Digital Literacy: A Catalyst for the 21st Century Education

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The seamless integration of new digital technologies into higher education teaching and learning has transformed education pedagogies and changed how students learn. The students are now required to have digital competencies to survive in the era of learning with technology; therefore, measuring the students' digital competencies is of utmost importance. This study evaluates the first-year university students' digital competencies at a higher education institute using a newly designed digital literacy measuring tool named digitlitfj. The digitlitfj is an online tool consisting of a 5 point Likert scale questionnaire ranging from 'No understanding' to 'Advanced level of understanding' that was piloted to the first-year university students. The results show that 86.15% of the students were average to very highly digitally literate. Also, Deep learning, Support Vector Machine, Random Forest and Decision Tree algorithms in RapidMiner were used to evaluate the most important and influential variables in predicting an individual's digital literacy competency. The results show that all the variables utilized in the research were important, with computer literacy being the most influential variable in predicting an individual's digital literacy.

Keywords: digital literacy, digitlitfj, digital literacy scale, higher education, random forest.

I. INTRODUCTION

The proliferation of digital technology in this digital era has changed the norms of the digital society. Digital society suitably describes the society we live in today because there is extensive use of digital technology used to carry out daily activities and create a wide range of opportunities. The world is embracing new digital technologies and using them for the betterment of societies. Since digitization is permeating society, every individual living in the digital society needs to have digital literacy skills to survive and have better livelihood [1][2][3]. According to the literature, the term digital literacy skills was used until the mid-1990s, after which the digital literacy skills and digital competencies were used interchangeably [4][5].

The current job market and the education system have also incorporated technology-oriented environments to increase efficiency and productivity. According to Phuapan et al. [6], jobs now require innovation, creativity, social intelligence, and high productivity, which are associated with digital literacy skills. Therefore, the most effective way to yield a workforce with relevant digital survival skills can be through adequate and proper education in digital literacy

The educational institutes are adopting digital technology to engage their students with various teaching and learning processes [5][7][8]. Students are now exposed to new pedagogical tools at higher education and they are required to learn using these tools and survive in the technology-oriented learning environment [9][6]. The higher education forefront now uses digital platforms to facilitate the teaching and learning processes for all online and face-face enrolled students [10][8][5]. The digitally-driven learning processes now demand and expect students to have digital literacy skills to enable them to negotiate online activities and adopt the digitally enhanced learning environments[1][11][12][13].

Since digital literacy has become an important component of higher education, the students' digital competencies must be measured [7][14]. According to Neilson and Khateeb [8][4], the younger generation is considered digital natives; however, they do not possess relevant digital literacy skills. It is often seen that many of the digital natives have poor academic performance and eventually drop out of their higher education studies [2][14]. The authors, Chan et al. [11], Dios et al. [3], and Zhang & Zhu [12], state that digital competencies must be measured so that educational institutions can place proper interventions to improve the digital literacy skills of the students. Many measuring tools have been developed in the literature such as instruments to measure ICT competencies and media literacy, scales to measure digital literacy and surveys to evaluate digital competencies [1][3][6]. As mentioned above, the authors measured digital competencies according to the different literacies they associated digital literacy with. Their studies also showed that each literacy positively correlates with the other literacies and the overall digital literacy.

Motivated from the above claims on the importance of digital literacy in the digital society and the important role of higher education in enforcing digital education to the future workforce, this research study aims to measure the digital competencies of higher education students and carry out a prediction analysis on the future incoming students. The study focuses on the digital competencies of the first-year students at a regional university in the South Pacific. Since digital literacy is an emerging concept in the South Pacific very little research has been conducted in this area. The current paper is a sequel to the research conducted on digital literacy by Reddy et al. [1], which evaluated the digital competencies of students

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in the second semester of their first year of study. This article aims to measure students' digital competencies using the newly designed digital literacy scale - *digitlitfj*. The research has also carried out a prediction analysis using the Random Forest Algorithm in RapiMiner to evaluate the most important and influential variables for an individual's digital literacy. The analysis was carried out to ensure that relevant interventions could be derived to improve students' digital literacy skills. Improved digital literacy skills will mean that the students can effectively interact and use the digital environment, hence reducing the attrition rates.

