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IMPACT OF TECHNOLOGY INTEGRATION ON STUDENTS' DIGITAL LITERACY SKILLS AT THE ELEMENTARY SCHOOL LEVEL: A QUANTITATIVE STUDY

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Abstract

This study investigated the impact of technology integration on elementary school students' digital literacy skills within the public school context of Gujrat District. Grounded in Constructivist Learning Theory, the study evaluated the operational status of technology deployment and its relationship with students' digital competencies. A quantitative descriptive survey design was adopted. The sample comprised N = 200 elementary level students drawn from Government Girls High School (GGHSS) Channi Deona utilizing convenience sampling. Data collection was executed via a structured 20-item instrument scored on a 5-point Likert scale. Content validity was established through an expert panel consisting of five (n = 5) subject specialists, yielding a Content Validity Index (CVI) of 0.87. Instrument reliability was pre-tested through a pilot study executed on n = 20 students, demonstrating strong internal consistency with a global Cronbach's Alpha of \alpha = 0.83 (Technology Integration \alpha = 0.82; Digital Literacy Skills \alpha = 0.84). Data were analyzed through descriptive statistics (Mean and Standard Deviation) via SPSS version 26.0. The descriptive findings revealed high moderate baseline levels of classroom technology integration (M = 3.85, SD = 0.62) and students' digital literacy skills (M = 3.78, SD = 0.65). The study concludes that structured, student-focused technology integration supports the development of critical digital competencies at the baseline tiers of schooling. The research recommends strategic institutional investments in digital infrastructure and standardized pedagogical training for faculty members.

Keywords: *Content Validity Index (CVI), Digital Literacy Skills, Reliability, Technology Integration.*

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1. Introduction

1.1. Background of the Study

The present world educational paradigm is experiencing a significant socio-technological revolution, with the shift in the former analog form of instruction to the digitized education ecosystem. The traditional notion of literacy in this digital era no longer relates to simple textual literacy and reading and writing, but to multifaceted digital literacies.

The implementation of technology in educational institutions is a necessary systemic requirement needed to put the basic schooling in line with the post-21 st century realities.Technology integration is the incorporation of digital tools and hardware in everyday classroom dynamics, systematically and purposefully, in instructional delivery.

This includes personal computers, interactive smart boards, tablets, multimedia projections, educational applications and online repositories. The essence of this technological program is to re-engineer the learning environment in such a way that it encourages student centered active learning.

In the center of this learning model is **Digital Literacy. Digital literacy refers to the complex capability to access, control, analyze, synthesize, exchange, assess and produce information using digital technologies safely.

The learning of digital literacy is utmost at the elementary level of schooling which is a sensitive stage in the development of humans with regard to their cognitive socialization.

There is a shift towards a more organized demand by elementary students in digital frontiers in the form of cognitive command. When the exposure to technology is structured and of sound pedagogical practices is administered in these formative years, it equips these students with those necessary toolsets in terms of critical cognition to handle the information-saturation of contemporary society.

In the state-funded system of educational establishments of Punjab, Pakistan, the shift to digital learning is very intricate. Although the policy documents emphasize the need to digitize the youth, the implementation of the idea in the classrooms usually creates gaps because of the structural and pedagogical variables.

Thus, the topic of classroom technology integration and how it is connected to the digital literacy of students is a significant scholarly need. This paper puts this research into context within the elementary school-level as the study directly involves the student to offer empirical evidence in order to inform current curriculum and infrastructural changes.

The statement of the problem is presented below;

Although policy guidelines are becoming increasingly focused on the use of digitized classrooms, operationalization on a technological integration in elementary education systems is still not consistent.

Technology use in most Pakistani state-run schools is usually confined to administrative offices, or is only done occasionally in multimedia presentations by the teachers themselves. This disorganized integration is an empirical blank when it comes to student-based outcomes.

However, whereas much is written about how technology can be used by teachers to deliver lesson, there is a lack of localised studies that put the student as the active agent in digital literacy acquisition.

The pressing point here is that in the absence of orderly, student-centered technology integration, schoolchildren in public schools are doomed to remain passive receivers of media as opposed to the digitally literate citizens and of critical thinking and problem-solving abilities.

Unless schools purposefully consider technology as part of the active learning process of the students, the digital divide between the different schooling sectors will only widened.

This leads to a pedagogical need to scientifically explore and measure the connection between the integration of technologies in the classroom and the digital literacy of students. This paper seeks to fill this gap on this particular institutional level of District Gujrat.

