ARE THE PAKISTANI HIGHER EDUCATION INSTITUTIONS PREPARED FOR THE DIGITAL LITERACIES CHALLENGE? EXPLORING THE LANDSCAPE

By

ZAHRA MUGHIS

Research Thesis submitted to The Lahore School of Economics in partial fulfilment of the requirement for the degree of M. Phil. Development Studies 2020-2023)

Research Supervisor: Dr. Fareeha Zafar

Abstract

The definition and criteria for productive and meaningful economic and social participation is changing as a transformative impact of digital proliferation. This mandates development of multiple transversal literacies or capabilities which extend beyond function know-how of digital technologies. Global evidence suggests that higher education institutions' (HEIs) approach to digital literacies education is based on conjectures on the young adults' natural digital abilities. However, the subject hasn't been studied in the context of Pakistan. On this premise, this mixed methods research explored the relevant perceptions, and development of students' digital literacies – levels and determinant factors – in the case of two (HEIs), one public and one private, in Lahore. Faculty and student representatives across four selected disciplines (Business Administration, Economics, Computer Science, and Physics) were engaged in two sequential phases on enquiry. Qualitative data, collected through qualitative interviews with 16 stakeholders, was analysed using thematic analysis. Analysis highlighted the absence of a holistic DLs education framework, technical and tools-specific focus of the curriculum, inconsistencies in integration of digital concepts across disciplines, and underlying assumptions on students' natural abilities. Quantitative analysis of data from 200 students, collected through questionnaire surveys, illustrated the impact of curricular focus and contextual impact of personal attributes on acquisition of DLs across different domains. Analysis showed that, on average, undergraduate students had moderate levels of digital literacies. Results of Structural Equation Modelling estimated corroborated the hypothesized positive impact of Digital Nativity and Gender. This research highlighted the inadequacy of physical access in holistic development of students' digital literacies and emphasised the need for rethinking curriculum and learning environments for the same.

***Keywords*:** digital literacies, digital literacy, higher education, perceptions

Acknowledgements

I would like to take this opportunity to extend my profound gratitude to my thesis supervisor, Dr. Fareeha Zafar for her guidance and constant support throughout this research. I sincerely acknowledge her mentorship that not only allowed me to explore this topic and apply my research skills, but consistently allowed it to be my own endeavour.

Beside my supervisor, I am thankful to Dr. Ahmad Nawaz, Research Director, Graduate Institute of Development Studies (GIDS), for his continued support and invaluable input in this research study.

I am grateful to Dr. Rashid Amjad, Director GIDS, for encouraging research on a novel topic. Also, for generously funding this study, I would like to thank Dr. Naved Hamid and the Lahore School of Economics review committee.

Last but not the least, I am sincerely grateful to my family and friends for their unwavering support, patience, and encouragement. This research journey would not have been possible without them.

All errors remain mine.

Table of Contents

List Of Abbreviations

Abbreviation	Definition
BA	Business Administration
CFA	Confirmatory Factor Analysis
CS	Computer Science
CN	(Communication for) Networking
COL	Collaboration
DCC	Digital Communication and Collaboration
DIL	Digital Information Literacy
DLs	Digital Literacies
DN	Digital Nativity
DPS	Digital Problem Solving
ECON	Economics
HE	Higher Education
HEI(s)	Higher Education Institution(s)
ICT	Information and Communication Technologies
IE	Information Evaluation
IT	Information Technology
IS	Information Search
LGO	Learning Goal Orientation
PEU	Perceived Ease of Use
MA	Material Access
PHY	Physics
SDG	Sustainable Development Goal
SEM	Structural Equation Modelling
SS	Social Support
UG	Undergraduate
UNESCO	United Nations Educational, Scientific, and Cultural Organization

Glossary

Term	Definition
Digital Citizenship	Digital Citizenship denotes effective, positive, and responsible engagement with digital technologies and media for economic and social participation in the digital sphere. It encompasses ethics, cultural awareness, ethics, participation and critical resistance, and media literacies.
Digital Communication	Digital Communication refers to the abilities to communicate effectively, meaningfully, and engaging using digital devices and media of different types and for different purposes.
Digital Competences	Digital Competences encompass the skills to use digital tools and media in particular contexts and for achievement of specific outcomes.
Digital Ethics	Digital Ethics represents the context domain of ethical awareness in the digital environment. They denote the concepts of responsible use of digital technologies and media in the legal, social, cultural, environmental, and economic contexts.
Digital Goods	Digital Goods are the intangible commodities and products that exist digital. These goods are an outcome of the digital production process. Examples of digital goods include software, online encyclopaedias, e-books, document templates.
Digital Information Literacy	Digital Information Literacy entails the skills required for searching relevant and accurate information using digital tools, evaluation for authenticity, reliability, and relatability or logical combination of digital data and information and managing or organizing the found data.
Digital Literacies	Digital Literacies are a set of technical and non-technical abilities required for efficient navigation of digital space. These capabilities include, but are not limited to, meaningful engagement with information, communication

	for ideation, collaboration, networking, problem-solving, ethical and responsible use of digital technologies, and media.
Digital Natives	Individuals born after 1984 (in the context of advanced countries and 1994 in other countries) who gain access to digital technologies at a very early age. Resultantly, they have an innate ability to efficiently engage with digital technologies.
Digital Problem Solving	Digital Problem Solving abilities are a set of mindsets and skills required to rely on digital technologies and media to find solutions for the problems at hand.
Digital Skills	Digital Skills refers to the functional knowledge and ability to use digital tools and media.
Digital Storytelling	Digital Storytelling refers to the use of digital tools, media forms, including but not limited to text, audio, and video, and skills to create and tell meaningful stories aimed at showcasing a narrative or even explaining a concept, event, or related phenomena.
IT Literacy	IT Literacy or Information Technology Literacy is defined in terms of the functional knowledge of information technology, computers and other types of devices, hardware, and software.

List of Tables

List of Figures

1. Introduction

1.1 The Significance of Digital Literacies

It is the digital age that we live in. Our world is proliferated with digital technologies and orientation to them has come to define the common understanding of what defines the twenty-first century society. One of the most consequential realities of this time the need to rethink what are foundational literacies and competences for the youth to thrive in the increasingly digital world. This challenge has stemmed from the increased interaction between the human and what is essentially the computer due to rapidly increasing economic and social digitalization. It has transformed the way humans produce and consume information and navigate through their work and social spaces (Dondi et al., 2021).

To be digitally literate means to be literate in the practices of digital technologies and media usage. It means to have the capabilities essential for effective engagement with these devices and media for information access, communication, and participation in all matters of economy and society (Ng, 2012; Spante et al., 2018; WEF, 2023). To be digitally literate has been recognized as an imperative for the 21st century, particularly in the wake of the coronavirus pandemic and the recent artificial intelligence wave (WEF, 2023). It is projected that over 70% of value to global economy will be added through digitalization over the next decade (WEF, 2023). To be literate in what is digital has been identified as one of the fifty-six core elements of talent that individuals must possess for the future by McKinsey & Company (Dondi et al., 2021). Thus, literacies of the digital are now considered a foundational life skill in equivalence with reading, writing, and numeracy (Bandura & Leal, 2022).

Developing relevant capabilities of the future workforce and citizenry in the face of rapid digitalization is prerequisite for ensuring equitable and sustainable economic, social, and human development in the twenty-first century (Sa & Serpa, 2020). However, following the question of access to digital technologies is the conundrum of literacies and competences. Just as foundational literacies and learning gaps exist, and as access to digital devices is yet to be a universal characteristic of the 21st century world, there is exists gaps in individual's digital literacies and capabilities. recognizing which "digital literacy" has been included as a target under the education and human capital development related SDG 4 (UNESCO, 2018). While indicator 4.4.1 is related to "proportion of youth with ICT skills, by type of skills," indicator 4.4.2 as foundational literacies in a rapidly digitalizing world categorically refers to digital literacies as it refers to the" percentage of youth/adults who have achieved at least a minimum level of proficiency in digital literacy skills" (UNESCO, 2018).The onus of producing digitally literate graduates falls on the education system, particularly the higher education system as it is at the forefront of societal, economic, and human development (Corrin et al., 2018).

1.1.1 Definition of the Concept

Since Gilster's (1997) seminal work twenty-five years ago, the conceptualization of what it means to be digitally literate has evolved (see Section 2.1 for a detailed overview). The newer models and definitions of the concept of digital literacy are multidimensional, encompassing a range of capabilities pertinent to information engagement, communication, problem-solving, critical thinking, content creation, ethics, citizenship, etc. Given so, a set of other terms have been used to describe what capabilities of a digitally literate individual could encompass (Eshet-Alkalai, 2004; Miranda et al., 2018; Ng, 2012; Spante et al., 2018). Thus, to address ambiguities with respect to the concept's scope and to retain its integrative nature, this research referred to the term

"Digital Literacies" which encapsulates all domains of technical and non-technical capabilities as wells as attitudes and mental models (Belshaw, 2017; Lankshear & Knobel, 2007). Accordingly, the concept of Digital Literacies in this research has been defined as follows:

> *Digital Literacies refer to an individual's abilities to interact with and use digital technologies appropriately and efficiently, wherein the abilities are a combination of operational skills, contextual competences, and metacognitive prowess. These abilities enable individuals to understand processes necessary for deriving and producing meaning the value of which extends beyond a specific context of origin in the digital world.*

1.2 Background of the Study

This research explores the existent Digital Literacies landscape in the higher education system of Pakistan. To set the premise, it needs to be highlighted that the country in question has immense untapped digital potential as it is home to one of the youngest populations on the planet (World Population Review, 2023), its human capital and skills outlook is bleak. In discourse on Pakistan's digital opportunities, economic, social, and development, the skills profile of its population is, more often than not, assessed as a bottleneck (Khan, et al., 2023).

The Global Competitiveness Index 2019, published by the World Economic Forum, ranks Pakistan 125th out of 141 countries on the metric of skills. Moreover, on the indicators for skills of the future workforce, Pakistan ranks at 123rd on the list (Schwab, 2019). On the global Digital Skills Gap Index (DSGI) 2021, Pakistan ranks 94th in a list of 134 countries with a score 3.9 (Wiley, 2021).

1.2.1 Data Gaps

Digital literacy or literacies entail more than what can be classified as skills or functional knowledge. It is multifaceted, composed of capabilities and knowledge of engaging with hardware and software, as well as soft or cognitive and social abilities, attitudes, and practices (Ng, 2012; Belshaw, 2017; UNESCO, 2018). There is no publicly available dataset relevant to digital literacies. Although an attempt has been made to include Indicator 4.4.1 into the Pakistan Social and Living Standards Measurement Survey (PSLM) which provides a snapshot of all included indicators at household level, the module is restrictive in the sense that it only provides data on access (PBS, 2021).

Moreover, examination of the country profile for the aforementioned Digital Skills Gap Index (DSGI) 2021 (Wiley, 2021) provides important insights into the existent date gaps in this field. It highlights that there is no data available on digital skills acquisition levels at the time of graduation, education system's responsiveness, or government's digital skills landscape understanding in the context of Pakistan. These observations affirm that the digital literacies education landscape in the country is an underexplored area.

1.2.2 Policy Outlook

1.2.2.1 National Digital Policy. On the policy front, the Government of Pakistan's flagship policy aimed at developing the country's digital potential, i.e., the Digital Pakistan Policy, refers to skills development as a key enabler of digital inclusion and opportunities (MOITT, 2018). It refers to skillsets pertinent to the IT industry and market-relevant competences for freelancers and other technology-specific professionals as key components of the digital strategy. However, it does not sketch a framework of competences describing a national consensus on the type of skills that it aims to foster. In other words, the country's first strategic document with reference to its digital

focus does not consider competences and capabilities requirements of the non-IT professionals and general workforce and citizenry.

