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DIGITAL TOOLS AND INCLUSIVE GROWTH IN HIGHER EDUCATION: AN EMPIRICAL STUDY ALIGNED WITH SDG 4

Akanksha Singh [1], Dr. Mukta Martolia [2]

[1] Research Scholar, SSMFE, Sharda University, Uttar Pradesh, India
[2] Associate Professor, SSMFE, Sharda University, Uttar Pradesh, India

ABSTRACT

Purpose

The purpose of this empirical study is to explore the efficacy of digital tools in enhancing learning outcomes within Indian higher education, specifically in the context of supporting Sustainable Development Goal 4 (SDG4), which aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. This research seeks to identify how digital tools can facilitate improved learning experiences and outcomes, thus contributing to the broader educational objectives outlined in SDG4. The research seeks insights from a range of higher education stakeholders, including students, faculties, employers, entrepreneurs, and self-employed individuals.

Study design/methodology/approach

This is a study via questionnaire containing closed ended questions to gather comprehensive data from students and educators across 5 higher education institutions of Delhi/NCR. A sample of 400 educators & learners members participated in the study, providing insights into their experiences with digital learning tools. The data collected were analyzed using statistical methods to identify trends and correlations regarding the use of digital tools in the learning process.

Findings

The findings indicate that the integration of digital tools significantly enhances student engagement, motivation, and overall learning outcomes. Students reported increased accessibility to educational resources, institutional support, improved collaboration among peers, and a more personalized learning experience. Additionally, educators noted that digital tools facilitate more effective teaching strategies and foster an inclusive learning environment. However, challenges such as technological disparities and the need for adequate training were also identified, highlighting the importance of addressing these barriers to maximize the potential of digital tools in higher education.

Originality/value

This study contributes to the existing literature by providing empirical evidence on the role of digital tools in supporting SDG4 within higher education. It offers valuable insights into the benefits and challenges associated with digital learning environments, making it a significant resource for educators, policymakers, and institutions aiming to enhance educational practices through technology. The findings underscore the necessity for ongoing investment in digital infrastructure and training, ensuring that all learners and educators can benefit from the transformative potential of digital learning tools. This research not only reinforces the importance of digital education in achieving SDG4 but also serves as a call to action for stakeholders to prioritize equitable access to digital resources in higher education for inclusive growth.

Keywords: Digital Tools, Inclusive Education, Sdg4, Digital Literacy, Digitalization

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1. INTRODUCTION

1.1. EDUCATION AND SUSTAINABLE DEVELOPMENT GOALS

Education is a public good, a core human right, and a basis for other personal rights to be realized. It promotes peace, tolerance, personal fulfillment, and long-term growth. At the same time, education is necessary for creating full employment and eradication of poverty. In today's world, the rise of Information & Communication technologies has brought about profound changes in number of fields. One area where this has had a more pronounced impact is the educational context. In particular, the sphere of higher education has gradually been infused with educational activities that rely on ICT resources. The adoption of new teaching techniques, the development of new learning environments, and the presence of instructors who can equip their students with the life skills, information, and abilities they need have all facilitated the transition of traditional universities into digital ones [Cortese et al., A.D. 2003]. The result of all these changes is a more sustainable educational approach [Makrakis et al., V2017]. Research indicates that the innovative application of ICTs in educational settings aims to achieve academic objectives that yield positive outcomes for university students. Additionally, these technologies can raise the standard of education at all levels—academic, social, and personal.

In order to achieve Sustainable Development Goal 4 (SDG 4), which is to ensure inclusive and equitable quality education for all, digitalization in education has become a crucial tool for promoting sustainable development. Education is a driving force behind economic growth, social advancement, and personal development in addition to being a basic human right. The United Nations' 2030 Agenda for Sustainable Development sets forth a comprehensive framework aimed at fostering long-term sustainability through the lens of social, environmental, and economic well-being. Education plays a central role in realizing the SDG by directly enhancing the effectiveness of e-learning initiatives and emphasizing the importance of, inclusive and quality education, for lifelong learning opportunities.

2. LITERATURE REVIEW

2.1. OVERVIEW OF SDG4 AND ITS EMPHASIS ON INCLUSIVE, EQUITABLE EDUCATION

The United Nations 2030, Agenda for Sustainable Development lays out a new, more inclusive path to long-term viability. The Sustainable Development Goals pave the way to equity, justice, and prosperity by taking into account social, environmental and economic well-being. As a means of accomplishing the SDG‟s, Education is given special attention by directly implementing the development and improvement of E-learning effectiveness. Focus on ensuring, inclusive and quality education and promote lifelong learning opportunities, for one and all. According to the Incheon Declaration and SDG 4 – Education 2030 Framework for Action (2015). (Qian Tang, 2016) . Ensure inclusive and equitable education and promote lifelong learning opportunities for everyone. The significance of this target is highlighted by the acknowledgment that fostering quality education is essential for improving individual lives and facilitating sustainable development. Goal 4 is organized into ten targets to facilitate implementation (SDG Tracker, 2020).

