2018; Sharma et al., 2018a). The proliferation of the digital revolution has been accelerated by the "Net Generation" in the South Pacific region and with this realization, the education sector has gone under reforms to meet the demands of learners who become the future workforce (Reddy et al., 2020a; Reddy, Chaudhary & Sharma., 2019; Sharma et al., 2019a; Sharma et al., 2019b). The governments of the South Pacific countries have also worked in collaboration with the industries, non-government organisations, and tertiary institutions to prepare a digitally skilled workforce in the region (Asian Development Bank,2019; The Fijian Government, 2019; Council of Regional Pacific Community, 2018; PRIF, 2015). The adaptation of new technologies will support transportation, renewable energy, manufacturing, agriculture, ICT, education and other service-related sectors (Sharma et al., 2019a; Council of Regional Organisations in the Pacific,2018; Park, 2018; Raturi, 2018). For the current research, the authors will reflect on the impact of the 4th industrial revolution on the education sector.

The University of the South Pacific (USP) is playing an active role in driving technology-enabled learning in the South Pacific region. The university is owned by 12 member countries across the region and is responsible for integrating ICT and digital technologies to deliver its teaching and learning processes (Reddy et al., 2020a; USP, 2019; Sharma et al., 2019a; Raturi, 2018; Sharma et al., 2018a). Some of the technology-enabled facilities at USP include (Sharma et al., 2018b):
1. distance flexible learning, which includes blended learning, cohort-based learning, online learning, tablet learning through the use of assistive technologies such as teleconferencing, learning management systems, smartphones, mobile devices and Big Blue Button.
2. virtual classrooms using the Remote Education and Conferencing Tool (REACT) services.
3. Online Mathematics Diagnostic Tool (OMDT) is an intelligent testing system that diagnoses student's knowledge in different areas of mathematics.
4. early warning system (EWS) to track student activity and performance via the learning management system Moodle.
5. lecture capture system which records lectures that include the audio, the lecture slides that are projected on the screen and lecturers' annotations in class.

Other universities in the South Pacific region like the University of Fiji, The Fiji National University, the Univerity of New Caledonia, Solomon Islands National University and the National University of Samoa facilitate their teaching and learning processes similarly. The South Pacific researchers have termed these facilitation processes in the 4[th]IR as technology-enabled education or ICT-enabled education or digital education (Sharma et al., 2019b; Nand & Sharma, 2019; Raturi, 2018). However, if the above education processes or services are evaluated, they can be classified as active components of Education 4.0, captured in Figure 1. Therefore, to the best of the authors' knowledge, this study is the first from the South Pacific region, which recalibrates the education processes of the 21st century in the region as Education 4.0. Therefore, the term Education 4.0 will be used onwards in this paper to describe digital learning in the South Pacific region.

The global education sector demands its learners to be digitally literate for the successful implementation and facilitation of Education 4.0. Scholars have stated that many countries are implementing digital literacy education to successfully drive Education 4.0 (Tejedor et al., 2020, Feerrar, 2019; Lestari & Santoso, 2019). While the concept of digital literacy has been rapidly adopted by developed countries and integrated into their education system, for developing countries like the South Pacific, the process has just begun (Reddy, Chaudhary & Sharma., 2020b). The work of the authors Reddy et al.(2020a, 2020b) introduces the digital literacy scale, digilitFj, and the digital literacy intervention program, DLIP, which have been designed and developed using the South Pacific digital literacy framework. DigilitFj measures the digital literacy competencies of individuals and DLIP provides digital literacy remediation for improving the digital literacy competencies of the individuals. For more information, the reader is referred to " Measuring the digital competency of freshmen at a higher education institute" and "Digital Literacy: A Review of Literature" document details the status of digital literacy in the South Pacific. For details on the DLIP, the reader is referred to as "Contextualized Game-Based Intervention for Digital Literacy for the Pacific Islands" (Reddy et al., 2021). The above work on digital literacy that is designing and developing SPDLF, digilitFj and DLIP is the first digital literacy initiative that provide an opportunity to measure and address the digital literacy issues in the South Pacific.

