Challenging the Concept of Digital Nativeness–Through the Assessment of Information Literacy and Digital Literacy

Aavakare, Milla; Nikou, Shahrokh

Published in:
Well-Being in the Information Society. Fruits of Respect - 8th International Conference, WIS 2020, Proceedings

DOI:
10.1007/978-3-030-57847-3_15

Published: 01/01/2020

Document Version
Accepted author manuscript

Document License
Publisher rights policy

Link to publication

Please cite the original version:
Aavakare, M., & Nikou, S. (2020). Challenging the Concept of Digital Nativeness–Through the Assessment of Information Literacy and Digital Literacy. In M. Cacace, R. Halonen, H. Li, T. P. Orrensalo, G. Widén, C. Li, & R. Suomi (Eds.), *Well-Being in the Information Society. Fruits of Respect - 8th International Conference, WIS 2020, Proceedings* (pp. 211–225). (Communications in Computer and Information Science; Vol. 1270 CCIS). Springer. https://doi.org/10.1007/978-3-030-57847-3_15

Challenging the Concept of Digital Nativeness – Through the Assessment of Information Literacy and Digital Literacy

Milla Aavakare[1] and Shahrokh Nikou[ORCID: 0000-0002-0029-5852]

Åbo Akademi University, Turku, Finland
{milla.aavakare,shahrokh.nikou}@abo.fi

Abstract. New opportunities for learning and teaching are introduced as the aftermath of the emergence of new digital technologies. Concurrently, change is taking place within the concept of literacy, as different dimensions of literacy have emerged. Information- and digital literacy are prominent examples of this, as their significance in the 21st century has received an array of scholarly attention. However, dimensions of literacy and technology acceptance within the educational context have been extensively bound to the discussion of digital natives and digital immigrants based on their age factor. A generalisation of this nature disregards diversity within the suggested groups, as differences can appear in other influencing factors. Hence, this study aims to look beyond age as a divider of digital nativeness, and instead takes a focus on other possible boundaries of characterisation. The results show that both information and digital literacy are important factors, and that literacy is a competence that depends on the access, frequency of use and the ability to use digital technologies. As such, the interactions of individuals with digital technologies should be used to classify individuals as digital native and digital immigrants.

Keywords: Digitalisation. Digital immigrants. Digital literacy. Digital natives. Digital tools. Educational institutions. Information literacy.

1 Introduction

Two decades ago, Prensky [1] characterised the group of individuals born after 1980 as digital natives growing up with, and thereby relying on, technology. These digital natives, in contrast to their digital immigrant counterparts born before 1980, were said to live their lives surrounded by technologies and digital tools [1]. The claims made by Prensky generated discussion and debate, as some commentators [2-4] have questioned the claim of this generational change and the lack of empirical evidence. As mentioned by Bennett et al. [3], the discussion over the concept of digital natives' rests on two central claims, the first of which is the existence of a distinct generation of digital natives. The second claim is that the nature of education needs to change and accommodate to the needs of this new distinct generation. Yet, calling for such grand change during the absence of an empirical basis can be viewed as problematic. A generalisation of this nature disregards diversity within the suggested group of digital natives, as very real differences can derive from other factors, e.g., access to digital technologies, frequency of use of digital technologies, as well as self-reported levels of proficiency when it comes to the utilisation of digital technologies.

This paper aims to look beyond age as a divider of digital nativeness, and instead takes a focus on other possible boundaries of characterisation through the assessment of the following research questions "*to what extent do digital literacy and information literacy explain the intention to use digital technologies in a learning environment,*

[1] Corresponding author: Milla Aavakare
Åbo Aakdemi University
Address: Fänriksgatan 3B, 20500
Turku, Finland

and *"what role does access, frequency of use of and proficiency with digital technology play?*". To answer the research questions, based on an extensive literature review, we build a conceptual model and examine the model through an empirical study using a novel methodological approach. We employ fuzzy-set Qualitative Comparative Analysis (fsQCA) to provide unique and complementary insights to the phenomenon under investigation.

2 Background

As stated by Nikou et al. [5], literacy refers to the condition of an individual being literate. Traditionally, this concept of literacy has been associated with the abilities of reading and writing. With time, however, the literacy concept has evolved to encompass abilities reaching far beyond the original perception. In the information-based society, literacy can be understood as "a means of identification, understanding, interpretation, creation, and communication in an increasingly digital, text-mediated, information-rich and fast-changing world" [6]. The evolution of this concept is understandable when considering the technological progress and digitalisation of the past decades. As such, a multitude of new literacy dimensions such as information literacy [7-8] and digital literacy [9-10] have emerged. Abilities related to use of ICT for information evaluation have reached a new state of significance as they have developed in to a "survival skill" [9]. As suggested by Eshet-Alkalai [9], some of the underlying causes to this include the changes which have occurred in the rate of exposure to information, as well as the fact that information is easily manipulated to its nature. In consideration of these changes, it is not difficult to comprehend the importance of information- and digital literacy and therefore the concerns related to these abilities, especially in the context of utilisation of digital technologies. The usage of digital technologies can consist of versatile use of hardware and software for varying purposes, as digital technology is extensively present within contemporary activities. This prominent presence calls for the need of digital literacy skills, defined as "the multiplicity of literacies associated with the use of digital technologies" [10, p. 1066].