2.2. DIGITALIZATION IN EDUCATION: A PARADIGM SHIFT

The advent of digital technologies has catalysed a paradigm shift in education, redefining traditional notions of teaching and learning. As highlighted by Johnson et al., 2020 digitalization in education encompasses a wide range of practices, including online learning platforms, digital resources, interactive multimedia, and data-driven instructional methods. In addition to improving the efficacy and efficiency of educational delivery, the digital tools also enable individualized learning experiences catered to each learners' requirements and preferences, providing a bright future for education. In the context of human-centred recovery, digitalization is not just a tool, but a necessity for enabling inclusive and accessible education for all. As underscored by UNESCO et al., 2021, the COVID-19 pandemic has, starkly revealed the importance of digital technologies in ensuring continuity of learning during crises. However, it has also exposed the digital divide, particularly among marginalized communities and vulnerable populations. As we navigate the post-pandemic landscape, it is urgent that we adopt bottom-up approaches that prioritize equity, inclusion, and human dignity in education.

2.3. DIGITAL INCLUSION AND EDUCATION

The NEP 2020 emphasizes the use of digital technologies for educational purposes and to narrow the digital divide. The major goal is to make technology-assisted literacy learning accessible and meaningful to everyone. Digital literacy means critically engaging with technology and gaining a social awareness of how variety of circumstances can influence how information is conveyed and its meaning. It implies that knowledge can be represented and delivered in a variety of situations and to a diverse audience (example: In visual, audio, and textual modes). This entails locating and evaluating relevant data, critically evaluating and re-contextualizing knowledge and reinforcing knowledge by comprehending the cultural and social settings in which it occurs. Digital literacy has an impact on every part of our life. Indeed, it's difficult to imagine a part of our lives that isn't influenced by digital technology. Apps and software assist us in finding a job or a companion, as well as using household appliances to book theatre or movie tickets, vacations, and the best available discounts on shopping sites. Ministry of Education Government of India, et al., 2021.

2.4. DIGITAL TOOLS IN EDUCATION

The literature on digital tools in education spans various aspects, including their impact on student engagement, learning outcomes, and the transformation of traditional educational practices. A significant body of research has focused on blended learning environments that combine face-to-face instruction with online resources, enhancing the flexibility and accessibility of educational materials (Dancsa et al., 2023).

The COVID-19 pandemic accelerated the adoption of digital tools, highlighting their critical role in maintaining educational continuity during disruptions (Alhlak et al., 2013). This period saw a surge in the use of Learning Management Systems (LMS), which have been pivotal in managing course content and facilitating communication between educators and students (Goldin et al., 2022). Research by Haleem et al. (2022) underscores that educational systems must adapt proactively to digital transformations. This adaptation involves implementing new technologies and fostering a digital mindset among educators and students to leverage these tools effectively.

3. THEORETICAL FRAMEWORK

Everett Roger; Diffusion of Innovation (DOI): The Diffusion of Innovation (DOI) hypothesis developed by Everett Rogers describes how new concepts and innovations proliferate in a society. The "S-curve" that depicts the life cycle of innovations makes this theory essential to comprehending the adoption process. The influence of social systems, perceived benefits, and adopter classifications are important factors. The theory's application encompasses diverse domains, ranging from education to technology, underscoring its versatility and significance.

Uses & Gratification Theory: Understanding how digital learning technologies may satisfy learners' needs and motivations requires a theoretical foundation in the form of Uses and Gratifications Theory (UGT). Elihu Katz and colleagues developed UGT, which emphasizes the agency of the user in seeking out certain content depending on their motivations and gratifications. It focuses on why people actively choose media channels and content to suit various requirements.

The Technology Acceptance Model (TAM) is a well-known framework for comprehending technology uptake in digital learning contexts. It mainly concentrates on two crucial factors that affect the Intention to Use (ITU) technology: Perceived Ease of Use (PEOU) and Perceived Usefulness (PU). TAM has proved crucial in elucidating how these elements impact students' inclination to interact with digital learning environments. Numerous studies have confirmed the model's use in educational settings, demonstrating its applicability and flexibility in various situations.

Connectivism Learning Theory: Connectivism, proposed by Siemens (2005), is a theory of learning that acknowledges the dynamism of learning in the information age. It also focuses on the role of technology in the acquisition, storage, and retrieval of knowledge, integrating important aspects of chaos, network, complexity, and self-organization theories (Siemens, 2004). Unlike other conventional learning theories, connectivism concentrates on learning as a networked process where knowledge is stored on digital media and retrieved through learning community connections.

4. RESEARCH OBJECTIVES

1) To find Digital Media tools for Higher Education.
2) To Identify bottom up initiatives promoting digital tools & technologies in education and scaling practices to support instructors, digital learning, and connectivity.

5. RESEARCH METHODOLOGY

The study has employed a quantitative data analysis with the help of survey through questionnaire.

- Content analysis has been part of the primary investigation. The primary, exploratory, and empirical surveys will all use non- probability sampling.
- The primary data for the study has been collected using convenience techniques. Through convenience sampling, the researcher has contacted university students, working professionals and faculty members & educators/instructors.
- The survey entails the distribution of questionnaires to educators, instructors and students or learners in various majors enrolled in bachelor's, master's, and higher education programmes, both online and in person.
- The survey comprised closed-ended questions, Closed-ended questions were designed to elicit specific information, allowing for straightforward scoring. Each response was assigned a numerical value, transforming qualitative insights into quantitative data.

