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DIGITAL INFORMATION LITARACY AND METACOGNITIVE FUNCTIONING AMONG UNDERGRADUATE STUDENTS

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ABSTRACT

Digital Information Literacy (DIL) has developed into a critical and potentially commercial literacy benchmark for competency in higher education, but its development still varies across disciplinary groups. The present study measured the Digital Information Literacy (DIL) of undergraduate students in Odisha, and the influence of academic stream and metacognitive styles on DIL. A correlational survey design was used to achieve this, and data were collected with standardized instruments on digital literacy and metacognitive awareness from 149 undergraduate students in Arts, Science, and Commerce. The results indicated that most students' awareness was in the moderate to high Digital Information Literacy (DIL) level, and Science and Commerce students were statistically superior in Digital Information Literacy (DIL) to Arts students. Additionally, their metacognitive styles, specifically regulation and knowledge of cognition, were positively correlated with Digital Information Literacy (DIL) thus, confirming their cognitive processes in a digital context. These findings indicate DIL is more than just skills; rather, it relies on student reflection on learning behaviours. This study offered important exhortations to ways of thinking about student learning. Digital Information Literacy Digital Information Literacy (DIL) is much more than a checklist of practices; it also calls for a response to the discipline in order to generate curricular practices both considering metacognitive practices and practice in equitable conditions within the curriculum. Finally, curriculum reform, digital pedagogy, and students' readiness become relevant as the threats to knowledge driven academics and professions increase.

Keywords: Academic Streams; Digital Information Literacy; Metacognitive Awareness; Metacognitive Styles; Undergraduate Students.

INTRODUCTION

In an academic environment distinguished by increasing digitalization, colleges and universities must bear the added responsibility of enabling students to access, analyse and evaluate digital information. Accordingly, digital information literacy (DIL) has become a critical competency that enables academic achievement, informed decision-making, and employability in a knowledge-based society. Recently published studies from Smith and Storrs (2023) and Makaphola (2025), contextualize DIL not just as the technical ability to use digital technologies, but as an extension of critical thinking and reasoning, source validation, ethical

digital information use; and the ability to combine and integrate a variety of digital information. As higher education learning continues to emerge and transition to digital mediators, the ability to engage meaningfully with digital information is necessary for all undergraduate learners in all disciplines.

Despites of its central importance, remarkable disparities persist in the development of Digital Information Literacy across the academic streams respectively science, arts, and commerce. Students in the Science and Commerce streams are more likely to have formal ways of interacting with digital applications through laboratory work, data-driven assignments, and analysis-based coursework. While Arts students will also engage digitally, they may not have as many curricular touchpoints that systematically engage them digitally, meaning there may be varying levels of digital readiness from one stream to the next (Mishra & Yadava, 2019; Sonowal, 2020). This is indicative of broader disciplinary differences described in Biglan's (1973) typology, where fields diverge in epistemology, knowledge structures, and learning expectations. This variation in engagement shapes the way learners interact with information, and therefore to understand DIL outcomes, we need to consider academic stream as a viable construct. In addition to disciplinary influences, metacognitive styles have practically emerged as a key factor in evaluating students' digital learning behaviour. Following the theoretical work of Schraw and Dennison (1994), metacognition is thought of as thinking about thinking or the awareness and regulation of one's thinking. The literature indicates that learners who plan, monitor and evaluate their thinking demonstrate greater information processing, particularly in the complex environment of digital spaces. Research also illuminates that students who are metacognitively aware demonstrate higher accuracy to digital search tasks, stronger evaluative judgement and more effective navigation of digital information ecosystems (Gasque, 2017; Teng, 2021; Mbandje, 2023). More recent studies indicate that engagement with digital literacy can also enhance metacognitive function as learners are necessarily placed in the cognitively arduous circumstances that require learners to use decision making and reflective strategy use (Balgabayeva et al., 2024).

Considering this context, the current study examines Digital Information Literacy among undergraduate learners in Odisha and investigates how their academic stream and metacognitive styles influence DIL outcomes. In providing an empirical contribution to the understanding of learners' digital preparedness, the study will investigate (1) the current level of DIL among undergraduates, (2) the differences on DIL in the arts, science, and commerce streams, and (3) the relationship between learners' DIL and metacognitive styles. The study advances the global conversation around how digital literacy is being developed, within an Indian higher education context, and contributes important insights for curriculum development, teaching practices, and developmental opportunities for students in new, digitally mediated learning situations.

LITARATURE REVIEW

A comprehensive understanding of Digital Information Literacy (DIL) requires engagements with the intersecting bodies of scholarship on digital literacy, disciplinary learning patterns and metacognition. This section brings together contemporary studies to provide the conceptual basis of the study and to show how the literature supported the hypotheses and methodological plan.

Digital Information Literacy: Contemporary Academic Responsibilities

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Digital Information Literacy has become a multidimensional academic capability, composed of a set of competencies extending beyond technical capabilities to include some combination of critical questioning, critical assessment, synthesis, an ethic of responsibility, and purposeful participation with digital information. Scholars have collectively noted that the interaction between students and relevant academic subjects in the current digital environment necessitates the ability to manage an abundance of information, engage in authentic assessment of the credibility and reliability of information sources, and appropriately manage cognitive overload and distraction (Smith & Storrs, 2023). Most of the studies in higher education have established positive connections between DIL, enhanced academic performance, research efficacy, and digital citizenship (Kayyali, 2024; Caton, 2025). Together, these conceptualizations point to the necessity of determining the constellation of factors that inform students' digital literacy behaviours.