Additionally, the paper looks at the strong predictors of digital literacy from two perspectives; which literacy is the strongest predictor of digital literacy and which generally attributes from the sixty chosen are its strong predictors. The term strong predictor refers to an attribute that forecasts the occurrence of an event that is likely to happen. Usually, for such studies, a regression analysis is used and the coefficients are used to evaluate the strong predictors (Kar & Ilavarasan, 2017). There have been no prior studies that have evaluated strong predictors of digital literacy using any of the frameworks that have been developed to measure digital literacy. The authors of this paper believe that doing such evaluations is necessary as the results obtained can contribute to the effective championing of digital literacy education/ skills.

3. Research Objectives

Using the South Pacific digital literacy framework (SPDLF), the following objectives have been formulated:
1. To evaluate strong predictors of digital literacy from the 6 literacies
2. To evaluate the significant predictors of each literacy
3. To evaluate the significant predictors of digital literacy from the chosen sixty attributes in the SPDLF

4. Methodology

This exploratory research design study uses quantitative analysis to provide a three-stage statistical validation to the SPDLF, as shown in Figure 3. The study explores the (1) strong predictors of digital literacy from the six literacies- Figure 3, Process 1, (2) significant predictors of each literacy- Figure 3, Process 2 and (3) significant predictors of digital literacy from the sixty attributes- Figure 3, Process 3. According to USC Libraries (2020), quantitative analysis involves data collection through the use of closed-ended questionnaires or polls and then performing calculations using mathematical and numerical analysis to determine the relationship between variables. The current research uses the data collected to measure students' digital literacy status in the Fiji Islands. The data for the study was from 2755 senior high school students from the Fiji Islands in the final term of their senior high education. There is a need to evaluate the digital literacy of the mentioned sample as they would be soon entering higher education institutes where Education 4.0 is practised. To have a successful learning journey in HEI, the students need to have digital skills, and this research determines the important contributors to digital literacy from the sample. The attributes of the data set are described in Table 10 in the appendix. The Statistical Package for the Social Sciences (SPSS) was used to perform the following analysis; normality test for the date set, correlation analysis and multiple linear regression analysis to evaluate the strong predictors of the different literacies and the strongest predictors from the sixty attributes of digital literacy. For the validation of the attributes in the SPDLF, an Exploratory Factor Analysis(EFA) was carried out. The factor loadings for the sixty attributes were calculated to decide which ones to keep and which ones to delete. The factor loadings for almost all the variables were 0.5 and above and for those variables whose factor loading were 0.3 and 0.4, the authors decided to keep them as they were important for the study.

Figure 3 illustrates the SPDLF, which has been used to design and develop digilitFJ and DLIP. The processes shown in Figure 3 show the approach used for the data analysis – the three-stage validation process. Process 1 involves evaluating the significant predictor of digital literacy from the 6 literacies chosen for the study. In contrast,