1.2.2.2 Education Policy. In the education sphere, the Higher Education Commission of Pakistan (HEC) launched the country's latest Undergraduate Education Policy in the year 2020 (HEC, 2020). The policy document holds a paradigm shifts towards competence-based learning at the undergraduate level. It enlists "ICT-related skills" as one of the competences that the country's higher education system must strive to equip the students with. However, the policy document does not define the scope or outline a framework of ICT skills or competences it considers foundational and fundamental for long-term "student success" (HEC, 2020). Moreover, the HEC online repository does not archive any program or course outlines that may have been revised after the year 2017-2018, thus, no course outline in line with the Undergraduate Policy 2020 is publicly available. Scanning the 2018 archive reveals that the ICT course mandated for an undergraduate degree by the HEC does not include any concept or competence other than functional knowledge and skills of basic computer hardware and software (reference: (HEC, 2018).

Other initiatives taken by the HEC include provision of access to digital libraries to all chartered and recognized higher education institutions in the country as well as productivity suites and some other software. The HEC has also take skill training initiatives and forged international partnerships for certifications, such as with Microsoft (HEC, 2022) and Coursera (HEC, 2022).

However, the policy review clearly highlights that digital literacies requirements of general student fraternities remain unaccounted for. In other words, from a broad-based perspective, it is unclear if the patron body of higher education in Pakistan comprehends the scope of what it means to be digitally literate in the 21st century and in line with the global competitiveness requirements.

1.3 Statement of the Problem

Digital Literacies forms the foundational set of abilities every individual must possess to thrive in the rapidly digitalizing economy and society of the 21st century. These transversal literacies transcend the basic or functional knowledge of technology and entail abilities and attitudes required for interacting with and within the digital ecosystem. To develop the human digital capital, the education system must be the ringleader of every country's surge in the digital economy and society. The onus is particularly on the higher education institutions as they tend to be better equipped and suited for leading competence development and social transformation efforts. However, there is little known about the preparedness of the higher education system of Pakistan in the face of the country's Digital Literacies challenge.

There are wide data gaps in terms of the education system's responsiveness to this challenge, its perceptions, and practices with respect to holistic and systematic Digital Literacies (DLs) Education. In the absence of a national consensus on the subject, it is essential to explore how the challenge is perceived and addressed at the institutional level.

1.4 Research Objectives

Based on the above established premise, this research was designed as mixed methods study to serve the following objectives:

- To understand the HEIs' attitudes toward digital literacies.
- To assess the practices of digital literacies development of HEIs' faculties and student fraternities.
- To gauge the levels of digital literacies of the student fraternities enrolled in these HEIs.

- To explore the determinants of digital literacies development of undergraduate students.
- To suggest appropriate policy measures for developing a robust digital literacies landscape in the higher education system of Pakistan.

1.5 Significance of the Research

The findings of this research provide an overview of the institutional landscape of Digital Literacies education in the higher education system of Pakistan. To the best of the researchers' knowledge, it is the first of its kind of exercise in the country.

It contributes to the Digital Literacies in Higher Education scholarship by addressing the knowledge gap in the context of understudied population, i.e., higher education stakeholders in Pakistan. It makes preliminary observations on the HEIs' perceptions of what the term "digital" implies and what it means to be digitally literate. It also sheds light on relevant curriculum and policy focus in the absence of a specific framework guiding DLs education in the country's universities.

From the stakeholders' point of view, it provides insights from student voices on needs and expectations of DLs education at the undergraduate level. Moreover, it highlights the inconsistencies in development of Digital Literacies of young adults in particular contexts. Thus, the findings of this research underscore the need for putting Digital Literacies education on the policy agenda. These insights could form a basis for questioning the common-sense assumptions on students' capabilities and needs, developing an understanding of the multifaceted and evolving nature of the concepts and practices, and rethinking curriculum and instruction accordingly.

2. Literature Review

2.1 Overview and Definition of the Concept

2.1.1 Evolution of the Concept

The term "digital literacy" was popularized at the turn of the century through Gilster's (1997) seminal work. His book defined digital literacy as "the ability to understand and use information in multiple formats from a wide variety of sources when it is presented via computers." This definition has widely been understood as the "know-how" definition that has a skill-based underpinning and is, thus, "operational" or "functional" in nature. Definitions that align with that of Gilster's (1997) are generally classified as the operational definitions of digital literacy (Gourlay et al., 2013).

The more recent definitions, on the contrary, which emphasize the need for supplementing operational skills with cognitive abilities and are classified as conceptual definitions of digital literacy (Chan et al., 2017; Hague & Payton, 2010). Hague and Payton (2010), for instance, define digital literacy as "access to a broad range of practices and cultural resources that you are able to apply to digital tools. It is the ability to make and share meaning in different modes and formats; to create, collaborate, and communicate effectively, and to understand how and when digital technologies can best be used to support these processes." Gilster (1997) also conceptualized digital literacy as the mastery of ideas rather than tools-centric keystrokes which is indicative of the relevance of the concepts and practices of the digital. Thus, deeper analysis reveals that his definition, due to its semantic subjectivity, has stood its worth as the concept has developed and evolved over the past twenty-five years. Givens so, it tends to parallelise with the more recent

definitions which emphasize the need for supplementing operational skills with cognitive abilities and are classified as conceptual definitions of digital literacy (Bawden. , 2008).

Miranda et al. (2018) undertook an extensive exercise to outline a threefold model of digital literacy that highlights the operational and conceptual or cognitive domains covered by most definitions. This model dissects digital literacy into access to technologies, operational competencies (computer basics, internet navigation, communication, information search and management, and conceptual skills (critical thinking, ICT use in daily life, social interaction, and online safety). Based on this framework, analysis of most definitions of digital literacy unravels the operational and conceptual components neatly embedded into each of them. Thus, the contemporary theorizations of digital literacy extend it beyond technological or information or what could be classified as computer, ICT, or information literacies – competences and know-how of the hardware, tools, and software (Bawden , 2008).

The concept of digital literacy continues to evolve in tandem with advancement in digital technologies and proliferation of the same. From information literacy, computer literacy, digital skills, and new literacy to 21st century skills, media literacy, visual literacy, and even multimodal literacy, a plethora of terms has emerged and submerged into what is now considered digital literacy (Eshet-Alkalai, 2004; Jones & Flannigan, 2006). Recognition of the multiplicity of the literacies of the digital has resulted in multi-faceted and multi-layered conceptualizations of digital literacy (Miranda et al., 2018; Murray & Pérez, 2014; Ng, 2012). As Martin (2006) argues, digital literacy is not an overarching concept, but an integrative one.

Based on the concept overview presented above, to address ambiguities with respect to the concept's scope and to retain its integrative nature, this research used the term "Digital Literacies" (Belshaw, 2017; Lankshear & Knobel, 2007).

2.1.2 Assessing Digital Literacies

Multiple frameworks and scales have been designed and utilized for assessment of digital literacies over the last two decade. Regardless of the dimensions and elements incorporated in a framework, a common approach has been to evaluate relevant competences and skills. There is an understanding that there are certain competences of digital literacy that an individual must acquire for appropriation of digital technologies (Murray & Pérez, 2014). From the cross-national and global perspective, the guiding frameworks for assessing digital literacies have been developed by European Union – DigiComp 2.1 (Vuorikari, Punie et al., 2016) being a popular variant – and UNESCO which is in line with the considerations of SDG target 4.4.2 (Law et al., 2018). More importantly, the UNESCO reference framework for SDG target 4.4.2 is an extension of DigiComp 2.1, a revision of the original framework from ten years ago, which encompassed competences across twenty-one identified domains of digital literacies. These domains include but are not limited to information search, evaluation, sharing, engaging with digital devices and media, content creation, internet etiquette, etc. While DigiComp 2.1 has been used in multiple studies on skills evaluation in the higher education research, another widely used and adapted scale is Ng's (2012) instrument. It is constituent of three domains of digital literacies, namely technical, cognitive, and socioemotional.

Although there exists examples of quiz-like assessments of knowledge, such as (Murray & Pérez, Unraveling the digital literacy paradox: How higher education fails at the fourth literacy, 2014), and task-based evaluations as in the case of Alkali and Amichai-Hamburger (2004), most higher education relies on use of self-reported data (Zhao et al., 2021). Self-reported data provides an assessment of the respondents' perceptions instead of their actual acquired levels of the literacies in question. However, psychometric scales have long been used in competence

assessment research (Hall et al., 2014). Notably, UNESCO reference framework for measuring indicators of digital literacies under SDG 4.4.2 recommend utilizing scales of usage or frequency (Law et al., 2018). As with the concept of digital literacies, the frameworks and instruments developed for assessment and evaluation also keep evolving.

2.2 The Misplaced Beliefs of Digital Literacies in Higher Education

Digital literacies in Higher Education is an ever-growing field of research. Referenced as Digital Literacy, Digital Literacies, Digital Competences, or even Digital Skills, regardless of the conceptual origins whereby definitions vary among authors, the notion proliferates the student competence literature in the higher education context (Spante et al., 2018; Zhao et al., 2021). Digital Literacy or Literacies; however, dominates the research-based discourse on didactical change and development of the education system (Spante et al., 2018) which finds its footing in the higher education digital transformation perspectives for enhancing learning and employability outcomes (Farias-Gaytan et al., 2023). Moreover, review of the digitalization of higher education literature reveals that perceptions and beliefs underpin much of technology adoption and integration and skill development debate in the higher education context (Harmes et al., 2015; Kopp et al., 2019). Assumptions on student characteristics with respect to exposure to and affinity with digital technologies shape the perspectives on digital literacies in higher education (Burton et al., 2015). These assumptions generally align with the theory of Digital Nativity (Pensky, 2001a, 2001b) which argues that individuals belonging to a certain generation are more comfortable with use of digital technology due to early and unbounded exposure (see Section 3.1.1 for detail).

Available literature on the subject, however, shows that being born in a digitally proliferated society does not naturally develop one's digital literacies or competences (Bennett & Maton, 2010). Empirical evidence also poses questions on digital nativity assumption regarding

digital literacies levels among university students. Some studies show that undergraduate students adequately developed some digital skills but fare weaker on others (Gutiérrez-Ángel et al., 2022; Zhao et al., 2021). It also suggests that university students, belonging to the digitally native generation, do not have adequate levels of digital literacies required for efficient all-round use of technology (Sánchez-Caballé et al., 2020; Zhao et al., 2021). A mismatch between the assumptions about and the reality of student self-efficacy in the use of digital technologies has been identified by Gobel and Kano (2013) who found that Japanese undergraduates, members of the so-called digital generation, showed lower levels of prowess in the use of digital technologies. Similarly, Murray and Pérez (2014) emphasized that the assumptions related to digital literacies of twenty-first century youth based on their exposure to digital technologies are misconceived. They posited that HEIs in the United States failed to adequately develop their students' digital literacies. Their observations were based on results of a digital literacies test taken by college graduates, holding a four-year undergraduate degree, enrolled in a capstone course preparing them for the graduate school. Miranda et al., 2018 advocated for concept-based digital literacies education based on their finding that despite having a positive self-perception of their overall digital literacies, Greek university students rated their complex conceptual competences, such as digital copyrights, to be low. Existing literature, thus, provide empirical basis for questioning the long-persistent assumptions regarding university students, representing the generation of digital natives. Evidence further illustrates that acquired levels of digital literacies vary among students thereby highlighting the significance of other factors (further discussed later in the chapter) (Helsper & Eynon, 2013; Selwyn, 2009; Zhao et al., 2021). Although findings are scarcely comparable due to inconsistency in use of reference frameworks and scales (Spante et al., 2018), literature, in sum, suggests that assumptions on university students' digital literacies are not congruent with their actual level of

digital literacies. Age or generation does not, in isolation, determine if individuals qualify as digital literates. However, the digital myths narrative continues to anchor much of the discussion on digital literacies development (Judd, 2018), particularly in the higher education context (Burton et al., 2015). The review on digital literacies perspectives in higher education, thus, mandates exploration of the digital literacies' perspectives in higher education from the digital nativity lens in diverse contexts.

