

Pragmatic Profile of Digital Competence of Undergraduate Students

Priya Dey^{1*}, Soumen Ghosh², C. Siva Sankar³

ABSTRACT

Background: Digital Competence (DC) has emerged as an essential skill for students in the contemporary technology-driven educational setting. DC encompasses skills, knowledge, and behaviours that are essential for engagement with various digital technologies. **Objective:** This study aims to assess Digital Competence among Undergraduate (UG) students with respect to gender, locality and stream. **Method:** The researchers have adapted descriptive-cum-survey method with a view to knowing the current practices relating to DC among UG students. The sample comprised 410 UG students enrolled in general degree colleges in North 24 Parganas of West Bengal. A convenience sampling technique was employed to collect the data. The Digital Competence tool was re-standardised and adapted by the investigators using appropriate psychometric techniques. The collected data were analysed using suitable descriptive and inferential statistical techniques. **Results:** The study reveals that 49.5% of students possess a moderate level of DC. There were significant differences in DC among UG students due to variation in gender and stream. However, no significant difference was found based on locality. **Conclusion:** The study highlights the need for targeted interventions and institutional support to strengthen DC among UG students and reduce disparities across different learner groups. The findings have important implications for educational policy, curriculum development, and digital literacy initiatives in higher education.

Keywords: Digital competence, Digital literacy, Digital inclusion, Higher education, Technology integration

The rapid advancement of digital technologies has fundamentally reshaped higher education by influencing the teaching and learning process, research, assessment, and academic communication. To meet the evolving demands of the 21st century, universities are increasingly integrating digital technologies into educational practices to promote student-centred approaches, an enhanced flexible learning environment, and develop essential competencies among students (Erstad et al., 2021; Núñez-Canal et al., 2022). This digital transformation has extended the role of higher education institutions. It shifts their

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focus from merely imparting disciplinary knowledge to equipping students with the skills needed to learn, collaborate and perform effectively in technology-mediated academic and professional environments (Núñez-Canal et al., 2022). Consequently, undergraduate students are expected to acquire not only disciplinary expertise but also the digital competencies needed to engage with technological tools in a confident, effective and ethical manner throughout their educational journey (Sánchez-Caballé et al., 2021).

The significance of digital competence became especially evident during the COVID-19 pandemic, as higher educational institutions were compelled to move from face-to-face instruction to online and blended learning environments. This unprecedented transition accelerated the integration of digital technologies, adoption of virtual classrooms, online assessment platforms, learning management systems, and collaborative digital tools into everyday academic practices (Vishnu et al., 2022; Núñez-Canal et al., 2022). Although digital technologies ensured the continuity of teaching and learning, they also revealed the differences in students' ability to use these technologies effectively for academic purposes (Patwardhan et al., 2023). Therefore, meaningful participation in digital learning requires not only the availability of digital resources but also the students' ability to use them competently.

Conceptualising Digital Competence

Over the past decade, digital competence has emerged as an important determinant of students' learning experiences and academic achievement in higher education. DC encompasses the knowledge, skills, and behaviour necessary for effective engagement with digital technologies across various contexts. It is increasingly recognised as a critical competency for students, particularly amid rapid technological advancements. DC is defined as the ability to use digital technologies confidently and critically for information, communication and problem solving (Hodlevska & Kotun, 2020). DC is a multifaceted set of knowledge, skills, and behaviour, responsible use of digital technologies for learning, work and participation in society (Basilotta-Gómez-Pablos et al., 2022). It is consistently treated as a key lifelong competency (Barboutidis & Stiakakis, 2023). Across frameworks, DC extends beyond basic ICT operation to include information and data literacy, communication and collaboration, content creation, safety, problem-solving and critical thinking (Basilotta-Gómez-Pablos et al., 2022; Fraile et al., 2018). DC is a multifaceted construct comprising several interrelated competencies which are required for engaging effectively with digital technologies. Based on the conceptual framework proposed by Tzafilkou et al. (2022), the present study conceptualises DC through six interrelated components, including (a) search, find and access; (b) develop, apply and modify; (c) communicate, collaborate and share; (d) store, manage and delete; (e) evaluate; and (f) protect. These collectively represent students' competencies in digital environments. These competencies are shown in Figure 1.