Prior research has shown that digital literacy education has just begun in the South Pacific [1]. There is a need to measure digital competencies so that more initiatives to improve digital literacy skills of the South Pacific populace can be implemented. The current research introduces a newly developed digital literacy scale, digilitfj, which can be used to measure digital competencies of individuals. The digilitfj is the first scale developed in the South Pacific and it aims to evaluate an individual's digital competencies. A knowledge of the digital literacy status will enable relevant stakeholders to develop appropriate interventions to improve the individuals' digital literacy skills. Furthermore, the analysis of the paper validates the claims by the current authors; that the six literacies are essential to evaluate the digital literacy of the individuals. Also, the levels in digilitfj, which is shown in Table 1, corresponds with the prediction analysis carried out in this research. Finally, the paper suggests ways to improve the digital literacy skills of the individuals in the South Pacific.

The paper's outline is as follows: section II entails the definition and framework of digital literacy. The details of the newly developed scale, which is digilitfj are entailed in section III. Section IV shows the results gathered for this study and the last section is the concluding remarks for the present study.

II. Literature Review

The term digital literacy was first introduced by Paul glister in 1997 when the use of the internet, access to digital content and the use of digital technologies were starting to grow. According to Glister [15], digital literacy is the ability of an individual to understand and use different formats of information gathered from various sources via computers. As new technologies evolved, the individuals required new sets of skills and abilities, therefore, the definition of digital literacy evolved [16]. Together with redefining digital literacy, the researchers associated different sets of skills with it [16][17]. These sets of skills were later termed as literacies associated with digital literacy [16][18].

The definition of digital literacy evolved with new and changing technologies. More attributes and characteristics were associated with the term. Given below are the definition of digital literacy from 2015;

i. the ability to use digital technology, communication tools, or networks to find, evaluate, utilize, share, and create content using information technologies and the internet [19][20][21][22].

ii. the assimilation and accommodation of the learning processes and have the elements of culture, construction, communication, confidence, creativity, and critical thinking [23][24].

iii. the ability of an individual to find and evaluate information, use this information effectively, create new content using this information and share and communicate this newly created information using appropriate digital technologies [1].

Together with the varied definitions of digital literacy, the term digital competence was also introduced by researchers.

The term digital competence gives more horizon in describing a digitally literate individual [25][26][27]. According to Spante et al.[28] and Khateeb [4], digital competence involves the confident and critical use of technology for work, leisure, and communication. Additionally, digital competencies show the ability to use potential technology and indicate meaningful participation in the emerging digital society [26][27]. Hence, for the current paper, the term digital competence or digital competency will define an individual's ability to perform tasks using digital technologies.

Literature shows that several frameworks for digital literacy have been developed by researchers to suit their learners and transform the learning process amongst individuals in the digital society [17][18]. These frameworks have included dimensions that empower individuals to develop abilities to use digital technologies and educate individuals on lifelong learning skills [14]. The frameworks of digital literacy and the association of different literacies to these frameworks had varied according to the nature of the research and environmental settings. The following are selected digital frameworks from literature:

i. Goodfellow [29] state that the digital literacy framework involved the following literacies; Information Communication Technology (ICT), Technology, Media, Visual, and Communication literacy.

ii. Martin & Grudziecki [19] associated technology literacy, information literacy, media literacy, visual literacy and communication literacy with digital literacy.

iii. Erstad[27] and Buckingham[21] and Dutta [30] associated with digital literacy with Media literacy.

iv. Stricevic [31] associated digital literacy with ICT literacy.

v. Nedungadi et al. [14] developed a digital literacy framework that included the following literacies: Information literacy, Health literacy, Financial literacy, eGovernance literacy, eSafety literacy, eLearning literacy.

vi. Reddy et al.[1] associated digital literacy with media literacy, visual literacy, information literacy, communication literacy, computer literacy, and technology literacy.

