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implies that assessing the digital competence of learners and educators in higher education is of vital significance.

Digital competence (DC) refers to the proficiency and knowledge required to utilise digital technologies effectively, and it encompasses a broad spectrum of abilities, including basic computer literacy, information management, critical thinking, digital communication, and creativity [19]. Digital competence is not merely about mastering technical skills but also a deep understanding of the ethical, social, and cultural dimensions of digital interactions while including knowledge and attitudes toward DTs [20].

The European Commission recognised the significance of digital competence and created the Digital Competence (Dig-Comp) Framework [21]. This framework offers a comprehensive way to evaluate people's digital abilities in different areas [19], [21], [22]. The Dig-Comp 2.1 Framework has gained widespread attention due to its thoroughness and relevance in various contexts [21], [23]. However, its validation in developing and non-Western countries has been limited, especially in Uganda. This literature gap inspired the present research authors to address this issue. It is crucial to urgently tackle the existing digital competence gap in the Ugandan education context [2]. This will significantly improve the teaching-learning process through the competent usage and integration of digital technologies. Thus, the present study aimed to address two research questions (RQs).

1. RQ1: What is the level of digital competence of higher education students in Uganda?
2. RQ2: Are there any significant competence disparities related to students' gender?

2 Review of Dig-Comp 2.1 Framework and Related Studies

The Dig-Comp 2.1 framework provides a comprehensive structure for assessing digital competence. It comprises eight proficiency levels, covering five competence areas: information and data literacy (IDL), digital problem solving (DPS), communication and collaboration (CC), digital content creation (DCC), and digital safety (DS) [21], [24]. The framework enables a holistic evaluation of an individual's digital competence across these dimensions. The Dig-Comp 2.1 framework is popularly used across European countries and has received positive perceptions from educational stakeholders [19], [25]. However, the validation and applicability of this framework in non-Western contexts, particularly among higher education students, remain underexplored adequately. Furthermore, despite the significance of the framework and its validity in various countries and contexts, there are multifaceted findings concerning gender differences in digital competence.

Exploring gender disparities in academic performance has been a fundamental subject in education, mainly because it can reveal potential discrepancies and unfairness in specific areas [26]. While most research has focused on conventional subjects like science and mathematics, there has been comparatively less investigation into gender differences in digital literacy. Nevertheless, the available empirical studies on digital competency are numerous and offer a wide range of findings [26]. In other words, findings on digital competence level differences between male and female students are not unanimous.

For instance, a European study (Martínez-Cantos, 2017) has shown that gender disparities persist in access to digital technologies, digital literacy, and digital skills worldwide. The study suggests that there are still considerable disparities in digital competence between female and male students, and these gaps are likely to endure across various societal and educational levels. Nonetheless, other studies found unsimilar results to this study. For example, a study [27] was conducted in India to investigate digital competence disparities among higher education scholars. Their findings indicate no significant difference in digital competence between genders among research scholars. However, there is a significant difference in digital competence based on the field of study, with scholars from engineering, management, and science being more highly competent than those from the education and language fields.

Similarly, another research examined the digital competence of high school teachers teaching science subjects. The authors found no significant difference in digital competence between male and female teachers [28]. This finding aligns with some previous studies' findings [29], [30] but contradicts other studies [31]–[33] that show that males tend to excel in digital competence more than females. Thus, this fact inspired the present study to investigate university students' digital competence and determine whether there is a gender gap in the Ugandan higher education context.

3 Methodology

3.1 Research Design, Data Collection, and Sample

This study is part of an ongoing project, and its data was collected from February to the end of March 2023. Thus, using a quantitative design, the researchers collected pilot data using an online survey through Google Forms distributed to a sample of ninety-nine (99) higher-education students from Uganda, consisting of sixty-

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three (63) male and thirty-six (36) female university students. The age of most participants (81) ranged between 18 and 25 years, followed by–26-35 age range (12); a few students were above 35 years (3) and below 18 years (3). Furthermore, the majority had an undergraduate education level (92), and a few of them were undertaking a diploma (4) and a master's degree (3).

3.2 Instrumentation and Analysis Methods

The Dig-Comp 2.1 framework's instrument comprises five constructs aligned with the five competence areas: DCC, CC, DS, IDL, and DPS. The items of these constructs were derived from a previous study conducted in Turkey [32]. Additionally, three items (CC5, DCC5, and DCC6) were included and obtained from other researchers [25], resulting in each construct having six items. All research items were assessed using a 5-point Likert scale, ranging from five (= Strongly Agree) to one (= Strongly Disagree).