Figure 1: Components of Digital Competence

The concept of DC has gradually evolved from earlier notions of computer literacy and digital literacy into a more comprehensive construct. Previous studies revealed that DC has been interpreted from diverse perspectives such as Digital literacy, ICT literacy, e-skills, and e-literacy. These diverse definitions reflect both the multidisciplinary nature of the field and the absence of a universally accepted definition during its early evolution (Gallardo-Echenique et al., 2015). In the context of higher education, digital competence has emerged as a key core graduate attribute as students are required to navigate technology-rich learning environments, critically assess digital content, communicate through digital platforms, and apply appropriate technological tools to solve academic and real-life problems (Wang et al., 2021). Existing evidence consistently demonstrates that DC contributes to students' learning experiences, engagement in academic activities, and readiness to meet the demands of a technology-driven society (Zhao et al., 2021). Recent studies have extended this perspective by revealing that students with well-developed DC tend to exhibit higher levels of participation in digital learning environments and achieve better academic outcomes. These findings reinforce the educational significance of DC as an important factor influencing students' success in contemporary higher education institutions (Hidayat-Ur-Rehman, 2024; Song et al., 2025).

Previous studies revealed that DC varies by population, but weak or only basic performance is common across higher education teachers, university students, pre-service teachers and health professionals (Basilotta-Gómez-Pablos et al., 2022; Longhini et al., 2022; Zhang et al., 2026). Students described learning many digital skills by trial and error rather than formal instruction (Martzoukou, 2023). Age, gender, training and specialisation repeatedly differentiate digital competence across students and teachers (Martzoukou, 2023; Zhang et al., 2026).

Core Frameworks of Digital Competence

With the growing recognition of DC, several theoretical and policy frameworks have been proposed to explain its core dimensions and support its evaluation in an educational context. These frameworks have provided a more structured understanding of DC by identifying the essential knowledge, skills, and attitudes required to participate effectively in digitally supported learning environments (Gallardo-Echenique et al., 2015). Some influential frameworks have been discussed below.

- *DigComp 2.2 & 3.0 (Citizen)*: It is a citizen-focused framework, with 21 competencies in 5 areas and defined proficiency levels. Those five areas are information and data literacy, communication and collaboration, digital content creation, safety and problem-solving (Vuorikari et al., 2022). DigComp has become a widely implemented reference for curriculum planning, instruction, assessment and policy monitoring in Europe and beyond (Vuorikari et al., 2025). The latest 3.0 update integrates 500 new learning outcomes and systematically includes Artificial Intelligence (AI) competence across all areas (Directorate-General for Employment, Social Affairs and Inclusion, 2025).
- *DigiCompEdu* is the main educator-specific adaptation, presented as a common European framework for teachers' digital competence (Christine, 2017). It specifies 22 competencies in 6 areas and uses six cumulative proficiency levels from A1 to C2 (Caena & Redecker, 2019). Its six areas are professional engagement, digital resources, teaching and learning, assessment, empowering learners and facilitating learners' digital competence.
- *Digital Literacy Global Framework (DLGF)*: This framework, developed by UNESCO's Institute of Statistics, builds on the five DigComp areas but adds two specific categories, such as devices and software operations and career-related competencies, to ensure applicability across countries with varying income levels (UNESCO, 2018).

Identification of gap

DC has been examined internationally as an essential capacity. Contemporary empirical studies have largely focused on assessing the levels of DC among students across different educational settings by using multidimensional assessment tools. These tools evaluate competencies such as information management, communication, content creation, problem-solving, and responsible technology use (Cepe-Rodriguez & Murgiondo, 2024; Herrera-Lillo & Urrejola-Contreras, 2025). Studies revealed that in 2023, only 56% of adults in the European Union (EU) possessed basic digital skills (Directorate-General for Employment, Social Affairs and Inclusion, 2025). While 92% of EU workers use digital technologies and 30% use AI systems, only 15% have received formal training in AI (Directorate-General for Employment, Social Affairs and Inclusion, 2025). Students often demonstrate high ethical awareness but only moderate AI literacy, suggesting they understand digital ethics conceptually but lack deep knowledge of how AI algorithms actually function (Nguyen, 2025). Educators and students often show low to moderate DC overall, and reviews repeatedly identify insufficient training as a major contributor (Basilotta et al., 2022; Fernández-Batanero et al., 2021; Ma & Ismail, 2025). The most consistent weak spots are digital content creation, problem-solving, and parts of safety/security, even when information or communication skills score better (García et al., 2021; Zhang et al., 2026). Access to and use of technology matter, including PC, smartphone, and internet use, as well as digital course participation (Barboutidis & Stiakakis, 2023; Luís et al., 2025). Academic performance and family background are associated with competence, and students with more