Since the research presents the continuous work on digital literacy of the authors Reddy et al. [1], [32] and [33], digital literacy will be associated with media literacy, visual literacy, information literacy, communication literacy, computer literacy, and technology literacy. These six literacies have been chosen because, according to prior research conducted, they are the most suitable literacies for evaluating digital competence in an educational setting [1][3][6]. The literacies were used to develop a new digital literacy scale, digilitfj, to measure the digital competencies, particularly in educational settings. There have been scales developed in the literature that measure individuals' digital competencies[3][6]. However, the authors of the research study believe that those scales do not include all the relevant competencies that are

important in this digital age. The details about digilitfj are in section III of the paper.

The higher education institutes globally are pitching in to deal with the notion of using digital technologies for the teaching and learning processes [35][36][37][38]. The year 2020 forced the education institutes to reinvent themselves and shift the education system to online and emergency remote teaching [39] [40] due to the unknown circumstance of COVID-19 [41]. The unprecedented event of COVID-19 and the emergency shift of the world's entire education system emphasized the need for digital literacy education [42]. The quest for digital literacy education is the same for South Pacific educators when compared to the rest of the world.

In the South Pacific, digital literacy work has already begun, and the current study introduces digilitfj. The study is set in a regional university, namely the University of the South Pacific (USP), whose main campus is located in Suva, Fiji [10][43]. The university uses virtual classrooms, mobile learning, tablet learning, cohort-based learning to provide collaborative and distance-based learning to its students [1][9]. Also, tools like Online Mathematics Diagnostic Tool (OMDT), Early Warning System (EWS) and Lecture Capture System are used to facilitate online delivery [9][44]. The university faces similar challenges of lack of digital fluency by its students [45]. The authors believe that if the students' digital competencies are known, then appropriate interventions can be derived to improve the students' digital literacy skills. Therefore, this study was conducted to gauge the digital competency of the first-year students enrolled at the university using the digilitfj. Since there are six literacies associated with digital literacy from this research, the authors also performed a correlation analysis to evaluate digital literacy's most influential predictor literacies.

Literature has many predictive analytic tools, but for this study, RapidMiner was used. RapidMiner brings artificial intelligence to the enterprise through an open and extensible data science platform [46][47]. Built for analytics teams, RapidMiner unifies the entire data science lifecycle from data prep to machine learning to predictive model deployment and is appropriate for educational data mining [47][48]. According to Ahmed [49], Massaro et al. [50] and Teja et al. [51] RapidMiner is one of the most effective data mining tools for prediction analysis. Prediction analysis indicates the associated values to the predictor variable and this enables the relevant stakeholders to prepare their material accordingly[52]. The RapidMiner tool has many algorithms out of which Deep Learning, Support Vector Machine (SVM), Random Forest, and Decision Tree were used for the current study. According to the authors, Reddy et al.[48] and Massaro et al.[50], predictive algorithms and techniques can also be used to identify the essential or most important predictor variables.

The current study intends to use digilitfj to measure the digital competencies of the students'. The digilitfj is the first-ever tool that has been developed in the South Pacific and to some extent in the world which encompasses the relevant skills needed to be tested for a digitally literate individual. Evaluating digital competencies of the students will give an idea of the skills they are lacking, therefore, appropriate interventions can be derived for the students. The current study works on the following research questions:

i. What is the status of digital literacy for first-year university students?

ii. Which literacies are important in defining a digitally literate individual?

iii. Which literacy is the most influential to digital literacy?

III. Methodology

The research methodology for this study was quantitative with a survey methodology research design. The survey was carried out using an online self-reporting questionnaire, which was part digilitfj. The data set for this study consists of 6 literacies defined as follows:

i. media literacy (M), which has 13 attributes

ii. information literacy (Info), which has 11 attributes

iii. communication literacy (Comm), which has 5 attributes

iv. visual literacy(V), which has 12 attributes

v. computer literacy (C), which has 6 attributes

vi. technology literacy (T), which has 13 attributes

Each of the six literacies consists of self-reporting items ranging from "No Understanding" to "Advanced Understanding" and the points ranging from 1 to 5. Using these literacies digilifj was developed.