A recent study (Abubakari et al., 2023) reports the reliability and validity scores of the instrument in which they used confirmatory factor and composite analyses and found the Dig-Comp framework has highly reliable and valid measures. Thus, the current study adapted the instrument validated by that study. The research instrument demonstrated high reliability, with a Cronbach's alpha score of 0.959 [34]. Moreover, as for data analysis of the present study, descriptive statistics (means and standard deviations) and t-tests were analysed through Microsoft Excel (Microsoft 365 Office) and the JASP software [35].

4 Results

4.1 Descriptive Results

We assessed individuals' proficiency in the five competence areas of the DigComp 2.1 framework using descriptive statistics- Mean (M) and Standard Deviation (SD). The five competence areas are Information and Data Literacy (IDL), Communication and Collaboration (CC), Digital Content Creation (DCC), Digital Safety (DS), and Digital Problem-Solving (DPS). As for M, using a range of one (1) to five (5) Likert scale, values from 1 to 2.9 indicate low competence, scores from 3 to 4.5 indicate intermediate competence, while values above 4.5 imply higher digital competence in a particular competence area of the DigComp 2.1 framework. Table 1 portrays descriptive results of items and their respective areas of DigComp 2.1 using a sample (N) of ninety-nine (99) university students.

The results show that the M scores of individual items from all five areas ranged from 3.38 to 4.21, indicating that students' samples have intermediate digital competence levels in each item. The SD shows moderate values (ranging from 0.85 to 1.23 for all indicators and from 0.98 to 1.16 area-wise), indicating some variability in responses but not overly diverse opinions on their digital competence. Moreover, the M scores ranged from 3.52 to 4.02 for all competence areas, with the CC area scoring the highest and the DPS area scoring the least. These results imply that, overall, students possessed average levels of digital competence in each area.

Table 1. Descriptive Results of Dig-Comp 2.1 Items and Areas (N = 99)

Construct (Competence Area)	Indicator	Mean (M)		Standard Deviation (SD)	
Digital Safety (DS)	DS1	3.80	3.81	1.11	1.13
	DS2	3.80		1.13	
	DS3	3.56		1.22	
	DS4	4.04		1.10	
	DS5	3.96		1.11	
	DS6	3.71		1.10	
Digital Problem Solving (DPS)	DPS1	3.42	3.52	1.19	1.15
	DPS2	3.42		1.13	
	DPS3	3.47		1.06	
	DPS4	3.62		1.13	
	DPS5	3.57		1.14	
	DPS6	3.64		1.23	
Digital Content Creation (DCC)	DCC1	3.38	3.55	1.20	1.16
	DCC2	3.72		1.04	
	DCC3	3.57		1.17	
	DCC4	3.48		1.18	
	DCC5	3.61		1.19	

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	DCC6	3.54		1.19	
Information & Data Literacy (IDL)	IDL1	3.73	3.74	1.08	1.05
	IDL2	3.87		1.03	
	IDL3	3.95		1.04	
	IDL4	3.65		1.07	
	IDL5	3.69		1.04	
	IDL6	3.54		1.06	
Communication & Collaboration (CC)	CC1	4.12	4.02	0.90	0.98
	CC2	4.12		0.85	
	CC3	3.87		1.04	
	CC4	4.21		0.90	
	CC5	3.89		1.15	
	CC6	3.91		1.03	

4.2 T-Test Results on Gender Differences

We performed independent t-tests for each competence area with assumed equality of variances between genders as Levene's test was satisfied in which P-values were above 0.05. Note that M scores result from the average score of each competence area calculated from its items. Further, the effect size was determined using Cohen's (d) parameter and used a $P < 0.05$ to determine the effect's significance. Table 4 exhibits the descriptive statistics and independent t-test results. The independent t-tests between male (N=63) and female (N=36) students in every five competence areas show no significant disparities between men and women, according to the DigComp framework in any competence area, as all P-values are higher than 0.05. Table 2 presents the results of the *t*-test and group descriptive analyses.

