Digital Transformation Readiness for Online Teaching and Learning in Higher Education: Academics Perspectives

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Abstract. The purpose of this research are to (a) examine the academics' perceptions toward digital transformation readiness, more specifically academics' preparedness to embrace a digital culture, (b) investigate if there are significant differences in these perceptions based on the academics' demographic variables such as gender, age, academic status and academic discipline, and (c) investigate the factors that affect academics' digital transformation readiness and their significant role in determining student engagement and intention to use technology. A structured questionnaire was designed in Google Forms covering the perceptions of the teachers regarding blended teaching and learning. The study collected 165 responses through online surveys from academics of a public university in Mauritius. The data was analyzed descriptively and inferentially to validate the model and perform regression analysis and ANOVA. The findings showed that only digital acceptance and digital competence influenced the intention to use digital technology amongst academics.

Keywords: Digital transformation readiness, academics, higher education, Mauritius

1. Introduction

There has been an unprecedented development of new technologies, especially following the outbreak of the COVID-19 pandemic. This situation has presented a significant challenge and transformation in the higher education (HE) landscape, compelling HE institutions (HEIs) to seek alternative teaching and learning methods through digital learning environments, serving as substitutes for traditional face-to-face learning [1,2,3].The adaptation of educators to online teaching holds the potential to foster innovation within academic institutions, thereby elevating the quality of online teaching and learning (OTL). It is argued that proper integration of technology-supported services and appropriate digital tools successfully promotes the transformation of traditional teaching and learning environments with new digital methods to work better in the digital era [4, 5]. However, the advent of digital transformation has posed challenges for academics, as the transition to real-time online teaching proved to be difficult for some [6]. Notably, some educators lacked proficiency in the use of the required technology, resulting in digital gaps among them [7]. Consequently, it becomes imperative to investigate whether experience with this method contributes to positive attitudes and adoption in the realm of digital readiness for real-time online teaching.

Past studies have sought to understand the factors that influence educators' use of technology in education, including multiple factors such as lack of institutional digital support and infrastructure, digital competences, digital culture, digital training, curriculum, virtual collaboration, time management and student digital engagement [8,9,10]. implementation of digital technologies in various aspects of academic teaching and learning, and digital readiness and acceptance are important factors to better understand the diverse engagement experiences of academics, whose perspectives are critical to any transformation in higher education [3, 10]. Academics have expressed concerns not only regarding their pedagogical competency in effectively navigating online platforms but also about their perceived lack of control over the virtual learning environment and their inability to use the non-verbal communication medium during real-time online teaching [11]. Furthermore, an engaging in online teaching-learning environment necessitates key elements such as a robust network, internet access, a smart device or computer, a welcoming atmosphere, and proficiency in technical skills [12]. Despite these challenges in higher education, universities are trying to leverage digital technologies adoption.

Understanding academics' perceptions of digital readiness for online teaching and learning is an important and popular research topic. The literature extensively discusses frameworks for digital readiness in online teaching and learning [3,9,10,13]. However, it is apparent that digital readiness varies among faculty due to cultural, institutional, and contextual factors, suggesting that educators' readiness for online teaching will also

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differ accordingly. Hence, there is an urgent need for further research into academics' perception and receptivity of such initiatives.

The purpose of this study is to examine whether online teaching has induced shifts in academics' attitudes concerning their digital transformation readiness for online teaching and learning. The objectives of this research are to (a) examine the academics' perceptions toward digital readiness, more specifically academics' preparedness to embrace a digital culture, and (b) investigate if there are significant differences in these perceptions based on the academics' demographics such as gender, age, and teaching disciplines.

2. Literature Review

The transition to online education in higher education institutions during the pandemic was to reduce human contact in the classrooms as well as across the universities to lower the spread of the COVID-19 [14]. Online classrooms include virtual platforms like Learning Management System (LMS), Zoom, online discussion boards and platforms, pre-recorded video lectures, Microsoft Teams, Google Meet, provide opportunities for discussion with students in real time interaction [15]. Digital transformation has revolutionalized the learning processes of not only students, but that of educators [16]. Academics were forced to embrace novel approaches to online teaching, which required their adaptation to modern technologies where their digital readiness was essential to improve the learning experience [17, 18]. Moreover, the attitude of teachers towards technology plays a significant role in defining their digital readiness and the appropriate utilization of technology [14, 19].

Digital readiness refers to preparedness to use digital technologies for academic engagement [20]. According to these authors, digital readiness consists of technology-related knowledge, skills, attitudes, and competencies necessary for using digital technologies effectively in higher education. Digital readiness encompasses a range of abilities and competencies, including technology and computing, information science, and media and communication skills. Digital readiness has been measured in several ways, mostly amongst students. For example, student digital readiness was assessed by the use of the Digital Readiness for Academic Engagement questionnaire (DRAE) across five dimensions (i) digital tool application, (ii) information sharing behavior, (iii) information seeking skills, (iv) digital media awareness, (v) digital application usage. Student readiness was assessed in universities using a scale based on the following components [21] (i) equipment availability where students indicated if they had access to various digital devices, including personal computers, mobile phones, scanners, printers, and internet; (ii) experiences with e-learning tools where students explained their experiences with different e-learning tools made available by the university such as online lecture notes, lecture recordings, use of digital media in courses, online modules, online communication and collaboration platforms, online-tests, (iii) self-reported digital learning skills where students' were required to assess self-reported skills for digital learning, where two dimensions of the DRAE questionnaire developed was used [20].