The validation for digilitfj was carried out using the Explanatory Factor Analysis (EFA) and the Cronbach alpha test. According to Reddy et al. [1], the EFA analysis is the most effective and reliable analysis that can be carried out to validate a newly developed scale in the early stages of research. The EFA results show that the newly developed scale was valid and reliable. This was also supported by the Cronbach alpha value that yielded to 0.9. Research shows that the Cronbach alpha value above 0.8 means that results are excellent [36]. The newly designed and developed scale, digilitfj, was piloted to the first-year university students and accessed using a link provided to them. A total of 260 students participated in the survey. The digilitfj was used to evaluate the digital literacy status of the students. Table 1 shows the levels, point distribution, and descriptions of digilitfj.

Table 1 Points Table for digilitfj

Levels	Points	Description
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)

Once the digital competencies of the students were evaluated, a prediction analysis was performed to evaluate the important and most influential literacies which were used to define a digitally literate individual for the current study. Predictive models were generated using Deep Learning, Decision Tree, Random Forest, and Support Vector Machine (SVM) algorithms. The authors of this paper decided to use the four algorithms as they were the most commonly used algorithms for educational data mining[53]. However, the algorithms

were individually used or used as a combination. The data set was trained using the four algorithms together.

IV. Results and Discussion

From the data gathered, the digital literacy status of first-year university students was measured. The results show that 86.15% of the students fall in the range of being average to highly digitally literate, while 14.71% of the students are in the range of being very low to low digitally literate. Figure 1 shows the digital literacy status of the students.

Fig. 1 Digital Literacy Status

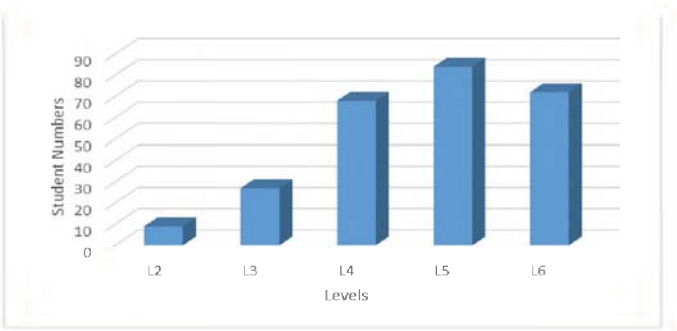


Table 2 shows the error rate, accuracy value, and precision value for the four algorithms chosen for this study.

Table 2 Performance of the four algorithms

Algorithm	Error Rate (%)	Accuracy (%)	Precision (%)
Deep Learning	0.0	100	100
Decision Tree	4.0	96.0	93.3
Random Forest	2.8	97.2	100
Support Vector Machine	0.0	100	100

Table 2 shows the best algorithm for this study, Deep Learning and Support Vector Machine, followed by Random Forest and then Decision Tree. Deep Learning and SVM have 0% error rate and 100% precision making them the best algorithms. For SVM the best fitted kernel was Radial Basis Function (RBF). The optimal parameter was picked by using the Set Parameters operator in RapidMiner. This operator is mostly used for applying an optimal set of parameters of one operator to another similar operator. The Set Parameters operator takes a set of parameters as input. Operators like Optimize Parameters (Grid) or Read Parameters can be used as a source of parameter set. The Set Parameters operator takes this parameter set and assigns these parameter values to the parameters of the specified operator which can be specified through the name map parameter. Researchers have also stated that in the last decade Deep Learning and SVM were gaining momentum in many research fields and educational data was one of them [49][53]. Although Random Forest and Decision Tee algorithms have lower precision rate and higher error rate compared to Deep Learning and SVM, they are usually used by researchers in educational data mining [49][51][53].

Table 3 shows the weight by correlation values generated for the chosen algorithms for this study. According to Krstevski et al.[47], the weight by correlation operator calculates the weight of attributes concerning the label attribute by using correlation. The higher the weight of an attribute, the more relevant it is considered.

Table 3 Calculated weights for each literacy

Variable	Deep Learning	SVM	Random Forest	Decision Tree
C	0.601	0.691	0.467	0.336
Info	0.547	0.619	0.399	0.334
M	0.366	0.449	0.334	0.194
V	0.362	0.267	0.311	0.164
T	0.361	0.217	0.239	0.153
Comm	0.250	0.195	0.187	0.072

As per the results in Table 3, the most influential variable is computer literacy. This indicates that for an individual to possess digital literacy skills, computer literacy is of utmost importance. The researchers, reddy et al.[48], Sakarji et al.[54],Cacciamani et al.[55], Joo[56] and Lai[57] state that an individual must have relevant computing skills to use a given technology and continue using the given technology. Literature also showed over the years that the most common literacy associated with digital literacy was computer literacy [32][7][20][58].