1.2. Research Objectives

The primary focus of this empirical investigation is guided by the following research objectives:

1. To measure the current level of technology integration within elementary classrooms at GGHSS Channi Deona.
2. To assess the status of digital literacy skills possessed by elementary school students within the target institution.

1.3. Research Questions

In a bid to fulfill the objectives above, this project will answer the following research questions:

1. What is the descriptive level of technology integration in elementary classrooms as perceived by the students?
2. What are the specific levels of digital literacy skills demonstrated by elementary school students?

1.4. Significance of the Study

The research has practical implications to different parties involved in the educational ecosystem:

To School Administrators: It provides localized, data-driven understanding of the existing situation of digital resource use and allows them to plan the infrastructure better.

To Classroom Practitioners: It demonstrates the connection between the use of interactive technology and skill development in students, and points to the need to shift to a student-oriented digital interaction.

To Curriculum Designers: It empirically supports the importance of incorporating structured digital literacy outcomes into elementary structures of the public school curriculum.

2. Literature Review

2.1. Construct the Technology Integration

Traditionally, technology in the classroom was perceived to be just an instructional addition, a support system to facilitate the process of lectures delivery (Ertmer, 2005). Nevertheless, recent studies in the field of educational technology underline that an actual incorporation of technology takes place once online technologies reinforce the overall learning objectives and actively involve students into the educational experience (Koehler and Mishra, 2009).

Selwyn (2016) supports this assertion by stating that technology integration cannot be the number of computers or smart boards located in a school building. Rather, it is to be assessed by frequency, depth and intent of active usages by the students. Significant technology adoption will be achieved by ensuring that students frequently use online resources to explore, analyze, and produce. This involves engagement in multimedia presentations, using educational software, online learning platforms, and digital communication channels in collaborative projects in an elementary school setting (Ifenthaler & Schweinbenz, 2016).

2.2. Conceptualizing Digital Literacy Skills

The meaning of literacy has significantly changed since the end of the 20th century. Digital literacy was originally defined by Gilster (1997) as the literacy index of recognizing and utilizing information contained in any number of digital sources. The complexities of the contemporary web ecosystem have since been extended via this initial definition by international bodies to provide the standard definition. Digital literacy conceptualized by the UNESCO Institute of Statistics (2019) is a multifaceted matrix of competencies divided into separate areas:

1. Technical (first-level device navigation and interface fluency).
2. Information processing (Search, filter and critical assessment of the data credibility).
3. Digital creation (creation of content with the help of digital media).
4. Safety and communication (knowledge of digital ethics, privacy, and social networking).

At the elementary level, these skills are crucial to develop. Hague and Payton (2010) are of the opinion that, digital literacy enables young learners to by equipping them

with critical thinking skills to enable them to get equal opportunities to interpret, as opposed to passively consuming the online media. It changes the role of the student to a consumer of entertainment technologies to an active producer of academic knowledge.

2.3. Theoretical Framework

This paper is scientifically informed by **Constructivist Learning Theory, especially its subdivisions advanced by Jean Piaget and Lev Vygotsky, and extended into the cyber space through the constructionism theory by Seymour Papert. Constructivism teaches that students do not simply receive what is taught to them by their teacher, but rather actively, they develop internalized mental structures of the world by engaging in essential and purposeful communication with the environment.

The constructivist framework speculates that in the case of educational technology, digital devices are psychological and cognitive tools that increase the ability of a student to develop knowledge. Whenever a student uses educational software, writes a digital presentation or does an online search, one is in the process of controlling the cognitive process.

The information of technology integration is the external environment that provokes and forms inner cognitive systems in the student. Making the interaction with students the focus of learning rather than the passive audience, this framework directly informs the model: the routine technology incorporation within the classroom is the practical setting in which students develop, experiment, and develop digital literacy skills.

3. Research Methodology

3.1. Research Design

In this study, the research design was a quantitative descriptive survey research. Quantitative designs are efficient to isolate certain variables and measure their distribution in case of the established conditions.

Using a unified survey tool, the scholar transformed subjective experiences (which were abstract) to the exact numerical data, which made it possible to use the descriptive statistics.

3.2. Population and Sample

These students (Elementary school 6 th to 8 th grade) enrolled in the public sector school system of District Gujrat, Punjab, Pakistan were the target population of the study. A sample of 200 elementary students was considered to represent the population but subject to the practicability of the logistics a sample of 200 students distributed among a central institution: Government Girls High School (GGHSS) Channi Deona.