6. ANALYSIS OF QUESTIONNAIRE

Digital Media Usage & Preferred Learning Styles

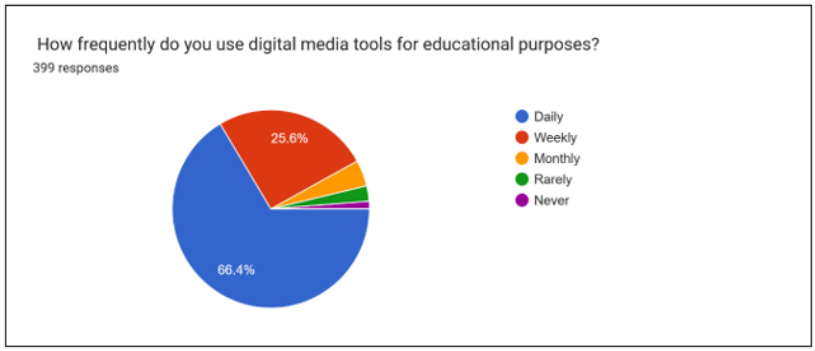

Figure 1 Frequency of Digital Media Tool Usage

Figure 1 The chart displays the frequency of digital media tool usage for educational purposes. The majority use them Daily at 66.4%, followed by weekly at 25.6%, Monthly at 4.3%, Rarely at 2.5%, and never at 1.3%.

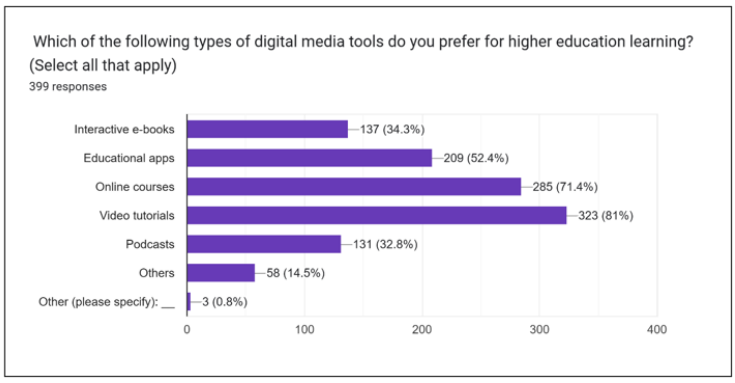

Figure 2 Preferred Digital Media Tools

FIGURE 2 This chart shows the types of digital media tools preferred for higher education learning. The most popular are Video tutorials at 81%, Online courses at 71.4%, Educational apps at 52.4%, Interactive e-books at 34.3%, Podcasts at 32.8%, and Others at 14.5%.

Digital Media Tool Effectiveness, Accessibility and Availability

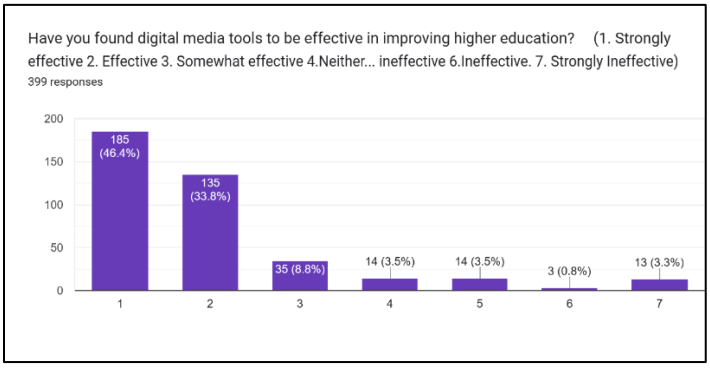

Figure 3 Effectiveness of Digital Media Tools

FIGURE 3 The chart depicts the perceived effectiveness of digital media tools in improving higher education. The majority find them Strongly Effective at 46.4%, followed by Somewhat Effective at 8.8%, Effective at 33.8%, Neither Effective nor Ineffective at 3.5%, Somewhat Ineffective at 3.5%, and Ineffective at 0.8%. Strongly ineffective are 3.3%.

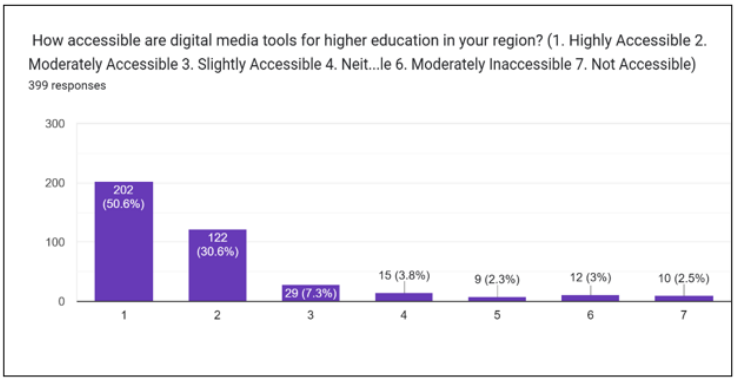

Figure 4 Accessibility of Digital Media Tools

FIGURE 4 This chart shows the accessibility of digital media tools for higher education in the respondents' regions. The majority find them Moderately Accessible at 30.6%, followed by Slightly Accessible at 7.3.1%, Highly Accessible at 50.6%, Neither Accessible nor Inaccessible at 3.8%, Slightly Inaccessible at 2.3%, Moderately Inaccessible at 3.%, and Not Accessible at 2.5%.