educational resources score better (Cabero-Almenara et al., 2022). Learning experiences, exposure to digital technologies, institutional support, and opportunities to integrate into technology-integrated educational activities significantly contribute to the acquisition and enhancement of DC (Rodríguez-Moreno et al., 2021; Cepa-Rodríguez & Murgiondo, 2024). At the academic level, mode of learning, prior experiences with digital technologies, and gender have been investigated across different educational contexts, although the findings differ across countries and educational contexts (He & Zhu, 2017; Cepa-Rodríguez & Murgiondo, 2024). A study investigated the DC of 4762 students and reported that university students exhibited four distinct DC profiles, indicating significant variation in digital knowledge, skills, and use of ICT (Burgos-Videla et al., 2021). Students' preparedness for higher education, use of digital resources, and parents' educational level were significant predictors of DC. Gender is statistically significant, but a weak predictor of DC and older students reported comparatively lower levels of digital competence than younger students (Cabero-Almenara et al., 2023). Pre-service teachers demonstrated a moderate level of DC, with significantly higher competence in information and data literacy, communication and collaboration, and safety than in digital content creation and problem-solving. DC varies significantly by gender and academic branch, with male and CEIT pre-service teachers demonstrating higher competence in most dimensions (Çebi, A., & Reisoğlu, İ., 2020).

In the Indian education context, DC has gained popularity due to the rapid expansion of the digital learning environment and the incorporation of technology into the teaching and learning process. Undergraduate students in India generally possess a moderate level of DC, with most being familiar with the use of smartphones and digital devices, learning applications, and online communication tools for academic use (Dhanasree & Bhavani, 2025). Technology-integrated project-based learning improves students' confidence in using technological tools, encourages collaborative problem-solving, and strengthens their ability to apply these tools in the learning context (Lapina & Prakash, 2022). Higher education learners generally possess satisfactory DC, which differs significantly based on gender, socio-economic status, and academic level. Male students, post-graduate learners, and those from economically advantaged backgrounds exhibit comparatively higher levels of DC (Vishnu et al., 2022). Improvement in digital infrastructure alone was insufficient to strengthen DC, as the growth of teachers' digital training slowed after the COVID-19 Pandemic. Teachers' digital training and the availability of computers and internet facilities in schools are positively correlated (Rawal, 2024). DC has a significant positive influence on students' perceived learning and learning agility, while learning agility also mediates the relationship between DC and perceived learning (Patwardhan et al., 2023). The inclusive digital literacy framework (IDLF) improved digital literacy and like skills among rural tribal communities, with 89% of participants successfully passing the digital literacy assessment after training. The intervention also improved participants' confidence in using digital technologies and greater awareness of e-governance, health, and online safety (Nedungadi et al., 2018). Researchers' attitude and ICT usage significantly enhanced DC among faculty and research scholars. DC is associated with improved research performance (Rani et al., 2026). NEP 2020 advocates the integration of digital technologies into higher education and promotes the development of students' digital competencies to enhance quality of learning, accessibility, and future employability among students (Ministry of Education, 2020).

Although the research on DC has expanded considerably at both the international and national levels, several important gaps remain evident. Existing studies have explored DC in terms of academic performance, learning agility, research productivity, technology adoption, and readiness for digital learning (Cabero-Almenara et al., 2023; Patwardhan et al., 2023;

Rani et al., 2026). Comparatively fewer investigations have focused on a comprehensive understanding of undergraduate students' DC within a specific regional context. Previous research has identified factors associated with DC, including gender, socioeconomic status, academic level, institutional support, and digital resources availability. However, the influence of these factors was inconsistent across countries and educational settings. Moreover, limited research has explored demographic variations based on gender, locality and stream of study simultaneously, particularly within the Indian higher education context. Existing Indian studies have largely focused on digital literacy, online learning readiness, technology-enabled pedagogy, and the role of DC in improving educational and research outcomes, with limited attention to the overall level of DC among UG students. Moreover, despite the NEP 2020's considerable emphasis on the digital transformation of higher education, empirical studies from West Bengal, particularly the North 24 Parganas district, remain scarce. Therefore, the present study aims to address these gaps by examining the levels of DC among UG students of North 24 Parganas of West Bengal, India. The present study also aims to investigate the significant difference in DC with respect to gender, locality, and stream of study. By doing so, the present study intends to provide context-specific evidence that will enrich the existing body of knowledge.

Objectives of the study

1. To find out the level of Digital Competence among UG students with regard to gender, locality and stream.
2. To find out the significant difference between male and female UG students in their Digital Competence.
3. To find out the significant difference between rural and urban UG students in their Digital Competence.
4. To find out the significant difference between arts and science UG students in their Digital Competence.

Hypotheses of the study

- **H₀₁:** There is no significant difference between male and female UG students in their Digital Competence.
- **H₀₂:** There is no significant difference between rural and urban UG students in their Digital Competence.
- **H₀₃:** There is no significant difference between arts and science UG students in their Digital Competence.