The significance of information- and digital literacy matter particularly in the context of education. Possibilities enabled by data and analytics have facilitated new ways of monitoring progress, predictive ways of harnessing information of learning trajectories, as well as new opportunities for targeted and personalised learning [11]. Moreover, additional educational possibilities enabled by digital technologies have been researched in the context of 5G technology [12], social media [13] and telecommunications [14]. The development of digital technologies can therefore have a profound effect on both formal and informal learning environments. However, in order to obtain the advantages of digital technologies in education, the technologies must first be accepted by students and teachers. Thus far, research has been conducted on technology acceptance within classrooms, as e.g., Gu et al. [15] have set out to assess differences in technology acceptance and utilisation among digital immigrant teachers and digital native students. The findings indicate that there are, indeed, differences between digital immigrant teachers and digital native students when it comes to their interpretation of the importance of technology utilisation [15].

However, as mentioned by Bennett et al. [3], research evidence tends to focus on highly technologically adept young people while simultaneously somewhat neglecting to incorporate young people who do not have resembling access to technology or resembling technology skills. In fact, Bennett et al. [3] suggest that "with this [generalisation] comes the danger that those less interested and less able will be neglected, and that the potential impact of socio-economic and cultural factors will be overlooked. It may be that there is as much variation within the digital native generation as between the generations" (p. 779). The conclusion being that although technology might be embedded in the lives of young people, it does not mean that young people's utilisation and skills are uniform or superior than their counterpart generation. Hence, further research regarding the concept of digital nativeness should commence before inaugurating major fundamental changes within education in order to accommodate to a generalised perception of digital natives.

3 Theoretical Background

This section discusses factors that are assumed to have impact on the intention to use technology and the development of a theory-based conceptual model. The aim is to connect dimensions of literacy with intention to use technology while examining the moderating, if any, effects of access, frequency of use and proficiency with digital technology.

3.1 Alternative Boundaries of Characterisation

According to the American Library Association [16], information literacy (IL) can be defined as a collection of abilities which bring about an individual's ability to "recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information" (p. 2). Prior research [5, 18] has revealed that information literacy has a significant effect on the attitude towards the use of digital technologies, while in turn, attitude has been shown to have a significant effect on intention to use said technologies [18]. In addition to information literacy, digital literacy (DL) has also been found to affect the intention to use technology [18-19]. Differing partially from IL, DL is defined by the American Library Association [17] as "the ability to use information and communication technologies to find, understand, evaluate, create, and communicate digital information" (p. 2). Although IL is occasionally presented as a component of DL, a distinction is made between the two in this paper, as IL refers here to the cognitive skills which are used to evaluate information in an educated and effective way [9], whereas DL refers to the ability to understand and use information in multiple formats from an array of digitally available sources [20]. Both IL and DL related skills can be seen as vital in the contemporary society, especially due to their connection to education and the fact that learning today can occur through the utilisation of digital technologies. Thus, the effects of IL and DL on the intention to use digital technologies for learning are inevitable.

This paper intends to challenge the concept of age as a divider of digital nativeness, and instead focus on other possible boundaries of characterisation. Therefore, in addition to IL and DL, three other factors of possible impact will be explored: access (ACC), frequency of use (FRE) and proficiency (PRO). Access refers here to the individuals' access to digital technologies, FRE refers to the frequency at which they use said technologies, and PRO refers to the individuals self-reported proficiency of using digital technologies. The suggested factors can impact an individual's intention to use digital technologies for various purposes, including learning. We also believe using these factors would enable to characterise and categorise individuals better than relying merely to their age. Moreover, access to digital technologies or proficiency with said technologies enable to assess more profoundly individual's literacy competency.

3.2 Intention to Use Digital Technologies for Teaching and Learning

In this paper, intention to use technology (INT) refers to an individual's intention to use digital technologies for teaching and learning purposes. The INT construct was selected as the observed outcome, as the aim of this research is to explore how the intention to use digital technologies can be influenced by information- and digital literacy when simultaneously taking access, frequency and proficiency into account. The construct of intention to use has been widely studied as an outcome variable in the research of future technology use [21-25].

4 Research Methodology

Prior studies of the subject matter have been conducted with extensive use of Structural Equation Modelling [19, 36-38], which has provided insights that need further research. Therefore, fuzzy-set Qualitative Comparative Analysis (fsQCA) can provide new knowledge of the subject matter and will thus be used for this study.