process 2 involves evaluating the significant contributor of each literacy based on the attributes of each literacy. Finally, process 3 involves evaluating the significant contributors to the overall digital literacy.
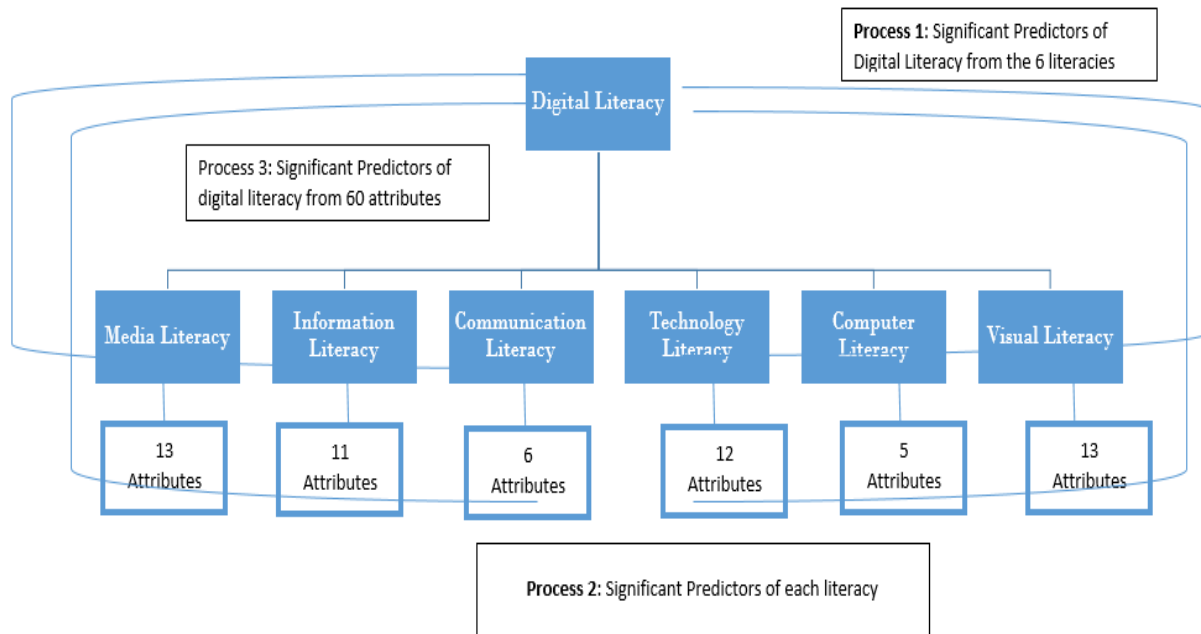

Figure 3: The three-stage validation process from the SPDLF

4.1 Data Set

As mentioned in the Introduction, the digital literacy framework has 6 literacies and sixty attributes. Table 11 in the Appendix shows a description of the attributes.

4.2 Data Analysis

The Kolmogorov-Smirnov and Shapiro-Wilk test were performed to evaluate the normality of the data set. As the sample size is 2755, the results from Kolmogorov-Smirnov will be used. According to Laerd (2020) to determine the normality of a data set with a population size greater than 50, it is best to use the Kolmogorov-Smirnov normality test. A spearman's correlation analysis was also performed to evaluate the relationship between the 6 literacies and between each literacy with digital literacy. The mentioned result will rely upon the importance of each literacy concerning digital literacy and if it corresponds with the digital framework that has been developed for the study. The multiple linear regression is also carried out to evaluate the contribution of each variable and attribute in different instances like:

1. evaluating the most significant contributor from the 6 literacies to digital literacy
2. evaluating the most significant contributors to each literacy
3. evaluating the most significant contributors to digital literacy from the 60 attributes that are given in Table 10.

According to Kenton (2021), multiple linear regression (MLR), also known simply as multiple regression, is a statistical technique that uses several explanatory variables to predict the outcome of a response variable. The independent variable is the parameter that is used to calculate the dependent variable or outcome. For this case, there are multiple independent variables and only one dependent variable hence, performing an MLR, enabled the team to evaluate the most significant contributor/s to the outcome of the dependent variable.

5. Results

5.1 The normality test

The Kolmogorov-Smirnov test was utilized and as per the results, the sig value is 0.00, which is < 0.01; therefore, the null hypothesis is rejected and it can be concluded that the data is not normally distributed. Therefore, to evaluate the relationship between the different literacies, spearman's correlation was performed.

5.2 The correlation Analysis

Table 1 shows the correlation between the 6 literacies with digital literacy and the correlation between the 6 literacies. According to the results, each literacy has a significant relationship with digital literacy. The correlation coefficient values for each literacy with digital literacy range from 0.8 to 0.9, indicating that there is a very strong correlation between each literacy with digital literacy (statstutor, 2019). As far as the relationships between the 6 literacies are concerned, the relations can be described as moderate to a very strong relationship as the correlation values range 0.57 and above (statstutor, 2019).