The sampling was carried out using a convenience sampling method, which was chosen because of its institutional accessibility, cooperation of the administration, and existence of functional digital infrastructure within the cluster of schools.

3.3. Research Instrument

The main data collection method was a closed-ended and structured questionnaire that clearly targeted the students and was specifically designed to be used in this study.

The instrument was subdivided into two fundamental functioning parts, and had a total of 20 statements in a straightforward, simplified academic language to understand at the elementary level:

Subscale A: Technology Integration (Items 1110): Considered the perception students had on the availability, frequency and how digital tools were being used in their daily classroom setting.

Subscale B: Digital Literacy Skills (Items 1120):- Measured the self-reporting ability of students in core digital skills, such as online search skills, using an app, and device confidence.

The data on the answers were recorded via the standardized 5-point Likert Scale, which is ranked in the following order: 1 = \text{Strongly Disagree}, 2 = \text{Disagree}, 3 = \text{Neutral} 4 = + 5 = Strongly Agree.

3.4. Expert validation Framework (CVI)

In order to develop Content and Face Validity, the original instrument was valuated by a panel of five (n = 5) experts who were subject specialists. Each item was assessed based on their linguistic clarity, relevation, and coverage of the constructs by this panel. The Content Validity Index (CVI) was used to carry out the analysis of the quantitative responses of the experts. According to the feedback of the experts, redundant items were changed. The overall 20-item tool had a total of a **CVI of 0.87 that is greater than the psychometric acceptable limit of 0.80 thus confirming its structural soundness.

Expert Opinion

Dear Expert,

The record of the 20 items evaluated to make the research instrument is below. Each item was rated with a 3-point alignment scale (3 = \text{Essential}, 2 = \text{Useful but Not Essential}, 1 = \text{Not Necessary) by the panel of 5 subject specialists at the same time with regard to the item's Relevance, Clarity, and Construct Coverage.

All 5 experts have given their answers, which have been summarised as shown below. A global Content Validity Index (CVI) has been mathematically solved and filled in, as well as the Content Validity Ratio (CVR) of each item.

Panel Response and CVR Calculation Matrix

Total Experts (N) = 5

*Minimum Experts agreeing on "Essential" (n_e) required for statistical significance

(p < .05)** = 4

Formula used for Content Validity Ratio:*

Item No	Statement profile	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Total Essential (n e)	Calculated CVR	Status/ Decision
1	Teachers use computers in classroom teaching.	Essential	Essential	Essential	Essential	Useful	4	**0.60**	**Accepted**
2	Multimedia is used during lessons.	Essential	Essential	Essential	Essential	Essential	5	**1.00**	**Accepted**
3	Smart boards are available in our classroom.	Essential	Essential	Useful	Essential	Essential	4	**0.60**	**Accepted**
4	Internet is used for learning activities.	Essential	Essential	Essential	Essential	Useful	4	**0.60**	**Accepted**
5	Teachers encourage the use of digital tools.	Essential	Essential	Essential	Essential	Essential	5	**1.00**	**Accepted**
6	Technology makes learning easier for me.	Essential	Essential	Essential	Essential	Essential	5	**1.00**	**Accepted**
7	Students participate in technology-based activities.	Essential	Useful	Essential	Essential	Essential	4	**0.60**	**Accepted**
8	Educational videos are used for teaching concepts.	Essential	Essential	Essential	Essential	Essential	5	**1.00**	**Accepted**

9	Digital resources are easily accessible in school.	Useful	Essential	Essential	Essential	Essential	4	**0.60**	**Accepted**
10	Technology is regularly used in daily lessons.	Essential	Essential	Essential	Essential	Essential	5	**1.00**	**Accepted**
11	I can use a computer for learning tasks independently.	Essential	Essential	Essential	Essential	Useful	4	**0.60**	**Accepted**
12	I can search for information on the internet.	Essential	Essential	Essential	Essential	Essential	5	**1.00**	**Accepted**
13	I can easily navigate educational applications.	Essential	Essential	Useful	Essential	Essential	4	**0.60**	**Accepted**
14	I can evaluate if online information is useful.	Essential	Essential	Essential	Essential	Essential	5	**1.00**	**Accepted**
15	I can use digital tools to complete my assignments.	Essential	Essential	Essential	Essential	Essential	5	**1.00**	**Accepted**
**16	I understand basic computer terms and functions.	Useful	Essential	Essential	Essential	Essential	4	**0.60**	**Accepted**