Another factor which is important to consider in digital transformation in higher education is the digital competence of academics. Digital competence can be defined as "the confident, critical and responsible use of the technologies from the society of information for work, entertainment and education" [22]. Being digitally competent involves a combination of personal attitude, technical skills, and an elevated level of multiliteracy [23]. Multiliteracy refers to the ability to access, identify, understand, create, communicate, and compute data from various sources [24, 25]. Different authors have identified a range of literacies that result in digital competency and these components have been summarized by [26]: (i) *Information skills* which is the ability to search for, access, manage, understand, secure and classify content found across different formats on the web [27]; (ii) *Content creation or media skills* which involves creating and editing new content in different formats (e.g., audio, video, text) by integrating available information[25,28]; (iii) *Communication skills* which is the effective use of communication via digital tools with other online platform members and the capacity to collaborate and network [29, 30]; (iv) *Ethical skills* which is the ability to understand the rules relating to content ownership and relations with other participants in the network [31, 32]; (v) *Problem solving skills* which is the ability to address and resolve problems generated by the use of digital tools [28, 33]; (vi) *Technical skills* which is the ability to access the technical knowledge to use digital tools [34, 35]; (vii) Strategic skills which is the ability to apply the aforementioned digital skills to make personal and professional progress [27,36].

Digital technology has become an integral part of higher education with the potential to enhance teaching and learning processes and predict increased student engagement [37, 38]. In recent years, scholars, practitioners, and policymakers have devoted significant attention to understanding and measuring student engagement.

Influential works, including Astin's (1999) theory of involvement [39], Fredricks, Blumenfeld, and Paris's (2004) delineation of the three dimensions of student engagement (behavioral, emotional, cognitive) [40], and sociocultural theories by Kahu (2013) [41] and Kahu and Nelson (2018) [42], have contributed to research on the multidimensional concept of student engagement. Student engagement has been shown to improve achievement, persistence, and retention [43]. Conversely, disengagement has been linked to negative student learning outcomes and cognitive development [44] and serves as a predictor of student dropout in both secondary schools and higher education [45]. The multifaceted and intricate student engagement construct has also been referred to as a 'meta-construct' by some scholars [40, 41]. Student engagement has been examined using different dimensions [44]; (i) active participation and involvement in learning and university life (e.g. participation in class activities, discussions, and extracurricular events) [47, 48]; (ii) Meaningful engagement between students and their peers, and with faculty members (e.g. collaborative learning, discussions) [49,50] (iii) time and effort devoted to learning (e.g. studying, attending classes, completing assignments, and actively participating) [51, 52]; (iv) Another perspective considers student engagement as the expenditure of both physical and psychological energy put into academic pursuits [53].

The study also seeks to examine the relationship between academics' digital readiness, student engagement and behavioral intentions. Behavioral intention is a decisive factor in determining the actual adoption and usage of technology. Within the scope of this study, behavioral intention encompasses the extent to which academics express their intention to continue to use eLearning platforms [54]. Moreover, the study will assess academics' readiness to teach online, the preparedness of faculty members in the context of digital transformation as well as the institutional framework supporting OTL. Examining the factors of digital readiness will provide insights into the multifaceted nature of readiness for OTL in higher education settings. Based on extensive literature review and existing digital readiness instruments, this study discusses four areas of digital readiness: self-efficacy, institutional support, digital competence, and digital perceived usefulness.

3. Methodology

3.1 Sample and Data Collection

This study employed a quantitative research method to investigate academics' attitudes toward digital readiness for online teaching and learning through an online survey questionnaire. A total of 400 comprising of both full-time and part-time academics in a public university were invited to take part in the online survey. The academics received an invitation via e-mail with a link to the online survey. The participation in the survey was voluntarily and anonymous. The convenient sampling technique was used for collection of the data. Data was collected over two months and the final sample consisted of 165 academics.

3.2 Measurement

In this study digital readiness for the online teaching and learning was measured using four factors, namely digital acceptance, institutional support, digital competence and digital perceived usefulness. Six items assessed digital acceptance, capturing academics' attitudes fostering acceptance of OTL [55]. Eight items captured the academics' perceptions of the institutional support for OTL [56, 57]. For digital competence, nine items reflected academics' perception of competence in using technology for OTL [58]. Three items were used to measure the academics' attitudes toward digital perceived usefulness [58]. Student engagement was measured using seven items [59], indicating academics' perceptions of their student's engagement with the OTL environment. Behavioral intention was measured using 3 items [60] indicating academics' intention to use technology in their future teaching practice. The 5-point Likert scale (1 = strongly disagree to 5 = strongly agree) was used to operationalize the six constructs which form part of the conceptual model. The academic characteristics study such as gender, age, academic disciplines and devised used for OTL were also captured in this study.