Table 1: Correlation between the different literacies

	Digital Literacy	*Communication Literacy*	*Computer Literacy*	*Information Literacy*	*Media Literacy*	*Technology Literacy*	*Visual Literacy*
Digital Literacy	1.000	.790	.785	.896	.864	.896	.896
Communication Literacy	.790	1.000	.670	.664	.615	.588	.611
Computer Literacy	.785	.670	1.000	.600	.567	.630	.593
Information Literacy	.896	.664	.600	1.000	.809	.778	.814
Media Literacy	.864	.615	.567	.809	1.000	.762	.757
Technology Literacy	.896	.588	.630	.778	.762	1.000	.827
Visual Literacy	.896	.611	.593	.814	.757	.827	1.000

5.3 Significant contributors to digital literacy

The stepwise multiple linear regression was performed to evaluate the strongest predictor of digital literacy from the 6 literacies used for this study's digital literacy framework. For each literacy, each variable was independent variables and overall literacy were independent variables. Table 2 shows the standardized beta values (β) from the multiple linear regression analysis. Looking at the weights for each literacy, it can be stated that all the literacies significantly contribute to digital literacy. The weights for the given literacy show that the most significant contributor to digital literacy is *computer literacy*, followed by *technology* and *visual literacy*, followed by *communication* and *media literacy*. *Information literacy* has the lowest weight, however, there is no statistical difference in the weights of each literacy. Therefore, all literacies are significant contributors to digital literacy.

Table 2: Significant contributors to digital literacy

Variable	*Standardized Coefficients*
	β
Information Literacy	.174
Computer Literacy	.208
Technology Literacy	.205
Communication Literacy	.185
Media Literacy	.185
Visual Literacy	.205

5.4 Significant contributors for each literacy

5.4.1 Communication literacy

There are 5 attributes of communication literacy and Table 3 shows the standardized beta values (β) for each. As per the result, *C1* (Using a digital platform for personal use – online booking and appointments) is the most significant contributor of digital literacy, followed by *C2* (Participating in online chats and forums for learning and research) and *C5* (Using Open Educational Resources (OERs)). However, the results in Table 3 also show

that the β values differ by 0.01; therefore, there is no significant difference in the β values. All the attributes of communication literacy are important.

Table 3: Significant contributors to communication literacy

Communication Literacy	Standardized Coefficients Beta (β)
C1	.261
C2	.259
C3	.248
C4	.234
C5	.258

5.4.2   Computer literacy

Table 4 displays the standardized beta values (β) for computer literacy. Computer literacy has 6 attributes and Comm3 (Resolving basic technical equipment problems) is the most significant contributor for computer literacy, followed by Comm5 (Using of office applications) and then Comm2 (Using anti-virus software). However, the β values for all the attributes of computer literacy differ by 0.01, hence, there is no significant difference in the β values. All attributes are important for an individual to be computer literate. Although Comm4 (Using google to search for topics) is slightly lower than the other attributes, it will also be considered an important contributor to computer literacy.

Table 4: Significant contributors to computer literacy

Computer Literacy	Standardized Coefficients Beta
Comm1	.196
Comm2	.201
Comm3	.214
Comm4	.180
Comm5	.207
Comm6	.199

5.4.3   Information literacy

Table 5 shows the significant contributors to information literacy. The most significant contributor of information literacy is *Info7* (Sharing files legally with others) followed by *Info2* (Citing references for online resources used), *Info6* (Collaborating safely with others online, for example, secured password, aware of spams and fake websites) and *Info8* (Adding comments to blogs, forums or web pages for online communications). The standardized beta values (β) for other attributes are lower, but there is no statistically significant difference between the 11 attributes of information literacy, hence, all the attributes shown in Table 5 are significant contributors to information literacy.