4.1 Data collection

After an extensive literature review, a survey questionnaire was devised to obtain the opinions of the potential respondents (university students and university staff), after which it was utilised to gain deeper insight to their intention to use digital technology in learning and teaching environments. The questionnaires consisted of questions assessing background information, respondents' access to digital technologies, frequency of use of digital technology, and self-reported levels of proficiency with digital technology, being all related to the educational context and learning purposes. This was followed by questions designed to measure the respondents' perception regarding their own information- and digital literacy. The information literacy items were adapted from Kurbanoglu et al. [26], while the digital literacy items were adapted from Ng [10]. Questions regarding information- and digital literacy were measured on a 7-point Likert scale, ranging from 1 – Strongly disagree to 7 – Strongly agree. Meanwhile, access and frequency were answered as categorical variables. In the question regarding access, respondents were asked about their access to mobile smart phones, tablets, desktop computers, laptop computers, game consoles and wearable devices. In the questions regarding frequency and proficiency, respondents were asked about word processors (e.g., Word, Pages), spreadsheets (e.g., Excel, Numbers), presentations (e.g., PowerPoint, Keynote), file sharing (e.g., Google Drive, Dropbox), photo editing (e.g., Photoshop, PhotoScape), website management tools (e.g., WordPress, Squarespace), mobile device organisers (e.g., address book, calendar), email services (e.g., Outlook, Gmail) and social media (e.g., Facebook, Instagram). Proficiency was measured on a 7-point Likert scale, ranging from 1 – Not proficient at all to 7 – Very proficient. The devised online questionnaire was then distributed through multiple channels digitally. In addition, flyers were circulated at four university campuses in Finland.

5 Descriptive Data Analysis

The dataset for students comprised of 157 students, where 100 were females, 55 were males, and 2 identified as other. Meanwhile, the dataset for non-students, i.e., university staff (teachers and researchers), administrative and service personnel consisted of 100 employees, where 51 were females, 48 were males, and 1 identified as other. The average age of the students is 25.3 and for the non-students group the average is 42.3. Naturally, the student group included also older individuals just at the non-student group included younger individuals. However, the average age of the groups aligns well with the traditional concept of age as a divider for digital nativeness, but a concept debated by e.g., Nikou et al. [38]. Additional information regarding the demographic information of the respondents and the results with respect to access to digital technology (Table 1), frequency of software use (Table 2) and self-report rating of proficiency with digital technology can be seen in Table 3.

Table 1. Access to digital technology.

Digital tools	1	2	3	4	5	Mean
Mobile (smart) phone	.06 % [0%]	.06 % [1%]	0% [0%]	1.3% [1%]	97.5% [98%]	4.94 [4.96]
Tablet	57.3% [43%]	21.7% [20%]	8.3% [10%]	7.6% [7%]	5.1% [20%]	1.81 [2.41]
Desktop computer	31.2% [22%]	28.7% [12%]	11.5% [8%]	5.7% [5%]	22.9% [53%]	2.6 [3.55]
Laptop computer	.06% [2%]	8.9% [3%]	18.5% [6%]	21.7% [11%]	50.3% [78%]	4.12 [4.6]
Game console	54.8% [71%]	25.5% [21%]	14.6% [6%]	2.5% [2%]	2.5% [0%]	1.72 [1.39]
Wearable device (e.g., smartwatch, fitbit)	80.3% [75%]	3.8% [4%]	1.3% [2%]	3.8% [4%]	10.8% [15%]	1.61 [1.8]

Note: 1 = I do not use; 2 = A few times a month or less; 3 = A few times a week; 4 = About once a day; 5 = Several times each day. Values within the brackets represent data for non-students.

As shown in the tables above, differences between students and non-students can be identified within all variables. In Table 1, non-students scored a higher mean regarding

access to mobile smart phones, tablets, desktop computers, laptop computers, and wearable devices. Meanwhile, students scored a higher mean only in regard to game consoles.

Table 2. Frequency of software use.

Digital tools	1	2	3	4	5	Mean
Word processor	0% [0%]	15.3% [7%]	47.1% [12%]	15.9% [10%]	21.7% [71%]	3.43 [4.45]
Spreadsheet	11.5% [2%]	39.5% [19%]	29.9% [31%]	9.6% [13%]	9.6% [35%]	2.66 [3.61]
Presentation	3.2% [2%]	69.4% [23%]	24.2% [37%]	.06% [20%]	2.5% [18%]	2.29 [3.29]
File sharing	2.5% [1%]	24.8% [28%]	38.9% [27%]	18.5% [19%]	15.3% [25%]	3.19 [3.39]
Photo/image editing	39.5% [28%]	40.8% [44%]	14.6% [20%]	2.5% [3%]	2.5% [5%]	1.87 [2.13]
Website management	70.7% [52%]	19.7% [39%]	4.5% [5%]	2.5% [4%]	2.5% [0%]	1.46 [1.61]
Mobile device organiser	8.3% [16%]	14% [17%]	26.1% [12%]	20.4% [24%]	31.2% [31%]	3.52 [3.37]
Email services	0% [0%]	.06% [0%]	3.8% [1%]	23.6% [6%]	72% [93%]	4.66 [4.92]
Social media	.06% [7%]	2.5% [3%]	2.5% [6%]	12.1% [18%]	82.2% [66%]	4.72 [4.33]

Note: 1 = I do not use; 2 = A few times a month or less; 3 = A few times a week; 4 = About once a day; 5 = Several times each day. Values within the brackets represent data for non-students.