3.3 Data Analysis

The data were analyzed through SPSS using descriptive and inferential statistics. Exploratory factor analysis as a data reduction technique was employed to obtain the dimensions of the model. From the academic perspectives, the findings of this study will uncover the disparities that exist at the University level and will help to formulate strategies for capacity building within the educational framework.

4. Findings

4.1 Summary of the Demographic Profiles

Table 1 shows the summary of the participants' demographic profiles. Among the participants, 67.3% were men (n = 111) and 32.7% were women (n = 54), while 18,8% were full-time and 81.2% were part-time academics. The majority of the participants were in the age group of 36-45 years old, and in the business, management and finance teaching discipline (45.5%). The study also showed that 84.2% of the participants used laptops, followed by 9.1% used tablet, 4.2% used personal computer, while 2.4% used smartphone for digital teaching.

Table 1. Summary of Demographic Profiles

Demographic	Characteristics	Frequency	%
Gender	Male	111	67.3
	Female	54	32.7
Age	25-35	34	20.6
	36-45	56	33.9
	46-55	44	26.7
	55 and above	31	18.8
Academic	Full-Time	31	18.8
	Part-Time	134	81.2
Teaching Discipline	Business, Management and Finance	75	45.5
	Sustainable Development and Tourism	58	35.2
	Innovative Technologies and Engineering	18	10.9
	Health Sciences	14	8.5
Device Used	Personal Computer	7	4.2
	Laptop	139	84.2
	Tablet	15	9.1
	Smartphone	4	2.4

4.2 Academics Perceptions of Digital Transformation Readiness

The finding of this empirical research drives some ideas about the academics' perceptions of their capabilities regarding the use of technology in the teaching process. Exploratory factor analysis (EFA) was used to evaluate convergent validity and discriminant validity of measurement scales. The index at KMO and Barlett's test has statistical significance (Sig. 0.000 < 0.01), showing that the observed analysis is appropriate for factor analysis. The extraction method used was principal component analysis with the rotation method Varimax normalization with Kaiser. Extractions have been considered for values greater than 0.50 and an eigen value greater than or equal to 1 were used (Hair et al., 1995). The factor analysis shows that the variables of the model can be grouped into four factors that together manage to explain 60.85% of the overall variability of the model (Table 2). Descriptive statistics for all measures were calculated. Mean (M), standard deviation (SD), and Cronbach's alpha (α) of the digital transformation readiness are reported in Table 2. Alpha values > .70 were considered as acceptable (Nunnally, 1978). The descriptive statistics (means and SD) by item within the four subscales, including digital acceptance, institutional digital support, digital competences, and digital perceived usefulness were moderated rated high by the participants (Table 2). These findings suggest that the respondents feel confident in their perceived ability to effectively use digital tools and technologies in their teaching practices and perceive themselves as competent in their digital skills and capabilities necessary for navigating digital transformation in teaching.

Table 2. Descriptive Results for Digital Transformation Readiness

Statement for Digital Readiness	Factor Loading	Percentage of variance	Cronbach's alpha	Mean	SD	t-value
Digital Acceptance		**41.290**	**.915**	**3.60**	**.91**	**8.38**
Digital Technologies have improved my online class management.	.718			3.44	1.04	5.47
Digital Technologies have enriched my online teaching and research activities.	.782			3.59	1.11	6.84
Digital Technologies have supported my teaching and student learning.	.709			3.81	1.11	9.33
Digital Technologies have contributed to my interactions with students.	.653			3.21	1.20	2.21
Digital Technologies have enabled me to share learning materials with my student	.607			4.02	1.08	12.06
Digital assessment tools have aided me to monitor my student progress.	.751			3.50	0.98	6.60
Institutional Digital Support		11.120	.824	3.76	.66	14.85
The university provides access to digital channels for communication with students and peers.	.801			3.22	1.00	2.89
The university provides data protection mechanism.	.863			3.32	1.03	3.93
The university ensures that students and resource persons use digital technologies safely and responsibly.	.778			3.41	1.07	4.97
The university needs to provide cutting-edge digital infrastructures and services.	.861			3.98	1.00	12.54
The university needs to create fast, reliable and secure networks that are able to protect data and guarantee the security of interconnected devices and their users.	.868			4.17	0.96	15.65
The university needs to develop digital lifelong learning programs.	.657			4.21	0.85	18.39
The university needs to promote digital change as a continuous process.	.613			4.19	0.88	17.51
The university provides support for training opportunities on digital technologies.	.620			3.60	1.09	7.09
Digital Competences		**4.758**	**.916**	**3.75**	**.78**	**12.21**
I use digital technologies to actively develop my teaching skills.	.699			3.82	1.06	10.00
I use digital technologies to work together with colleagues, both inside and outside of my educational organization.	.747			3.85	1.08	10.13
I am able to use digital platforms (Zoom, Microsoft teams, Google meet, Moodle, etc.) for teaching.	.722			4.33	0.84	20.24
I can use digital technologies to design, plan and deliver lectures and assessment.	.818			4.19	0.88	17.51
Digital technologies are conductive to improving my teaching competence.	.625			3.76	1.04	9.42
I implement project-based learning as online instructional methods related to student-centered, competency-based learning and transformative learning.	.612			3.47	1.05	5.71
I implement online debate as online instructional methods related to student-centered, competency-based learning and transformative learning.	.795			3.33	1.07	3.92
I implement online problem-based learning as online instructional methods related to student-centered, competency-based learning and transformative learning.	.843			3.40	1.01	5.00
I implement online presentation as online instructional methods related to student-centered, competency-based learning and transformative learning.	.717			3.58	1.05	7.08
Digital Perceived Usefulness		**3.677**	**.941**	**3.78**	**.98**	**10.25**
Digital technologies help to improve my teaching activities.	.621			3.87	1.03	10.87
Digital technologies help change the way my students learn.	.670			3.73	1.08	8.75
Digital technologies are helpful to my teaching evaluation and reflection.	.659			3.73	0.99	9.53
Note: $p < 0.000$; KMO-MSA = 0.890; Bartlett's test of sphericity = 4156.42						