17	I can communicate with others using digital tools.	Essential	Essential	Essential	Essential	Essential	5	**1.00**	**Accepted**
18	I can troubleshoot simple problems using technology.	Essential	Essential	Essential	Essential	Useful	4	**0.60**	**Accepted**
19	I feel confident operating digital devices.	Essential	Essential	Essential	Essential	Essential	5	**1.00**	**Accepted**
20	I can successfully complete online educational tasks.	Essential	Useful	Essential	Essential	Essential	4	**0.60**	**Accepted**

Global Content Validity Index (S-CVI) Derivation

Final Validation Summary Judgment

The professional panel assessment determines that the scale is in line with normal psychometric standards. As a Scale-Level Content Validity Index (**S-CVI = 0.87) is greater than the minimum index (0.80), each of the 20 items is confirmed as structurally sound and confirmed to be fielded.

Testing andWorking 3.5 Pilot Testing and Reliability Analysis:

Before the actual field use of the validated instrument itself, a pilot study was conducted with the help of a small sample of twenty (n = 20) elementary students (chosen among the target population). The final population to include (N = 200) did not include these pilot participants since this would have contaminated the data.

The pilot study data were analyzed through SPSS version 26.0 with the help of the **Cronbach Alpha (\alpha) coefficients to identify internal consistency:

Since all the alpha coefficients were more than the generally acceptable educational cut-off point of 0.70, the instrument had been found to be very reliable in collecting field data.

3.6 Data Collection Procedure

The researcher also collected data on-site, which guaranteed the integrity of data. Clearance was obtained at the school at GGHSS Channi Deona.

A questionnaire survey was done in a classroom during specific free time. The participants were guaranteed of anonymity and confidentiality.

Out of the 200 questionnaires issued, none were left unanswered by respondents hence the response rate of 200 out of the 200 questionnaires passed to respondents was 100 percent.

4. Results and Discussion

4.1 Descriptive Characteristics of the Variables

In order to assess the initial distribution of research constructs, means of subscale scores and the standard deviation of both subscales were computed.

Table 1: Composite Descriptive Statistics (N = 200)

Variable	No of Items	Mean(M)	Standard Deviation (SD)	Interpretation
Technology integration	101	3.85	0.62	High moderate level
Digital literacy skills	10	3.78	0.65	High moderate level

The descriptive statistics in **Table 1** indicate that elementary students perceive a relatively high level of technology integration within GGHSS Channi Deona (M = 3.85, SD = 0.62). Similarly, the composite mean for self-reported Digital Literacy Skills (M = 3.78, SD = 0.65) reflects a confident level of digital competency among the sampled students.

4.2. Item-Level Descriptive Analysis

To examine specific patterns within the subscales, item-level responses for all twenty statements were analyzed using mean scores and percentage distributions.

Table 2: Item-Wise Descriptive Statistics for Technology Integration Subscale

Item No.	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
1	Teachers use computers in classroom teaching.	2.0	8.0	15.0	50.0	25.0	3.88
2	Multimedia is used during lessons.	3.5	10.5	12.0	48.0	26.0	3.82
3	Smart boards are available in our classroom.	5.0	12.0	18.0	42.0	23.0	3.66
4	Internet is used for learning activities.	4.0	11.0	20.0	45.0	20.0	3.66
5	Teachers encourage the use of digital tools.	1.5	5.5	10.0	52.0	31.0	4.05
6	Technology makes learning easier for me.	1.0	4.0	9.0	49.0	37.0	4.17

7	Students participate in technology-based activities.	3.0	9.0	16.0	51.0	21.0	3.78
8	Educational videos are used for teaching concepts.	2.5	7.5	13.0	47.0	30.0	3.94
9	Digital resources are easily accessible in school.	4.5	13.5	17.0	44.0	21.0	3.64
10	Technology is regularly used in daily lessons.	3.0	10.0	14.0	53.0	20.0	3.77

Table 2 shows that Item 6 ("Technology makes learning easier for me") secured the highest individual mean score (M = 4.17), indicating a strong positive attitude toward technology among students. Item 5 also reflects a high score (M = 4.05), showing strong perceived teacher encouragement. Conversely, items related to infrastructure accessibility, such as Item 3 (M = 3.66) and Item 9 (M = 3.64), received lower scores, highlighting potential physical resource constraints within the public school environment.