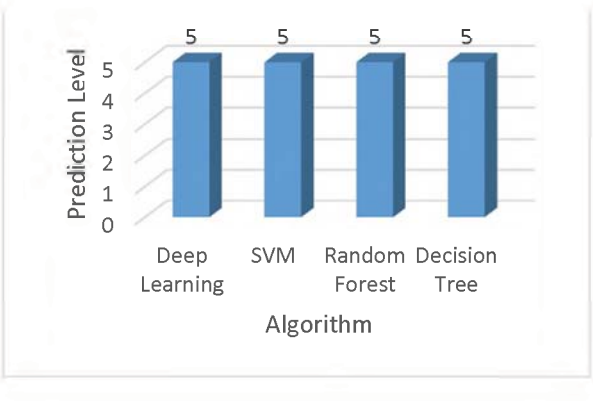
Table 4 Correlation of each literacy with digital literacy

Variable	Weights by Correlation Value
M	0.837
Info	0.895
Comm	0.827
V	0.844
Com	0.866
T	0.881

Table 4 shows that all the variables range from 0.827 – 0.881, with no significant difference between them. Therefore, all the variables are important and positively correlate with the predicting variable, which is digital literacy. A similar result has been obtained in the literature, where the six variables used for this study have a positive correlation amongst each other and with digital literacy [1].

Since all the literacies are important to determine a person's digital literacy, the predictive models included all the literacies. For Random Forest, the predictive model's root was information literacy, and the Decision Tree was technology literacy. The prediction for the overall digital literacy of an individual on the basis that he/she scores 7 out of 10 in each literacy is as follows for the following algorithms; Deep Learning the overall digital literacy is 5, for SVM its 5, Random Forest its 5 and Decision Tree is also 5. Figure 2 shows the predicted digital literacy for each algorithm.

Fig 2 Predicted Digital Literacy Status



According to digilifj, level 4 indicates that a person is averagely digitally literate and level 5 indicates that the person is higly digitally literate. Looking at the predicted values for all the algorithms with an average score of 7 out 10, the digital literacy status of an individual is level 5. The results reflect the exact status from digilitfj levels shown in Table 1. A person with a score of 7 in each literacy will have a total of 42 points, corresponding this with the level from digilitfj indicates that the individual falls in level 5 of the digital literacy table.

V. Conclusion

Digital literacy is playing a pivotal role in the survival of the students who are part of the technology-rich environment in the 21st-century. The students' need to be educated accordingly so that they possess the relevant skills they need to complete their higher education learning journey successfully. To achieve the goal of successful graduates and low attrition rates, digital literacy needs to be measured. While many studies have been conducted on the evaluation of digital literacy competencies globally, the current study attempts to evaluate the digital literacy status of first-year students at a regional university in the South Pacific. Additionally, the most influential and important literacies were identified. Predictive models were also generated to predictive digital literacy for individuals using the six literacies identified for this study. The study also introduced the newly designed and developed digital literacy scale digilitfj, which was used to evaluate the students' digital competencies.

The results show that 86.15% of the students had an average to very high levels of digital literacy skills. Since the DLS encompasses the six different literacies which define digital literacy for this study, the authors noted that not all students had high competencies in the different literacies. To design appropriate interventions to improve the digital literacy of the students, a prediction analysis was carried out using RapidMiner.

Deep Learning, SVM, Random Forest and Decision Tree algorithms were identified as the most appropriate algorithm to be used for prediction for this study compared to other algorithms. The results showed that all six literacies were important in evaluating the overall digital literacy of an individual. The weights by correlation analysis for Deep Learning, SVM, Random Forest and Decision Tree showed that computer literacy was the most influential of the six literacies used for the study. The generated predictive models show that if a student scores 7 out of 10 for each literacy, then the individual's digital literacy status is at level 5. According to *digilifj,* level 5 indicates that a person is highly digitally literate. The predicted value accurately reflected the level value given by digilitfj.