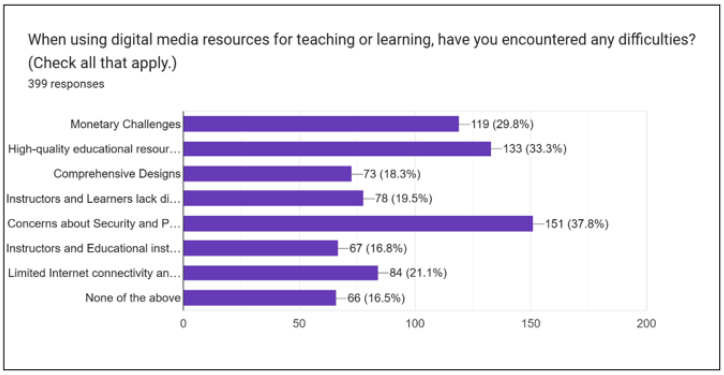

Figure 5 Difficulties Encountered with Digital Media Tools

FIGURE 5 The chart displays the difficulties encountered when using digital media resources for teaching or learning. The most common are Concerns about Security and Privacy at 37.8%, High-quality educational resources at 33.3%, Monetary Challenges at 29.8%, Limited Internet connectivity at 21.1%, Instructors and Learners' digital literacy at 19.5%, Comprehensive Designs at 18.3%, Instructors and Educational Institutions' resistance to change at 16.8%, and None of the above at 16.5%.

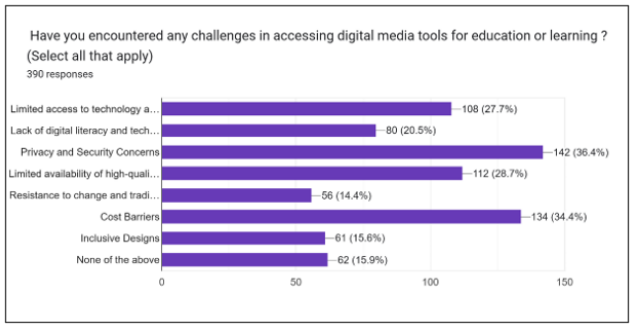

Figure 6 Challenges in Accessing Digital Media Tools

FIGURE 6 This chart shows the challenges encountered in accessing digital media tools for education or learning. The most common are Privacy and Security Concerns at 36.4%, Cost Barriers at 34.4%, Limited access to technology at 27.7%, Limited availability of high-quality resources at 28.7%, Lack of digital literacy and skills at 20.5%, Resistance to change and adoption at 14.4%, Inclusive Designs at 15.6%, and None of the above at 15.9%.

Preferred Features

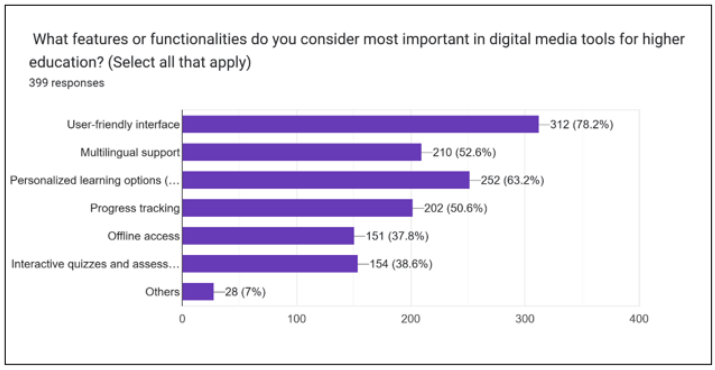

Figure 7 Important Features in Digital Media Tools

FIGURE 7 The chart depicts the features or functionalities considered most important in digital media tools for higher education. The top ones are User-friendly interface at 78.2%, Personalized learning options at 63.2%, Multilingual support at 52.6%, Progress tracking at 50.6%, Interactive quizzes and assessments at 38.6%, Offline access at 37.8%, and Others at 7%.