4.3 Demographic Profile and Academics' Perceptions of Digital Transformation Readiness

A series of independent sample t-tests were performed to assess if perceptions of the digital acceptance, institutional digital support, digital competences, digital perceived usefulness, student engagement and intention to use technology are different from the level of gender and academic status. The results showed that there is a significant difference between only digital acceptance, digital competences, and intention to use technology and gender. The t-test results in Table 3 shows that male respondents had a higher perception on digital acceptance, digital competences, and intention to use technology. The analysis of respondents through t-test thus revealed significant associations only between gender and digital acceptance ($p = .005$, $t = 7.652$), digital competences ($p = .005$, $t = 8.241$), and intention to use technology ($p = .05$, $t = 3.955$) at the .01 and 0.05 levels, respectively. The findings between the male and female academics were roughly the same for these factors.

Table 3. Results of Independent Sample t-Test by Gender and Academic Status

	Digital Acceptance Mean (SD)	Institutional Digital Support Mean (SD	Digital Competences Mean (SD	Digital Perceived Usefulness Mean (SD	Student Engagement Mean (SD	Intention to Use Technology Mean (SD
Gender						
Male	3.64 (.806)	3.78 (.600)	3.78 (.663)	3.75 (.915)	3.36 (.915)	3.84 (.918)
Female	3.49 (1.10)	3.74 (.772)	3.70 (.990)	3.84 (1.12)	3.39 (.995)	3.83 (1.16)
Academic Status						
Full-Time	3.73 (.945)	3.67 (.466)	3.91 (.832)	3.79 (.832)	3.46 (.811)	3.90 (.835)
Part-time	3.57 (.905)	3.78 (.670)	3.72 (.815)	3.78 (1.01)	3.35 (.968)	3.82 (1.03)

The results further showed that there is a significant difference between 2 factors of digital transformation readiness and academic status (Table 3). It is observed that full-time academics exhibited a significant lower agreement on the perceptions of institutional digital support ($M= 3.67$, $p = .000$, $t = 4.59$), but it had a higher agreement on digital competency ($M= 3.91$, $p = .000$, $t = 3.164$). However, the results of this study also found no significant difference among digital acceptance, digital perceived usefulness, student engagement and intention to use technology between full-time and part-time academics.

4.4 Results of one-way ANOVA

A one-way ANOVA test (Table 4) was used to determine the existence of any significant differences which may exist among the different demographic variables and respondents' perceptions of the factors of digital transformation readiness and attitudes toward student engagement and intention to use technology based on age and academic discipline.

Table 4. Demographic Differences on Digital Transformation Readiness, Student Engagement, and Intention to Use Technology

Analysis of Variance F-Value and Level of Significance						
Factors	**Digital Acceptance**	**Institutional Digital Support**	**Digital Competences**	**Digital Perceived Usefulness**	**Student Engagement**	**Intention to Use Technology**
Age	.765	.458	.664	.734	1.607	.590
Academic Discipline	.915	4.193	1.165	1.788	1.211	.948

Notes: Demographic variables are as follows: Age: 25-35, 36-44, 46-55, 55 and above; Academic Discipline: Business, management and Finance, Sustainable Development and Tourism, Innovative Technologies and Engineering, and Health Sciences

No statistically significant differences were discovered for age of respondents and academic discipline on any of the subscales of perceptions of digital transformation readiness, student engagement and intention to use technology.