In Table 2, non-students scored a higher mean regarding the usage frequency of word processors, spreadsheets, presentations, file sharing, photo editing, website management, and email services. Meanwhile, students scored a higher mean in regard to mobile devices organisers and social media.

Table 3. Self-report rating of proficiency.

Digital tools	1	2	3	4	5	6	7	Mean
Word processor	0 % [0%]	0 % [0%]	0% [3%]	7% [6%]	31.2% [13%]	37.6% [35%]	24.2% [43%]	5.78 [6.1]
Spreadsheet	3.8% [2%]	10.8% [6%]	19.7% [14%]	24.2% [17%]	19.1% [23%]	14% [20%]	8.3% [18%]	4.19 [4.85]
Presentation	0% [1%]	1.3% [0%]	7.6% [2%]	22.9% [14%]	31.2% [28%]	24.2% [26%]	12.7% [29%]	5.07 [5.62]
File sharing	0% [2%]	3.2% [7%]	7% [7%]	9.6% [15%]	26.1% [23%]	29.9% [21%]	24.2% [25%]	5.45 [5.13]
Photo/image editing	21.7% [21%]	16.6% [19%]	22.3% [11%]	17.8% [18%]	12.1% [11%]	7% [15%]	2.5% [5%]	3.13 [3.44]
Website management	43.3% [38%]	14% [14%]	15.3% [18%]	16.6% [13%]	3.2% [10%]	3.2% [5%]	4.5% [2%]	2.49 [2.66]
Mobile device organiser	1.3% [9%]	2.5% [9%]	6.4% [9%]	14% [13%]	18.5% [20%]	25.5% [22%]	31.8% [18%]	5.49 [4.64]
Email services	.06% [0%]	0 % [0%]	0 % [0%]	7% [5%]	15.3% [16%]	36.9% [38%]	40.1% [41%]	6.07 [6.15]
Social media	.06% [8%]	1.9% [2%]	3.2% [7%]	10.2% [7%]	17.2% [26%]	33.1% [26%]	33.8% [24%]	5.75 [5.15]

Note: 1 (Not proficient at all) and 7 (Very proficient). Values within the brackets represent data for non-students.

In Table 3, non-students scored a higher mean regarding the self-reported rating of proficiency in the use of word processors, spreadsheets, presentations, photo editing, website management, and email services. Meanwhile, students scored a higher mean in regard to file sharing, mobile devices organisers, and social media. Overall, non-students (i.e., university staff, the "digital immigrants") scored higher at various instances when compared to the students (i.e., the "digital natives"). This counteracts the traditional line of division drawn using age as a divider when it comes to digital nativeness and the perceived capabilities that come with said assumption.

5.1 Measurement Model

In this section, we present the statistical results of the measurement model. A confirmatory factor analysis (CFA) was run for all the constructs in order to examine

internal consistency and discriminant validity. The results show that all items were loaded into their respective constructs. The internal consistency was examined through the Cronbach's alpha, composite reliability and average variance extracted (AVE). Cronbach's alpha (α) values were all above the threshold of .70 (min = .854; max = .918). The values of AVE ranged from .599 to .637, CR values ranged from 0.897 to .931, all well above the recommended minimums of .50 and .70 respectively [28]. The standardised item loadings for each construct exceeded the recommended value of .70; some items with lower loadings were excluded from the further analysis. Discriminant validity was examined in order to evaluate if each construct's AVE square root was greater than its highest correlation with any other construct, and the results showed no discriminant validity issues (see Table 4).

Table 4. Discriminant validity (diagonal values show AVE square root).

	DL	IL	INT
Digital literacy	**0.785**		
Information literacy	0.621	**0.774**	
Intention to use	0.420	0.409	**0.798**

In addition to all the validity tests explained above, the common method bias was examined through a two-step approach. First, Harman's single factor test was conducted, and the test result showed that the majority of variance could not be attributed to one factor. The first factor accounts for 42% of the variance [29]. In the second step, all items were modelled as the indicators of a factor, as recommended by Malhotra et al. [30]. The test results showed poor model fit, thus, it can be assumed that the CMB was not an issue in this study. Next, we examined our data using fuzzy-set Qualitative Comparative Analysis [27], a method which has attracted attention from many researchers in various research disciplines.