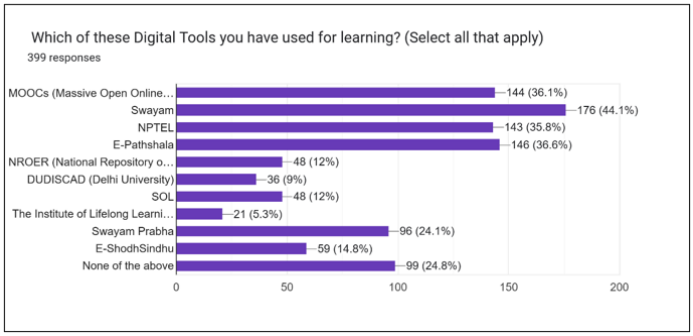

Figure 8 Digital Tools Used for Learning

FIGURE 8 AThis chart shows the digital tools used by the respondents for learning. The most commonly used are MOOCs (Massive Open Online Courses) at 36.1%, Swayam at 44.1%, NPTEL at 35.8%, E-Pathshala at 36.6%, NROER (National Repository of Open Educational Resources) at 12%, DUDISCAD (Delhi University Distance and Continuing Education) at 9%, SOL at 12%, The Institute of Lifelong Learning at 5.3%, Swayam Prabha at 24.1%, E-ShodhSindhu at 14.8%, and None of the above at 24.8%.

Higher Education Digital Technology Initiatives

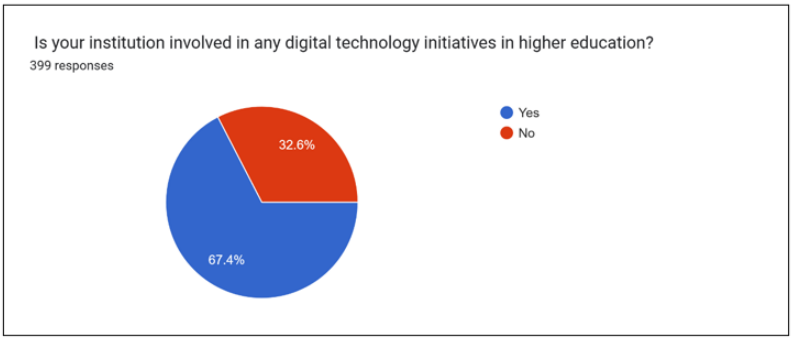

Figure 9, Institutional Involvement in Digital Technology Initiatives

FIGURE 9, The chart displays the involvement of the respondents' institutions in digital technology initiatives in higher education. The majority (67.4%) indicate that their institution is involved, while 32.6% say their institution is not involved.

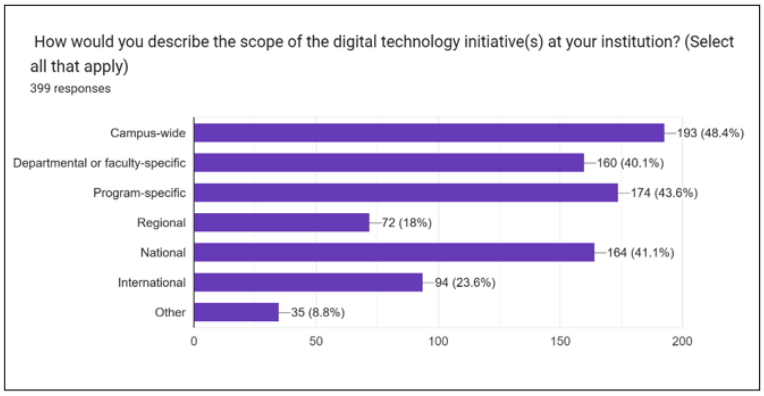

Figure 10 Scope of Digital Technology Initiatives

FIGURE 10 This chart shows the scope of the digital technology initiatives at the respondents' institutions. The most common scopes are Program-specific at 43.6%, Regional at 18%, National at 41.1%, Departmental or faculty-specific at 40.1%, Campus-wide at 48.4%, and International at 23.6%.

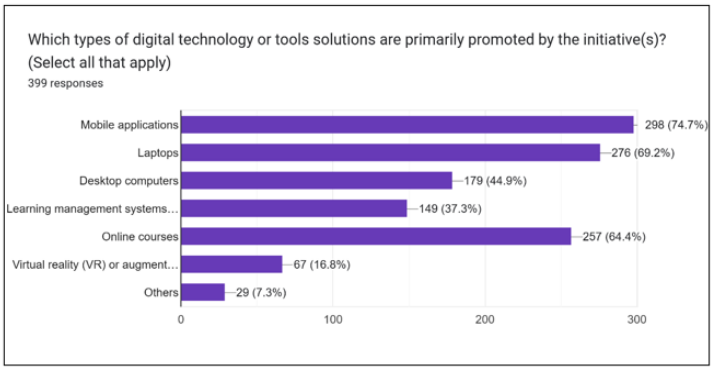

Figure 11 Types of Digital Technology Solutions Promoted

FIGURE 11 The chart depicts the types of digital technology or tool solutions primarily promoted by the initiatives. The most common are Learning management systems at 37.3%, Online courses at 64.4%, Laptops or Desktop computers at 44.9%, Mobile applications at 74.7%, and Virtual reality (VR) or augmented reality (AR) at 16.8 %.