METHODOLOGY

Method

The study has adopted a descriptive cum survey method (Macfarlane, 1997) with a view to knowing the current practices relating to Digital Competence among UG students. This approach is appropriate for the present investigation as it allows the investigators to describe existing levels of DC and simultaneously examine differences across demographic groups (gender, locality and stream) without manipulating any variable.

Population

The North 24 Parganas district of West Bengal has 39 general degree colleges, comprising 117000 enrolled undergraduate students (WBSU, n.d.). This constitutes the population for the present study.

Sample and sampling

The sample comprised 410 UG students enrolled in general degree colleges in North 24 Parganas of West Bengal, India. A convenience sampling technique was employed to collect the data. It enabled investigators to select colleges and respondents that adequately represented the variables under study within the available time and resource constraints. The demographic characteristics of participants are illustrated below.

Table 1: Demographic characteristics of participants (N=410)

Variable	Sub-variable	Frequency (f)	Percentage (%)
Gender	Male	154	37.6
	Female	256	62.4
Locality	Rural	312	76.1
	Urban	98	23.9
Stream	Arts	256	62.4
	Science	154	37.6

Sampling criteria

The following criteria were used to select the respondents for the study:

- The respondent must be a bona-fide UG student currently enrolled in a general degree college situated in North 24 Parganas, West Bengal, India.
- Students from both male and female, rural and urban, and arts and science students were included to allow gender-, locality- and stream-wise comparison.
- Only students who gave informed consent and completed the tool in full were considered for final data analysis; incomplete or partially filled responses were excluded.

Tool used

The Digital Competence scale was re-standardized and adapted by the investigators for the Indian higher-education context. The source tool was originally developed by Tzafilkou et al. (2022). The adapted version retained the tool's core dimensions (1) search, find and access, 2) develop, apply and modify, 3) communicate, collaborate and share, 4) store, manage and delete, 5) evaluate, and 6) protect) while items were revised and contextualized for UG students studying in general degree colleges of West Bengal. Responses were obtained on a 5-point Likert scale. The scale scores range from 5 to 1. The scale is constructed in English. The re-standardized process involved expert content validation followed by a pilot try-out. The Cronbach's alpha of the digital competence scale is 0.78. The validity was established through face validity, content validity and intrinsic validity. The value of intrinsic validity is 0.88.

Procedure of data collection

The investigator visited 4 general degree colleges in North 24 Parganas of West Bengal to collect data. Data were collected in July 2026. Prior permission was obtained from the respective college authorities before data collection. The purpose of the study was explained to the students, and their informed consent was sought. The adapted Digital Competence scale was administered to the selected students in a paper-and-pencil format. Respondents were assured of the confidentiality and anonymity of their responses. Completed responses were then scored, coded and tabulated for analysis.

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Statistical techniques used

The collected data were analysed using descriptive and inferential statistics. Descriptive statistics (frequency, percentage, Mean, and Standard Deviation (SD) were used to determine the level of digital competence among UG students with regard to selected variables. The independent-sample t-test was used to test the three null hypotheses, examining significant difference in DC between male and female students, rural and urban students, and arts and science stream students, respectively.

RESULTS

The level of digital competence among UG students with regard to gender, locality and stream

Table 2: Showing the norms for the interpretation of derived scores

Range of Raw Score	Range of Z-score	Interpretation (Level)
Below 108	Below -1.09	Low
108-123	-1.09 to 0.89	Moderate
Above 123	Above 0.89	High

Table 3: Showing frequency and percentage of digital competence among UG students with regard to gender, locality and stream

Variable	Sub-variable		Level of digital competence			Total
			Low level	Moderate level	High level	
Gender	Male	f	30	95	28	153
		%	7.3%	23.2%	6.8%	37.3%
	Female	f	53	108	96	257
		%	12.9%	26.3%	23.4%	62.7%
Locality	Rural	f	72	138	102	312
		%	17.6%	33.7%	24.9%	76.1%
	Urban	f	11	65	22	98
		%	2.7%	15.9%	5.4%	23.9%
Stream	Arts	f	30	144	82	256
		%	7.3%	35.1%	20.0%	62.4%
	Science	f	53	59	42	154
		%	12.9%	14.4%	10.2%	37.6%

Note: f= Frequency, %= Percentage

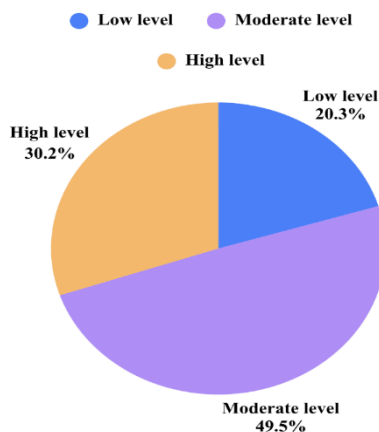


Figure 2: Showing percentage of digital competence among UG students with regard to gender, locality and stream

Pragmatic Profile of Digital Competence of Undergraduate Students

Table 3 reveals that 26.3% (f=108) of female students and 23.2% (f=95) of male students have a moderate level of digital competence. 23.4% (f=96) of female students and 6.8% (f=28) of male students have a high level of digital competence. 12.9% (f=53) of female students and 7.3% (f=30) of male students have a low level of digital competence.