Academic Stream and Disciplinary Differences in Digital Literacy

Disciplinary structures have a robust relationship with digital readiness. Biglan (1973) binary typology is foundational to understanding differences across academic streams such as epistemology, structure of knowledge, and preferences for modes of inquiry. Current literature reveals that students in Science and Commerce disciplines are more likely to use digital tools for data-rich tasks (including laboratory analysis, simulations, and applied coursework), while Arts-based students will have fewer structured opportunities to engage with digital practices (Mishra & Yadava, 2019; Sonowal, 2020). In addition, large-scale studies demonstrate and quantify the significant stream-based differences in information-seeking behaviours, evaluation of sources online, and digital research strategies (Head et al., 2019; McCoy, 2022; Vázquez-Cano et al., 2023). The evidence supports the premise that DIL varies by academic stream and stream has specific differences and evidence to propose Hypothesis 1.

Metacognitive Styles as the Predictors of Digital Engagement

Schraw and Dennison (1994) defined metacognition as "knowledge and regulation of cognition" and is widely considered to be a key to effective processing of information in a digital format. Research consistently demonstrates that students high in awareness of metacognition are more strategic and accurate in online search activities, better filter misinformation, and are more able to evaluate credibility and relevance of information in digital contexts (Gasque, 2017; Teng, 2021; Mbandje, 2023). Building on this, Veenman (2013) contends that metacognitive regulation is crucial for students to navigate unstructured digital contexts when they must monitor their own comprehension and adjust strategies on their own. In its entirety, the collective literature gives strong theoretical and empirical support for Hypothesis 2, which focuses on the relationship between metacognitive styles and Digital Information Literacy.

Impact of Digital Literacy on Metacognitive Development

Recent research suggests a likely two-directional relationship between digital literacy proficiency and metacognition. Interacting with digital tasks, particularly those that involve evaluation, organization, and synthesis of resources, can lead learners to reflect and cognitively regulate over time (Arjaya et al., 2023). Hidayat et al. (2024) showed that experiences in digitally-mediated learning may benefit metacognitive development because learners are forced to continuously monitor their comprehension, adapt their responses, and evaluate what is worth attending to and what is not. This aligns with self-regulated learning (Akyol & Garrison, 2011), which theorizes that complex digital environments generate metacognition by

their mere existence. These forms of explanations establish the directionality expectation in Hypotheses 3 that digital literacy would produce metacognitive mannerisms.

RATIONALE OF THE STUDY

The literature review highlights three primary aspects: (i) Academic stream significantly influence digital engagements and literacy; (ii) Metacognitive styles support meaningful processing of the digital information & (iii) Digital tasks support the metacognitive development. In sum, Digital Information Literacy (DIL) lies at the intersection of disciplinary exposure and cognitive regulation, which provides a rational logic for the direction of the study's hypothesis and methodology. Though Digital Information Literacy has been widely accepted as important, little research examines the interaction between academic stream and metacognitive style on students' digital competencies in the context of Indias higher education landscape. Most studies have examined the relationship between these concepts in an independent manner and or explore the interaction among both considerations, especially in a sub-region like Odisha, which has both differences in technology access and curricular design based on the academic stream. The relationship between streamlined discipline and digital exposure has also been minimally explored. This study is framed using Biglan's (1973) stream-based discipline framework and Schraw and Dennison's (1944) model of metacognitive regulation, and therefore has the potential to address this clear gap in the literature. Digital learning has increasingly influenced modern higher education, but Digital Information Literacy (DIL) is not assumed to be acquired uniformly.

Disparities in curricular design imply that Science and Commerce programs generally facilitate greater technology-rich learning experiences, while Arts programs posit their learning work on text-based or interpretive work, resulting in varied engagement and exposure to digital texts (Mishra & Yadava, 2019; Sonowal, 2020). This means the academic stream is an important factor in the way students think about, find, evaluate, and utilize digital information.

Students' metacognitive styles - their ability to plan, monitor and evaluate their own thinking - also impact their engagement in digital spaces. Studies have shown that learners with greater metacognitive awareness, exhibit better judgment when evaluating content online, are more likely to manage the cognitive load of digital information, and exhibit better navigation skills within digital spaces (Schraw & Dennison, 1994; Gasque, 2017; Teng, 2021). Other studies suggest that digital tasks themselves can enhance metacognition by promoting strategic thinking and making judgments about the generic potential of digital content for depth and reliability (Arjaya et al., 2023; Hidayat et al., 2024). Thus, it defines a recognized relationship between DIL and metacognition.

However, many institutional practices continue to view digital literacy as a technical skill, ignoring the cognitive and discipline specific elements that lead to meaningful engagement in and with digital texts (Beetham & Sharpe, 2013; Caton, 2025). This misunderstanding results in some degree of dissonance between what students need their digital skills to be beyond the university's focus.

This research attempts to address these deficits while providing a more integrated, discipline-specific, and cognitively inspired view of digital literacy development in higher education, by exploring the combined influence of academic stream and metacognitive styles on DIL among undergraduate learners in Odisha.

STATEMENT OF THE PROBLEM

The rise of digital learning in higher education has intensified the demand for effective Digital Information Literacy (DIL), yet it is still developing unevenly in different academic streams and courses. However, at some institutions in Odisha, this challenge has also been influenced by supporting digital infrastructure. At the same time, metacognitive styles, or students' abilities to plan, monitor, and regulate their learning, are acknowledged as important factors influencing digital engagement and learning, but their relationship to students' DIL as Indian undergraduates has been under explored. In practice, attention has been focused on operational digital skills, with less attention to disciplinary factors and cognitive dimensions connected with DIL. As a result, there is limited empirical research on how academic stream and metacognitive styles interact to affect DIL. The purpose of this study is to contribute to this gap by exploring these relationships to assist discipline-aware and cognitively valid digital pedagogy in higher education contexts.

