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Digital Literacy in mathematics Among Secondary School Students: Gender and Regional Differences.

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ABSTRACT
The present study investigates the influence of gender and region on digital literacy in relation to achievement in mathematics among secondary school students. With the increasing integration of digital tools into mathematics instruction, understanding demographic disparities in digital competencies has become essential. The study employed a quantitative research design and analyzed data collected from students representing diverse gender and regional backgrounds. Results revealed significant differences across both variables. Girls demonstrated higher levels of digital literacy compared to boys ($p = 0.002$), suggesting stronger engagement with and utilisation of digital learning resources. Similarly, urban students outperformed their rural counterparts ($p = 0.003$), highlighting persistent inequalities in access to digital infrastructure and technologically enriched learning environments. These findings underscore that demographic factors continue to shape students' readiness to engage with digital mathematics learning. The study emphasizes the need for targeted interventions, improved digital access in rural areas, and gender-responsive digital pedagogies to ensure equitable opportunities for all learners. Implications for curriculum development, teacher training, and future research are also discussed.

KEYWORDS: Digital literacy, Mathematics education, gender differences, and urban–rural regional differences

INTRODUCTION
The digitalization of education has reshaped how students learn and engage with academic subjects, particularly mathematics. The integration of digital tools, interactive platforms, and technology-enhanced resources has made digital literacy an essential competency for accessing content, analyzing information, and solving mathematical problems. In mathematics education, digital literacy extends beyond basic computer skills and involves the ability to evaluate digital resources, apply technological tools, and navigate digital environments that support conceptual understanding and higher-order thinking.

Despite its importance, significant disparities remain in students' access to and effective use of digital technologies. Gender and regional differences continue to shape learners' digital experiences, with studies reporting mixed findings regarding gender-based digital engagement and persistent gaps linked to regional inequalities in infrastructure, connectivity, and teacher readiness. These disparities may limit students' opportunities to develop the digital skills needed for success in mathematics. Understanding such demographic differences is therefore vital for informed educational planning and equitable digital learning provision. In this context, the present study explores gender and regional variations in digital literacy among secondary school students, contributing to ongoing efforts to address digital divides within mathematics education.

OBJECTIVES
- To compare digital literacy between male and female secondary school students
- To compare digital literacy between urban and rural secondary school students.

HYPOTHESES (NULL FORM)
H1: There is no significant difference in digital literacy in mathematics between male and female students.
H2: There is no significant difference in digital literacy in mathematics between urban and rural students.

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3.1 Tools used for the study

Digital literacy scale is prepared by the researcher which has 32 items with five point scale and five of them are negative questions

3.2 Sample

102 school students are used as sample for this study

3.3 Reliability and Validity

In order to establish the reliability of the digital literacy scale, the split half method was used. The reliability of digital literacy scale is 0.807 and validity is 0.898

CONCEPTUALIZING DIGITAL LITERACY IN THE 21ST CENTURY

Digital literacy has evolved from a basic focus on technical skills to a multidimensional construct incorporating critical thinking, communication, collaboration, safety, and creativity. Early definitions emphasized the ability to read and process digital information using tools such as computers or the internet (Gilster, 1997). However, contemporary conceptualizations broaden this perspective. Ng (2012) proposed a tripartite model of digital literacy encompassing technical, cognitive, and socio-emotional dimensions. Technical literacy includes software use, device handling, and troubleshooting. Cognitive literacy refers to evaluating and synthesizing information, while socio-emotional literacy involves responsible engagement in online spaces.

The International Society for Technology in Education (ISTE) highlights that digital literacy extends beyond operational competence to include effective problem-solving, digital citizenship, and creative digital expression. Similarly, Siddiq et al. (2016) argue that digital literacy involves the integration of critical thinking with technological proficiency, enabling learners to adapt to increasingly complex digital environments.

Empirical research shows that students with higher digital literacy demonstrate better academic engagement, improved self-regulated learning, and higher confidence in navigating online learning environments. Digital literacy particularly enhances learning in subjects that benefit from interactive visualizations and dynamic simulations, such as mathematics.

However, digital literacy remains uneven across student populations due to socio-economic, cultural, and infrastructural factors. Such disparities necessitate an examination of how digital literacy functions across different gender and regional groups, especially in relation to their academic motivation.
5. Digital Literacy in Mathematics Learning

The integration of digital tools in mathematics education has been widely documented as an effective means for enhancing understanding, engagement, and achievement. Tools such as graphing calculators, digital simulations, GeoGebra, learning management systems, and interactive problem-solving applications help students visualize abstract mathematical concepts. According to Kong (2019), the digital environment enables cognitive scaffolding that supports conceptual understanding, especially for learners who struggle with traditional instructional approaches.