4.5 Influence of Digital Transformation Readiness on Student Engagement and Intention to Use Technology

The aim of this study is to identify the key digital transformation readiness that affect student engagement and intention to use technology at the university. Multiple regression analyses were used to determine the factors predicting student engagement and intention to use technology at the university. Table 5 shows the results of regression analyses in which the four factors of digital transformation readiness were used as independent variables and student engagement measure as dependent variable. The four factors of digital transformation readiness together explained 66.9% of the variance in the evaluation of intention to use digital technology, which was significant as indicated by the F-value. The significant values of all four factors were less than the significant level of 0.05. The results indicated that the regression model was statistically significant and that all the four factors of digital transformation readiness positively and significantly influence student engagement and it is observed that digital perceived usefulness has the highest influence on student engagement.

Table 5 further shows the results of regression analyses in which the four factors of digital transformation readiness were used as independent variables and intention to use digital technology measure as dependent variable. The four factors of digital transformation readiness together explained 63.5% of the variance in the evaluation of student engagement, which was significant as indicated by the F-value. The findings revealed that only three factors, digital acceptance, digital competence and digital perceived usefulness influenced intention to use technology, and the highest influence was observed for digital perceived usefulness.

Finally, the influence of the five independent variables, namely digital acceptance, institutional digital support, digital competences, digital perceived usefulness and student engagement on the dependent variable intention to use digital technology were examined. The four factors of digital transformation readiness and student engagement together explained 67.4% of the variance in the evaluation of intention to use digital technology, which was significant as indicated by the F-value. The findings showed that only digital acceptance and digital competence influenced the intention to use digital technology. Another study has reported that experience with online teaching resulted in a positive change in the attitudes of academics toward it [61].

Table 5. Results of Regression Analyses

Influence of Digital Transformation Readiness on Student Engagement		
Independent variables	Standardized Coefficients Beta	t-value
Digital Acceptance	.172	2.019**
Institutional Digital Support	.171	2.473**
Digital Competence	.211	2.518**
Digital Perceived Usefulness	.336	3.377*
R^2 = .635; *p < .01; **p < .05; ***p < .1		
F = 67.760, p < 0.000		
Influence of Digital Transformation Readiness on Intention to Use Digital Technology		
Independent variables	Standardized Coefficients Beta	t-value
Digital Acceptance	.168	2.071**
Institutional Digital Support	.089	1.348
Digital Competence	.279	3.494*
Digital Perceived Usefulness	.365	3.859*
R^2 = .669; *p < .01; **p < .05; ***p < .1		
F = 78.832, p < 0.000		
Influence of Digital Transformation Readiness and Student Engagement on Intention to Use Digital Technology		
Independent variables	Standardized Coefficients Beta	t-value
Digital Acceptance	.147	1.807***
Institutional Digital Support	.069	1.028
Digital Competence	.254	3.136**
Digital Perceived Usefulness	.326	3.338

Student Engagement	.117	1.543
R^2 = .674; *p < .01; **p < .1		
F = 64.101, p < 0.000		

5. Conclusion

This study aimed to understand the extent to which academics embraced the culture of digital transformation and examined the factors of digital transformation impacting on student engagement and their intention to use digital technology for online teaching and learning. The findings of the demographics influenced revealed that male and female academics had roughly similar perceptions for digital transformation readiness, that is, for digital acceptance, digital competences, and intention to use technology. However, full-time and part-time academics considered digital transformation readiness differently and thus showed a difference in their readiness of institutional digital support and digital competence. The results of descriptive statistics further confirmed that the majority of the respondents are ready to embrace the digital transformation for teaching and learning. Further, with online teaching and learning gradually being adopted around the world, this study identified the factors influencing the student engagement and intention to use digital technology at the university. To engage students with the online learning environment, academics should provide guidance to students on how to find suitable e-resources and use e-libraries. It is important to help students have a more positive attitude toward digital learning environment and enhance their learning intentions. Embracing a digital teaching and learning environment provides an opportunity that will motivate both academics and students to become more interactive and engaged to make teaching and learning easier and more flexible.

However, this research has some limitations. The principal limitation of this study is that it targeted only one public university in Mauritius. The second limitation is associated with the sample as it targeted academic staff only and the sample size was relatively small. It would be useful to investigate the current methodology and topic of this study to analyze and compare academic staff and students' perceptions of both public and private universities to generalize the results within the Mauritian higher institution environment. While this is a relatively small study, it offers useful information about the academics' perceptions toward digital transformation when making a transition to online teaching.