6 Fuzzy-set Qualitative Comparative Analysis

Fuzzy-set Qualitative Comparative Analysis (fsQCA) introduced by Ragin [27] has been utilised by scholars conducting research within several different fields [39, 41-42]. As stated by Nikou et al. [5], "this method [fsQCA] provides a means to overcome some of the limitations of conventional statistical methods, such as regression-based analysis. It enables to account for the complex interdependencies, conjunctive paths, and the causal relationships between variables which might better inform the factors influencing the outcome variables" [5, p. 9]. Through the use of Boolean algebra, fsQCA provides logical comparisons, while presenting dependent and independent variables on a scale rather than as binary values. This enables the possibility to identify patterns of elements behind the outcome of study [5].

6.1 FsQCA Necessity Analysis

The necessity analysis enables to assess if there are any variables (conditions, in term of the fsQCA approach) that can be identified as necessary for intention [31]. Necessary refers to a situation where a condition must be present for the outcome of interest to occur, and sufficient if it can produce an outcome by itself. If the consistency value exceeds 0.90, then it can be assumed that considerable relationships exist [32]. The necessity analysis results showed that none of the conditions (variables) used in the analysis (i.e., digital literacy, information literacy) were seen as necessary conditions for intention to use digital technologies for learning. Although, this cannot be confirmed without running the main part of fsQCA, that is sufficiency analysis. There are several steps and phases in fsQCA that should be sequentially followed. First, all the variables (conditions) measured on a continuous scale have to be converted into fuzzy sets between 0 to 1, a practice which is called calibration. A value of 0 indicates fully out or no set membership and a value of 1 indicates fully in or full set membership [33]. According to Ragin [33], three anchors can be defined to determine the degree of

membership for each condition (variable). These anchors indicate for full membership a fuzzy score = .95, for full nonmembership a fuzzy score = .05, and for cross-over point a fuzzy score = .50. After all values were calibrated into fuzzy sets, a truth table of 2^k rows was constructed, where k is the number of predictor variables (conditions), and each row represent a possible combination [34].

Regarding the consistency threshold, Ragin [33] suggested to set the level to > .75. Consistency measures the degree to which a subset relation has been approximated and it is similar to significance in correlational methods [32]. When constructing the truth table and reviewing the configurations, those that do not comply to this rule can be deleted. The solution coverage is used to assess the empirical relevance of a consistent subset, similar to the explained variance (R^2) value in regression analysis [35]. The fsQCA analysis produces three different solution sets: (a) parsimonious, (b) intermediate, and (c) complex. Ragin [33] suggested to use the intermediate solutions to articulate the results. The interpretation of the intermediate solutions is tricky, and the domain knowledge of the researcher is highly important [33]. The following notations will be used when fsQCA results are discussed. Black circles (●) indicate the presence of a condition and blank circles (○) indicate its absence. Blank spaces indicate "do not care," in other words, the causal condition may be either absent or present [31]. Three control variables were included in the analysis, access to digital technologies, frequency of use of digital technologies and proficiency with digital technologies. They have been presented in the form of crisp variables. Thus, black circles (●) indicate "high (access, frequency and proficiency)" and blank circles (○) denote high (access, frequency and proficiency). For the gender, black circles (●) were used to indicate males and blank circles (○) to indicate females.

6.2 fsQCA Results

In this section the fsQCA results are presented and discussed. The results are identified based on the casual configuration of five conditions (variables), namely, digital literacy (DL), information literacy (IL), access to digital technologies (ACC), frequency of use of digital technologies (FRE) and proficiency with digital technologies (PRO) leading to the occurrence of the outcome, i.e., intention to use digital technologies for learning. Two different analysis were conducted, one for university students and one for non-students (i.e., university staff). The fsQCA results for the student sample without including gender as a control variable are presented in Table 5. As shown, five configurations of conditions were obtained. The overall consistency is .864 and the overall solution coverage value is .768, indicating that these five solutions cover 77% of the cases (respondents). *Solution 1* indicates that the presence of both ACC and IL and the absence of PRO are sufficient conditions for the outcome of interest (intention to use digital technologies for learning) to occur. *Solution 2* indicates that the presence of ACC and the absence of IL lead to the outcome of interest. *Solution 3* indicates that the presence of ACC and the presence of DL lead to the outcome of interest. *Solution 4* indicates that the presence of FRE and presence of DL combined with the absence of PRO lead to the outcome of interest. *Solution 5* indicates that the presence of FRE, presence of IL and presence of DL lead to the outcome of interest.

Table 5. Intermediate solution for intention to use digital technology (student sample)

Solution	ACC	FRE	PRO	IL	DL	Raw Coverage	Unique Coverage	Consistency
1	□		○	□		0.135	0.041	0.744
2	□			○		0.132	0.007	0.988
3	□				□	0.170	0.031	0.991
4		□	○		□	0.067	0.020	0.985
5		□		□	□	0.111	0.026	0.999