Students proficient in digital literacy tend to engage more actively with digital mathematical tasks, use online resources for self-study, and employ digital tools for exploring advanced problems. Studies indicate that digital literacy reduces cognitive load by providing quick access to explanations, examples, and instant feedback (Ainley et al., 2016). When students know how to navigate technological tools effectively, they spend less time struggling with interfaces and more time engaging with the mathematical content itself.

Furthermore, research shows that digital literacy and mathematics learning interact in ways that influence students' motivation. Students who feel confident using digital tools are more likely to attempt challenging problems, seek help online, and employ growth-oriented strategies. Conversely, low digital literacy can impede learning, causing frustration that leads to decreased motivation.

These findings illuminate the importance of exploring how digital literacy serves as a predictor of mathematics achievement motivation among secondary school students.

STATISTICAL ANALYSIS:

6.1 DESCRIPTIVE STATISTICS

Descriptive statistics deals with mean and graphical representation of the scores obtained from the sample.

FREQUENCY AND PERCENTAGE DISTRIBUTION OF THE VARIABLES FOR THE SUB SAMPLES CLASSIFIED ACCORDING TO THE SELECTED PERSONAL VARIABLES

TABLE 1.1

Frequency and percentage distribution of digital literacy in mathematics based on Gender and Region

Figure1.1

VARIABLE	SUB VARIABLE	FREQUENCY	PERCENT	CUMULATIVE PERCENT
GENDER	Boys	19	18.6	18.6
	Girls	83	81.4	100
REGION	Urban	49	48	48
	Rural	53	52	100

Figure showing the percentage distribution of digital literacy in mathematics based on Gender

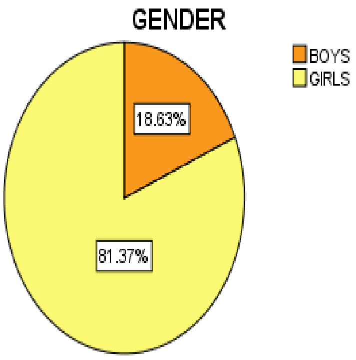
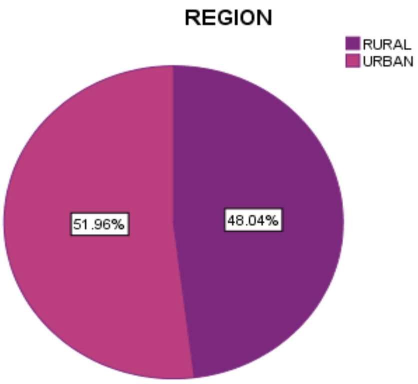


Figure1.2

Figure showing the percentage distribution of digital literacy in mathematics based on Region



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6.2Hypothesis Analysis:

H1: There is no significant difference between boys and girls in their Digital literacy in mathematics among the school students.

TABLE1.2

Gender	N	Mean	Standard deviation	df	Calculated 't' value	'p' value
Girls	19	110.32	17.957	100	1.962	0.002 S
Boys	83	118.87	16.948			

The above table shows that the mean scores of boys 110.32 with standard deviation 17.95 similarly the mean scores of girls 118.87 with standard deviation 16.948. Here the 'p' value is 0.002 which is greater than 'p' value at 95% confidence level with the degrees of freedom 100. The hypothesis which assumed that there is no significant difference among the school students in gender difference in their digital literacy in mathematics. is rejected.

Gender differences in digital literacy have been widely researched, with findings indicating mixed trends. Traditional analyses suggested a male advantage in technological competence, attributed to early exposure to digital tools, societal expectations, and confidence in technical tasks (Cooper, 2006). Boys consistently reported higher computer self-efficacy and stronger interest in technology-based activities.

However, more recent studies reveal a narrowing gender gap. Increased access to digital devices, the ubiquity of internet usage, and more inclusive pedagogical strategies have contributed to improved digital competencies among girls. Some studies find that girls outperform boys in certain aspects of digital literacy, such as digital communication, ethical use of technology-, and collaborative problem-solving (Vekiri & Chronaki, 2008).

Despite these improvements, gender-based differences in digital confidence persist. Girls may still approach digital tasks with caution, often underestimating their abilities despite performing equally well or better. This phenomenon aligns with stereotype threat and socialization theories, which suggest that girls internalize societal messages that frame technology as a male-dominated domain.

Understanding how gender moderates the relationship between digital literacy and mathematics motivation is crucial because it may reveal important pathways for interventions aimed at creating equitable learning environments.

H2: There is no significant difference between urban and rural students in their Digital literacy in mathematics among the school students.