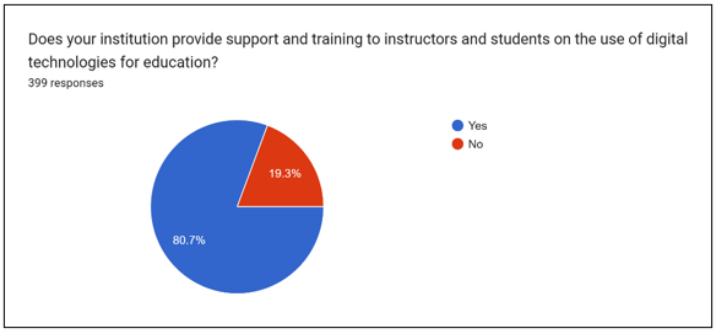

Figure 12 Institution Training & Support

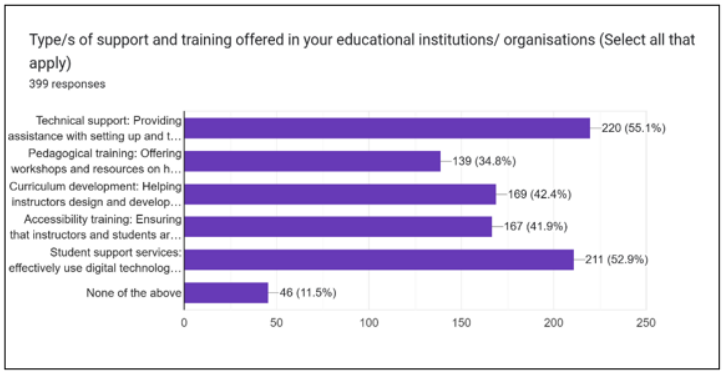

Figure 13 Institution/Organisational Support and Training Provided

FIGURE 13 This chart shows the types of support and training offered by the respondents' institutions or organizations. The most common are Accessibility training at 41.9%, Curriculum development at 42.4%, Pedagogical training at 34.8%, Technical support at 55.1%, and Student support services at 52.9%.

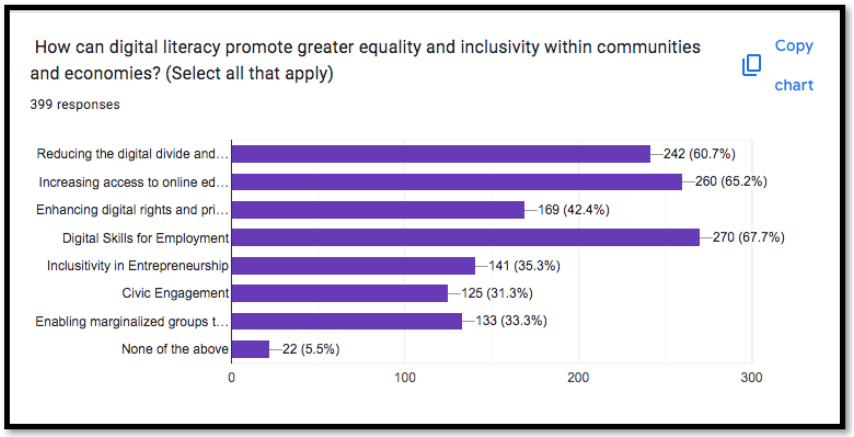

Figure 14 Contributions of Digital Literacy for Equity & Inclusion Chart

FIGURE 14 This chart represents survey responses on how digital literacy can contribute to greater equality and inclusivity within communities and economies. The dominant factor is Digital Skills for Employment (67.7%) followed by Increasing Access to Online Education (65.2%), Reducing the Digital Divide (60.7%), Enhancing Digital Rights and

Privacy (42.4%) Inclusivity in Entrepreneurship (35.3%), Civic Engagement (31.3%), Enabling Marginalized Groups (33.3%) and None of the Above (5.5%).

7. DATA ANALYSIS & INTERPRETATION

HYPOTHESIS 1 (Quantitative Analysis)

H1: There is a significant relationship between digital media tools and improved literacy rates.

HO: There is no significant relationship between digital media tools and improved literacy rates.

H1 and Ho: Use multiple/regression analysis to determine the relationship between digital media tools and literacy rates.

Independent variables	**Dependent variables**
F1 - Technology Adoption	F4 - Learning outcomes
F2 - Preferred types of digital media tools	F5 - Digital Literacy / Technological Access or Device Availability
F3 – Availability of Digital Media Tools	F6 - Digital skills & Competencies
F7 - Usage, Usefulness & Ease of Use of Digital Learning Tools	

Table 1 Hypothesis 1: Independent and Dependent Variables

7.1. (PART 1) CORRELATION

Dependent_Variable	Independent_Variable	Correlation	P_Value	Data_Points
F4.score	F1.score	0.17**	0.00	798
F4.score	F2.score	0.02	0.74	798
F4.score	F3.score	0.71**	0.00	798
F4.score	F7.score	0.05	0.31	798
F5.score	F1.score	-0.08	0.11	798
F5.score	F2.score	0.38**	0.00	798
F5.score	F3.score	-0.17**	0.00	798
F5.score	F7.score	0.33**	0.00	798
F6.score	F1.score	0.01	0.77	798
F6.score	F2.score	0.33**	0.00	798
F6.score	F3.score	0.06	0.25	798
F6.score	F7.score	0.26**	0.00	798

Table 2 Correlation, P Value, Data Points of Hypothesis 1 Variables

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

Correlation is significant at the 0.05 level (2-tailed).