Table 5: Significant contributors to information literacy

Information Literacy	Standardized Coefficients Beta	Information Literacy	Standardized Coefficients Beta
Info1	.120	Info7	.138
Info2	.129	Info8	.129
Info3	.123	Info9	.126
Info4	.120	Info10	.118
Info5	.127	Info11	.116
Info6	.129		

5.4.4 Media literacy

Table 6 shows the standardized beta values (β) for the thirteen attributes of media literacy. M2 (Choosing appropriate media) is the most significant contributor to media literacy followed by M3 (Creating new content word/excel/powerpoint) and M11(Creating pdf documents). Since β values for the thirteen attributes of media literacy differ by 0.01 therefore there is no significant difference in the β values. All the attributes of media literacy will be treated as significant contributors to media literacy.

Table 6: Significant contributors to media literacy

Media Literacy	Standardized Coefficients Beta	Media Literacy	Standardized Coefficients Beta
M1	.106	M8	.116
M2	.113	M9	.100
M3	.112	M10	.104
M4	.107	M11	.112
M5	.105	M12	.109
M6	.110	M13	.093
M7	.098		

5.4.5 Technology literacy

Technology literacy has twelve attributes and the standardized beta values (β) are given in Table 7. The attribute T4 (Knowing how to use search engines and online directories) and T7 (Knowledge about password protection) have the highest β values making them the most significant contributors of technology literacy. The highest value is for T10 (Knowledge of word processing, spreadsheet, database and presentation software) followed by T2 (Planning, creating and editing presentations, video, animations, simulations and podcasts). Since the β values for the other attributes differ by 0.001, there is no significant difference in the β values. All the attributes will be considered significant contributors to technology literacy.

Table 7: Significant contributors to technology literacy

Technology Literacy	Standardized Coefficients Beta	Technology Literacy	Standardized Coefficients Beta
T1	.101	T7	.108
T2	.104	T8	.100
T3	.101	T9	.096
T4	.108	T10	.106
T5	.096	T11	.101
T6	.103	T12	.102

5.4.6 Visual literacy

Table 8 shows the standardized beta values (β) for the thirteen attributes of visual literacy. According to the results, *V2* (Identifying a variety of sources for images) is the most significant contributor of visual literacy followed by *V3* (Accessing required images and visual media using tools and technology to produce images and visual media) and V11(Using tools and technology to produce images and visual media). For visual literacy, there is no statistically significant difference between the β values for the thirteen attributes, hence all the attributes are significant contributors to visual literacy.

Table 8: Significant contributors to visual literacy

Visual Literacy	Standardized Coefficients Beta	Visual Literacy	Standardized Coefficients Beta
V1	.106	V8	.116
V2	.113	V9	.100
V3	.112	V10	.104
V4	.107	V11	.112
V5	.105	V12	.109
V6	.110	V13	.093
V7	.098		

5.5 E: Significant contributors to digital literacy from sixty attributes

Table 9 shows the complete sixty attributes of digital literacy. For this analysis, each literacy was independent vairbale and overall digital literacy was dependent variable.The most significant contributors of digital literacy are *Comm3* (Resolving basic technical equipment problems)*, Info7* (Sharing files legally with others)*, Comm5* (Using of office applications), *T4* (Knowing how to use search engines and online directories), *T7* (Knowledge about password protection) with β value of 0.27. Table 9 also shows that the β values for technology literacy (T1-T12) range from 0.24 to 0.27 that is the highest β values amongst the sixty attributes. However, the β values for the other attributes range from 0.021 to 0.026; therefore, there is no significant difference in the β values of all the sixty attributes. As such, all the attributes will be treated as significant contributors to digital literacy.