2.3 What Explains the Digital Literacies Gap?

Complementing the higher education literature highlighting the gaps between expected and actual levels of digital literacies of students, factors explaining the digital literacies development of young adults have also been explored (Zhao et al., 2021). Theoretically, the first variable determining the variation in digital literacies development within the so-called digitally generation can be traced in the digital nativity myth (Pensky, 2001a, 2001b), i.e., access or exposure to digital technologies. Level and quality of access to digital technologies and acquisition of digital literacies for all individuals tend to be a function of their resources as elucidated by the van Dijk's (2005) Resources and Appropriation Theory (see Section 3.1.2). Generally, access is studied in terms of socioeconomic factors such as economic and material resources, educational background, gender, etc. (Scheerder et al., 2017; van Laar et al., 2020). Research shows that individuals with stronger socioeconomic backgrounds tend to have better access to digital technologies and are more digitally literate (Du, et al., 2021; Scherer & Siddiq, 2009). A relationship between level of education or number of schooling years and acquired levels of digital literacies is evidenced in existing literature (Sánchez-Caballe et al., 2020); however, it may also be insignificant in certain cases, such as knowledge or creativity intensive industries (van Laar et al., 2019). Studies schooling background, which is more relevant to higher education student profiles, remain

wanting, available evidence shows that students from private schooling backgrounds tend to be more digitally literate than their public sector counterparts (Silva-Quiroz & Morales-Morgado, 2022). Gender is one of the most widely examined determinants of access to digital technologies and digital literacies; however, the evidence on its impact remains inconclusive. (Zhao et al., 2021), for instance, studied gender as a factor in digital literacies profiles of 5164 undergraduate students enrolled in a Chinese university. They found male students' perceptions of their digital competences to statistically significantly higher compared to their female university mates. Galindo-Domínguez anf Bezanilla (2021), however, found gender to be an insignificant predictor of digital competence in a sample of two-hundred undergraduate students of the faculty of education at two universities in Spain. Empirical evidence on both age-related assumptions and gender stereotypes constrains broad generalizations of what shapes the digital literacies gaps among individuals. Thus, it is important to account for variables and contextual nuances at play that affect the level and quality of access to digital technologies and development of digital literacies. Existing literature has explained these nuances in the form of personal or individual-specific factors, dispositions, and experiences (van Dijk, 2005).

Within the higher education specification, these personal factors could be considered in terms of grade levels and disciplines or field of study which form a type of sociodemographic profile. Grade level could be taken as synonymous to level of education or years of schooling and its relationship with digital literacies development is the same. Literature search on the subject did not provide any tangible results. However, Zhao et al.'s (2021) empirical evidence on higher perceived levels of digital literacies among undergraduate seniors versus freshmen is notable. In terms of diversity across disciplines or fields of education, existing evidence shows that levels of digital literacies vary across disciplines in general as well as specific dimensions (Samani et al.,

2019; Yoleri & Anadolu, 2022). Ozden (2018) conducted a study of digital competences levels of 317 undergraduate students at a Turkish university. They found that computer science students fared better on all indicators compared to Turkish Language students. In a broad categorization of social sciences versus humanities, Voda et al (2022), in a survey of 259 undergraduate students enrolled at a Romanian HEI, found social sciences to be more digitally literate compared to their humanities university mates. Allied with that, knowledge of ICT tools and digital experiences have also been studied as personal factors positively influencing development of digital literacies of young adults (Zhao et al., 2021).

Other individual-specific factors that determine access to digital resources and development of digital literacies could be summarized as mental, motivational, social, and cultural, etc. (de Haan, 2004; van Dijk, 2020). These broad categories could include characteristics related but not limited to ICT attitudes, perceived ease of use, learning goal orientation, access to support networks, etc. Furthermore, the deterministic impact of these intrinsic personal characteristics may be context dependent. van Laar et al.'s (2020) systematic review of a hundred and twenty-eight published works provides evidence on inconsistent empirical digital skills outcomes of socioeconomic, demographic, mental, motivational, psychological, social, and cultural resources. Thus, a generalization of impact across contexts remains disputable.

2.4 Institutional Landscape for Digital Literacies in Higher Education

The institutional landscape for digital literacies in higher education is underpinned by the digital nativity and shaped by specific learning outcomes. Data, observations, and anecdotes have debunked the myth since the initial days of popularization thus bringing digital literacies to focus on the education discourse. This focus has largely been driven by the widespread economic digitalization, equated with Industry 4.0 and the resultant need for work readiness or graduate

employability (Khan et al., 2022; Teichler, 2009). Aligned with these are apprehensions related to students' abilities to do well in digitally mediated learning environments that HEIs are building through digitalization (aimed at digital transformation) to prepare students for the twenty-first century workplace (Beetham, 2009; Coldwell-Neilson, 2018). In line with these observations on the focus sphere of digital literacies education at the higher education level and evidence on substantial across the globe, a picture of the existing landscape could be traced from the insights on digital literacies policies and practices in higher education and stakeholders' perceptions.

Review of existing literature revealed that most higher education institutions did not adopt specific frameworks for digital literacies education through general or specific curricular modules highlighting a lack of consensus on what literacies of digital entail (Farias-Gaytan et al., 2023; Murray et al.; 2022). Reviews of concept and definition adoption in the higher education research reflected a similar lack of standardization and consensus (Sánchez-Caballé et al., 2020; Sparte et. al, 2018). Murray et al.'s (2022) comprehensive global review of digital literacies policies and strategies adopted by the top fifty higher education institutions surfaced as the most notable work in this domain. It underscored the diversity in institutional approach towards digital literacies education at the undergraduate level and identified differences in adoption and initiatives taken by institutions based in the US versus those elsewhere in the world. It found that only a handful of universities mandated courses or modules digital literacies as a graduation requirement. Some universities embedded relevant modules in general curriculum, others took and "across the disciplines' approach. Moreover, it was highlighted that all US-based HEIs in the sample engaged in some sort of training and research initiatives on digital literacies, either through education technology, digital learning, or human and societal interactions lens. Insights from this review were consistent with Littlejohn et al.'s (2012) exercise for UK-based universities from a decade ago.

They found that digital literacies frameworks adopted by UK-based institutions were very instrumental and tool-centric in nature and focussed more on solitary skills compared to literacies as situated practices. In the Canadian context, content analysis of curriculum offered across forty undergraduate programs at a university highlighted variation in elements of digital literacy across disciplines (Sánchez-Caballé et al, 2021). In their review, technological or IT literacy was most pronounced in engineering programs while information literacy, not particularly categorized as digital literacy element, was most emphasized in social sciences curriculum. Notably, none of the elements seemed to be sufficiently stressed in the pure sciences curriculum. These inconsistencies across disciplines and institutions could induce and exacerbate digital inequalities among the future workforce and citizenry (Murray et al/, 2022). Furthermore, it could render digital literacies education ineffective as certain elements and concepts would be emphasized in one discipline or institution's curriculum compared to others (Miguel-Angel, et al., 2018). Digital literacies development at the higher education level would remain deficient and inconsistent unless its elements and relevant learning outcomes are categorically included in policies and strategic frameworks (Coldwell-Neilson, 2018).

Studies on the subject underscore the wide gaps between the importance placed on digital literacies and their elements by the stakeholders and their coverage in the curriculum. In Miguel-Angel, et al.'s (2018) international assessment across five European countries, for instance, suggested that employers viewed higher education's efforts to produce digitally literate workforce as lacking and deficient. Smith and Storrs (2023), on the other hand, elicited student's perceptions on existent gaps between the need for and coverage of digital literacies in curriculum and instruction at a Canadian university. Students have also held the opinion that emphasis on use digital technologies or skills in higher education have been associated with processes,

organizational or educational, more than their repercussions in the larger social digitalization context (Monteiro & Leite, 2021; Smith & Storrs, 2023). Where teachers have expressed the need for development of systematic frameworks for digital literacies, students have deemed necessary a shift in focus from tools and software to concepts and situated practices (Miguel-Angel, et al., 2018) wherein the role of digitally literate faculty and staff remains indispensable (Gutiérrez-Ángel et al., 2022); Littlejohn et al. 2012). Arguably, the observations made in the literature reviewed for this research could be summarized as a highlighted need for questioning any assumptions about the student's digital literacies that higher education practitioners, policymakers, or faculties, may hold. Moreover, there is a case for rethinking higher education's approach to digital literacies development, improving integration of relevant concepts into the curriculum (Corrin et al., 2018).

2.5 The Country Context: Digital Literacies in Pakistan's Higher Education System

In the country context of Pakistan, rigorous scholarship on Digital Literacies in the higher education is wanting. Studies of relevance were, however, included in this review. From the perspective of institutional attitudes, Ameen and Gorman (2009) conducted a review of the then available studies and evidence on that state of information and digital literacies development among university students in Pakistan. Findings revealed that information and digital literacies formed neither a policy priority nor an on-campus practices at the time. Relatedly, based on interviews of twelve public sector educators eliciting stakeholder views on digitalization of the educational system, Khan et al. (2018) outlined institutional infrastructure, teachers' beliefs and digital abilities, and training as the main constraints. They made a case for developing teaching faculties' Digital Literacies to enable integration of education technology with pedagogical practices aimed at improved digital literacy and learning outcomes of students. This assertion aligned with Malik et al.'s (2021) work. They highlighted teachers' low digital literacy as one of

the challenges to digitalization of Pakistani HEIs for hybrid learning with an objective of producing a workforce capable of navigating the ever-digitalizing workspaces in the post-pandemic world. Although both Khan et al. (2018) and Malik et al. (2021) focussed on the aspect of digitalization of the education system, they posited development of students' Digital Literacies as an endline objective. Moreover, while Khan et al.'s (2018) findings were based on an analysis of the educators' opinions, Malik et al. (2021) seemed to be primarily a perspective based on existing literature and authors' observations or views. In terms of putting Digital Literacies education for university students, Malik et al. (2021) made a recommendation for setting up "analytical skills departments" for developing "skills required for the digital era." Ameen and Gorman (2009), on the other hand, made a call for adoption of a broad-based approach whereby information and digital literacies should be integrated with curriculum at all levels of education in both public and private institutions. In all direct and indirect assessments of the state of Digital Literacies education reviewed, student voices on the subject were not included.

Literature search for studies on the development of Digital Literacies in the higher education institutions of Pakistan did not yield much. However, Amin et al.'s (2021) work was reviewed as foundational in this field in the country context of Pakistan. With an objective of measuring the Digital Literacies levels of undergraduate freshmen, they developed and validated a Digital Literacy Scale. This 36-item scale was modelled after Chen's (2015) framework of the "9C's of Digital Literacy" including communication, connectedness, collaboration, critical thinking, creativity, curation, citizenship, character, and copyright. Although the published research did not report any findings on the acquired levels of Digital Literacies among the sampled students for validation of this scale, it could prove consequential in moving the discussion from tool-centric digital skills to well-rounded Digital Literacies education in Pakistan. Another relevant

study in this domain was conducted by Soroya et al. (2021) which, based on existing literature, developed a scale to measure internet literacy skills of digital natives. Contrary to Amin et al. (2021) their published work did not provide much detail on scale validity; however, it reported survey findings as it was their primary research purpose. They found that exposure to digital media among undergraduate students across disciplinary fields (arts, humanities, pure and social sciences) at a public university in Lahore was considerably high. However, communication proficiency was weak. Furthermore, awareness among students regarding online awareness and ethics did not translate into behaviours. Thus, this research underscored the need for developing mindsets along with awareness and skills to ensure concrete digital literacies practices.

Although determinants of university students' Digital Literacies were not found to be a subject of research in Pakistan, Digital Literacies has, however, been studied as an antecedent to student outcomes. In a sample of eight-hundred students across ten universities in Pakistan, Abbas et al. (2019), for instance, found positive correlations between students' levels of digital literacies and academic achievements, measured by students' cumulative grade point average. With reference to graduate employability, Pirzada and Khan's (2013) work was notable. It showed that students with higher levels of digital competences, specifically pertaining to complex processes of evaluation, had higher employability potential. They relied on descriptive statistics obtained from survey data of two-hundred students from two private universities in the metropolitan city of Karachi. Employability status was judged based on the criterion highlighted by fifty employers.