Summarizes the correlations and their statistical significance. The relationship between independent variables (F1, F2, F3, and F7) and dependent variables (F4, F5, F6) was first assessed using Pearson correlation coefficients.

7.1. (A) F4 (LEARNING OUTCOMES)

- A significant positive correlation was observed between F4 (Learning outcomes) and F1 (r=0.17,p<.001) Technology Adoption and F3 (r=0.71,p<.001) Availability of Digital Media Tools, suggesting a meaningful relationship between technology adoption and learning outcomes.
- F2 (r=0.02,p=.74) and F7 (r=0.05,p=.31) showed weak and non-significant correlations and indicating minimal association.

(b) F5 (Digital Literacy/Technological Access)

- F2 (r=0.38,p<.001) Preferred Types of Digital Media Tools and F7 (r=0.33,p<.001) Usage, Usefulness & Ease of Use of Digital Learning Tools demonstrated moderate positive correlations with F5, highlighting the role of preferred digital media tools and Usage, Usefulness & Ease of Use of Digital Learning Tools.
- Conversely, F3 (r=−0.17,p<.001) Availability of Digital Media Tools, showed a significant but negative correlation suggesting that increased institutional and technological focus may inversely relate to Availability of Digital Media Tools.

(c) F6 (Digital Skills and Competencies)

- Moderate positive correlations were observed between F6 and F2 (r=0.33,p<.001) and F7 (r=0.26,p<.001). This finding emphasizes the importance of both preferred type of digital media tools and attitudes in enhancing digital competencies.
- F1 (r=0.01,p=.77r=0.01) Technology Adoption and F3 (r=0.06,p=.25)Availability of Digital Media Tools were not significantly correlated with F6.

(PART II) Multiple Linear Regression Model Summary

Table 4.5 Multiple Linear Regression Model, R Square, Adjusted R square, Std Error of Estimates

Dependent_Variable	Model	R	R_Square	Adjusted_R_Square	Std_Error_of_Estimate
F4.score	Model 1	0.71	0.51	0.50	1.01
F5.score	Model 2	0.49	0.24	0.23	2.19
F6.score	Model 3	0.38	0.14	0.13	1.32

Table 3 Multiple Linear Regression Model, R Square, Adjusted R square, Std Error of Estimates

Summarizes the model statistics, including R, R2, adjusted R2, and the standard error of the estimate (SEE).

To further explore the relationships between digital media tools (independent variables) and literacy rates (dependent variables), multiple linear regression analyses were conducted for each dependent variable.

(a) Model 1 - F4 (Learning Outcomes)

- The regression model for F4 yielded a strong positive correlation (R=0.71), with the independent variables explaining 51% of the variance in the dependent variable (R2=0.51, adjusted R2=0.50).
- This suggests that digital media tools, particularly e.g., F3 preferred type of digital media tools, substantially contribute to learning outcomes and related impacts.
- The standard error of the estimate (SEE=1.01) indicates reasonable predictive accuracy.

(b) Model 2 - F5 (Digital Literacy/Technological Access)

- The model for F5 showed a moderate correlation (R=0.49), with the independent variables explaining 24% of the variance (R2=0.24, adjusted R2=0.23).
- This finding highlights the importance of preferred digital tools (F2) and usability factors (F7) in shaping digital literacy. However, other unexplored variables may account for the remaining variance.
- The standard error of the estimate was higher (SEE=2.19), suggesting some limitations in predictive precision.

(c) Model 3 - F6 (Digital Skills and Competencies/Access to Education)

- For F6, the regression model exhibited a weaker correlation (R=0.38) and explained 14% of the variance (R2=0.14, adjusted R2=0.13).
- While F2 preferred digital tools and F7 Usage, Usefulness & Ease of Use of Digital Learning Tools emerged as significant predictors, the relatively low R2 indicates that additional factors beyond the scope of this study may influence digital skills and access to education.
- The standard error of the estimate (SEE=1.32) was moderate.

The regression models indicate that the strength and significance of the relationships between digital media tools and literacy-related outcomes vary depending on the dependent variable. The model for F4 (learning outcomes) was the most robust, demonstrating the substantial impact of factors such as Availability of Digital Media Tools (F3). In contrast, the models for F5, F6 were comparatively weaker, suggesting the need to incorporate additional predictors in future studies to capture the multidimensional nature of these constructs.

(PART III) Regression Coefficients for Each Dependent Variable

Table 4.6 Regression Coefficients for Each Dependent Variable: Intercept, B, Standard Error, Beta , T test, Level Of Significance

Dependent_Variable	Model	B	Std_Error	Beta	t	Sig
Model 1: F4.score	**(Intercept)**	**0.96**	**0.35**	**0.54**	**2.71**	**0.007**
F4.score	F1.score	0.13	0.06	0.13	2.09	0.038
F4.score	F2.score	0.05	0.04	0.05	1.20	0.230
F4.score	F3.score	0.72	0.04	0.84	19.59	0.000
F4.score	F7.score	0.01	0.03	0.01	0.31	0.756
Model 2: F5.score	**(Intercept)**	**4.65**	**0.77**	**1.49**	**6.04**	**0.000**
F5.score	F1.score	-0.40	0.14	-0.21	-2.87	0.004
F5.score	F2.score	0.59	0.09	0.33	6.74	0.000
F5.score	F3.score	-0.26	0.08	-0.18	-3.30	0.001
F5.score	F7.score	0.38	0.07	0.12	5.45	0.000
Model 3: F6.score	**(Intercept)**	**1.37**	**0.46**	**0.77**	**2.95**	**0.003**