Table 2. Group Descriptives and Independent Samples t-Test Results

Competence Area	Group	N	Mean (M)	SD	*t*	df	*P*	d
DS	Female	36	3.940	0.836	1.099	97	0.275	0.230
	Male	63	3.735	0.921				
DPS	Female	36	3.653	0.731	1.098	97	0.275	0.230
	Male	63	3.447	0.975				
DCC	Female	36	3.778	0.763	1.879	97	0.063	0.393
	Male	63	3.415	1.002				
IDL	Female	36	3.908	0.734	1.567	97	0.120	0.327
	Male	63	3.637	0.872				
CC	Female	36	4.158	0.664	1.377	97	0.172	0.288
	Male	63	3.941	0.797				

As shown in Table 2, the descriptive results (for M) indicate that female students scored slightly higher in every competence area than Males. However, these M differences are not statistically different, as confirmed by P-values. Moreover, Cohen's d-effect sizes are slightly small (ranging from 0.23 to 0.393), implying little to no practical difference between the genders in these areas. In conclusion, based on the independent t-tests conducted for each competence area in the DigComp framework, there were no statistically significant differences between male and female students. The results suggest that both groups performed similarly in these competence areas.

5 Discussion and Implications

From descriptive and t-test analyses, research questions (RQ1 and RQ2) are resolved in which, generally, students possessed average levels of digital competence in each area, with females indicating slightly higher levels of DC in every competence area than Males. However, these differences were not statistically different. The descriptive results can help identify areas where individuals excel or struggle within the DigComp 2.1 framework. Researchers and educational stakeholders can use this information to inform targeted interventions, educational programs, or training initiatives to enhance digital competencies in specific areas where improvement is needed.

Further, the t-test results signalled insignificant differences between females and males in all the competence areas of the DigComp framework, as all P-values were higher than the 0.05 significance level. Despite females exhibiting slightly higher competence levels in all areas of Dig-Comp 2.1, the lack of statistical significance

suggests that the overall digital competence between male and female students is comparable. This finding challenges the common stereotype that males are generally more digitally competent than females [32], [33], emphasising the importance of recognising individual skills and abilities rather than gender-based assumptions. The findings of insignificant differences between genders align with previous works [27], [28], [30], highlighting the absence of gender disparities in individuals' digital competence.

The findings of this study have important implications for Ugandan higher education institutions. Since there are no statistically significant differences between male and female students in digital competence, it is crucial to ensure that educational practices and resources are accessible and inclusive for all students. Gender-sensitive pedagogies should be integrated into the curriculum to address existing disparities and encourage both male and female students to embrace further and develop their digital skills. Furthermore, universities and colleges must continue promoting digital literacy initiatives and training programs tailored to the student population's specific needs and preferences. This will aid in fostering an environment where students feel comfortable and confident in engaging with digital technologies regardless of gender [36]. Besides that, understanding the experiences, challenges, and motivations behind students' digital skill development through the Dig-Comp framework can inform the design of more targeted and effective interventions to enhance digital literacy in higher education [19]. Furthermore, understanding how digital skills translate into real-world benefits will provide valuable information for educators and policymakers to strengthen the integration of digital competence in the curriculum and enhance students' overall preparedness for the digital era [36].

6 Conclusion

This study aimed to evaluate the digital competence of students in Ugandan higher education using the Dig-Comp 2.1 framework. The questionnaire used in this study effectively captured the diverse aspects of digital competence, allowing for a comprehensive evaluation of students' skills, knowledge, and attitudes in the digital proficiency domain. Interestingly, the study also revealed that females tended to score slightly higher in competence levels across all areas of the Dig-Comp 2.1 framework. However, no significant difference was observed between genders regarding digital competence. This result challenges the notion of a significant gender disparity in digital skills. It indicates that both male and female students in Ugandan higher education possess similar levels of digital competence.

This study has some interesting findings; however, a few drawbacks need to be noted. Firstly, the cross-sectional nature of the research design limits our ability to establish causal relationships between digital competence and other factors. Longitudinal studies or experimental designs would be beneficial in providing a more in-depth understanding of how digital competence evolves and how various factors influence it. Secondly, while reasonably enough for statistical analysis, the study's sample size may not fully represent the entire population of students in Ugandan higher education. The findings might not be generalised to other institutions or different demographic groups, warranting caution in interpreting the results beyond the studied sample.

Building upon this study's findings, several future research directions emerge. Firstly, conducting follow-up studies using a longitudinal design would be beneficial to explore how digital competence evolves over an extended period and how educational interventions or experiences impact students' digital skills. Moreover, expanding the research to include a more diverse and representative sample of students from various institutions and regions across Uganda would be valuable. This will provide a more comprehensive understanding of the digital competence landscape in the country and allow for comparisons and identification of potential disparities or specific needs that may vary by demographics. In conclusion, this study contributes to the growing body of knowledge on digital competence in the context of Ugandan higher education. By uncovering gender-related patterns in digital competence based on the DigComp 2.1 framework, this research offers valuable insights for educators, policymakers, and stakeholders in developing strategies to promote digital literacy and bridge the digital divide among students in Uganda.

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