OPERATIONAL DEFINITIONS

Digital Information Literacy (DIL)

In this present study Digital Information Literacy denotes an individual's ability to locate, evaluate, interpret, curate, and ethically leverage digital information. Further, Digital Information Literacy (DIL) is measured using the Digital Literacy Scale developed by Amin, Malik, and Akkaya (2021), which consists of nine dimensions: collaboration, creativity, critical thinking, communication, citizenship, character, curation, copyright, and connectedness. Digital Information Literacy (DIL), as outlined in this study, conforms with frameworks of information literacy that are based on the intentional use of digital resources for learning in higher education (Association of College & Research Libraries, 2016).

Undergraduate Students

In this study Undergraduate students are defined as individuals enrolled in full-time B.A., B.Sc., and B.Com. (Hons.) courses at select institutions located in Odisha during the 2022–2025 period. This definition is based on common definitions of undergraduate students used in higher education research that define undergraduate students as learners who have been learning foundational disciplinary academic skills.

Metacognitive Functioning

In this study the term "Metacognitive Functioning" refers to one's capacity to plan, monitor, regulate and evaluate their thinking, learning, and reasoning. According to Schraw & Dennison (1994), metacognition includes two components: Knowledge of Cognition and Regulation of Cognition. In digital contexts, metacognitive styles can impact how learners analyze and make sense of information online (Teng, 2021; Veenman, 2013). This study will use the Metacognitive Awareness Inventory (MAI) to operationalize metacognitive styles in the learners from higher education institutions.

OBJECTIVES

Thre study was undertaken with the following objectyives

i. To examine the level of digital literacy skills of undergraduate students focusing on their ability to locating, integrating, interpreting, evaluating, and creating information in academic context
ii. To compare the digital literacy of undergraduate students in relation to their academic stream.
iii. To determine the extent to which digital literacy influence the metacognitive styles of undergraduate students.

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HYPOTHESES

Based on the review of related literature and the theoretical framework, the following hypotheses were formulated:

H_{o1}: There exists no significant difference in digital information literacy of undergraduate students across academic streams (Arts, Science, and Commerce).

H_{a1}: There exists a significant positive relationship between digital information literacy skills and metacognitive styles of undergraduate students.

H_{a2}: Digital information literacy significantly influences the metacognitive styles of undergraduate students.

DELIMITATION OF THE STUDY

The study is focused on undergraduate students of Arts, Science and Commerce disciplines for the academic progression period of 2022-2025 from some selected universities/colleges in state of Odisha, India. The study did not include professional courses (e.g., Medical, Engineering, or Law) for the purpose of making them comparable across targeted disciplines. It further narrowed the focus to two constructs on this topic: Digital Information Literacy, measured by the Digital Literacy Scale (Amin, Malik, & Akkaya, 2021), and Metacognitive Styles, measured by the Metacognitive Awareness Inventory (Schraw & Dennison, 1994). The boundaries were established for clarity, specificity and situated interpretation of the study for the scope and interpretation.

METHODS

Research Design

The study employed a descriptive and correlational survey design to examine undergraduate students' levels of Digital Information Literacy (DIL), compare these levels across academic streams, and explore the relationship between DIL and metacognitive styles. This approach was suitable as it facilitated the systematic exploration of students' existing literacy levels as well as examining the possible associations with cognitive and disciplinary factors to better explain digital competence. The descriptive part identified students' current digital literacy status. The correlational part explored the interaction between metacognitive awareness and digital learning behaviours in real educational settings.

Sampling Strategy and Sample Characteristics

The target population of the current study was undergraduate students in Bachelor of Arts (B.A.), Bachelor of Science (B.Sc.), and Bachelor of Commerce (B.Com.) programmes at specific institutions of higher education located in Odisha in the 2022--2025 academic session. The sampling frame was comprised of five institutions (three autonomous colleges calling themselves Banki Autonomous College, Banki, Salipur Autonomous College, Salipur and Udayanath Autonomous College of Science & Technology, Adaspur and two affiliating universities as Ravenshaw University and Utkal University) that were selected according to predetermined criteria. These predetermined criteria for participating institutions included that at least two of the three chosen streams were offered, that the course should be delivered from a recognized university curriculum, and that undergraduate cohort groups were accessible. The sampling strategy selected was stratified random sampling as the most appropriate sampling strategy, because while there is considerable enrolment variation among the three academic

streams in Odisha, stratification ensured some proportional representation of each of the three streams. Additionally, this method reduced sampling bias and enhanced the precision of comparative analyses. Each academic stream was sampled as a separate stratum, and random sampling was done within each stratum to ensure equal probability of selection. The sample consisted of 149 students, including 49 students from Arts, 50 students from Science and 50 students from Commerce, providing a balanced representation that allowed for adequate statistical comparison.

Tools and Techniques

In this study, data collection and data analysis involved the use of two standardized instruments. The Digital Literacy Scale (DLS), created by Amin, Malik, and Akkaya (2021), evaluated nine aspects of digital literacy: collaboration, creativity, communication, critical thinking, curation, citizenship, character, copyright, and connectedness, the DLS has been described as sufficiently valid and appropriate to conduct empirical studies on digital literacies of students in higher education. The Metacognitive Awareness Inventory (MAI), developed by Schraw and Dennison (1994), was utilized to assess students' knowledge of cognition (declarative, procedural, and conditional) and regulation of cognition (planning, monitoring, evaluating, debugging, and managing information). The MAI is known to have good reliability, used in studies that focus on cognitive and metacognitive students in higher education.