Review of country-specific literature available on the subject illustrated that Digital Literacies development in the higher education system is an undeveloped field of scholarship in Pakistan. Moreover, the discourse remained dominated by the digitalization discourse wherein Digital Literacies of the teaching faculties were seen as a bottleneck to adoption of education

technologies. Thus, this review underscored the need for exploring the institutional landscape from the lens of Digital Literacies education of university students as future workforce as well as citizenry perspective.

2.6 Research Gap

The field of digital literacies in higher education research continues to evolve with number of studies multiplies. Its scope has also widened from Anglo contexts to diverse populations and communities across the globe (Spante et al., 2018). Didactics, competence development, skill evaluation, etc. have been the focus of these studies using varied frameworks, definitions, and considerations for literacies, competences, and concepts of the digital (Spante et al., 2018; Zhao et al., 2021). However, beyond solitary focus, studies on institutional landscape through a multifaceted lens and engagement of multiple stakeholders appear to be scant (Miguel-Angel, et al., 2018).

Most studies rely on either qualitative or quantitative methodologies, using student-centric samples, to address the research questions in focus (Guzman-Simon et al., 2017; Voda et al., 2022; Zhao, Llorente, & Sanchez (2021). Furthermore, relevant literature provides evidence on contextual variation in development of digital literacies of individuals as a function of their personal factors (van Laar et al., 2019) and persistence of the myth of digital nativity in shaping HE's perspectives (Burton et al., 2015).

Higher education research on Pakistan analysing development of students' digital literacies is relatively nascent. There exists a wide knowledge gap in terms of what guides the higher education discourse on digital literacies in the country, the frameworks or policies adopted and

their resultant impact on the future workforce and citizenry enrolled, and the stakeholders' perceptions of the same.

In light of the gaps identified in the literature reviewed, this research was designed as an exploration of the digital literacies landscape in the higher education system of Pakistan. It took a multidimensional lens to institutional preparedness in the face of the digital literacies challenge, engaging both teaching faculties and student fraternities at selected universities.

2.7 Research Questions

In line with the research objectives outlined in Section 1.4 and research gap highlighted above, this exploratory study sought to address the following research questions:

- **RQ1:** What are the Pakistani HEIs attitudes towards Digital Literacies education?
- **RQ2:** Are Digital Literacies concepts integrated with curriculum and instruction in the higher education institutions in Pakistan?
- **RQ3:** What are the levels of Digital Literacies acquired by undergraduate students in Pakistan?
- **RQ4:** What is the impact of personal attitudes on Digital Literacies development of undergraduate students in Pakistan?

3. Theoretical Perspectives

3.1 Theoretical Underpinnings

3.1.1 The Digital Nativity Myth

Myths offer explanations of practices and systems because these are rooted in beliefs and sustained in popular narratives. Whether these beliefs are based on anecdotes or substantiated through repeated observations, they tend to shape general thoughts and drive sociocultural institutions (Ornellas & Sancho, 2015). Thus, myths have an explanatory power to initiate rational arguments and inform research agendas. Epistemological assumptions and beliefs shape learning and teaching objectives and influence practices in education too (Harmes et al., 2015).

With reference to development of Digital Literacies, student characteristics are central to teaching and learning myths and rhetoric (Burton et al., 2015), especially at the higher education level. Arguably, the most common and misplaced belief affecting discourse on and practices of teaching or developing Digital Literacies at the higher education level is the one of today's youth's innate ability to interact with digital technologies and use them efficiently and appropriately (Ornellas & Sancho, 2015). This belief stemmed from observations, sustained through common sense interpretations of those observation, and has been backed by logically crafted thesis. A consensus has been developed that the young generation, born toward the turn of the century, gained early exposure to digital technologies. Therefore, it is argued that this generation not only comfortably interacts with but virtually relies on these technologies to navigate through their daily lives. While a few terms have been used to describe this "digital generation" (Evans & Robertson, 2020), the concept that is widely accepted as theoretical foundation for this belief is known as Digital Nativity (Koutropoulos, 2011).

The term Digital Natives was coined and popularized by (Pensky, 2001a, 2001b) who classified children born after the year 1980 as such based on his observation and a general consensus that these new generations were growing up in a world immersed in digital technologies. He used statistics on usage of the then available digital technologies and applications to draw his inferences (Pensky, 2001a, 2001ab, 2006, 2009). His inductive reasoning was based less on rigorous research and more on general observation and uncontextualized statistics; however, it formed the logical foundation of common-sense narratives around exposure to digital technologies and the birth of a "new generation" (Ornellas & Sancho, 2015).

According to Weiser (1991) when technologies of any type are embedded in the daily lives, they tend to be naturalized. Such technologies are seen as fundamental, natural, or simply an indispensable part of the ecosystem of daily lives. Orientation to and comfort in interaction with these technologies is, therefore, assumed and factualized through common sense understanding. Resultantly, technological myths are formed that impact the discourse around them even in the spheres of education. Proliferation of digital technologies and increased use of digital media applications and software has led to their 'naturalization.' This naturalization has strengthened the myth of Digital Nativity. Digital Nativity theorists originally called for drastic changes in pedagogy to support the learning needs of the new generation as it processed information differently (Bennett, Maton, & Kervin, 2008; Pensky, 2001a, 2001b). However, in the wider context, the generalized assumptions reduced the appropriation debate to a question of physical access or functional skills only.

Generalization of the Digital Nativity thesis without adequate contextualization has been deemed detrimental to the discourse on digital literacy instruction and learning, particularly at the

higher education level. Literature posits that individuals form an age cohort neither have the same level of exposure to digital technologies nor are their abilities to engage with these technologies homogenous (Burton et al., 2015). Youth's ability to use technology appropriately and efficiently is dependent on several factors that include, but are not limited to, socioeconomic status, gender, education, etc. These disparities might be subtle due to proliferation of digital technologies and their subsequent naturalisation but are systematic in nature and align with the more generic social fragmentation or "fault lines" determining both resource access and opportunities of all sorts (Selwyn, 2009). Thus, the youth's ability to use digital technologies appropriately is a dimension of the Digital Divide (van Dijk, 2020).

Digital Divide, which refers to the systematic inequalities in access and usage of digital technologies, is multi-dimensional and dynamic in nature. Over the past two decades, it has evolved from a physical access gap into a material access gap and then into a skill and knowledge gap. Access to digital technologies is now considered a necessary but not sufficient condition for technology appropriation for outcomes of economic, social, and human development (van Dijk, 2020). While communication science scholarship highlighted the physical access gap and sociologists unveiled the digital divide dynamics with respect to systematic social inequalities, the economists theorized on adoption, innovation, and appropriation in the context of economic and human development. Education sciences have contributed to the digital divide debate and broadened its scope by uncovering the skills and knowledge gap and emphasized the need for digital literacies development for efficient and appropriate use of digital technologies (Van Dijk, 2017). As the core component of the digital divide, access to digital technologies in terms of appropriation is, therefore, multifaceted. It encompasses more than physical access and exposure

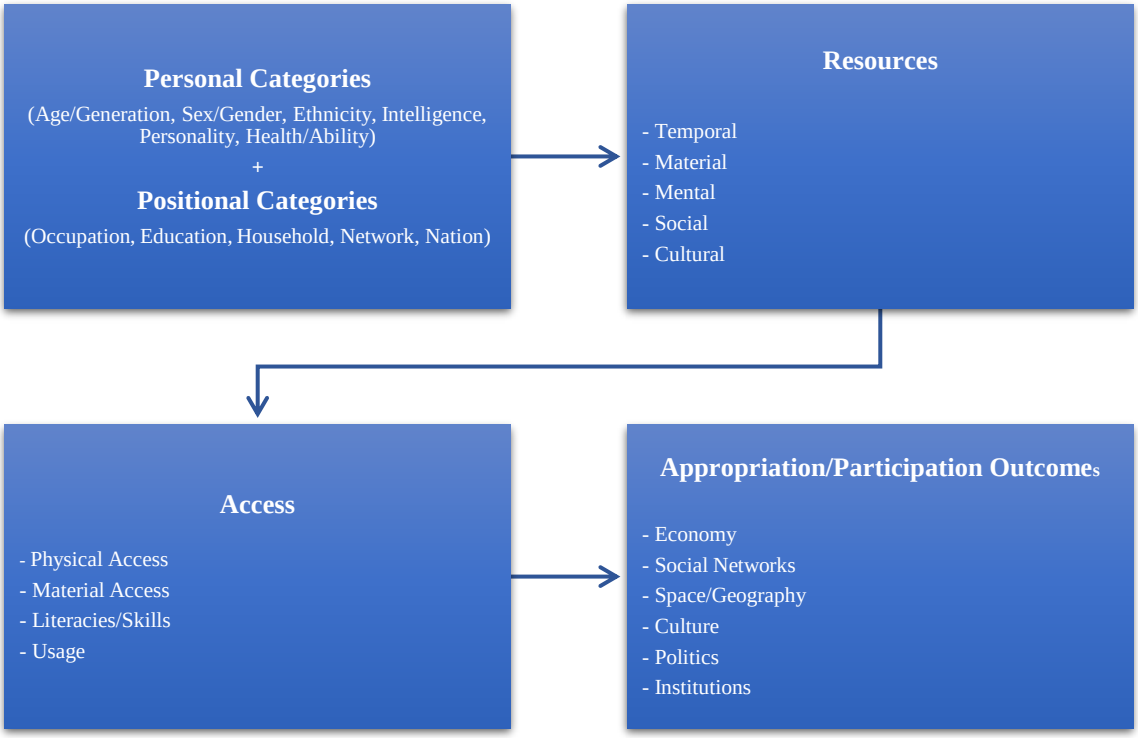
that Pensky ((2009) and other Digital Nativity theories assume to be adequate for efficient and comfortable use of digital technologies.

3.1.2 Resources & Appropriation Theory

Van Dijk (2005) proposed the Resources and Appropriation Theory which has since served as an overarching framework explaining the multiple forms of access and digital divides. It combines tenets of theories of social capital, psychological frameworks of motivation, educational concepts of literacies, and economic models of diffusion and adoption as well as resource access to explain the "deepening digital divide" (Van Dijk, 2017). Van Dijk (2005) explains the "deepening digital divide" as the gaps in access and literacies creating digitally disadvantaged fragments due to immersion and naturalization of digital technologies. The Resources and Appropriation Theory postulates that everyone has a certain set of temporal, mental, motivation, social, and cultural resources that determine their level of appropriation of digital technologies. The individual's personal and positional category, explained by factors such as demographics and socio-economic status, determine their set of resources (van Dijk, 2005, 2020).

Figure 3.1

Resources & Appropriation Theory



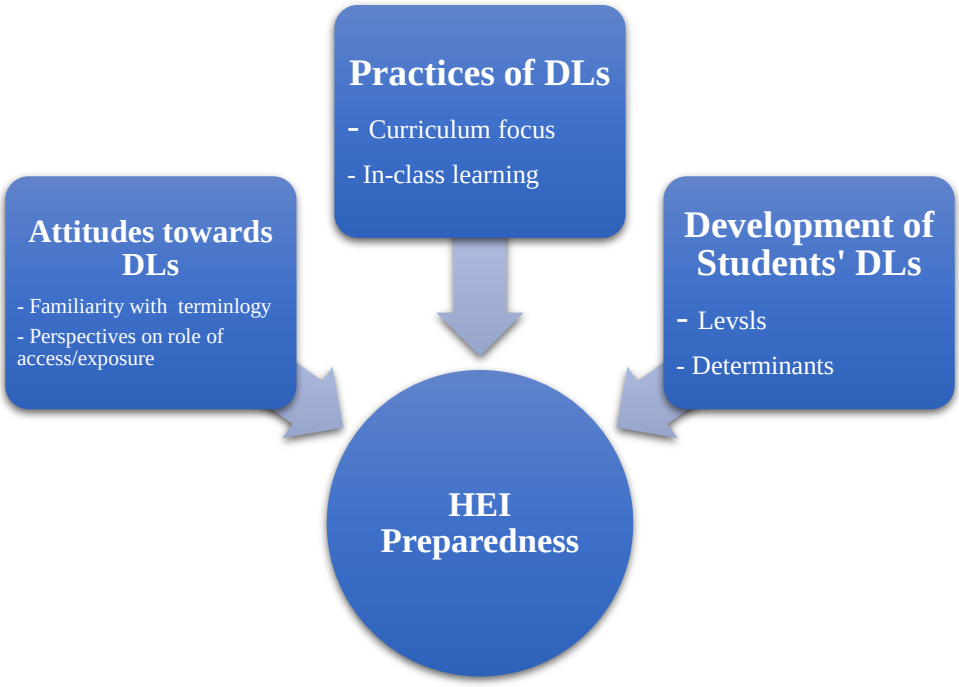
In terms of personal demographic of age, the Resources and Appropriation Theory aligns with (Pensky, 2001a, 2001b, 2006, 2009) emphasis on age or generational boundaries as the single-most important factor in determining abilities to appropriate digital technologies. However, it differentiates based on the premise of positional categories, particularly the one of education. Thus, the Resources & Appropriation Theory offers a more comprehensive explanation for inequalities in appropriation of digital technologies as they continue to proliferate economies, societies, and personal lives in the twenty-first century.