The fsQCA results for the student sample with gender included as a control variable is presented in Table 6. As shown by the table, eight configurations of conditions were obtained. The overall consistency is .942 and the overall solution coverage value is .407, indicating that these eight solutions cover 41% of the cases (respondents). *Solution 1* indicates that the presence of FRE and the absence of PRO are sufficient

conditions for the outcome of interest (intention to use digital technologies for learning) to occur. This is the only solution where gender does not play a role. *Solution 2* indicates that the presence of DL and IL lead to the outcome of interest, although it should be noted that this solution applies only to male respondents. *Solution 3* indicates that the presence of ACC and the presence of IL combined with the absence of PRO lead to the outcome of interest, although it should be noted that this solution applies only to female respondents. *Solution 4* indicates that the presence of PRO and IL combined with the absence of ACC and DL lead to the outcome of interest, although it should be noted that this solution applies only to female respondents. Solution 5 indicates that the presence of ACC combined with the absence of FRE and IL lead to the outcome of interest, a solution which applies only to female respondents. Solution 6 indicates that the presence of ACC and PRO combined with the absence of DL lead to the outcome of interest, a solution which applies only to female respondents. Solution 7 indicates that the presence of ACC, PRO and DL combined with the absence of FRE lead to the outcome of interest, a solution which applies only to male respondents. Solution 8 indicates that the presence of RPO, IL and DL combined with the absence of ACC and FRE lead to the outcome of interest, a solution which applies only to female respondents.

Table 6. Intermediate solution for intention to use digital technology (student sample + gender)

Solution	Gen	ACC	FRE	PRO	IL	DL	Raw Coverage	Unique Coverage	Consistency
1			□	○			0.097	0.057	0.801
2	□				□	□	0.117	0.092	1.000
3	○	□		○	□		0.055	0.021	0.995
4	○	○		□	□	○	0.038	0.018	1.000
5	○	□	○		○		0.043	0.016	1.000
6	○	□		□		○	0.035	0.027	1.000
7	□	□	○	□		□	0.038	0.025	0.988
8	○	○	○	□	□	□	0.071	0.071	0.998

The fsQCA results for non-students (i.e., university staff) without including gender as a control variable are presented in Table 7. As shown, four configurations of conditions were obtained. The overall consistency is 0.932 and the overall solution coverage value is .608, indicating that these four solutions cover 61% of the cases (respondents). *Solution 1* indicates that the presence of ACC and the absence of DL are sufficient conditions for the outcome of interest to occur. *Solution 2* indicates that the presence of PRO and IL combined with the absence of FRE lead to the outcome of interest. *Solution 3* indicates that the presence of FRE and IL combined with the absence of PRO lead to the outcome of interest. *Solution 4* indicates that the presence of FRE and IL f combined with the absence of ACC lead to the outcome of interest.

Table 7. Intermediate solution for intention to use digital technology (staff sample)

Solution	ACC	FRE	PRO	IL	DL	Raw Coverage	Unique Coverage	Consistency
1	□				○	0.135	0.041	0.744
2		○	□	□		0.132	0.007	0.988
3		□	○	□		0.170	0.031	0.991
4	○	□		□		0.111	0.026	0.999

The fsQCA results for non-students with their gender included in the fsQCA analysis are presented in Table 8. As shown, five configurations of conditions were obtained. The overall consistency is 0.910 and the overall solution coverage value is 0.671, indicating that these five solutions cover 67% of the cases (respondents). *Solution 1* indicates that the presence of ACC and DL are sufficient conditions for the outcome of interest (intention to use digital technologies for learning) to occur. It should be noted

in this solution gender of the respondents does not play a role. *Solution 2* indicates that the presence of ACC and IL lead to the outcome of interest, a solution which applies only to male respondents. *Solution 3* indicates that the presence of PRO and IL combined with the absence of FRE lead to the outcome of interest, a solution which gender of the respondents does not play a role and this solution. *Solution 4* indicates that the presence of FRE and IL combined with the absence of PRO lead to the outcome of interest. It should be noted that this solution is applicable only to females. *Solution 5* indicates that the presence of FRE, IL and DL combined with the absence of ACC lead to the outcome of interest, a solution which applies only to female respondents.

Table 8. Intermediate solution for intention to use digital technology (staff sample + gender)

Solution	Gen	ACC	FRE	PRO	IL	DL	Raw Coverage	Unique Coverage	Consistency
1		□				□	0.310	0.086	0.981
2	□	□			□		0.294	0.096	0.838
3			○	□	□		0.062	0.043	0.932
4	○		□	○	□		0.227	0.102	0.827
5	○	○	□		□	□	0.178	0.028	1.000

7 Conclusion

The application of information literacy, digital literacy, access to digital technologies, frequency of use of digital technologies and proficiency with digital technologies has been examined and evaluated. This paper examines their impact on the intention to use digital technology in teaching and learning environments among university students and university staff. The fuzzy-set Qualitative Comparative Analysis (fsQCA) has been employed and the findings indicate that for university students, digital literacy, frequency of use and access to digital technology are detrimental factors influencing the intention to use digital technology. As for the university staff sample, the results indicate that frequency and information literacy are important factors. When taking gender into account, some variations can be found within the result. For both groups, the majority of solutions only apply for female respondents.