Table 9: Significant contributors to digital literacy

Attributes	Standardized Coefficients Beta	Attributes	Standardized Coefficients Beta	Attributes	Standardized Coefficients Beta
V3	.025	C4	.021	Info2	.025
T12	.026	Info7	.027	T8	.025
Info6	.025	T11	.025	Comm4	.023
V11	.024	Comm5	.027	M2	.025
Comm3	.027	M6	.024	Info1	.022
M11	.024	V1	.025	Info3	.023
Info10	.022	T4	.027	M1	.023
T9	.024	Info9	.024	T10	.026
M10	.023	C5	.024	V4	.025
Comm1	.025	V8	.024	V12	.024
V9	.026	M5	.023	M4	.023
Info5	.025	V5	.024	M3	.025
C2	.024	C1	.025	C3	.023
T5	.024	M13	.021	Comm6	.025
V6	.024	M12	.024	V10	.025
Info8	.025	T6	.026	Info4	.022
M9	.022	M7	.022	T3	.025

Attributes	Standardized Coefficients Beta	Attributes	Standardized Coefficients Beta	Attributes	Standardized Coefficients Beta
T2	.026	T1	.025	V7	.024
V13	.025	T7	.027	V1	.023
M8	.025	Comm2	.026	Info11	0.22

6. Discussion

For the study, a digital literacy framework designed for PICs that consists of 6 other literacies was utilized to evaluate the digital competencies of the senior high school students in the Fiji Islands. Each literacy consisted of specific attributes and in total, there were sixty attributes, as shown in Table 10 in the appendix section. The authors claim that all the literacies and as well as all the attributes associated with digital literacy are important to define a digitally literate individual. A spearman's correlation analysis and a stepwise multiple linear regression analysis were performed to evaluate the claim.

Prior studies have shown that literacies associated with digital literacy strongly correlate with digital literacy (Hamaguchi, Nematollahi & Minter,2020; Makhmudov, Shorakhmetov & Murodhosimov., 2020; Pem, 2019; Kedra, 2018). The results of the current study also show that the 6 literacies chosen for the digital literacy framework designed for PICs have a strong relationship with digital literacy, with the correlation values ranging from 0.8 to 0.9. Also, each literacy has a moderate to a very strong relationship with each other as the correlation values are 0.57 and above. The correlation values verify that the 6 literacies associated with digital literacy for the study are appropriate and significant.

The standardized beta values (β) obtained from the stepwise multiple linear regression indicate that all the attributes for each literacy are significant and a strong contributor in defining the literacy competencies for each literacy. For example, the standardized beta values (β) for all the attributes in media literacy are significant and predictors of media literacy. The values obtained are not different from each other; therefore, an individual must have all the attributes of media literacy to be media literate. The β values for the sixty attributes are given in Table 9 and the values obtained are closer to each other. The β values for the sixty attributes differ by 0.01, which is not statistically significant; therefore, all sixty attributes are significant predictors/contributors to digital literacy.

The results from the study statistically validate the South Pacific digital literacy framework and prove that the literacies and the attributes associated with digital literacy are statistically significant and appropriate predictors of digital literacy. Additionally, the results comprehended the results of the studies by Reddy et al.(2020b,2020c). Therefore, the SPDLF, digitliFj, and DLIP can be used with complete trust and conviction to evaluate individuals' digital competencies reliably.

7. Conclusion

The impact of the 4th industrial revolution will continue to bring profound impacts and changes to the education landscape. Therefore the individuals of the digital society must be prepared to appreciate new technologies and learn the appropriate skills required to function using the new technologies that are introduced. The required skills to function and survive in the 21st century are digital literacy skills. Research also shows that digital literacy is driving the education sector as learners require appropriate digital literacy skills to function in the technology-enabled learning environment. Hence, the current research communicates a digital literacy framework that has been developed to evaluate the digital competencies of individuals.

The paper entails whether the attributes that are associated with digital literacy for this study are statistically significant or not. The study provides statistical validation for the South Pacific digital literacy framework (SPDLF) which has been used to design and develop the digital literacy scale, digilitFj and the digital literacy remediation tool, DLIP, to improve the digital literacy competencies of the South Pacific populace. The results obtained show that all the literacies and the attributes associated with digital literacy are statistically significant. Thus the SPDLF developed for digital literacy by the authors is valid and significant. Also, there is a strong and positive statistical relationship between 6 literacies and digital literacy thus the literacies associated with digital literacy in the SPDLF are valid and significant. Moreover, the results show that the beta values (β) for sixty attributes in the

SPDLF differ by 0.01, which is not statistically significant; therefore, all the sixty attributes are significant contributors/predictors of digital literacy. Therefore, the digital literacy framework (SPDLF) is a good measure of the digital competencies of individuals.