The findings from the current study indicate that the students who join higher education are digitally literate. However, students are not competent in all aspects of digital literacy. Therefore educators need to design and develop appropriate interventions and training programs which comprise all aspects of digital literacy. These developed tools then need to be administered appropriately by relevant stakeholders to improve the digital literacy skills of the students. This will ensure that the students have the required digital skills when they join the technology-oriented workforce.

VI. REFERENCES

[1] Reddy, P., Sharma, B., & Chaudhary, K. (2020). Measuring the digital competency of freshmen at a higher education institute. *PACIS 2020 Proceedings* (pp. 1-13). https://aisel.aisnet.org/pacis2020/6.

[2] Techataweewan, W., & Prasertsin, U. (2017). Development of digital literacy indicators for Thai undergraduate students using mixed-method research. *Kasetsart Journal of Social Science*, 215-221.

[3] Dios, I., Igartua, J, & Vázquez, A. (2016). Development and Validation of a Digital Literacy Scale for Teenagers. *Proceedings of the Fourth International Conference on Technological Ecosystems for Enhancing Multiculturality*, (pp. 1067-1073). New York.

[4] Khateeb, A. (2017). Measuring Digital Competence and ICT Literacy: An Exploratory Study of In-Service English Language Teachers in the Context of Saudi Arabia. *International Education Studies*, 38-51.

[5]Tang,C.,&Chaw,L.(2016).Digital Literacy: A Prerequisite for Effective Learning in a Blended Learning Environment.*The Electronic Journal of e-Learning*, 64-65.

[6] Phuapan, P., Viriyavejakul, C., & Pimdee, P. (2016). An Analysis of Digital Literacy Skills among Thai University Seniors. *International Journal of Emerging Technologies in Learning*, 24-31.

[7] Ferrar, J. (2019). Development of a framework for digital literacy. *Reference Services Review*, 91-105.

[8] Neilson, C. (2018). Digital Literacy Expectations in Higher Education. *Open Oceans: Learning without borders. Proceedings ASCILITE*, (pp. 113-120). Geelong.

[9] Sharma, B., Prasad, A., Narayan, S., Kumar, B., Singh, V., Nusair, S., & Khan, G. (2019). Partnerships with Governments to Implement In Country-Science Programmes in the South Pacific Region. *IEEE Asia-Pacific Conference on Computer Science and Data Engineering (CSDE)* (pp. 1-6). Melbourne, Australia: IEEE.

[10] Sharma, B., Reddy, E., Mohammed, N., & Nand, R. (2019). Effectiveness of online presence in a blended higher learning environment in the Pacific. *Studies in Higher Education*, 1-20.

[11] Chan, B., Churchill, D., & Chiu, T. (2017). Digital Literacy Learning In Higher Education Through Digital Storytelling Approach. *Journal of International Education Research*, 1-16.

[12] Zhang, H., & Zhu, C. (2016). A Study of Digital Media Literacy of the 5th and 6th Grade. *The Asia-Pacific Education Researcher*, 579–592.

[13] Ukwoma, S., & Iwundu, N. (2016). Digital literacy skills possessed by students of UNN, implications for effective learning and performance. *New Library World*, 703-719.

[14] Nedungadi, P., Menon, R., Gutjahr, G., Erickson, L., & Raman, R. (2018). Towards an inclusive digital literacy framework for digital India. *Education and Training*, 516-528.

[15] Glister, P. (1997). *Digital Literacy.* academia.edu.

[16] Lankshear, C., & Knobel, M. (2008). *Digital Literacies—Concepts, Policies and Practices.*

[17] Leahy, D., & Dolan, D. (2010). Digital literacy: A vital competence for 2010? *IFIP International Federation for Information Processing 2010* (pp. 1-12). Berlin, Heidelberg: Springer.