Reliability of Instruments

The reliability analysis employed Cronbach's alpha to evaluate the internal consistency of the measures administered in the current study sample (i.e., n = 149). The Digital Literacy Scale displayed excellent reliability in the present study with an alpha of .93 indicating that the items consistently measured students' digital literacy competencies. Similarly, the Metacognitive Awareness Inventory yielded a high reliability of .94 to demonstrate that the inventory consistently collected measures of students' metacognitive knowledge and regulation. Based on these findings, both instruments were established as psychometrically sound for use in the current study.

Data Analysis Techniques

The data was analysed utilizing the SPSS system and both descriptive and inferential statistical analyses. Descriptive analysis including means, standard deviation, frequency distributions, skew and kurtosis tested the full extent of the Digital Information Literacy (DIL) for participants. Inferential data analysis involved a one-way ANOVA which determined significant difference of DIL among academic streams with pair-wise comparisons assessed using Tukey's HSD. A Pearson's correlation analysis determined the relationship between DIL and metacognitive styles with regression analysis indicating the predictive power of all metacognitive dimensions for DIL. Assessment of normality models was completed using Kolmogorov–Smirnov and Shapiro–Wilk tests of normality following visual assessments of histograms. Taken together this statistical method for statistical analysis provided a systematic and objective consideration of quantitative analysis while maintaining high degrees of rigor that surpass standards for high-quality quantitative inquiry.

Procedure

Data collection sites obtained formal consent from the administrative agency of the responding institution. Participants were expressly informed about the purpose and voluntary nature of the study, and written informed consent was obtained from all participants. Data collection took place in a controlled environment by asking students to respond to the DLS and

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MAI questionnaires via paper-and-pencil administration in a monitored classroom atmosphere with an attempt to control for consistency and outside influences; students were expected to respond to both questionnaires immediately following each other in the same classroom session. Confidentiality of participant responses was appropriately maintained through the anonymous survey format. Participants were assured of their rights based on ethical principles related to withdrawing and documented informed consent, anonymity and confidentiality and MIT Identity, in keeping with ethics expectations set forth in the American Psychological Association's (2020) publication, Ethical Principles of Psychologists and Code of Conduct.

Analysis and Interpretation of the results

Objective 1: To examine the level of digital literacy skills of undergraduate students focusing on their ability to locating, integrating, interpreting, evaluating, and creating information in academic context

Table-1: Descriptive statistics of Digital Information Literacy (Overall)

	N	M	Sd.	Minimum	Maximum	Range	Sd.	Skewness	Kurtosis
Digital Information Literacy	149	130.93	16.141	89	172	83	16.141	-0.624	-0.107

Result of Descriptive statistics Digital Information Literacy

The descriptive analysis (Table 1) demonstrated that Digital Information Literacy (DIL) scores for undergraduates were between 89 and 172. The group mean was 130.93 (SD = 16.14). The skewness value (-0.624) indicated that more students scored above the mean, while the kurtosis (-0.107) suggested normality of distribution. This suggests a relatively even distribution with a slight leaning towards higher performance.

Result of Normalcy Test of Digital Information Literacy

Table-2: Level of Digital Information Literacy

Level	Frequency	Percent	Cumulative Percent
2.00	59	39.6%	39.0%
3.00	90	60.4%	100.0%
Total	149	100.0%	100.0%

The distribution became clearer with a categorical classification of the DIL levels arranged in Table 2. Nearly 40% of students fell into the "moderate" category, and more than 60% of students fell into the "high" category. Importantly, none of the students fell into the "low" category which also indicates that students who did not meet the strong benchmarks of digital information literacy also had a level of performance that indicated at least a basic level of digital competence.

Interpretation:

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These findings confirm that undergraduate students in Odisha have a generally good foundation in digital competence. The negative skew implies that institutional exposure to digital competence within curriculum, as well as a good use of digital tools in an academic, campus-wide or social context have allowed for a majority of students to have performance levels that are above average in DIL. Further, over 60% of students in the "high" category shows that digital literacy is becoming an important and core academic competence that looks to rival the academic task of reading and writing.

Objective 2: To compare the digital literacy of undergraduate students in relation to their academic stream.

Analysis of Normality Check for Academic Stream-wise Groups

Table-3: Result of Normality Test

Stream	Kolmogorov-Smirnov[a] (Sig.)	Shapiro-Wilk (Sig.)
Science	0.000	0.000
Arts	0.174	0.035
Commerce	0.000	0.001

Prior to conducting comparisons, normality was assessed using the Kolmogorov–Smirnov and Shapiro Wilk tests (see Table 3). For the Science and Commerce streams, and while Arts stream yielded some mix results with deviations from normality, all showed significant deviations from normality ($p < .05$). Weak evidence of a violation of normality would not affect the ability of ANOVA to be robust enough to carry out further tests.