3.2 Conceptual Framework

Theoretical perspectives of the Digital Nativity Theory (Pensky, 2001a, b) and the Resources & Appropriation Theory (van Dijk, 2005) shaped the hypothetical conceptual framework of HEI Preparedness for this research. Preparedness for the Digital Literacies challenge, i.e., producing a digitally literate workforce and citizenry, entails a well-rounded Digital Literacies education and provision of a conducive environment wherein access to computers and the internet is necessary, however, not sufficient. It could be understood in terms of attitudes towards Digital Literacies education, its practices at the undergraduate level, and the implications of the same. While attitudes would highlight the understanding of a given subject shape related policy and practices of teaching and learning, implication, connoted by development of abilities, would illustrate the impact of these policies and practices.

Figure 3.2

HEI Preparedness for the Digital Challenge Conceptual Framework



The three dimensions of interest in the context of HEI Preparedness for the Digital Literacies challenge are described below.

Table 3.1

Dimensions of HEI Preparedness

Dimension	Description
Attitudes towards Digital Literacies	This dimension explored HEIs' familiarity with and approach towards teaching and learning Digital Literacies. Familiarity with the concepts is fundamental to adopting policies and practices prioritizing development of knowledge base and skills. Moreover, this dimension delved into the institutional perspective on the Digital Nativity Myth (Pensky, 2001a, b). Specifically, it involved an investigation of the HEI's realization that exposure to digital technologies may not be sufficient to produce digitally literate workers and citizens.
Practices of Digital Literacies	Practices of Digital Literacies referred to curriculum and in-class focus on Digital Literacies across disciplines. Curriculum focus and content defined if, to what extent, and how Digital Literacies concepts and skills were embedded in the undergraduate programs. Furthermore, it explored if there was an informal integration of the literacies of interest, i.e., as a part of in-class discussions, etc.
Development of Students' DLs	Levels of Digital Literacies acquired by undergraduate students were studied to gauge the impact of the DLs education. Furthermore, a set of factors as determinants of the acquired Digital Literacies levels, outlined by the stakeholders' views, were also explored. These factors and their hypothesized effects were studied through the lens of van Dijk's (2005) Resources and Appropriation Theory.

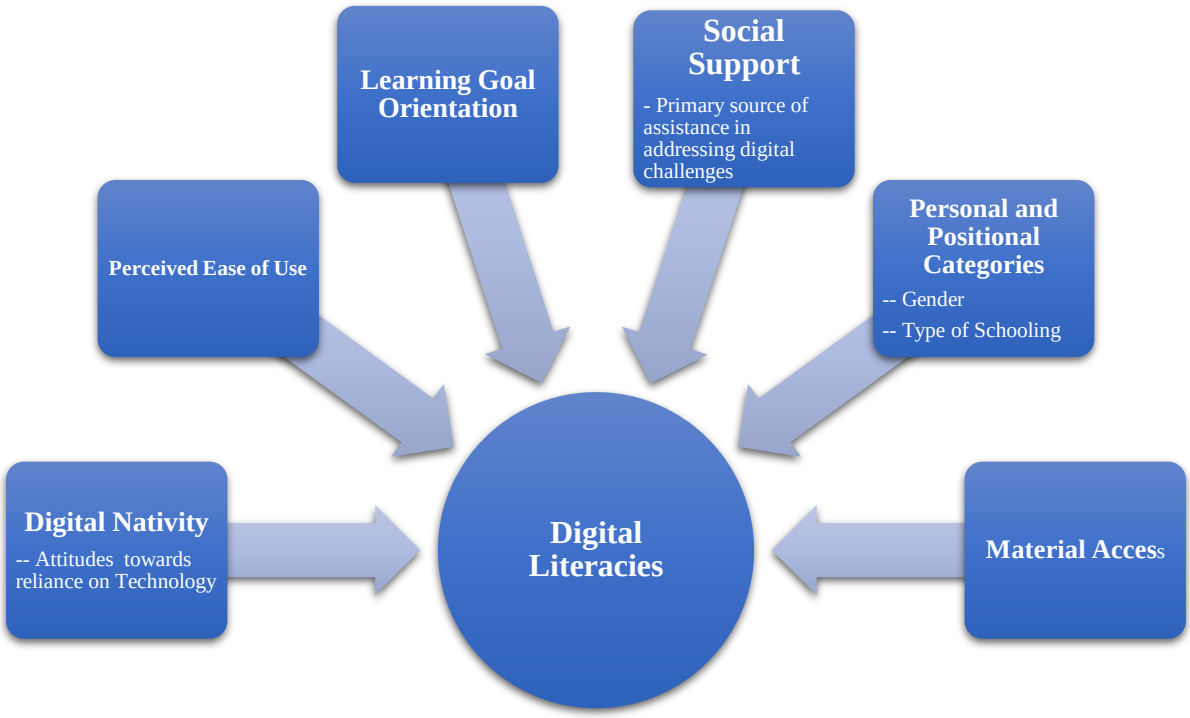
3.2.1. Determinants of Digital Literacies

3.2.1.1 Theoretical Framework. For exploration of the determinants of Digital Literacies as outlined in the third dimension of HEI preparedness, the Resources and Appropriation Theory (van Dijk, 2020) provided the theoretical foundation. Determinant factors were selected based on Phase I findings. Given the scope of this research was limited to undergraduate education where

age and level of education would not vary among sampled students, the personal and positional categories were attributed to respondents' gender and type of pre-undergraduate schooling.

Figure 3.3

Determinants of Digital Literacies Conceptual Framework



Note: See Section 4.3 for Variable Descriptions

3.2.1.2 Hypothesis Statements. The empirical estimation of determinants or antecedents of Digital Literacies, per the existing works of Scheerder et al. (2017), van Laar et (2019), van Dijk (2020) etc., tested the following hypotheses statements.

H1: Digital Nativity, i.e., positive attitudes towards reliance on and use of digital technologies, positively affects students' Digital Literacies development.

H2: Perceived Ease of Use has a positive impact on students' Digital Literacies development.

H3: Learning Goal Orientation is positively linked with students' Digital Literacies development.

H4: Reliance on formal channels of support, when faced with digital challenges, improves students' Digital Literacies.

H5: Male students have higher levels of Digital Literacies compared to female students.

H6: Students with public schooling background have lower levels of Digital Literacies versus students with private schooling background.

H7: Material Access is positively related with students' Digital Literacies development.

4. Research Methodology

4.1 Research Design

To explore the Digital Literacies landscape in the Higher Education System of Pakistan, this research employed an Exploratory Sequential Mixed Methods design. Definitionally, a mixed methods research design integrates some elements of qualitative and quantitative approach to broaden the scope of a study or corroborate findings from the two methodologies (Johnson et al., 2007). In other words, it enables blending the qualitative and quantitative research methodologies to ensure an in-depth inquiry on the subject of interest. It is aimed at developing a broader perspective, conduct a more in-depth analysis of the research question(s) at hand, or seeking convergence on a thesis based on results obtained from distinct research methodologies (Creswell & Cresswell, 2017).

Exploratory Sequential Mixed Methods designs is particularly deemed appropriate for studies on emergent or underexplored topics. It moves from qualitative lines of enquiry to quantitative methods through subsequent phases. Theoretically, in an Exploratory Sequential Mixed Methods research, qualitative component is exploratory in nature and provides foundational ideas. The quantitative component builds on the qualitative findings to test, corroborate, or measure the identified assumptions, perceptions, factors, or linkages (Creswell & Plano Clark, 2017).

Seeking answers to the research questions guiding this study (as outlined in Section 2.7), this study was conducted in two sequential phases. In Phase I, qualitative interviews were conducted to gain stakeholders' perspectives HEI's attitudes towards and practices of digital literacies were assessed. Building on that, in the quantitative component or Phase II, the level of

digital literacies of the undergraduate students enrolled in these HEIs and their determinants were also studied.

4.2 Data and Sample

4.2.1 Data Source

This research study mapping the digital literacies landscapes in the higher education system of Pakistan was based on first-hand primary data. It took the provincial capital of Punjab, i.e., the Lahore district, as a case in point.

To gain stakeholders' perspectives on institutional preparedness for the digital challenge and approach to digital literacies, qualitative data was collected through in-depth interviews of faculty members and student representatives at selected HEIs. Quantitative data on undergraduate students' acquired levels of Digital Literacies and selected determinant factors was collected through a self-administered questionnaire.

Data was collected during summer and fall of the year 2022.

4.2.2 Sample Selection Criteria

Specific criteria for sample selection were applied at different stages. First, the scope of this study was defined in terms of undergraduate education programs being offered in four selected disciplines. These disciplines included Business Administration, Computer Science, Economics, and Physics, where Business Administration and Economics represented the soft disciplines and Computer Science and Physis represented the hard disciplines. The primary reason for selection of these disciplines was representativeness. Cumulatively, these disciplines represented majority of student fraternities enrolled in most higher education institutions across Lahore. Moreover, all

disciplines varied in their scope of subject matter and professional practices. Thus, only those Lahore-based HEIs which offered four-year undergraduate programs in these disciplines could be included in the study. Second, to ensure appropriate gender representation and balance in the sample, only those Lahore-based HEIs that offered co-education were shortlisted.

During Phase I of the research, faculty and student representatives from the selected disciplines were interviews for collection of qualitative data on attitudes towards and practices of Digital Literacies. Faculty representatives with at least three years of experience at their respective institution were approached. This criterion was set to ensure that the faculty representatives had adequate experience and understanding of the institutional policies, environment, and practices. For student representation, undergraduate seniors, i.e., students in their final year or Semester 7 or 8, from the selected disciplines were approached because of their adequate exposure to the institutional environment.

In Phase II of the research, acquired levels of Digital Literacies were assessed by surveying junior year and senior year undergraduate students from four selected disciplines. The students enrolled in these semesters had at least two full years of exposure to their respective HEIs' Digital Literacies landscape. Thus, the implications or impact of institutional approach towards DLs would have materialized or begun to do so. For this reason, their acquired levels of Digital Literacies were most pertinent to the research questions in this study.

4.2.3 Sampling Techniques

Focusing on the digital literacies landscape of undergraduate education in the district of Lahore, this research relied on purposive sampling technique for selection of institutions. Institutions were selected based on the criteria identified in Section 4.2.2. Convenience sampling

method was used to select representatives of the faculty and senior year student fraternities for the interviews. To collect data on levels of digital literacies and related factors, also, the convenience sampling technique was employed.