The theoretical component of the paper discusses that digital literacy in the 21st century is an essential component of Education 4.0. Since the results from the current study show the SPDLF, digitlitFJ and DLIP are significant and valid, it can be stated that the three tools are strong and significant components of Education 4.0. In the digital society, Education 4.0 and digital literacy can be used to improve the digital competencies of individuals and prepare individuals for the technology-enabled working environment. Moreover, the South Pacific digital literacy framework and the digital literacy scale can be used by relevant stakeholders and academics to measure the digital competencies of individuals. Furthermore, workshops and training programs to improve the digital competencies of individuals can be implemented. Education 4.0 and the tools mentioned in the paper can be used to impart essential skills to the students to prepare them for their prospective working environments.

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Appendix

Table 10: Description of data set

Variables	Description
M1	Interpreting media messages
M2	Choosing appropriate media
M3	Creating new content in word/excel/PowerPoint
M4	Communicating and presenting using media such as using Blogs and YouTube
M5	Revising existing content
M6	Participating in public debates eg using social media, emails and online forums
M7	Using different sources of information and media devices eg Internet and social networks
M8	Navigating through hyperlinks
M9	Understanding copyright
M10	Selecting possibilities through online newspapers, cookies, websites and news channels
M11	Creating pdf documents
M12	Understanding Intellectual property rights
M13	Knowing how to use computers, smartphones, tablets and smart media

Variables	Description
C1	Using a digital platform for personal use – online booking and appointments
C2	Participating in online chats and forums for learning and research
C3	Using publication technologies
C4	Using the Internet to communicate
C5	Using Open Educational Resources (OERs)
Info1	Using the information in different media, for example, podcasts or videos
Info2	Citing references for online resources used
Info3	Creating content in different media
Info4	Knowing what and how to find information on the web
Info5	Keeping a digital record of information relevant to you
Info6	Collaborating safely with others online for example secured passwords, aware of spams and fake websites
Info7	Sharing files legally with others
Info8	Adding comments to blogs, forums or web pages for online communications
Info9	Assessing whether an online resource (e.g. web page, blog, wiki, video, podcast, academic journal article)credible and trustworthy
Info10	Using advanced search options to look for information on the web
Info11	Knowing what a bibliography is
V1	Defining and identifying the need for an image
V2	Identifying a variety of sources for images
V3	Accessing required images and visual media
V4	Organizing images and the source of information
V5	Identifying the physical, technical and design components of an image
V6	Interpreting and analyzing an image
V7	Evaluating the effectiveness and reliability of an image
V8	Evaluating textual information accompanying the images
V9	Using technology to work with images
V10	Knowing how to interpret images and including them in your scholarly projects
V11	Using tools and technology to produce images and visual media
V12	Understanding and following ethical, legal, social, and economic issues surrounding images and visual media
V13	Citing images and visual media in projects and presentations
T1	Backing up and Recovery of data
T2	Planning, creating and editing presentations, video, animations, simulations and podcasts
T3	Choosing best hardware / software for a given task
T4	Knowing how to use search engines and online directories
T5	Identifying different computer platforms and software versions

Variables	Description
T6	Creating mail merge
T7	Knowledge about password protection
T8	Compressing and Decompressing files
T9	Knowledge of emerging technology and its limitations
T10	Knowledge of word processing, spreadsheet, database and presentation software
T11	Installing and uninstalling software
T12	Knowledge about web authoring tools
Comm1	Having an email account
Comm2	Using anti-virus software
Comm3	Resolving basic technical equipment problems
Comm4	Using google to search for topics
Comm5	Using of office applications
Comm6	Having and using social media accounts