TABLE1.3

Gender	**N**	**Mean**	**Standard deviation**	**df**	**Calculated 't' value**	**'p' value**
RURAL	49	116.13	15.585	100	0.689	.003
URBAN	53	118.51	19.211			

The above table shows that the mean scores of urban students 118.51 with standard deviation 19.21 similarly the mean scores of students who come from rural 116.13 with standard deviation 15.58. Here the 'p' value is 0.003 which is greater than 'p' value at 95% confidence level with the degrees of freedom 100. The hypothesis which assumed that there is no significant difference among the school students in region in their digital literacy towards achievement in mathematics. is rejected. Urban students show high digital literacy in mathematics than students who come from Rural

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Regional disparities constitute a major source of inequality in digital literacy and academic motivation. The "digital divide" between urban and rural students is well documented globally. Urban schools often have Better internet connectivity, More digital devices, Well-trained teachers, Exposure to digitally mediated learning environments.

In contrast, rural students frequently face limited infrastructure, outdated devices, and fewer opportunities for digital immersion. UNESCO (2020) reports that inadequate access to digital tools in rural regions significantly hinders students' digital literacy development and digital confidence.

These disparities directly affect students' learning experiences in mathematics. Students in rural regions may have fewer opportunities to explore digital simulations, online tutorials, or interactive mathematics platforms. Limited exposure to technology can reduce mathematics confidence and lower achievement motivation, particularly when mathematics instruction increasingly integrates digital resources.

Additionally, teachers in rural schools may have limited professional development opportunities related to digital teaching, further widening the gap. The stress associated with navigating unfamiliar digital learning environments may contribute to negative attitudes toward mathematics.

Exploring regional variations thus provides critical insights into how contextual inequalities influence students' digital literacy and mathematics motivation.

DISCUSSION

The present study identified statistically significant differences in digital literacy in mathematics across both gender and region. The results indicate that girls ($M = 118.87$, $SD = 16.95$) performed substantially better than boys ($M = 110.32$, $SD = 17.95$), with a p-value of 0.002 confirming significance at the 95% confidence level. This suggests that female students possess comparatively stronger digital competencies, which may be attributed to more consistent engagement with technology for academic purposes, higher levels of self-regulated learning, or more positive dispositions toward digital learning environments. These outcomes align with emerging literature reporting that gender gaps in digital proficiency are shifting as digital resources become more accessible and integrated into school learning.

Similarly, the comparison of region-based groups reveals significant differences in favour of urban students ($M = 118.51$, $SD = 19.11$) compared to rural students ($M = 116.13$, $SD = 15.58$). Although the mean difference is modest, the p-value (0.003) supports the conclusion that region remains an influential determinant of digital literacy in mathematics learning. This pattern is consistent with long-standing disparities in access to digital infrastructure, availability of technological resources, quality of internet connectivity, and teacher preparedness typical of rural contexts. Urban students generally benefit from more technology-rich learning environments, enabling them to utilize digital tools more effectively in mathematics classrooms.

Overall, the results reaffirm that demographic factors continue to shape learners' digital literacy development within mathematics education. The findings highlight the need for targeted interventions to ensure equitable opportunities across gender and regional groups.

RECOMMENDATIONS

- Schools should design initiatives that encourage balanced participation of male and female learners, along with tailored support to enhance boys' engagement in technology-assisted mathematics learning.
- Authorities should prioritize improving internet connectivity, access to devices, and availability of digital learning platforms in rural schools to minimize regional disparities.
- Ongoing professional development focusing on digital integration in mathematics instruction is essential to equip teachers with the skills required to support diverse learners. The use of interactive applications, digital simulations, and problem-solving platforms should be incorporated to deepen understanding and promote active learning among students.

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- Educational institutions should adopt assessment mechanisms to regularly evaluate progress and identify demographic groups requiring additional support.

EDUCATIONAL IMPLICATIONS

The findings carry significant implications for curriculum design, instructional strategies, and policy planning. The observed gender differences indicate a need for learning environments that actively engage boys in digital mathematics tasks through interactive, collaborative, and interest-oriented strategies. At the same time, the regional differences emphasize the structural inequities that continue to limit rural students' access to quality digital learning experiences. Without deliberate intervention, these disparities may widen existing achievement gaps.

Furthermore, the integration of digital literacy within mathematics curricula requires not only adequate technological resources but also pedagogical expertise among teachers. Educational planners must consider embedding digital competency standards into mathematics instruction and establishing support mechanisms for schools with limited technological readiness.

CONCLUSION

The study concludes that both gender and region significantly influence students' digital literacy in relation to mathematics achievement. The higher performance of girls compared to boys, and of urban students compared to rural students, indicates persisting inequalities in access to and utilisation of digital learning opportunities. These findings signal the need for targeted, inclusive, and systemic efforts to bridge demographic gaps in digital literacy. Ensuring equal access to technological resources, enhancing teacher preparedness, and adopting balanced digital learning strategies can enable all learners—irrespective of gender or region—to develop the digital competencies required for success in mathematics and future academic pathways.

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