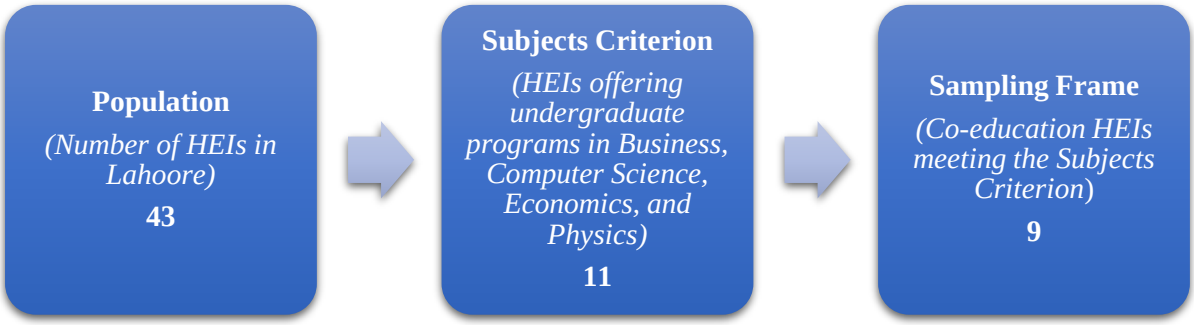
4.2.4 Sampling Frame

Lahore district, the provincial capital of the province of Punjab, served as the point of focus for this mixed methods exploration of the digital literacies landscape in the higher education system of Pakistan. To identify the population of interest, an exhaustive list of chartered and recognized higher education institutions in the Lahore district has been extracted from the Higher Education Commission of Pakistan's (HEC) official website (HEC, 2022). The acquired list revealed that forty-three institutions of higher education had chartered, recognized, and functional campuses in Lahore as of Spring of 2022. The list was filtered to construct the sampling frame based on the specified criteria (see Section 4.2.2).

First, the list was filtered based on the subject criteria, thus, higher education institutions offering undergraduate programs in Business Administration, Computer Science, Economics, and Physics were shortlisted. Eleven HEIs included in the forty-three-member list met this criterion. To ensure gender balance in the final sample, only the HEIs offering co-education undergraduate programs in the selected subjects have been included in the sampling frame. Two public sector HEIs, out of the eleven shortlisted in the first round, did not meet this criterion. Thus, a sampling frame constituting of nine higher education institutions has been constructed for sample selection.

Figure 4.1

Sampling Frame Construction



4.2.5 Sample Size

From the identified sampling frame, tow co-education HEIs offering undergraduate programs in selected subjects, i.e., Business Administration, Computer Science, Economics, and Physics, constitute the final sample. Both public and private sector were, thus, represented by one higher education institution operational in the district of Lahore. For Phase I of the research, one faculty member and one senior year student from each subject department was interviewed per university. Therefore, the final sample comprised of sixteen respondents, eight representatives of the teaching faculty and student fraternity representatives. For Phase II, targeted sample size was two-hundred and forty students across two institutions based on the response rates observed during the pilot study. After deleting forty-seven surveys due to incomplete responses or related data quality issues, the final, usable sample size was two-hundred students across all selected institutions and disciplines. Participation was voluntary; however, it was restricted to junior year and senior year students only. It is to be noted that due to low response rate and compromised data

quality, the survey questionnaire for quantitative data collection was eventually incentivized. As a result, response rate increased, and data quality improved significantly.

Table 4.1

Sample Size

Unit	Sample Size
HEIs	2 (1 Public Sector HEI + 1 Private Sector HEI)
Interviews (Qualitative Component)	
Faculty Representatives	8 (1 representative per selected department* from each HEI)
Student Representatives	8 (1 representative per department from each HEI)
Total	16
Questionnaire Survey (Quantitative Component)	
Students	200 (100 students from each HEI)

*Selected departments: Business Administration, Computer Science, Economics, and Physics

4.2.6 Data Collection

In Phase I, data was collected through semi-structured, in-depth interviews of the faculty and student representatives of selected subjects at the selected institutions. To that end, English-language interview guides including both open and closed-ended questions were prepared. While open-ended questions helped assess the level of the respondents' knowledge, closed-ended question had the advantage of ensuring content clarity for a question (Bryman, 2012). Conducted bilingually, all interviews were recorded with the respondents' permission and transcribed in English language for coding and data analysis. For quantitative analysis in Phase II, a self-administered questionnaire survey was employed. The questionnaire was based on pre-coded closed-ended questions.

Instruments used in this research were pilot-tested and vetted for relevance, readability, and understandability before administration to respondents included in the final sample. Reviewers did not identify any difficulty in reading and understanding the questionnaire items. Feedback on discussion and item relevance was also positive.

4.3 Variables: Levels and Determinants of Digital Literacies

Variables included in the conceptual framework underpinning the assessment of levels and determinants of Digital Literacies, as outlined in Section 3.2.1, are described below.

4.3.1 Outcome Variable

Digital Literacies of Students: The outcome variable of interest in this research was a measurement of the levels of Digital Literacies acquired by undergraduate students. Based on the definition outlined in Section 1.5 and the findings of the qualitative interviews of student representatives conducted in Phase I, and in line with the van Laar et al (2019) theoretical model of skills of digital literacies, a 16-item scale encompassing three dimensions of Digital Literacies was used. Selected dimensions included digital Information Literacy, Digital Problem Solving, and Digital Communication and Collaboration. The scale was modelled keeping in view the expectations expressed and needs identified by the student representatives during their interviews.

Table 4.2

Dimensions of Digital Literacies

Dimension	Description	Variable Type	Scale	No. of Items
Digital Information Literacy	Digital Information Literacy, in this study, included the functional domain of the ability to search for required and relevant information across several digital platforms and databases (Miranda, Isaias, & Pifano, 2018). It also included the metacognitive domain of evaluation of information for authenticity, reliability, and relatability or logical combination of digital data and information (Tsai & Tsai, 2003). Digital Information Literacy for this research comprised of two distinct sub-	Latent	6-point Likert Scale of Frequency	6

	dimensions, namely Information Search and Information Evaluation wherein the abilities to search for required information, validation of reliability, and sensemaking were gauged.			
Digital Problem Solving	Digital Problem Solving referred to the use of digital technologies to solving complex problems. In this research, it was measured as ability and inclination to rely on digital tools to find solutions to problems, specifically utilizing information search capabilities (van Laar et al., 2019).	Latent	6-point Likert Scale of Frequency	5
Digital Communication & Collaboration	The communication and collaboration dimension of digital literacies assessed in this research covered the non-technical domains of networking to achieve goals, solve problems and generate creative ideas (Wolff & Moser, 2010).	Latent	6-point Likert Scale of Frequency	5

Note: Scale of Frequency: 1 = Never, 2 = Very Rarely, 3 = Rarely, 4 = Occasionally, 5 = Frequently, 6 = Very Frequently

4.3.2 Explanatory Variables

The following list of factors was selected for the study of determinants of students' digital literacies based on Phase I findings and in line with the Resources and Appropriation Theory (van Dijk, 2005).

Table 4.3

Determinants of Digital Literacies

Variable	Description	Variable Type	Scale	No. of Items
Digital Nativity	Referring to the access process of the resources and appropriation theory (van Dijk, 2005), this research relied on exposure scale as a proxy for attitudes towards use of digital technologies. It was based on the	Interval	6-point Likert Scale of Agreement	5

	Digital Nativity theory's canons of exposure and access in terms of positive attitudes towards reliance on digital technologies and media among children born after the year 1980 (Pensky, 2001b). The measurement scale was adapted from (Teo, 2013).			
Perceived Ease of Use	Perceived Ease of Use referred to a user or potential user's perceptions on the amount of effort required to use or learning to use digital technologies. It indicated perceived level of convenience in usage or development of required competences. It formed a mental and motivational resource for individuals to use and learn to use digital technologies to reap their benefits (Edmunds et al. 2012); Verhoeven et al., 2016).	Interval	6-point Likert Scale of Agreement	3
Learning Goal Orientation	Individuals with learning goal orientation tend to have a stronger inclination to develop competences and skills (van Laar et al., 2019). They are likelier to invest time and effort in learning new skills and developing literacies. These individuals Dtend to be lifelong learners and keep their skillsets updated (Yi & Hwang, 2003). Learning goal orientation was studied as a mental resource in this research.	Interval	6-point Likert Scale of Agreement	6
Social Support	As a socio-contextual resource, availability of a support network for resolution of problems related to appropriation of digital technologies is fundamental to digital literacies (van Laar et al., 2019). This information support network can be both formal and informal. In the context of this research, formal support referred to institutional support, from designated helpdesks or even instructors and classmates, informal support networks included friends and family from	Dichotomous	Pre-coded categories	1

	outside the institution or online contacts.			
Personal & Positional Categories	Factoring in the personal and positional categories domain of resources and appropriation theory van Dijk, 2005), gender and type of schooling were included in the analysis. Research over the last two decades has shown that females have always been disadvantaged in the acquiring of digital literacies (van Dijk, 2020). Studying education as a positional category was logical because a person's level of education defines their social status (van Dijk, 2005). This research, however, used type of schooling as an educational positional category.	Dichotomous	Pre-coded categories	1
Material Access	Material access was included in the model as an additional indicator of access process per the Resources and Appropriation Theory (van Dijk, 2005). It indicated whether an individual had simultaneous ownership of more than one type of digital technologies. Access defined by ownership is a pre-condition for technology appropriation by means of acquisition of necessary skills and knowledge.	Dichotomous	Pre-coded categories	1

Note: Scale of Agreement: 1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Somewhat Agree, 5 = Agree, 6 = Strongly Agree

4.4 Data Analysis

4.4.1 Qualitative Analysis

Qualitative analysis methods were utilized in Phase I of this research. Insights on stakeholders' perceptions on HEIs' preparedness for the Digital Literacies challenge were drawn from qualitative interviews through thematic analysis of transcriptions. Thematic analysis is a

qualitative methodology applied to textual data, such as interview transcripts, with an objective of finding common ideas, topics, or themes. Thematic analysis is a commonly used methodology in research on perceptions, knowledge, and insights from experiences (Bryman, 2012).

In this research, collected data was categorized by identified patterns to generate broad themes across the dimensions of interest, namely Attitudes and Practices of Digital Literacies in the Higher Education System. However, the process was also guided by the research questions defining the focus and scope of this study. Therefore, both inductive and deductive lines of reasoning were adopted. Interview transcriptions were reviewed in an iterative process to generate codes identifying patterns. The four themes generated in this process were named as Familiarity with Terminology, The "IT" Focus, Discipline-specific Literacies, and Perspectives on HEIs' Role in Students' DLs Development. Interpretations for emergent themes were based on explicit responses as well as implicit suggestions made by the interviewees. Similarities and contrasts between responses within and across themes were also studied.

4.4.2 Quantitative Analysis

Quantitative analysis in this research comprised of two sections, a detailed descriptive analysis and inferential estimation. To describe the data and assess the levels of Digital Literacies, univariate and bivariate data analysis techniques were used. Univariate analysis for numeric or continuous variables included measures of central tendency and dispersion, while frequency distributions were reported for categorical variables in the dataset. Average Levels of Digital Literacies acquired were also assessed through univariate analysis. For bivariate analysis of categorical variables in the dataset, contingency tables and chi-squared based test of statistical significance were used. To explore the variations in Levels of Digital Literacies across

Demographics, however, bivariate analysis method of comparison of means tested for statistical significance with two-sample t-test was used (Bryman, 2012).

To test the hypothesized relationship between the determinants and the acquired levels of digital literacies, the multivariate method of structural equation modelling (SEM) was utilized. Prior to estimation of the final model as conceptualized in Section 3.2.1, the psychometric scales included in it were tested for scale reliability and validity.

4.4.2.1 Structural Equation Modelling (SEM) Overview. Structural equation modelling (SEM) is a method of multivariate analysis suitable for testing theoretical models inclusive observed as well as unobserved variables, endogenous and exogenous. It is a set of procedures that accounts for latent constructs in a correlation-covariances-based analysis and traces paths between all variables of interests (Schumacker & Lomax, 2010). With structural equation modelling, it is possible to test if data structures align with theorized constructs accounting for the underlying, unobserved, latent factors, and the relationship between a latent and its sub-latent components (Bollen, 1989).

Structural models comprise of measurement and path components (Schumacker & Lomax, 2010). Measurement models test the theoretical relationships between observed items and the underlying latent factors. Therefore, measurement models in SEM are used to perform confirmatory factor analysis (CFA). These models are sometimes referred to CFA models for simplicity (Acock, 2013).