In this paper, university students and university staff consisted of both traditionally perceived "digital natives" and "digital immigrants", disregard to their age. Classifying individual as digital native and digital immigrant has been debated by many authors such as [38]. Access, frequency and proficiency were instead suggested as possible boundaries of characterisation. When looking at these suggestions, differences between students and non-students were identified within all these factors (i.e., access, frequency and proficiency). In fact, non-students (i.e., university staff, the "digital immigrants") scored higher at various instances when compared to the students (i.e., the "digital natives"). Overall, the university staff had more access to digital tools, had a higher frequency of software use, and even a higher self-report rating of proficiency. This challenges the traditional point of division utilising age [1] as a divider when it comes to digital nativeness.

The utilisation of fsQCA in this paper has provided complementary insights to prior research using the SEM method [19,36-37, 39-40] through different configurations of conditions which lead to the outcome of interest. Regarding the sample of students, the most frequently appearing conditions (variables) within the solutions were access and digital literacy. Meanwhile, for the university staff sample, the most frequently appearing condition was information literacy. When taking gender into account, the most prominent conditions within the solutions for the student sample were access, proficiency and information literacy. With the non-student group, the most prominent condition was information literacy. Concludingly, the concept of digital nativeness can be perceived as more complex than a line of division drawn between those born before and after 1980. Other boundaries of characterisation should not be left overlooked while exploring individual's intention to use digital technologies for teaching and learning, as factors such as digital literacy, information literacy, access to digital tools, usage frequency, and individuals trust in their own proficiency can impact said intention.

Naturally, this research possesses some limitations. Due to the data collection method

being a self-completion survey, the limitations include inability to control the quality of the respondents. Furthermore, the outcomes of the answers provided by the respondents are limited due to closed-ended questions. Future research could build upon the findings of this paper while simultaneously suggesting new factors for boundaries of characterisation. The direction of future research could additionally incorporate qualitative efforts in order to gain more dimension within the subject matter.

References

1. Prensky, M.: Digital natives, digital immigrants, part 1. On the Horizon 9(5), 1- 6 (2001).
2. Benini, S., Murray, L.: Challenging Prensky's characterization of digital natives and digital immigrants in a real-world classroom setting. Digital literacies in foreign and second language education, 69-85 (2014).
3. Bennett, S., Maton, K., Kervin, L.: The 'digital natives' debate: A critical review of the evidence. British journal of educational technology, 39(5), 775-786 (2008).
4. Bennett, S., Maton, K.: Beyond the 'digital natives' debate: Towards a more nuanced understanding of students' technology experiences. Journal of computer assisted learning, 26(5), 321-331 (2010).
5. Nikou, S., Brännback, M., Widén, G.: The impact of digitalization on literacy: digital immigrants vs. digital natives. In Proceedings of the 27th European Conference on Information Systems (ECIS), Stockholm & Uppsala, Sweden (2019).
6. UNESCO. Literacy. Retrieved 31st March from: https://en.unesco.org/themes/literacy, (2019).
7. Eisenberg, M. B.: Information literacy: Essential skills for the information age. DESIDOC journal of library & information technology, 28(2), 39-47 (2008).
8. Lloyd, A.: Information literacy landscapes: an emerging picture. Journal of documentation, 62(5), 570-583 (2006).
9. Eshet-Alkalai, Y.: Digital literacy: a conceptual framework for survival skills in the digital era. J. Educ. Multimed. Hypermed. 13(1), 93–106 (2004).
10. Ng, W.: Can we teach digital natives digital literacy? Computers & Education, 59(3), 1065-1078 (2012).
11. Lodge, J. M., Kennedy, G., Lockyer, L.: Digital learning environments, the science of learning and the relationship between the teacher and the learner. In A. Carroll, R. Cunnington & A. Nugent (eds.) Learning under the lens: Applying findings from the science of learning to the classroom. Abingdon, UK: CRC Press (2019).
12. Baratè, A., Haus, G., Ludovico, L. A., Pagani, E., Scarabottolo, N.: 5G Technology for Augmented and Virtual Reality in Education. In *Proceedings of the International Conference on Education and New Developments 2019 (END 2019)* (pp. 512-516) (2019).
13. Piotrowski, C.: Emerging research on social media use in education: A study of dissertations. Research in Higher Education Journal, 27 (2015).
14. Uskov, V., Uskova, M.: Applications of telecommunications in education: National Science Foundation projects on advanced technological and online education in information engineering technology. In *10th International Conference on Telecommunications, 2003. ICT 2003.* (Vol. 2, pp. 1701-1708). IEEE (2003).
15. Gu, X., Zhu, Y.,Guo, X.: Meeting the "digital natives": Understanding the acceptance of technology in classrooms. Journal of Educational Technology & Society, 16(1), 392-402 (2013).
16. American Library Association (ALA).: Information literacy competency standards for higher education (2002).
17. American Library Association (ALA).: Digital Literacy Task Force. Digital Literacy, Libraries, and Public Policy. Retrieved 7 February from https://www.districtdispatch.org/wp-content/uploads/2013/01/2012_OITP_digilitreport_1_22_13.pdf (2013).
18. Nikou, S., Brännback, M., Widén, G.: The Impact of Multidimensionality of Literacy on the Use of Digital Technology: Digital Immigrants and Digital Natives. In *International Conference on Well-Being in the Information Society* (pp. 117-133). Springer, Cham (2018).