Analysis with graphical representation of Digital Information Literacy

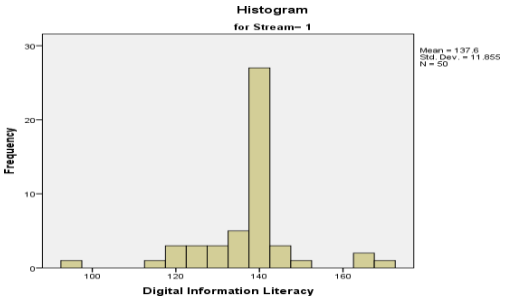

Figure No 1. Histogram of stream 1 (Science)

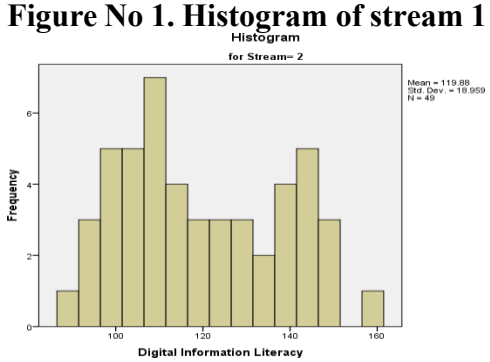

Figure No 2. Histogram of stream 2 (Arts)

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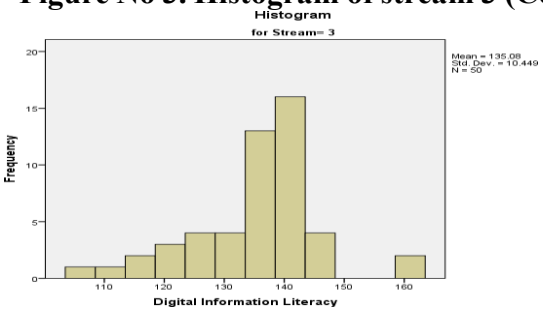
Figure No 3. Histogram of stream 3 (Commerce



The histograms (Figures 1–3) supplied more specific insights into streams' score distributions. The science student distribution exhibited a relatively symmetrical bell-shaped curve and low variability (M = 137.60, SD = 11.86), demonstrating a high level of digital competence and stability across the cohorts. In comparison, the visual form of the profile for arts students presented a wider and irregular distribution, with the scores positively skewed (M = 119.88, SD = 18.96), suggesting a larger range of values and uneven digital exposure, while commerce students exhibited a normal distribution with a slight left-skew and a tight range of scores (M = 135.08, SD = 10.45), indicating a strong homogeneity in the digital competence across students within the stream.

Table-4: ANOVA Summary of Digital Information Literacy

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9071.243	2	4535.621	22.456	0.000
Within Groups	29488.945	146	201.979		
Total	38560.188	148			

Result

The **ANOVA results (Table 4)** confirmed statistically significant differences among streams, $F(2,146) = 22.456$, $p < .001$, indicating that academic stream significantly influences Digital Information Literacy (DIL).

Table-5: Post Hoc Test: Tukey HSD Multiple Comparisons.

	Stream(I)	Stream(J)	Mean Difference	Std. Error	Sig.	95%CI (Lower Bound)	95% CI (Upper Bound)
Comparison	Science	Arts	17.722	2.857	0.000	10.96	24.49
	Science	Commerce	2.520	2.842	0.650	-4.21	9.25

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	Arts	Science	-17.722	2.857	0.000	-24.49	-10.96
	Arts	Commerce	-15.202	2.857	0.000	-21.97	-8.44
	Commerce	Science	-2.520	2.842	0.650	-9.25	4.21
	Commerce	Arts	15.202	2.857	0.000	8.44	21.97

The mean differences is significant at the 0.05 level.

To examine the source of the differences found the researchers carried out Tukey's HSD post hoc test (Table 5) to investigate any statistically significant mean difference between Science vs. Arts (MD = 17.72, $p < .001$) or Commerce vs. Arts (MD = 15.20, $p < .001$). However, investigators did not find a statistically significant mean difference between Science vs. Commerce (MD = 2.52, $p = .650$).

Interpretation

The analysis clearly establishes academic stream as a significant predictor of DIL. In both mean scores and for distributions, Science and Commerce students consistently outperformed Arts students. The histograms demonstrate that Arts students scored lower than the means of the other groups, and further, show that Arts students had greater variability which indicates this group may have a greater inconsistency in digital training. However, both Science and Commerce distributions were narrow and symmetrical, indicating that these two streams consistently integrated digital tools into their curricular experience. The absence of a statistically significant difference between Science and Commerce indicated that both groups displayed comparable levels of engagement with digital tools, while Arts students were disengaged. This outcome supports previous studies that have similarly documented a systematic digital divide between disciplines (Ranaweera, 2010; Sonowal, 2020). Overall, this evidence supports a case for broad curriculum reform, along with focused Arts work toward addressing inequity and preparing students for equitable futures**.**

Objective 3: To determine the extent to which digital literacy influence the metacognitive styles of undergraduate students.

Analysis

Table-6: Correlation; Digital Information Literacy & Regulation of Cognition

Variables	Mean	Std. Deviation	Number	Pearson corr.	Sig. (2-tailed)
Regulation Of Cognition	29.68	6.452	149	0.488	0.000
Digital Information Literacy	130.93	16.141	149	1	

Correlation is significant at the 0.01 level (2-tailed).

The correlation analysis showed that Digital Information Literacy (DIL) had meaningful positive correlations with both overarching domains of metacognition. Regulation of Cognition (the planning, monitoring, and evaluating components), as indicated in Table 6, demonstrated a moderate correlation with DIL ($r=.488$, $p<.01$). The same pattern was noted for Knowledge of Cognition (declarative, procedural, and conditional knowledge), which shared a positive

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correlation with DIL (r=.495, p<.01), as indicated in Table 10. Both correlations were significant at the 0.01 level.