Path or structure models are prediction or regression models that test the paths or linkages between variables or estimate the hypothesized effects of explanatory variables on outcome or response variables (Kline, 2016). Thus, causal inference can be drawn based on the results of the

path models. It is to be noted that causal linkages tested with SEM are theoretical in nature. If the data is consistent and supports the hypothesized structure model, the causal theory holds, otherwise not (Acock, 2013).

4.4.2.2 Scale Reliability and Validity. For this analysis, the outcome variable of interest, i.e., Digital Literacies, and three explanatory variables, namely Digital Nativity, Perceived Ease of Use, and Learning Goal Orientation, were measure through latent constructs. It was necessary to ensure that the designed constructs are appropriate for measurement of the intended concept or characteristic. Thus, reliability and validity analyses were conducted for all scales predicting latent constructs in this research (Bryman, 2012; Reynolds et al., 2021). For reliability testing, Cronbach's Alpha coefficient was calculated for each scale in the final estimation model (Cronbach, 1951; Nunnally & Bernstein., 1994). To test the constructs for validity, confirmatory factor analysis (CFA) was conducted using structural equation modelling (SEM). Before conducting the CFA, sample data had to be analysed to establish fitness for factor analysis. Sampling adequacy and sphericity were, thus, tested for each scale using the Kaiser-Meyer-Olkin (KMO) coefficient and the Bartlett's Test respectively.

For scale validity, two-order confirmatory analysis was conducted (Kline, 2016).. First, all psychometric items in the questionnaire instrument were included in the model to test for the model for each intended scale or variable. These scales included the three sub-latent factors or dimensions of the outcome variable Digital Literacies, namely Digital Information Literacy, Digital Problem Solving, and Digital Communication and Collaboration, and three psychometric explanatory variables, i.e., Digital Nativity, Perceived Ease of Use, and Learning Goal Orientation. First-order CFA was performed to confirm the structure of these individual six scales. Items that loaded statistically significantly on their respective intended factors and had a factor loading of 0.5 or

above were considered for the second-order CFA which accounted for the composite nature of the outcome variable, Digital Literacies. Similar statistical significance criterion was also applied to second-order CFA. Both models were assessed for goodness-of-fit (see Appendix C for criteria).

4.4.2.3 Empirical Estimation: Structural Equation Model. For empirical estimation of the effects of explanatory variables of interest on the outcome variable, Levels of Digital Literacies, the structural equation modelling (SEM) process of multivariate analysis was used. As described in the previous section, the final estimation model or the structural equation model comprised of two components: measurement analysis and path analysis models. The measurement model specified for the Second-order CFA was included in the final estimation model to account for complete structure of the latent and sub-latent factors. The path model integrated with it to complete the structural equation model followed the theoretical model outlined in Section 3.2.1. Mathematically, it could be written as follows.

$$\boldsymbol{DLs_i} = \boldsymbol{\beta_o} + \boldsymbol{\beta_1 DN_i} + \boldsymbol{\beta_2 PEU_i} + \boldsymbol{\beta_3 LGO_i} + \boldsymbol{\beta_4 SS_i} + \boldsymbol{\beta_5 Gender_i} + \boldsymbol{\beta_6 Schooling_i} + \boldsymbol{\beta_7 MaterialAccess_i} + \boldsymbol{\mu_i}$$

where,

DLs: Levels of Digital Literacies

DN: Digital Nativity

PEU: Perceived Ease of Use

LGO: Learning Goal Orientation

SS: Social Support, coded 0 for Informal Support and 1 for Formal Support

Schooling: Schooling Background, coded 0 for Private Sector and 1 for Public Sector

MaterialAccess: Material Access, coded 0 for No and 1 for Yes

β_o: Constant

β_k with k = {1 7} are the regression coefficients

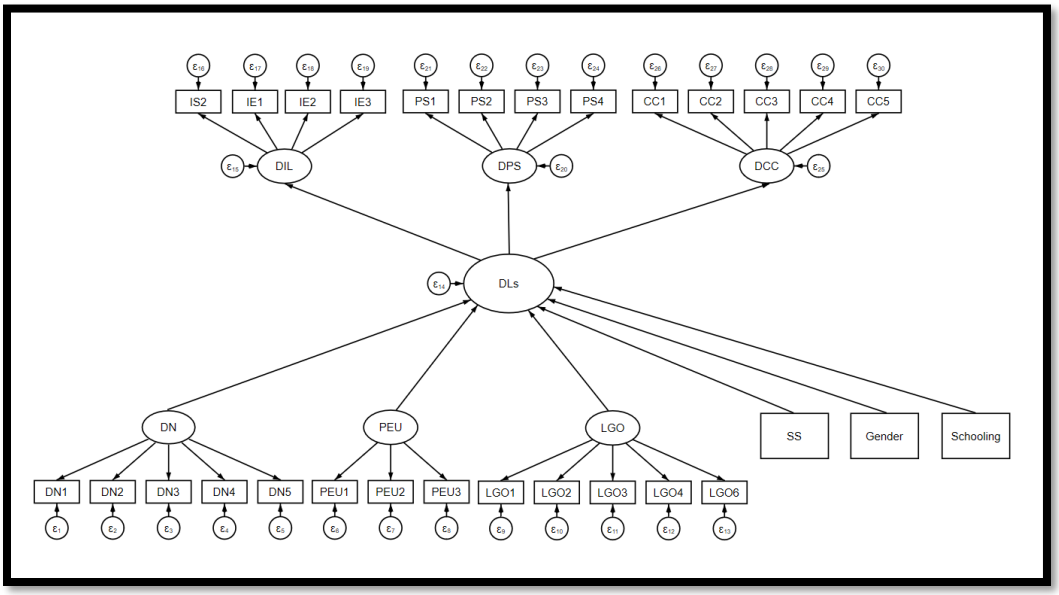
Subscript i = observation number such that i = {1 N} where unit of analysis is individual level

μ: predicted error term

Model Description: In the theoretical model of 'Determinants of Digital Literacies,' the outcome variable of interest, i.e., Levels of Digital Literacies is a latent variable, a composite of three sub-latent factors as conceptualized and tested for in Second-order CFA. The explanatory variables Digital Nativity, Perceived Ease of Use are also latent variables. The remaining explanatory variables, namely Social Support, Gender, and Schooling Background are observed variables. Moreover, in the final structural model, all variables are endogenous as they are explained by a predictor within the model, except the three observed variables of Social Support, Gender, and Schooling Background. The reference illustration of the full structural equation model, comprising of both the measurement and the path components, for this analysis is presented below.

Figure 4.2

Structural Equation Model Reference



Note: Ovals represent Latent Variables, Rectangles represent Observed Variables, Circles represent Error Terms, where SS, Gender, and Schooling are the only exogenous variables in the model.

For empirical analysis of the explanatories of digital literacies, three distinct structural models were estimated. The first specification referenced the theorized model illustrated in Figure 4.5. The second model included a covariate measuring individual's status of material access to digital technologies. The third model was a group-level analysis based on the second model where the data was grouped for the two higher education institutions represented in the sample. In other words, separate empirical estimates on determinants of digital literacies for the two institutions were obtained. The full structural models were also tested for goodness-of-fit (see Appendix C for criteria).

5. Qualitative Analysis: Findings and Discussion

This section delineates the findings of the first phase of this research which addressed the first two research questions (RQ1 and RQ2) outlined in Section 2.7. It presents stakeholders' insights from faculty and student representatives of the two selected HEIs operating in the district of Lahore. From thematic analysis of the stakeholders' interviews, four overarching themes pertinent to two specific dimensions of HEI Preparedness, i.e., Attitudes towards and Practices of Digital Literacies education, emerged. These themes were categorised as Familiarity with Terminology, The "IT" Perspective, Discipline-specific Literacies, and Perspectives on HEIs' Role in Students' DLs Development.

To put the findings of this phase into perspective, it is important to first define the context. To that end, relevant characteristics of the sampled HEIs are presented below.

5.1 HEI Characteristics

Two Lahore-based higher education institutions meeting the criteria specified in Section 4.2.2 were selected for this study, where the public and private sectors were represented by one HEI each. To define the context, HEI characteristics in terms of digitalization and Digital Literacies education were identified through a review of official websites and campus visits. Website reviews did not yield any results for written framework, policy document, or courses on Digital Literacies. However, both institutions included "Information Literacy" as an objective for student training through institutions' libraries. Lastly, no categorical mention of the term "digital" in the context of concern could be found on the websites; Through website reviews as well as campus visits, it was assessed that these universities had adopted digitalization of administrative and educational processes. Both universities hosted computer labs, digitalized libraries, IT helpdesks, campus-wide

internet connectivity, and in-class multimedia. Communication and organization through emails and learning management systems was in practice. Lastly, both universities offered an introductory course on Information and Communication Technologies to students enrolled in all undergraduate programs. It was assessed that in terms of access and digitalization, the two HEIs were quite comparable. Moreover, these universities represented the top-tier educational institutions in the city. Insights drawn from website reviews and observations during campus visits were validated during stakeholders' interviews.

5.2 Thematic Analysis: Findings and Discussion

Findings from the qualitative analysis conducted in Phase I of this research are presented and discussed below.

5.2.1 Theme I: Familiarity with the Terminology

Familiarity with terminologies and concepts served as the point of departure in Phase I of this research. It was enquired if the stakeholders, representatives of the teaching faculty or student fraternity of the selected HEIs, were familiar with terms commonly associated with digital-related literacies. To gauge surface level familiarity, three specific terms were selected. The rationale for selection was that these terms, namely Digital Skills, Digital Literacies, and Digital Competences (refer to Glossary for definitions), were generally used to refer to the literacies of the digital (Tinmaz et al., 2022).

Familiarity with the selected terminology was gauged at two levels, recognition and understanding. Respondents were first asked if they had heard or read the specified terms. Based on recognition, they were asked if they understood what a specific term referred to or entailed and if they were able to conceptually distinguish between the terms they recognized. While there exists

definitional ambiguity with reference to these concepts, basic criteria for conceptual differentiation were set based on existing literature (refer to Glossary for concept definitions).

5.2.1.1 Recognition. At the basic level, findings revealed that "Digital Skills" was the most widely recognized term among the interviewed faculty and student representatives. All respondent noted that they had "heard" or "read" the referenced term somewhere. The primary terminology of interest in the context of this research, i.e., Digital Literacies, seemed to be well-recognized too. However, the students appeared more familiar with the term compared to the faculty representatives. The term "Digital Competence" was recognizable for a few students and teachers as well. It is to be noted that the terms Digital Competences and Digital Literacies were largely recognized by the same respondents.

5.2.1.2 Understanding or Conceptual Differentiation. In terms of understanding, majority of the respondents categorically stated they could not distinguish between the terms or define them conceptually. It was assessed that the respondents had no formal conceptual orientation. Resultantly, they could not readily explain what a certain term meant, implied, or included per their understanding or even opinion. For instance, a faculty representative, an assistant professor of Business Studies, who could recognize all three terms remarked,

> *"Digital Skills is a buzzword. It is used everywhere these days. I have only heard the other two terms so, I may not be able to distinguish what digital skills, literacies, or competences specifically are."*

Faculty representatives generally perceived Digital Literacies to be technical, i.e., related to the know-how of using digital devices or software to accomplish a task which could be classified as IT or Computer Literacies or Digital Skills. To add to that, multiple faculty members highlighted

that these terms specific to the concept of "digital" were not used in their immediate academic circles representing their institute. Their comments implied that the term "Digital Skills" may be used but without conceptual specificity.

Majority of the student interviewees noted that the term "digital" was generally considered to be a more sophisticated 'synonym' for everything that is "ICTs" in their academic settings. However, in their opinion, the term "digital" encompassed much more than devices or even software. This perspective was widely endorsed by other student respondents as well. Although they could not discern between skills, literacies or capabilities, and competences of the digital, it was understood that these terminologies did not synonymize existing jargon, rather denoted theoretical evolution in the field.