33.7% (f=138) of rural students and 15.9% (f=65) of urban students have a moderate level of digital competence. 24.9% (f=102) of rural students and 5.4% (f=22) of urban students have a high level of digital competence. 17.6% (f=72) of rural students and 2.7% (f=11) of urban students have a low level of digital competence.

35.1% (f=144) of arts students and 14.4% (f=59) of science students have a moderate level of digital competence. 20.0% (f=82) of arts students and 10.2% (f=42) of science students have a high level of digital competence. 12.9% (f=53) of science students and 7.3% (f=30) of arts students have a low level of digital competence.

Significant difference between male and female UG students in their digital competence

Table 4: Showing N, Mean, Standard Deviation, Mean Difference, Standard Error of Difference, t-value and p-value with respect to gender

Variable	N	Mean	SD	D	SEd	t-value	p-value
Gender	Male	153	115.01	6.41	2.43	3.12**	0.00
	Female	257	117.44	8.27			

Note: df= 408, **= p<0.01

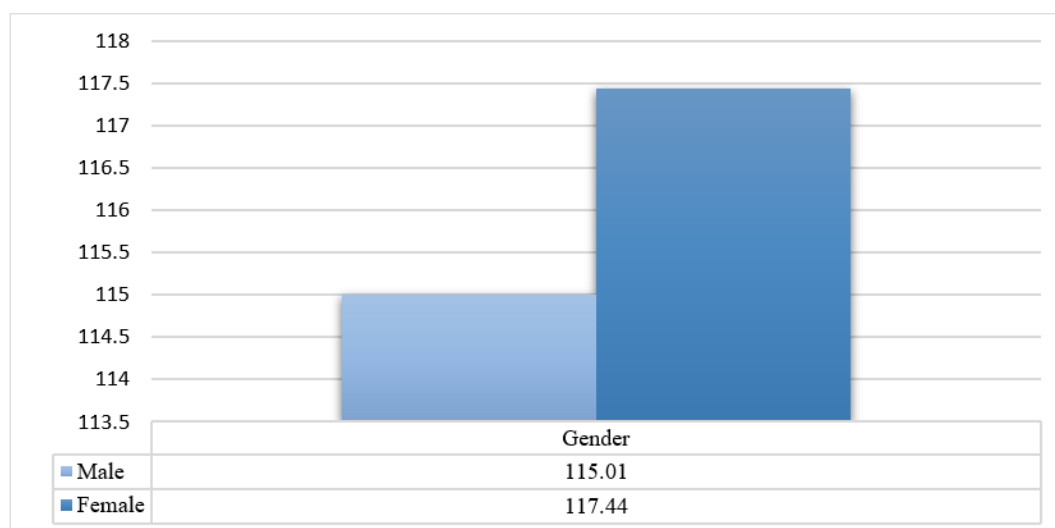


Figure 3: Showing Mean values of male and female UG students in their digital competence

Table 4 shows the computed t-value (3.12) with regard to digital competence due to variation in gender ($M_1=115.01$, $SD_1=6.41$, $M_2=117.44$, $SD_2=8.27$, $D=2.43$, $SEd=2.43$, $df=408$) ($p<0.01$) is significant. This indicates there is a significant difference in UG students' digital competence due to variation in gender. From the Mean values, it is evident that female UG students ($M_2=117.44$) are slightly higher than male UG students ($M_1=115.01$) in their digital competence. From the SD values, it is evident that female UG students ($SD_2=8.27$) are slightly deviated from male UG students ($SD_1=6.41$) in their digital competence. Hence, male UG students are consistent in their responses on digital competence.