Interpretation

The findings of this research confirm that metacognitive awareness is an important contributor/moderator of digital information literacy. Students who can consciously plan, monitor and regulate their own learning will likely be more successful at meeting learning challenges that emerge from the complexities of a digital world in gathering, evaluating and synthesizing online information. Similarly, their disposition toward applying their declarative and procedural knowledge of how to effectively use digital tools and strategies are also beneficial to students. This finding supports the existing literature on metacognitive skills as an important aspect of proficient, digital learning (Gasque, 2017; Denke et al., 2020).

These studies demonstrate that digital literacy is a competency that is also cognitively mediated, in addition to being a technical skill set. This has implications for policy and practice; access to digital tools is insufficient if education systems are not also investing in reflective learning practices which teach students to self-regulate their own engagement with the digital space. If metacognitive training were embedded into undergraduate programs, it would have the potential of increasing the future impact of digital literacy programs.

Analysis

Table 7: Regression of Digital Information Literacy on Overall Metacognitive Awareness

Predictor	B	SE B	t	p	95% CI Lower	95% CI Upper
Constant	38.9999	6.5030	5.997	< .001	26.148	51.851
DLS_Total	0.0271	0.0492	0.552	.582	–0.0700	0.1243

Model summary: R^2 = .002, Adj. R^2 = –.005, F(1,147) = 0.305, p = .582

Interpretation

From the table no. 7 it is depicted that the regression coefficient for DLS_Total (B = 0.027) indicates that for every 1-point increase in digital literacy, MAI_Total increases by only 0.027 points an effect so small that it is statistically and practically negligible. The p-value (.582) confirms not significance. With an R^2 of just 0.002, the model explains only 0.2% of the variance in overall metacognitive awareness. This means 98–99% of the variation in metacognition is unrelated to digital literacy.

Table-8: Regression of Digital Information Literacy on Knowledge of Cognition

Predictor	B	SE B	t	p	95% CI Lower	95% CI Upper
Constant	11.408	2.388	4.777	< .001	6.689	16.128
DLS_Total	0.0111	0.0181	0.615	.540	–0.0246	0.0468

Model summary: R^2 = 0.003, F(1,147) = 0.378, p = 0.540

Interpretation

From the table no. 8 it is depicted that the slope coefficient (B = 0.011) suggests that each 1-point rise in DLS_Total increases Knowledge of Cognition by only 0.011 points an extremely

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trivial effect. The p-value (.540) clearly indicates non-significance. An R^2 of 0.003 shows that digital literacy accounts for only 0.3% of the variance in students' knowledge of cognition.

Table-9: Regression of Digital Information Literacy on Regulation of Cognition

Predictor	B	SE B	t	p	95% CI Lower	95% CI Upper
Constant	27.592	4.3715	6.312	**< .001**	18.953	36.231
DLS_Total	0.0160	0.0331	0.485	.628	–0.0493	0.0814

Model Summary: R^2 = .002, F (1,147) = 0.236, p = .628

Interpretation

From the table no. 9 it is depicted that the predictive relationship between Digital Information Literacy and Regulation of Cognition is not statistically significant (p = .628). The coefficient is very small (β = 0.016), suggesting negligible practical effect. The confidence interval, extending from negative to positive values, confirms the absence of a reliable directional influence. With an R^2 of 0.2%, the model indicates that DIL does not meaningfully explain students' planning, monitoring, or evaluative learning behaviours. These findings support the argument that self-regulatory metacognition is a higher-order skill, not automatically enhanced by digital literacy, but rather through structured metacognitive instruction. While students who demonstrate digital literacy may handle digital resources efficiently, this does not necessarily imply they therefore possess improved metacognition. A student's metacognition (knowing how to plan, monitor, and regulate their own learning) seems to be impacted more by instructional design, reflective practice/training, and academic culture, rather than digital literacy alone. The regression analysis supports and shows that digital literacy is not an independent factor responsible for metacognitive development and supporting curriculum models embedded with digital literacy and metacognitive constructs would be more beneficial.

Findings and Discussion

The results offered evidence that undergraduate students were moderately to highly Digital Information Literate (DIM) with most students scoring in the highly proficient area, and none identified in the low scoring area (M = 130.93, SD = 16.14). This indicates a significant level of digital literacy readiness, and readiness in one sense, in students across Odisha, while students struggle with higher order skills, such as: evaluation, ethical reasoning, and curation of the information; this pattern has been seen in other research (Caton, 2025; Gutiérrez-Ángel et al., 2022; Kayyali, 2024; Smith & Storrs, 2023; Head et al., 2019; McCoy, 2022; Vázquez-Cano et al., 2023).

Findings also suggested there was a significant stream-wise difference, with Science and Commerce stream students outperforming Arts stream students: F(2,146) = 22.456, p < .001. This reflects disciplinary variations in technology integration, supporting previous work linking digital skills to curricular exposure (Mishra & Yadava, 2019; Ranaweera, 2010; Sonowal, 2020; Head et al., 2019; McCoy, 2022; Vázquez-Cano et al., 2023). Thus, the null hypothesis H_{01} (*There is no significant difference in Digital Information Literacy across academic streams*) was rejected.

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DIL was moderately and positively correlated with both Knowledge of Cognition and Regulation of Cognition ($r = .495$ and $r = .488$, $p < .01$), indicating that digitally competent students tend to show stronger metacognitive awareness. This aligns with studies emphasising the cognitive demands of digital information processing (Gasque, 2017; Mbandje, 2023; Teng, 2021; Veenman, 2013; Denke et al., 2020), supporting the research hypothesis H_{a1}: (*Digital Information Literacy is positively related to metacognitive styles*).