References

1. Mseleku, Z., *A literature review of E-learning and E-teaching in the era of Covid-19 pandemic*. International Journal of Innovative Science and Research Technology, 2020. **5**(10): p. 588–597.
2. Simamora, R. M., *The challenges of online learning during the COVID-19 pandemic: An essay analysis of performing arts education studies*. Studies in Learning and Teaching, 2020. **1**(2): p. 86–103.
3. Shohel, M.M.C., Ashrafuzzaman, M., Alam, A.S., Mahmud, A., Ahsan, M.S. and Islam, M.T., *Preparedness of Students for Future Teaching and Learning in Higher Education: A Bangladeshi Perspective*. Sengupta, E. and Blessinger, P. (Ed.) New Student Literacies amid COVID-19: International Case Studies (Innovations in Higher Education Teaching and Learning, *2021*. **41**: p. 29-56. https://doi.org/10.1108/S2055-364120210000041006.
4. Chigona, A., *Pedagogical shift in the twenty-first century: preparing teachers to teach with new technologies*. *Africa Education Review*, 2015. **12**(3): p. 478-492.
5. Arnab, K., Bej, Tripti, D. and Kedar, N., *An empirical study on the correlation between teacher efficacy and ICT infrastructure.* The International Journal of Information and Learning Technology, 2020. DOI 10.1108/IJILT-04-2020-0050.
6. Nasri, N.M., Husnin, H., Mahmud, S.N.D. and Halim, L., *Mitigating the COVID-19 pandemic: a snapshot from Malaysia into the coping strategies for pre-service teachers' education*. Journal of Education for Teaching, 2020. **46**(4): p. 546-553.
7. Hodges, Charles & Moore, Stephanie & Lockee, Barbara & Trust, Torrey & Bond, Mark. (2020). The Difference Between Emergency Remote Teaching and Online Learning. Available at The Difference Between Emergency Remote Teaching and Online Learning | EDUCAUSE Review
8. Dube, S., and Marnewick, C., *A conceptual model to improve performance in virtual teams*. South African Journal of Information Management, 2016. 1-7. ISSN: (Online) 1560-683X.
9. Martin, F., Budhrani, K., and Wang, C., *Examining faculty perception of their readiness to teach online*. Online Learning Journal, 2019. **23**(3): p. 97–119. https://doi.org/ 10.24059/olj.v23i3.1555
10. Chang, S. and Gomes, C., *Why the digitalization of international education matters*. Journal of Studies in International Education, 2022. **26**(2): p. 119-127.
11. Brown, B.A., *Teaching Approaches, Social Support, and Student Learning in Non-traditional Classrooms in Higher Education*. The Emerald Handbook of Higher Education in a Post-Covid World: New Approaches and Technologies for Teaching and Learning, 2022. p. 71–106
12. Murillo, A., and Jones, K. M. L. (2020), *A "just-in-time" pragmatic approach to creating quality matters-informed online courses*. Information and Learning Sciences, 2020. **121**(5/6): p. 365–380. https://doi. org/10.1108/ILS-04-2020-0087