F6.score	F1.score	-0.09	0.08	-0.08	-1.06	0.288
F6.score	F2.score	0.31	0.05	0.30	5.80	0.000
F6.score	F3.score	0.08	0.05	0.09	1.62	0.107
F6.score	F7.score	0.15	0.04	0.08	3.50	0.001

Table 4. Regression Coefficients for Each Dependent Variable: Intercept, B, Standard Error, Beta , T test, Level Of Significance

The regression coefficients for each dependent variable (F4, F5, F6) were analyzed to determine the significance and strength of the relationships with the independent variables (F1, F2, F3, and F7).

(a) Model 1: Predicting F4 (Learning Outcome)

- **Intercept:** The constant term (B=0.96,p=.007) indicates the predicted baseline value of F4 when all independent variables are zero.
- **F1 (Technology Adoption):** A small but significant positive effect (B=0.13,β=0.13,t=2.09,p=.038) suggests that higher technology adoption is associated with improved learning outcomes.
- **F2 (Preferred Types of Digital Media Tools):** The effect (B=0.05, β=0.05,t=1.20,p=.230) was not significant.
- **F3 (Availabilty of Digital Media Tools):** A strong and highly significant positive effect (B=0.72,β=0.84,t=19.59,p<.001) highlights its pivotal role in determining F4.
- **F7 (Usage, Usefulness & Ease of Use of Digital Learning Tools):** No significant effect (B=0.01,β=0.01,t=0.31,p=.756) was observed.

(b) Model 2: Predicting F5 (Digital Literacy/Technological Access)

- **Intercept:** The constant term (B=4.65,p<.001) represents the baseline digital literacy level.
- **F1:** A significant negative relationship (B=−0.40,β=−0.21,t=−2.87,p=.004) suggests that increased technology adoption may inversely affect perceptions of digital literacy.
- **F2:** A significant positive effect (B=0.59,β=0.33,t=6.74,p<.001) indicates that preferred types of digital media tools contribute to digital literacy.
- **F3:** A small but significant negative effect (B=−0.26,β=−0.18,t=−3.30,p=.001).
- **F7:** A positive and significant effect (B=0.38,β=0.12,t=5.45,p<.001) shows that Usage, Usefulness & Ease of Use of Digital Learning Tools positively influence digital literacy.

(c) Model 3: Predicting F6 (Digital Skills and Competencies)

- **Intercept:** The baseline value (B=1.37,p=.003) is significant.
- **F1:** No significant relationship (B=−0.09 ,β=-0.08,t=-1.06,p=.288) was found between technology adoption and F6.
- **F2:** A significant positive effect (B=0.31,β=0.30,t=5.80,p<.001) highlights the role of preferred digital tools in enhancing digital skills.
- **F3:** The effect (B=0.08,β=0.09,t=1.62,p=.107) was not significant.
- **F7:** A small but significant positive effect (B=0.15,β=0.08,t=3.50,p=.001) indicates the relevance of Usage, Usefulness & Ease of Use of Digital Learning Tools and digital Skills and Competencies.

8. FINDINGS

The analysis of the relationship between digital media tools and literacy rates revealed that various factors associated with technology adoption preferred digital media tools and learning outcomes significantly affected learning outcomes. Notably, F3 (Availability Of Digital Media Tools) demonstrated a robust positive correlation with F4 (Learning

outcomes), suggesting that enhanced learning outcomes play a critical role in improving literacy through digital tools. Other factors, such as F1 (Technology Adoption) and F2 (Preferred Types of Digital Media Tools), also exhibited significant relationships with literacy, although their effects were less pronounced. This reinforces the importance of supporting technology adoption and providing appropriate digital tools for improving literacy in educational settings.

9. CONCLUSION

Digital media tools have become integral to higher education, fostering learning outcomes, digital literacy, employability skills, and sustainability aligned with global objectives such as SDG4. This analysis synthesizes findings from regression and correlation models that explore relationships between various dependent variables (learning outcomes, digital literacy, digital skills, and sustainability initiatives) and independent predictors (technology adoption, preferred digital tools, tool availability, and usability). These results offer nuanced insights into how digital media tools influence higher education outcomes, underscoring their complex interplay with student learning and institutional objectives.

10. RECOMMENDATIONS

- Prioritize technology adoption and align digital tools with learners' needs to boost literacy.
- Invest in high-quality digital media tools, as their availability strongly improves learning outcomes.
- Support adoption and ensure accessible, user-friendly tools to maximize educational impact.
- Focus on tools that enhance engagement and comprehension to drive literacy gains.
- Promote equitable access to digital tools, especially for underserved communities, to bridge literacy gaps.

CONFLICT OF INTERESTS

None.

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