However, regression results showed that DIL did not significantly predict metacognitive outcomes (B values non-significant; $R^2 = .002–.003$). This suggests that metacognition is influenced more by the course design and experiences with reflection rather than digital abilities, which align with studies Schraw & Dennison (1994), Akyol & Garrison (2011), and Veenman (2013). Some research has shown that tasks incorporating digital components may facilitate reflection (e.g. Arjaya et al., 2023; Hidayat et al., 2024) but the effects will depend on the educational setting. Therefore, for the research hypothesis H_{a2} (Digital Information Literacy will significantly contribute to metacognitive styles.) To conclude, while students displayed an adequate digital information literacy and metacognition is connected with digital engagement, digital literacy is not wholly responsible for the development of metacognition. This indicates the need for stronger components within the Arts curricula that emphasize digital components as well as showing students skills to explicitly engage in metacognitive experiences with digital components in their other subjects, which would advance equitable digital readiness.

Summarization

This study examined undergraduate students' Digital Information Literacy (DIL), in different academic streams, and its relationship to metacognitive styles. The results indicate that most students displayed moderate to high levels of DIL across academic streams; however, some academic classes have an imbalance between the level of achievement. In all cases, students in Science and Commerce classes displayed better DIL scores than their peers in the Arts. There were positive moderate correlations between DIL to other metacognitive dimensions, and regression analysis shows that DIL was not predictive of metacognitive style. These findings indicate that digital competence is influenced by disciplinary exposure, while to develop metacognition, metacognition must be developed through programming.

Recommendations

Based on the findings of the study, the following recommendations are proposed:

1. Introduce systematic asymmetrical digital literacy modules across all disciplines, in particular in Arts programs, to mitigate inequities across disciplines.
2. Place intentional scaffolds for metacognitive training (planning, monitoring, evaluating strategies) into digital learning experiences to develop reflective engagement.
3. Utilize interdisciplinary digital pedagogy in order for students from all disciplines to approach data analysis and online evaluation tasks, as well as engage in authentic digital research tasks.
4. Engage in faculty development programming to equip instructors with strategies for developing digital literacy and metacognitive skill in light of classroom and blended learning approaches.
5. Implement frameworks for assessing digital literacy at the undergraduate level, so that institutions can monitor student competency progression and curriculum design.

Implications

The outcomes of this study suggest that it is vital for institutions of higher education to take up digital pedagogy that responds to the discipline. Although a strong association and weak predictive relationship of DIL with metacognitive styles was noted, DIL alone will not create self-regulated learners. Universities must provide digital training alongside reflective learning structures. Stream based differences will also provide equitable student preparedness for digital demands in their academic and work programs. In addition to that, the policy makers should acknowledge the cognitive aspects of digital literacy and design a national and state level initiatives in digital education for the students and teachers.

Conclusion

The study provides a more developed understanding of the interaction of digital literacy and metacognition in the undergraduate experience. Students reported relatively high levels of digital information literacy, and although there were differences in literacy across the academic streams in this sample, the differences may be attributable to the development of disciplinary eco-systems. In addition, the positive relationship found between digital information literacy and metacognitive awareness supports the hypothesis that the digital information literacy community is fundamentally a cognitive pursuit. However, the lack of predictive relationship highlighted in the results indicates that metacognitive development is not a direct outcome of simply engaging with digital literacy, especially when metacognitive awareness is not included in the design of the curriculum. Initiatives that enhance digital literacy practices across academic programs and seek to embed metacognition as a practical competency within the curriculum are important steps toward developing learners who are digitally capable, competent scholars, engaged, and reflectively aware in a digital mediated academic and work context.

REFERENCES

Akyol, Z., & Garrison, D. R. (2011). Understanding cognitive presence in an online and blended community of inquiry: Assessing outcomes and processes for deep approaches to learning. *British Journal of Educational Technology, 42*(2), 233–250. https://doi.org/10.1111/j.1467-8535.2009.01029.x

American Psychological Association. (2020). *Publication Manual of the American Psychological Association* (7th ed.). American Psychological Association. https://apastyle.apa.org/products/publication-manual-7th-edition

Amin, H., Malik, M. A., & Akkaya, B. (2021). Development and validation of Digital Literacy Scale (DLS) and its implication for higher education. *International Journal of Distance Education and E-Learning, 7*(1), 24-43. https://doi.org/10.36261/ijdeel.v7i1.2224

Arjaya, I. W., Setiawan, D., & Pratiwi, N. (2023). Digital tasks and reflective learning among university students. *Journal of Digital Learning Studies, 18*(1), 22–35.

Association of College and Research Libraries. (2016). Framework for information literacy for higher education. ACRL. http://www.ala.org/acrl/standards/ilframework

Beetham, H., & Sharpe, R. (Eds.). (2013). *Rethinking pedagogy for a digital age: Designing for 21st century learning* (2nd ed.). Routledge. https://doi.org/10.4324/9780203078952

Biglan, A. (1973). The characteristics of subject matter in different academic areas. *Journal of Applied Psychology, 57*(3), 195–203. https://doi.org/10.1037/h0034701

Chakravarty, R. (2019). Exploring digital confidence among arts students in Indian higher education. *Journal of Education and Development, 9*(4), 15–27. https://doi.org/10.5539/jed.v9n4p15

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE.