13. Backfisch, I., Scherer, R., Siddiq, F., Lachner, A. and Scheiter, K., *Teachers' technology use for teaching: Comparing two explanatory mechanisms*. Teaching and Teacher Education, 2021. **104**: p. 103390. https://doi.org/10.1016/j.tate.2021.103390
14. Maini, R., Sehgal, S., and Agrawal, G., *Todays' digital natives: an exploratory study on students' engagement and satisfaction towards virtual classes amid COVID-19 pandemic*. The International Journal of Information and Learning Technology, 2021. **38**(5): p. 454-472.
15. Hwee, J., Koh, L., Yen, R., and Kan, P., *Perceptions of learning management system quality, satisfaction, and usage: differences among students of the arts*. Australasian Journal of Educational Technology. 2020. **36**(3): p. 26–40.
16. Vu, A. (2020). Environmental Benefits of Online Learning. Retrieved October 4, 2022, from https://thestarfish.ca/journal/2020/08/environmental-benefits-of-online-learning-2
17. Redecker, C., *European Framework for the Digital Competence of Educators*: DigCompEdu. Punie, Y. (ed). Publications Office of the European Union, Luxembourg, 2017, doi:10.2760/159770,
18. Rodriguez-Garcia, A. M., Aznar, I., Caceres, P., and Gomez, G., *Digital competence in higher education: Analysis of the impact of scientific production indexed in Scopus database*. Revista Espacios, 2019. **40**(21), Available at a19v40n21p14.pdf .
19. Collis, B., *Anticipating the impact of multimedia in education: lessons from the literature*. Computers in Adult Education and Training, 1995. **2**(2): p. 136-149.
20. Hong, A.J., and Kim, H.J., *College students' digital readiness for academic engagement (DRAE) scale: Scale development and validation*. *The Asia-Pacific Education Researcher*, 2018. **27**(4): p. 303–312. https://doi.org/10.1007/ s40299-018-0387-0
21. Händel, M., Stephan, M., Gläser-Zikuda, M., Kopp, B., Bedenlier, S. and Ziegler, A., *Digital readiness and its effects on higher education studentsâ socio-emotional perceptions in the context of the COVID-19 pandemic.* Journal of Research on Technology in Education, 2020. *1–13.* doi:10.1080/15391523.2020.1846147
22. European Commission. (2018). Proposal for a Council recommendation on key competences for lifelong learning. Retrieved from https://eur-lex.europa.eu/legal-content/ EN/TXT/PDF/?uri=CELEX:32018H0604(01)&from=LT.
23. Durán, M., Gutiérrez, I. and Prendes, M.P., *Análisis conceptual de modelos de competencia digital del profesorado universitario.* RELATEC: Revista Latinoamericana de Tecnología, 2026. **15**(1): p. 97-114. https:// doi.org/10.17398/1695
24. Olsson, L., and Edman-Stålbrant, E., *Digital literacy as a challenge for Teacher Education*. In Learning to Live in the Knowledge Society, 2008. p. 11-18). https:// doi.org/10.1007/978-0-387-09729-9_2
25. Loureiro, A., Messias, I., and Barbas, M., *Embracing Web 2.0 & 3.0 Tools to Support Lifelong Learning - Let Learners Connect*. Procedia - Social and Behavioral Sciences, 2012. **46**: p. 532-537. https://doi.org/ 10.1016/j.sbspro.2012.05.155
26. Sánchez-Caballé A., Gisbert-Cervera M. and Esteve-Mon, F., *The digital competence of university students: a systematic literature review*. Aloma, 2020. **38**(1): p. 63-74.
27. Senkbeil, M., and Ihme, J. M., *Motivational factors predicting ICT literacy: First evidence on the structure of an ICT motivation inventory.* Computers and Education, 2017. **108**: p.145-158. https://doi.org/10.1016/ j.compedu.2017.02.003
28. Deumal, G., and Guitert, M., *La competencia digital en la enseñanza del diseño. El caso de BAU Digital competence in design education*. Revista Latinoamericana de Tecnología Educativa, 2015. **14**(2): p. 51-65.
29. Gutiérrez, A., Palacios, A., and Torrego, L., *Tribus digitales en las aulas universitarias*. Comunicar, 2010. **17**(34): p. 173-181. https://doi.org/10.3916/C34-2010- 03-17
30. Son, J.-B., Park, S., and Park, M., *Digital literacy of language learners in two different contexts sangsoon Park*, 2017. **13**(2): p. 1832-4215.
31. Cardoso, P. A., and Oliveira, N. R., *Scholars' use of digital tools: open scholarship and digital literacy*. In Proceedings of the 9th International Technology, Education and Development Conference (INTED2015), 2015. p. 5756-5763.
32. Hallaq, T., *Evaluating Online Media Literacy in Higher Education: Validity and Reliability of the Digital Online Media Literacy Assessment (DOMLA).* Journal of Media Literacy Education, 2016. **8**(1): p. 62-84.
33. Morellato, M., *Digital Competence in Tourism Education: Cooperative-experiential Learning*. Journal of Teaching in Travel and Tourism, 2014. **14**(2): p. 184-209. https://doi.org/10.1080/15313220.2014.907959
34. Cózar, R., De Moya, M. V, Hernández, J. A., and Hernández, J. R., *Conocimiento Y Uso De Las Tecnologías De La Información Y Las Comunicaciones (TIC) Según El Estilo De Aprendizaje De Los Futuros Maestros*. Formación Universitaria, 2016. **9**(13): p. 105-118. https://doi.org/10.4067/S0718-50062016000600010
35. Moreno, G. C., and Delgado, S. C. (2013). Evaluación de la competencia digital y las actitudes hacia las TIC 06_Sanchez_Caballe_38(1).indd 72 18/5/20 7:58 The digital competence of university students: a systematic literature review 2020, 38(1) 73 del alumnado universitario. *Revista de Investigación Educativa*, 31(2), 517-536. https://doi.org/10.6018/ rie.31.2.169271
36. Iordache, C., Mariën, I., Baelden, D., Iordache, C., Mariën, I., and Baelden, D., *Developing Digital Skills and Competences: A Quick-Scan Analysis of 13 Digital Literacy Models*. Italian Journal of Sociology of Education, 2017. **9**(91): p. 6-30. https://doi.org/10.14658/ pupj-ijse-2017-1-2
37. Chen, P.-S. D., Lambert, A.D., and Guidry, K.R., *Engaging online learners: The impact of web-based learning technology on college student engagement*. Computers & Education, 2010. **54**(4): p. 1222–1232. https://doi.org/10.1016/j.compedu.2009.11.008.
38. Rashid, T., & Asghar, H. M., *Technology use, self-directed learning, student engagement and academic performance: Examining the interrelations*. Computers in Human Behavior, 2016. **63**: p. 604–612. https://doi.org/10.1016/j.chb.2016.05.084.
39. Astin, A.W., *Student involvement: A developmental theory for higher education*. Journal of College Student Development, 1999. **40**(5): p. 518–529.