19. Aavakare, M. (2019). The Impact of Digital Literacy and Information Literacy on the Intention to Use Digital Technologies for Learning: A Quantitative Study Utilizing the Unified Theory of Acceptance and Use of Technology. Master thesis, available at: https://www.doria.fi/handle/10024/173070. Accessed 11 June 2020.
20. Gilster, P. (1997). *Digital literacy*. New York: Wiley Computer Pub.
21. Ajzen, I.: From intentions to actions: A theory of planned behaviour. In Action control (pp. 11-39). Springer, Berlin, Heidelberg (1985).
22. Davis, F. D.: Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS quarterly, 319-340 (1989).
23. Fishbein, M., Ajzen, I.: *Belief, Attitude, Intention, and Behaviour: An Introduction to Theory and Res*earch. Reading, MA: Addison-Wesley (1975).
24. Venkatesh, V., Morris, M. G., Davis, G. B., Davis, F. D.: User acceptance of information technology: Toward a unified view. MIS quarterly, 425-478 (2003).
25. Venkatesh, V., Thong, J. Y., Xu, X.: Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. MIS quarterly, 36(1), 157-178 (2012).
26. Kurbanoglu, S. S., Akkoyunlu, B., Umay, A.: Developing the information literacy self-efficacy scale. Journal of documentation, 62(6), 730-743 (2006).
27. Ragin, C. C.: The comparative method: Moving beyond qualitative and quantitative strategies, Berkeley. CA: University of California Press (1987).
28. Bagozzi, R. P., Yi, Y.: On the evaluation of structural equation models. Journal of the Academy of Marketing Science, 16(1), 74-94 (1988).
29. Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., Podsakoff, N. P.: Common method biases in behavioural research: a critical review of the literature and recommended remedies. Journal of applied psychology, 88 (5), 879-903 (2003).
30. Malhotra, N. K., Kim. S. S., Patil. A.: Common method variance in IS research: a comparison of alternative approaches and a reanalysis of past research. Management Science, 52(12), 1865-1883 (2006).
31. Ragin, C. C., Fiss, P. C.: *Net effects analysis versus configurational analysis: An empirical demonstration*. In C. C. Ragin (Ed.), Redesigning social inquiry: Fuzzy sets and beyond: 190–212. Chicago: University of Chicago Press (2008).
32. Schneider, C. Q., Wagemann. C. (2010). Standards of good practice in qualitative comparative analysis (QCA) and fuzzy-sets. Comparative Sociology, 9(3), 397–418 (2010).
33. Ragin, C. C.: Redesigning social inquiry: Fuzzy sets and beyond. Chicago: Chicago University Press (2008).
34. Mikalef, P., Pateli, A.: Information technology-enabled dynamic capabilities and their indirect effect on competitive performance: Findings from PLS-SEM and fsQCA. Journal of Business Research, 70, 1-16 (2017).
35. Mendel, J. M., Korjani. M. M.: Charles Ragin's fuzzy set Qualitative Comparative Analysis (fsQCA) used for linguistic summarizations. Information Sciences, 202(2012), 1–23 (2012).
36. Mohammadyari, S., Singh, H.: Understanding the effect of e-learning on individual performance: The role of digital literacy. Computers & Education, 82, 11-25 (2015).
37. Wongvilaisakul, W., Lekcharoen, S.: The acceptance of e-Learning using SEM approach: A case of IT Literacy development for PIM students. In 12th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON) (pp. 1-6). IEEE (2015).

38. Nikou, S., Cavalheiro, S., Widén, G.: Digital Natives and Digital Immigrants in the Creative Economy. In International Conference on Information (pp. 343-362). Springer, Cham (2020).

39. Bouwman, H., Nikou, S., Molina-Castillo, F. J., de Reuver, M.: The impact of digitalization on business models. Digital Policy, Regulation and Governance, 20(2), 05-124, (2018).

40. Nikou, S.: Factors driving the adoption of smart home technology: An empirical assessment. Telematics and Informatics, 45, (2019). https://doi.org/10.1016/j.tele.2019.101283.

41. Nikou, S., Brännback, M., Carsrud, A. L., Brush, C. G.: Entrepreneurial intentions and gender: pathways to start-up. International Journal of Gender and Entrepreneurship, 11, 3, 348-372, (2019).

42. Mezei, J., Nikou, S.: On the use of configurational analysis in entrepreneurial research. In A research agenda for entrepreneurial cognition and intention. Edward Elgar Publishing. DOI:https://doi.org/10.4337/9781784716813.00012, 142–160, (2019).