Denke, J., Jarson, J., & Sinno, S. (2020). Making the invisible visible: Enhancing information literacy and metacognition with a constructivist activity. *International Journal for the Scholarship of Teaching and Learning, 14*(2), Article 7. https://doi.org/10.20429/ijsotl.2020.140207

Eshet-Alkalai, Y. (2012). Thinking in the digital era: A revised model for digital literacy. *Issues in Informing Science and Information Technology, 9*, 267–276. https://doi.org/10.28945/1621

Field, A. (2018). *Discovering statistics using IBM SPSS statistics* (5th ed.). SAGE.

Gasque, K. C. G. D. (2017). Metacognition in digital literacy: Theoretical and empirical issues. *Revista Brasileira de Educação, 22*(71), 673–690. https://doi.org/10.1590/S1413-24782017227134

Gutiérrez-Ángel, J. A., García-Sánchez, J. N., & Ramírez-Montoya, M. S. (2022). Digital competence in higher education: A systematic review. *Education and Information Technologies, 27*(6), 7765–7788. https://doi.org/10.1007/s10639-022-10954-6

Head, A. J., Wihbey, J., Metaxas, P. T., MacMillan, M., & Cohen, D. (2019). How students engage with news: Five takeaways for educators, journalists, and librarians. *First Monday, 24*(3). https://doi.org/10.5210/fm.v24i3.9430

Irhandayaningsih, A., & Hastoto, S. M. (2022). The relationship between metacognitive experiences and digital literacy in a self-directed learning environment. *E3S Web of Conferences, 359,* Article 03018. https://doi.org/10.1051/e3sconf/202235903018

Kayyali, M. (2024). Digital Literacy in Higher Education: Preparing Students for the Workforce of the Future. *International Journal of Information Science and Computing, 11*(1), 53–73. https://doi.org/10.30954/2348-7437.1.2024.6

Koltay, T. (2015). *Data literacy: In search of a name and identity*. *Journal of Documentation, 71*(2), 401–415. https://doi.org/10.1108/JD-02-2014-0026

Li, X., Wang, Y., & Huang, J. (2025). Digital literacy and employability skills: Evidence from Chinese undergraduates. *Computers & Education, 210,* 105054. https://doi.org/10.1016/j.compedu.2024.105054

Martin, A., Grudziecki, J., & Pankowska, M. (2020). Digital literacy in the age of AI: Rethinking competencies for higher education. *Education and Information Technologies, 25*(5), 4079–4095. https://doi.org/10.1007/s10639-020-10152-5

Mbandje, P. (2023). Metacognitive awareness and online information evaluation. *Journal of Cognitive Education, 19*(2), 112–127.

McCoy, E. (2022). Teaching and assessment of metacognition in the information literacy classroom. *Communications in Information Literacy, 16*(1), 1–25. https://doi.org/10.15760/comminfolit.2022.16.1.5

Mishra, S., & Yadava, A. (2019). Discipline and digital divide: Examining digital literacy among Indian undergraduates. *International Journal of Education and Development*

using Information and Communication Technology, 15(2), 131–142. https://files.eric.ed.gov/fulltext/EJ1220045.pdf

Pangrazio, L., & Sefton-Green, J. (2020). What is digital literacy? A comparative review of contemporary definitions and competencies. *Learning, Media and Technology, 45*(3), 386–402. https://doi.org/10.1080/17439884.2020.1750891

Popa, D., & Vasilescu, M. D. (2024). Inequities in digital competence: Towards inclusive strategies in higher education. *International Journal of Inclusive Education, 28*(1), 15–30. https://doi.org/10.1080/13603116.2022.2063478

Ranaweera, P. (2010). Information literacy programmes conducted by the universities in Sri Lanka [Unpublished manuscript]. National Institute of Library and Information Sciences, University of Colombo.

Schraw, G., & Dennison, R. S. (1994). Assessing metacognitive awareness. *Contemporary Educational Psychology, 19*(4), 460–475. https://doi.org/10.1006/ceps.1994.1033

Smith, J., & Storrs, K. (2023). Beyond digital familiarity: Examining gaps in higher-order digital literacy in higher education. *Journal of Computing in Higher Education, 35*(2), 259–277. https://doi.org/10.1007/s12528-022-09333-7

Sonowal, R. (2020). Digital divide in higher education: An analysis of ICT use among disciplines. *Journal of Educational Technology Systems, 49*(1), 27–46. https://doi.org/10.1177/0047239520921537

Teng, F. (2021). The benefits of metacognitive reading strategy awareness for academic literacy. *System, 97,* 102431. https://doi.org/10.1016/j.system.2020.102431

van Deursen, A. J. A. M., & van Dijk, J. A. G. M. (2014). The digital divide shifts to differences in usage. *New Media & Society, 16*(3), 507–526. https://doi.org/10.1177/1461444813495232

Vázquez-Cano, E., León-Urrutia, M., & López-Meneses, E. (2023). Digital research strategies among university students: Patterns and disciplinary differences. *Education and Information Technologies, 28*(2), 1411–1429. https://doi.org/10.1007/s10639-022-11370-8

Veenman, M. V. J. (2013). Learning to self-monitor and self-regulate. In R. Mayer & P. A. Alexander (Eds.), *Handbook of Research on Learning and Instruction* (pp. 197-218). Routledge.

Veenman, M. V. J., Van Hout-Wolters, B., & Afflerbach, P. (2006). Metacognition and learning: Conceptual and methodological considerations. *Metacognition and Learning, 1*(1), 3–14. https://doi.org/10.1007/s11409-006-6893-0

Zakir, A., Rahman, M., & Chowdhury, S. (2025). Digital literacy and career readiness: Evidence from South Asian universities. *Education and Information Technologies, 30*(2), 1883–1902. https://doi.org/10.1007/s10639-024-12111-9