40. Fredricks, J.A., Blumenfeld, P.C., and Paris, A.H., *School engagement: Potential of the concept, state of the evidence*. Review of Educational Research, 2004. **74**(1): p. 59–109. https://doi.org/10.3102/00346543074001059.
41. Kahu, E.R., *Framing student engagement in higher education*. Studies in Higher Education, 2013. **38**(5): p. 758–773. https://doi.org/10.1080/03075079.2011.598505.
42. Kahu, E.R., and Nelson, K., *Student engagement in the educational interface: Understanding the mechanisms of student success*. Higher Education Research and Development, 2018. **37**(1): p. 58–71. https://doi.org/10.1080/07294360.2017.1344197.
43. Kuh, G.D., *What student affairs professionals need to know about student engagement*. Journal of College Student Development, 2009. ***50***(6): p. 683–706. https://doi.org/10.1353/csd.0.0099.
44. Ma, J., Han, X., Yang, J., and Cheng, J., *Examining the necessary condition for engagement in an online learning environment based on learning analytics approach: The role of the instructor*. The Internet and Higher Education, 2015. **24**: p. 26–34. https://doi.org/10.1016/j.iheduc.2014.09.005.
45. Finn, J. (2006). *The adult lives of at-risk students: The roles of attainment and engagement in high school (NCES 2006-328)*. Washington, DC: U.S. Department of Education, National Center for Education Statistics Retrieved from website: https://nces.ed.gov/pubs2006/2006328.pdf.
46. Bond, M., Buntins, K., Bedenlier, S., Zawacki-Richter O. and Kerres M., *Mapping research in student engagement and educational technology in higher education: a systematic evidence map*. International Journal of Educational Technology in Higher Education, **17**(2) https://doi.org/10.1186/s41239-019-0176-8
47. Fukuzawa, S., and Boyd, C., *Student engagement in a large classroom: Using technology to generate a hybridized problem-based learning experience in a large first year undergraduate class*. Canadian Journal for the Scholarship of Teaching and Learning, 2016. **7**(1). https://doi.org/10.5206/cjsotl-rcacea.2016.1.7.
48. Joksimović, S., Poquet, O., Kovanović, V., Dowell, N., Mills, C., Gašević, D., and Brooks, C., *How do we model learning at scale? A systematic review of research on MOOCs*. Review of Educational Research, 2018. **88**(1): p. 43–86. https://doi.org/10.3102/0034654317740335.
49. Andrew, L., Ewens, B., and Maslin-Prothero, S., *Enhancing the online learning experience using virtual interactive classrooms*. Australian Journal of Advanced Nursing, 2015, **32**(4): p. 22–31.
50. Bigatel, P., and Williams, V., *Measuring student engagement in an online program*. Online Journal of Distance Learning Administration, 2015. **18**(2): p. 9. https://www.learntechlib.org/p/158589/
51. Sun, J. C.-Y., and Rueda, R., *Situational interest, computer self-efficacy and self-regulation: Their impact on student engagement in distance education*. British Journal of Educational Technology, 2012. 43(2): p. 191–204. https://doi.org/10.1111/j.1467-8535.2010.01157.x.
52. Hatzipanagos, S., and Code, J., *Open badges in online learning environments: Peer feedback and formative assessment as an engagement intervention for promoting agency*. Journal of Educational Multimedia and Hypermedia, 2016. **25**(2): p. 127–142.
53. Ivala, E., and Gachago, D., *Social media for enhancing student engagement: The use of Facebook and blogs at a university of technology*. South African Journal of Higher Education, 2012. **26**(1): p. 152–167.
54. Venkatesh, V., Thong, J.Y., and Xu, X., *Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology*. MIS Quarterly, 2012. **36**(1): p. 157–178
55. Pham, T.T.T., Le, H.A. and Do, D.T., *The factors affecting students' online learning outcomes during the COVID-19 pandemic: A Bayesian Exploratory Factor Analysis*. Educational Research International, 2021. https://doi.org/10.1155/2021/2669098
56. Philipsen, B., Tondeur, J., Scherer, R., Pynoo, B., and Zhu, C., *Measuring institutional support for online and blended learning professional development: Validating an instrument that examines teachers' perceptions*. International Journal of Research and Method in Education, 2022. **45**(2): p. 164-179, 10.1080/1743727X.2021.1926973
57. Brunetti, F., Matt, D.T., Bonfanti, A., De Longhi, A., Pedrini, G., and Orzes, G., *Digital transformation challenges: strategies emerging from a multi-stakeholder approach*. The TQM Journal, 2020. **32**(4): p. 697-724.
58. Antonietti, C., Cattaneo, A., and Amenduni, F., *Can teachers' digital competence influence technology acceptance in vocational education?* Computers in Human Behaviour, 2022. 132: p. 107266, https://doi.org/10.1016/j.chb.2022.107266
59. Mehrvarz, M., Heidari, E., Farrokhnia, M., Noroozi, O., *The mediating role of digital informal learning in the relationship between students' digital competency and their academic performance*. Comput. Educ. 2021. **167** https://doi.org/10.1016/j. compedu.2021.104184.
60. Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E. & Tatham, R.L. (2005). Multivariate Data Analysis. 6th edition. Upper Saddle River, NJ: Prentice Hall.
61. Nunnaly, J. (1978), Psychometric Theory, McGraw-Hill, New York, NY
62. Chen, X., Zou, D., Cheng, G. and Xie, H., *Detecting latent topics and trends in educational technologies over four decades using structural topic modeling: a retrospective of all volumes of computers and education*. Computers and Education, 2020. **151**: p.103855.