Table 3: Item-Wise Descriptive Statistics for Digital Literacy Skills Subscale

Item No.	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
11	I can use a computer for learning tasks independently.	2.5	9.5	14.0	52.0	22.0	3.81
12	I can search for information on the internet.	1.5	6.5	11.0	55.0	26.0	3.97
13	I can easily navigate educational applications.	3.0	11.0	16.5	46.0	23.5	3.76
14	I can evaluate if online information is useful.	5.5	14.5	22.0	40.0	18.0	3.50
15	I can use digital tools to complete my assignments.	4.0	12.0	15.0	48.0	21.0	3.70
16	I understand basic computer terms and functions.	2.0	8.0	13.0	54.0	23.0	3.88
17	I can communicate with others using digital tools.	3.5	10.5	19.0	45.0	22.0	3.71
18	I can troubleshoot simple problems using technology.	6.0	16.0	24.0	38.0	16.0	3.42
19	I feel confident operating digital devices.	1.0	5.0	10.0	50.0	34.0	4.11
20	I can successfully complete online educational tasks.	2.5	8.5	15.0	51.0	23.0	3.83

Table 3 displays the operational breakout of digital literacies. Students expressed high confidence in basic device usage, as seen in Item 19 (M = 4.11, "I feel confident operating digital devices") and Item 12 (M = 3.97, web search capacity). However, advanced cognitive dimensions of digital literacy scored lower, specifically Item

14 (M = 3.50, critical evaluation of information) and Item 18 (M = 3.42, technical troubleshooting capacity).

4.3 Discussion

The averages of both (M = 3.85 of Technology Integration; M = 3.78 of Digital Literacy) indicate that the school in question, GGHSS Channi Deona, has a foundation to work with in regards to the creation of an instructional technology base. This pattern is congruent with the latest findings published by the UNESCO (2023), which show that the level of basic technological infrastructure in the systems of public schools has been steadily increasing.

Descriptive information given at an item level indicates that there is a significant trend in the interaction levels among the students towards technology. Some items such as direct access to infrastructure and frequent use of the system registered lower scores by students, although they reported high scores in psychological comfort and teacher encouragement.

This is in line with other studies that have offered similar arguments, that sometimes the psychological preparedness of young learners to use technology may be very high, but due to the lack of physical availability of the equipment in the state institutions, it is a type of bottleneck (Ifenthaler and Schweinbenz, 2016).

The results indicate a critical dimension to be enhanced within the digital literacy dimensions. Although those elementary students were rated high in basic operational tasks, including navigation in a device (M = 4.11) and web search (M = 3.97), the students showed low results in cognitive literacy tasks, like recognizing the credibility of the online information (M = 3.50) and basic troubleshooting (M = 3.42).

This disjuncture has been observed by other researchers such as Hague and Payton which reported that young learners tend to pick up superficial functional skills quite readily but need explicit and structured instructions to cultivate deeper, critical, digital literacies (2010). So, it is time to go beyond content showing and more to enrich students with the active problem solving and information curiosity of the technology.

5. Conclusion and Recommendations

5.1. Conclusion

In this research, the level of technology integration and its connection with digital literacy skills of elementary school learners at GGHSS Channi Deona baseline were evaluated. The results justify the conclusion that the integration of technology in classrooms is an effective tool in aiding development of the students in digital skills. The high baseline scores demonstrate that the existing technology efforts are effective in helping the students to get motivated and become familiar with the technical aspects.

There is also evidence in the study to indicate that although students demonstrate high confidence and basic technical operational competence, their high level cognitive

skills and knowledge such as informational evaluation and technical troubleshooting are not yet well established.

This trend demonstrates that the current technology application in the public sector schools is useful to orientation, although more development of pedagogical aspects is needed to sustain more complex digital skills. Overall, the following educational principles should be in place to meet the educational objective of having a digitally literate youth: (1) to have functional technological infrastructure (2) to have a student-focused approach of constructivist theory/methodology so that learners can get a chance at exploring, analysing, creating using digital tools.

5.2. Recommendations

Based on the empirical evidence, the following recommendations are suggested:

1. Infrastructural Optimization. School administrations are to increase the amount of direct student connection with digital equipment, promote the active availability of interactive smart boards or the basic laboratory equipment.

2. Faculty Pedagogical Training: Special professional development programs are needed to be developed concerning classroom educators, with the emphasis shifted to the passive presentation delivery to active student-centered models of digital teaching.

3. Integration of Higher Literacies into the Curriculum: Elementary curriculum developers must deliberately consider adding critical thinking, information assessment and digital safety practices to the elementary school curriculum framework.

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