[18] Rosenblit, S. (2011). *Digital Technologies in Higher Education: Sweeping Expectations and Actual Effects*. New York: Nova Science Publishers, Inc.
[19] Martin, A., & Grudziecki. (2015). DigEuLit: Concepts and Tools for Digital Literacy Development. *Taylor & Francis Group: Innovation in Teaching and Learning in Information and Computer Science*, 249-267.
[20] Walton, G. (2016). Digital Literacy: Establishing the Boundaries and Identifying the Partners. *New Review of Academic Librarianship*, 1-4.
[21] Buckingham, D. (2016). Defining digital literacy: What do young people need to know about digital media? *Nordic Journal of Digital Literacy*, 21-34.
[22] Tai, D., Zhang, R., & Wang, Y. (2017). Determining Digital Literacy Competencies in Technical Senior High Schools Using Fuzzy Delphi Analysis. *International Journal of Information and Education Technology*, 612-616.
[23] Hongthong, T., & Temdee, P. (2018). Personalized Mobile Learning for Digital Literacy Enhancement of Thai Youth. *IEEE*, 1-4.
[24] Yazon, A., Manaig, K., Buama, C., & Tesoro, J. (2019). Digital Literacy, Digital Competence and Research Productivity of Educators. *Universal Journal of Educational Research*, 1734-1743.
[25] Arneson, J., & Offerdahi, E. (2018). Visual Literacy in Bloom: Using Bloom's Taxonomy to Support Visual Learning Skills. *CBE—Life Sciences Education*, 1-18.
[26] Manda, M., & Backhouse, J. (2017). Digital transformation for inclusive growth in South Africa: challenges and opportunities in the 4th industrial revolution. *African Conference On Information Systems & Technology (ACIST)*, (pp. 1-11). Cape Town, South Africa.
[27] Erstad, O. (2016). Educating the Digital Generation: Exploring Media Literacy for the 21st Century. *Nordic Journal of Digital Literacy*, 85-102.
[28] Spante, M., Hashemi, S., Lundin, M., & Algers, A. (2018). Digital competence and digital literacy in higher education research: Systematic review of concept use. *Cogent Education*, 1-21.
[29] Goodfellow, R. (2011). Literacy, literacies and the digital in higher education. *Teaching in Higher Education*, 1-15.
[30] Dutta, A. (2017). Evolution of Digital Literacy project in rural India. *2017 IEEE Integrated STEM Education Conference (ISEC)* (pp. 182-185). Princeton, NJ: IEEE.
[31] Stričević, I. (2018). Literacies in the Digital Age- New Teaching Paradigms and Solutions for Academic Libraries. *5h International Symposium on Emerging Trends and Technologies in Libraries and Information Services*, (pp. 169-173).
[32] Reddy, P., Sharma, B., & Chandra, S. (2020). Student readiness and perception of tablet leaning in HE in the Pacific: A case study of Fiji and Tuvalu. *Journal of Cases on Information Technology (JCIT)*, 52-69.
[33] Reddy, P., Sharma, B., & Chaudhary, K. (2020). Digital Literacy: A Review of Literature. *International Journal of Technoethics (IJT)*, 65-94.
[34] Crawford, J., Henderson, K., Rudolph, J., Malkawi, B., Glowatz, M., Burton, R., . . . Lam, S. (2020). COVID-19: 20 countries' higher education intra-period digital pedagogy responses. *Journal of Applied Learning & Teaching*, 1-21.
[35] Adachi, C., blake, D., & Riisla, K. (2018). Exploring digital literacy as a graduate learning outcome in higher education – an analysis of an online survey. *Open Oceans: Learning without borders. Proceedings ASCILITE 2018*, (pp. 294-297). Geelong.
[36] Reddy, P., Chaudhary, K., Sharma, B., & Chand, R. (2020). he two perfect scorers for technology acceptance. *Education and Information Technologies*, 1-23.
[37] Komlayut, S., & Srivatanaku, T. (2017). Assessing Digital Literacy Skills Using a Self-Administered Questionnaire. *Review of Integrative Business and Economics Research*, 74-85.
[38] Rochte, T. (2017). Assessing the role of digital literacy in English for Academic Purposes university pathway programs. *Journal of Academic Language & Learning*, 71-86.