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Significant difference between rural and urban UG students in their digital competence

Table 5: Showing N, Mean, Standard Deviation, Mean Difference, Standard Error of Difference, t-value and p-value with respect to locality

Variable		N	Mean	SD	D	SEd	t-value	p-value
Locality	Rural	312	116.72	8.31	0.77	0.89	0.87	0.38
	Urban	98	115.94	5.38				

Note: df= 408

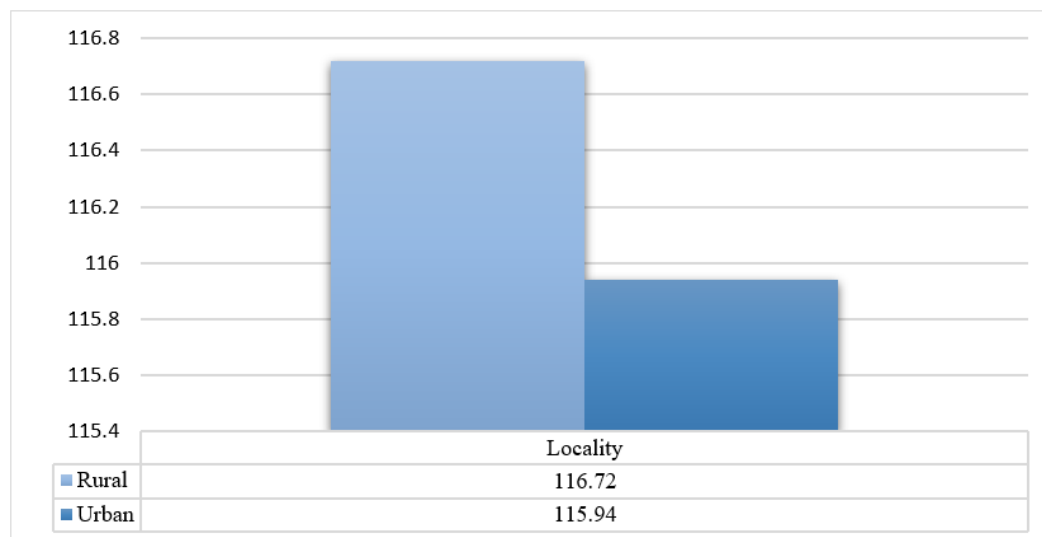


Figure 4: Showing Mean values of rural and urban UG students in their digital competence

Table 5 shows the computed t-value (0.87) with regard to digital competence due to variation in locality ($M_1=116.72$, $SD_1=8.311$, $M_2=115.94$, $SD_2=5.38$, $D=0.77$, $SEd=0.89$, $df=408$) ($p>0.05$) is not significant. This indicates there is no significant difference in UG students' digital competence due to variation in locality. From the Mean values, it is clear that rural UG students ($M_1=116.72$) are slightly higher than urban UG students ($M_2=115.94$) in their digital competence. From the SD values, it is clear that rural UG students ($SD_1=8.31$) are deviated from urban UG students ($SD_2=5.38$) in their digital competence. Hence, urban UG students are consistent in their responses on digital competence.

Significant difference between arts and science UG students in their digital competence

Table 6: Showing N, Mean, Standard Deviation, Mean Difference, Standard Error of Difference, t-value and p-value with respect to stream

Variable		N	Mean	SD	D	SEd	t-value	p-value
Stream	Arts	256	117.46	7.53	2.48	0.77	3.19**	0.00
	Science	154	114.98	7.77				

Note: df= 408, **= $p<0.01$

Pragmatic Profile of Digital Competence of Undergraduate Students

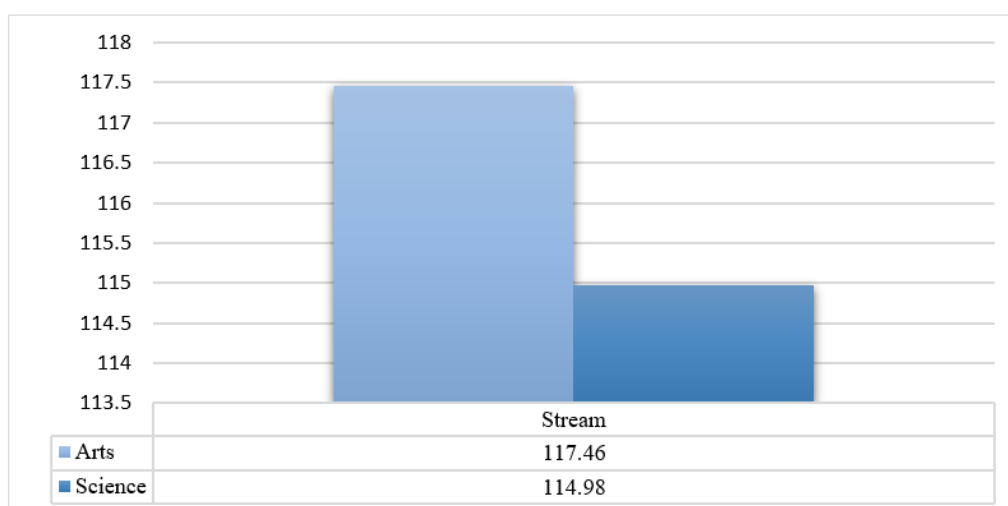


Figure 5: Showing Mean values of arts and science UG students in their digital competence

Table 6 illustrates the computed t-value (3.19) with regard to digital competence due to variation in stream ($M_1=117.46$, $SD_1=7.53$, $M_2=114.98$, $SD_2=7.77$, $D=2.48$, $SEd=0.77$, $df=408$) ($p<0.01$) is significant. This indicates there is a significant difference in UG students' digital competence due to variation in stream. From the Mean values, it is shown that arts UG students ($M_1=117.46$) are slightly higher than that of science UG students ($M_2=114.98$) in their digital competence. From the SD values, it is shown that science UG students ($SD_2=7.77$) is slightly deviated from arts UG students ($SD_1=7.53$) in their digital competence. Hence, arts UG students are consistent in their responses on digital competence.

DISCUSSION

The first objective of this study was to examine the level of DC among undergraduate students with regard to gender, locality and stream. Table 3 shows the percentage of DC among UG students and reveals that 49.5% of the respondents possess a moderate level of DC, while 30.2% demonstrate a high level and only 20.2% demonstrate a low level of DC. This distribution shows variations across the selected demographic variables. Female UG students (23.4%) represent a higher level of DC than male UG students (6.8%). While rural UG students (24.9%) show higher representation in the high DC category than urban UG students (5.4%), Arts UG students (20.0%) showed a comparatively greater representation in the high DC category than science students (10.2%). This finding suggests that, although digital technologies have become an essential part of higher education, many students have yet to acquire advanced competencies needed for effective information management, digital content creation, critical evaluation of digital resources, problem-solving, and digital safety. This finding is consistent with earlier international research indicating that university students generally demonstrate basic to moderate rather than advanced DC (Basilotta-Gómez-Pablos et al., 2022; Zhang et al., 2026). Similarly, in the Indian context, findings indicate UG students possess moderate DC despite regular engagement with smartphones, online learning platforms, and online learning platforms (Dhanasree & Bhavani, 2025).

The second objective of the present study examine the gender difference in DC among UG students. The independent sample t-test revealed a statistically significant difference in digital

competence between male and female students ($t=3.12$, $p<.01$), leading to the rejection of the null hypothesis. Female UG students obtained a significantly higher Mean score ($M=117.44$, $SD= 8.27$) than male UG students ($M=115.01$, $SD= 6.41$), which indicates that female UG students have higher DC than their male UG students. This finding contradicts the previous studies, which reported comparatively higher levels of DC among male students (Çebi, A., & Reisoğlu, İ., 2020; & Vishnu et al., 2022). However, this finding is consistent with recent studies that indicate that gender differences in DC are influenced by educational opportunities, institutional support, and digital engagement rather than by gender alone (Cabero-Almenara et al., 2023; Cepa-Rodríguez & Murgiondo, 2024).

The third objective examines the significant difference in DC among UG students based on their locality. The study revealed no statistically significant difference in DC between rural and urban UG students ($t=0.87$, $p>.05$); therefore, the researchers fail to reject the null hypothesis. Although the rural UG students obtained a marginally higher Mean score ($M=116.72$, $Sd=8.31$) than urban students ($M= 115.94$, $SD= 5.38$), the Mean difference is only 0.77, which is not statistically significant. This finding indicates that locality does not exert a meaningful influence on DC among UG students in the present study, contrasting with earlier studies that link geographical location with inequalities in digital access, infrastructure, and educational opportunities (Rawal, 2024). However, the lack of significant difference with regard to locality indicates that the digital divide between rural and urban UG students of North 24 Parganas of West Bengal has gradually diminished. The widespread availability of smartphones, affordable mobile data services, improved internet connectivity and continued expansion of digital learning after the COVID-19 pandemic may have enabled the students to access similar digital learning resources from both rural and urban areas. Furthermore, institutional and government initiatives under the NEP 2020 may have improved equitable access to digital learning.