[39] Toquero, C. (2020). Challenges and Opportunities for Higher Education amid the COVID19 Pandemic: The Philippine Context. *Pedagogical Research*, 2-5.
[40] Beaunoyer, E., Dupere, S., & Guittona, M. (2020). COVID-19 and digital inequalities: Reciprocal impacts and mitigation strategies. *Computers in Human Behaviour*, 1-19.
[41] Bao, W. (2020). COVID-19 and online teaching in higher education: A case study of Peking University. *Human Behavior and Emerging Technology*, 113-115.
[42] Moore, J. (2020). *15 Ways Colleges Are Mobilizing to Support Their Communities*. https://www.chronicle.com/specialreport/15-Ways-Colleges-Are/278.
[43] Raturi, S. (2018). Understanding learners preferences for learning environments in higher education. *The Online Journal of Distance Education and e-Learning*, 84-100.
[44] Reddy, E., Reddy, P. S., & Reddy, K. (2016). Student Readiness and Perception of the Use of Smart Phones for Higher Education. *2016 3rd Asia-Pacific World Congress on Computer Science and Engineering*, (pp. 258-264).
[45] Sharma, B., Nand, R., Mohammed, N., Reddy, E., Narayan, S., & Reddy, K. (2018). Smart Learning in the Pacific: Design of New Pedagogical Tools. IEEE International Conference on Teaching, Assessment, and Learning for Engineering. New South Wales,Australia.
[46] Albayati, M., Altamimi, A., & Uliyan, D. (2019). Evaluating The Accuracy Of Data Mining Algorithms For Detecting Fake Facebook Profiles Using Rapidminer, Weka, and Orange. *Journal of Theoretical and Applied Information Technology*, 1937-1947.
[47] Krstevski, J., Mihajlov, D., & Chorbev, I. (2011). Student Data Analysis with RapidMiner. *ICT Innovations, Web Proceedings*.
[48] Reddy, P., Chaudhary, K., & Sharma, B. (2019). Predicting Media Literacy Level of Secondary School Students in Fiji. *IEEE Asia-Pacific Conference on Computer Science and Data Engineering*, (pp. 1-7). Melbourne.
[49] Ahmed, K. (2017). Analysis of data mining tools for disease prediction. Journal of Pharmaceutical Sciences and Research, 1886-1888.
[50] Massaro, A., Maritati, V., & Galiano, A. (2018). Data Mining model performance of sales predictive algorithms based on RapidMiner workflows. International Journal of Computer Science & Information Technology , 1-18.
[51] Teja, J., Seshu, G., & Varma, M. (2020). Relative Exploration of Classification Techniques of Machine Learning on Various Data Mining Tools. Journal of Xi'an University of Architecture & Technology, 1-7.
[52] rapidminer. (2020). *Weight by Correlation*. Retrieved from https://docs.rapidminer.com/: https://docs.rapidminer.com/latest/studio/operators/modeling/feature_weights/weight_by_correlation.html#:~:text=The%20Weight%20by%20Correlation%20operator,more%20relevant%20it%20is%20considered.
[53] Hernández, A., Flores, B., Tomas, D., & Colorado, B. (2019). A Systematic Review of Deep Learning Approaches to Educational Data Mining. Complexity, 1-16.
[54] Sakarji, S., Nor, K., Razali, M., Talib, N., Ahmad, N., & Saferdin, W. (2019). Investigating students acceptance of eLearning using the technology acceptance model among diploma in office management and technology students at UITM Melaka. *Journal of Information System and Technology Management*, 13-26.
[55] Cacciamani, s., Villani, D., & Bonanomi, A. (2018). Factors Affecting Students' Acceptance of Tablet PCs: A Study in Italian High Schools. *Journal of Research on Technology in Education*, 120–133.
[56] Joo, Y., Park, S., & Lim, E. (2018). Factors Influencing Preservice Teachers' Intention to Use Technology: TPACK, Teacher Self-efficacy, and Technology Acceptance Model. *Journal of Educational Technology and Society*, 48-59.
[57] Lai, P. (2017). The Literature Review of Technology Acceptance Models and Theories for Novelty Technology. *Journal of Information Systems and Technology Management*, 21-38.
[58] Gokcearslan, s. (2017). Perspectives of Students on Acceptance of Tablets and Self-directed Learning with Technology. *Contemporary Educational Technology*, 40-55.