The fourth objective examined the significant difference in DC among UG students with regard to stream of study. The study revealed a statistically significant difference in DC between Arts and Science UG students ($t=3.19$, $p<.01$); therefore, the null hypothesis is rejected. Arts UG students obtained a higher Mean score ($M=117.46$, $SD= 7.53$) than Science ($M=114.98$, $SD=7.77$), with a Mean difference of 2.48. This indicates that Arts UG students demonstrate comparatively higher levels of DC than Science UG students. UG students. This finding contradicts the previous studies conducted by Cebi and Reisoğlu (2020) and Onasanya (2010), which reported that students from science and technology-oriented disciplines exhibit a higher level of DC due to greater exposure to technological tools and ICT-related activities. The contrasting finding may be due to the multidimensional assessment of DC in the present study. Unlike studies that primarily emphasised technical or ICT-related skills, the present study evaluated the broader dimensions of DC including (a)search, find and access; (b) develop, apply and modify; (c) communicate, collaborate and share; (d) store, manage and delete; (e) evaluate; and (f)protect. These collectively represent students' competencies in digital environments. Students enrolled in the Arts program may engage more frequently in activities such as online information searching, academic writing, collaborative learning through digital technologies, digital presentations and online communication, which contribute to the development of broader digital competencies. Although the Mean difference between the two groups was relatively modest (2.48), the statistically significant t-value suggests that this difference is unlikely to have occurred by chance. The overall DC is influenced not merely by streams of study but also by the nature and frequency of students' engagement with diverse digital learning activities.

Implication for policy and practices

The findings of the present study have important implications for higher education policy and educational practice. While almost half of the UG students possess a moderate level of DC, the results suggest considerable scope for strengthening the necessary digital skills among students for meaningful engagement in technology-enhanced learning environments. Therefore, higher educational institutions should extend their efforts beyond providing digital infrastructure and focus on integrating DC into the curriculum through subject-specific learning activities, project-based learning, digital assessments, and collaborative online learning activities. In view of the variations in DC among UG students across gender and stream of study, the present research recommends that higher educational institutions and policymakers design targeted interventions to provide additional support to students demonstrating comparatively lower levels of DC while promoting equitable access for all students. Faculty development programmes should also be conducted to strengthen educators' pedagogical and technological skills, help them to integrate DC effectively into instructional practices, learning activities and assessment processes. The present study also recommended making sustained investment in reliable digital infrastructure, affordable internet connectivity, institutional digital resources including digital libraries and e-journals, E-books and online databases, Virtual laboratories and simulation software, educational software and licensed applications, Institutional learning management systems, AI-assisted learning platforms and digital tutoring systems, OER, etc. remains crucial for equitable access to digital learning opportunities. In alignment with NEP 2020, universities and colleges should establish an institutional digital competence framework that encourages the responsible, critical, ethical and creative use of digital technologies while also preparing students for lifelong learning and an increasingly digital society and workforce.

Limitation and future research direction

Despite the contribution, the present study has certain limitations that should be acknowledged. First, the study is confined to UG students enrolled in general degree colleges of North 24 Parganas of West Bengal. Consequently, the findings may not be generalised to students studying in other districts, states, or other institutions. Second, the study employed a convenience sampling technique, which may limit the representativeness of the sample studied despite providing useful evidence from the selected context. Third, the study focuses only on the selected demographic variables such as gender, locality, and stream of study. Other factors may contribute to DC, such as socio-economic status, prior digital experience, frequency of technology use, academic performance, and access to digital learning resources, which were not included in the present study.

Future research may extend the present study by including large and more diverse samples from different regions of India to enhance the generalizability of findings and facilitate comparisons across varied educational contexts. Mixed-method and longitudinal research approaches may provide deeper insights into the development of original competence and its growth over time. Future research may also investigate the interrelation of DC with key educational variables including digital well-being, artificial intelligence literacy, employability and lifelong learning competencies. Additionally, intervention-based experimental studies need to be conducted to evaluate the effectiveness of curriculum-integrated DC initiatives, faculty professional development programs, technology enhanced pedagogical practices to provide valuable insight for educational policy and practice.

CONCLUSION

Digital Competence has emerged as an essential competency for UG students in contemporary higher education. The present study examined the DC of UG students in North 24 Parganas of West Bengal and explored the differences based on gender, locality and stream of study. The findings indicated that most students demonstrated a moderate level of DC, which indicates that although UG students possess the foundational digital skills required for academic activities, there remains scope for developing the advanced competencies required for effective engagement in technology-driven educational settings. The study found a significant difference in DC based on gender and stream of study, while no significant differences were observed between rural and urban UG students. It reveals that DC is influenced more by educational experiences and patterns of digital engagement than by geographical location. Overall, the findings highlighted the need for higher educational institutions to adopt a comprehensive approach to DC that extends beyond access to technology. Integrating DC into the curriculum, improving institutional support and ensuring equitable digital learning opportunities are essential for preparing UG students to thrive in an increasingly digital society. The study contributes empirical evidence from an underexplored region of India and offers useful insights for educators, policymakers, and institutional leaders to strengthen DC among UG students.

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Conflict of Interest

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