When offered explanation on each of the concepts, some of the students commented that they could "make sense' of the differences being outlined. However, they noted that they could not make the differentiation on their own. One student, an Economics major at the selected private sector HEI, referred to conventional literacies to differentiate Digital Skills and Digital Literacies to explain that,

"It is like the general concept of literacy. Reading is a literacy skill not literacy itself. Making sense of what is read and contextualizing it is literacy. Knowing how to use an app or a device feature is a skill. Knowing when to use it and when not to use it is literacy."

This perspective aligned with the premise of convergence of the general concepts of literacy skills with those of the digital. Moreover, existing literature posited that many, if not all, concepts of Digital Literacies predate the introduction of digital technologies itself. These concepts included but were not limited to information literacy, creative thinking, problem solving, etc. (Ala-

Mutka, 2011). The general or conventional skills overlap with the skills of the digital to an extent that the distinction between the two has depleted in the 21st century economy and society (van Laar et al., 2017).

5.2.1.3 Sources of Student's Familiarity with the Terminology. Lastly, it was assessed that all the interviewed students had been familiarized with the terms, they recognized, outside the academic settings. All student representatives noted that they heard or read the terms in an informal discussion or online. One student, an economics senior representing the public sector HEI in the sample, who could only recognize the term "Digital Skills" shared that a government-sponsored digital skills training initiative's promotional advertisement introduced them to the concept.

5.2.1.4 Recognition for Importance of Familiarity with the Terminology. Overall, regardless of their personal level of orientation to the terminologies or concepts, all the respondents agreed that familiarization with the concepts of the digital was important. A faculty representative noted that "familiarity with" and "use of terms" could prove instrumental in determining how the education system perceived and adapted to meet the newer challenges. A faculty representative from the department of Business Administration at the selected private sector HEI observed that trends and vocabularies should not be discounted as *"buzzwords' without exploring their conceptual scope and specificity."* It was reasoned that jargon, in any field, seldom evolved without theoretical groundwork. Therefore, it was deemed essential to identify what the terms of digital conceptualized, implied, and warranted, which in the respondents' opinions was not practised in the higher education system in the country. Furthermore, conversations with both teachers and students revealed that experiences of the accelerated digitalization of educational, economic, and social processes, particularly in the wake of the coronavirus pandemic, did not

appear to have respondents' outlook on the concepts of Digital Literacies in terms of conceptual orientation.

5.2.2 Theme II: The "IT" Perspective

Qualitative enquiry through in-depth interviews of faculty and student representatives showed that the domain of focus in the higher education institutions was "IT" and "IT Skills" not "digital." Several faculty representatives highlighted that the commonly recognized and used terminology in the academic settings, in both formal and informal exchanges, was "IT Skills" or sometimes "Software Skills." Familiarity with and usage of these terms reflected in the perspectives on institutional approach, curriculum design, and instruction.

5.2.2.1 An IT-oriented Culture. All the interviewed faculty representatives positively observed that their respective institutions and departments considered "IT Skills" an essential component of undergraduate education. Faculty representatives held that there was a collective realization that "IT Skills" had become an "industry requirement." With reference to institutional approach to Digital Literacies, it was emphasized that the HEIs had "digitalized the systems" including administrative systems, learning management systems and libraries. It was highlighted that the HEIs had invested in 'computer labs,' provided campus-wide "access to broadband internet," and ensured necessary integration of "multimedia technologies in the classrooms" to ensure that students had unconditional access and exposure to the "digital environment." A faculty member of the Business Administration department at the selected public HEI commented,

> *"It is a part of our institution and department's policy to focus on digitalization and promote IT-oriented culture in our organization. That also includes teaching necessary IT skills to our students."*

5.2.2.2 Insights on Learning Objectives from Faculty Representatives. In line with the above observations, faculty representatives were asked about the institutional policy and program-specific learning objectives related to Digital Literacies education. Respondents underlined development of "necessary IT or Software Skills" as an institutional policy and significant learning objective pursued by respective academic departments. A faculty representative of the department of Physics at the private university included in this study noted,

> *"These skills are essential for students now. Therefore, we have included IT Skills in our learning objectives and integrated them in our course work. We introduce our students to all the software that are now required in the industry. There are also compulsory IT courses, basic courses, for students to take in the initial semesters."*

While Computer Science could fundamentally be considered a technical discipline that drives the 'IT' innovation, the above highlighted theme emerged in discussions with all other departments as well, namely Business Administration, Economics, and Physics. For instance, faculty representatives of the Economics departments at both selected universities noted that their students were equipped with essential skills pertinent to 'sophisticated' data analysis software and databases. In the context of subject-specific curricula, it was highlighted that software specific to analysis of a particular type of data were at least introduced if not trained for, such as geographical information system packages for geospatial data in Urban Economics courses. It was highlighted that software and tools were selected based on the knowledge of industry trends and requirements.

5.2.2.3 Students' Views on Tools-specific Focus Curriculum. Insights shared by student representatives supported the assessments on institutional approach and narrow focus on software and software skills in curriculum. It was observed that the mandatory introductory courses on information and communication technologies taught to students across all departments, in both

institutions, primarily cantered on what could be categorized as "computer literacy" or "IT literacy." Student respondents shared that the course content comprised of introduction to computer hardware and software and basic computer processing along with training modules for operational skills related to the office suite. It was noted that the mandatory course(s) did not account for conceptual orientation to non-technical domains, such as information evaluation or digital goods. Student representatives held the view that in the context of Digital Literacies, their degree programs and individual courses had a unidimensional focus on operational or technical skills. A transition from skills for essential software to skills for discipline-specific sophisticated tools was, however, well noted. The mandatory IT courses covered basic hardware and software while the subject-specific courses included relevant software in the applied or practical modules.

The 'how-to' approach of the introductory courses which confines the scope to technical skills outlines how conceptual orientation shaped perspectives and practices of Digital Literacies in educational settings. Dominant usage of the terms "IT Skills" and/or "Software Skills" in the relevant spheres confined the curricular focus to technical skills. These courses could be considered as aimed at developing "computer literacy" or "IT literacy". Literature on the subject outlines "computer literacy" or "IT literacy" as the technical component of Digital Literacies (Ng, 2012). Whether considered as a pre-condition for developing Digital Literacies or an elementary component of the concept itself, the scope defined for computer or IT literacy is technical. These skills are theoretically differentiated from Digital Literacies, despite definitional inconsistencies) which are deemed as abilities inclusive of the non-technical and cognitive domains (Bawden D. , 2008).

5.2.3 Theme III: Discipline-specific Literacies

5.2.3.1 Integration of Digital Literacies Concepts in Curriculum. To better comprehend the scope of undergraduate curricula in the higher education institutions represented in the sample, students' familiarity with non-technical digital terminologies or concepts was gauged. Questions related to select concepts of the digital were asked. These concepts represented certain non-technical skills or relevant concepts in the digital context. It was enquired if student representatives could recognize these terms and if these concepts were integrated with the curriculum.

The five distinct concepts included Digital Goods, Digital Ethics, Digital Storytelling, and Digital Citizenship (see Glossary for Definitions). These concepts were selected because they connoted broad-based knowledge in the context of digital literacies. Furthermore, these concepts could be integrated into the standard curriculum across disciplines whether through discipline-specific courses or general courses forming the undergraduate degree courses, primarily the introductory courses on information and communication technologies.

5.2.3.1.1 General Curriculum: Lack of Broad-based Approach. Qualitative enquiry revealed that broad-based approach to developing Digital Literacies across discipline was lacking. None of the students had been introduced to any of the referenced terminologies or relevant concepts through the general components/courses comprising their respective undergraduate programs. Student representatives noted that the general or non-subject-specific courses which formed important degree credentials did not cover any of the concepts mentioned during the discussions.

Table 5.1

Integration of Digital Concepts in Curriculum

Concepts	Curriculum

	Business Administration	Computer Science	Economics	Physics	General IT Courses
Digital Citizenship	✕	✕	✕	✕	✕
Digital Ethic	✓	✓	✕	✕	✕
Digital Goods	✕	✕	✕	✕	✕
Digital Storytelling	✓	✕	✕	✕	✕

Note: ✓ indicates concept included in curriculum, ✕ indicates concept not included in curriculum

5.2.3.1.2 Subject-specific Curriculum: Inconsistencies Across Disciplines. In-depth discussions on course content with both students and teachers elicited the undergraduate curricula for selected majors across both institutions sought to foster discipline-specific literacies. However, even with this approach, inconsistencies in coverage of relevant concepts across disciplines were identified.

Students from the disciplines of Business Administration and Computer Science reported to have been familiarized with the concepts of Digital Ethics within their academic circles. Computer Science students across both institutions revealed that they were taught particular courses covering 'professional practices' in the 'industry' which covered the relevant concepts. Business Administration students noted that they had been introduced to some concepts which aligned with the concept of Digital Ethics in their courses on 'business ethics.' Similarly, only Business Administration students studied Digital Storytelling during their undergraduate courses on Digital Marketing. Economics and Physics students had either been familiarized with the concepts due to their personal engagements or had never heard of the term. Referring to the concept of Digital Goods, Economics students noted that they had never heard of the term in any discussions on relevant economics concepts, such as public goods, intangible goods, property rights, etc. Student representatives from the Physics department, on the other hand, revealed that

none of the discussed concepts of the digital were included in their subject-specific curriculum. They believed that digital concepts were not covered in their curriculum because they were not deemed important in the context of their field. In line with that, Business Administration and Computer Science student representatives also thought that they were only taught the digital concepts which were considered a core component of the contemporary subject knowledge.

These observations paralleled with other studies of Digital Literacies approaches in educational settings which show that the technical or operation content dominates learning policies where discourse remains discipline-specific (Hinrichsen & Combs, 2014; Sánchez-Caballé et al., 2021). The discipline-specific focus on Digital Literacies education aligned with the "literacies across disciplines" model postulated by Alexander et al (2016). However, it was assessed that all undergraduate programs in all disciplines were not at par in terms of discipline-specific literacies and a broad-based approach to Digital Literacies education was found lacking.

5.2.3.2 Perspectives on Digital-specific Literacies. Stakeholders' perspectives on why the curriculum was more focused on discipline-specific coverage of digital concepts and related inconsistencies were studied. Employability focus of HEIs' policies and classical approach to teaching were identified as two main reasons.

5.2.3.2.1 Faculty Observations: Employability as a Policy Objective. Discussions with the faculty representatives highlighted graduate employability was the primary reason for accentuated focus on discipline-specific tools and concepts. Digital Literacies were considered important for undergraduate students as the future workforce because refined 'IT Skills' enhance employability. Commenting on employability skills and discipline-specific demands, faculty representative of the department of Economics at the selected private sector university said,

"The field is growing more sophisticated by the day. Industry demands are changing. Economics graduates are required to have proficiency in data science software. So, our program includes specialized courses on data analysis and econometrics which equip students with relevant skills."

Employability of graduates, which refers to their ability to acquire jobs, has become a key objective of higher education policies around the globe (Teichler, 2009). It accounts for knowledge, skills, and the ability to adapt and cope with changing workplace. It is considered to be an immediate outcome of a candidate's education and skill training. While there is no clear consensus what employability skills entail, digital literacies are now considered fundamental for economic and social participation (Bejaković & Mrnjavac, 2020). The 21st century workplace essentially requires technical or hard and non-technical or soft skills which include skills and concept knowledge of the digital (van Laar et al., 2017). Therefore, the significance of equipping students with discipline-specific technical skills cannot be understated, However, broad-based approach to developing critical literacies of the digital is imperative.

5.2.3.2.2 Student Views: Conventional Approach to Teaching. Discussions with the student representatives highlighted that instruction in undergraduate education exhibited the same specificity as the curriculum. While the curriculum was assessed as discipline-specific and focused on software-specific/technical skills, instruction took a 'conventional' approach per the students' opinions. Students from all disciplines, from both institutions, observed that classroom discussions tended to encircle conventional references, examples, and ideas. Discussing the subject, an Economics senior at the selected private sector HEI noted:

"Their approach is very classical. Our classroom discussions have not evolved. We discuss topics in the contexts developed half a century ago, relying on textbooks that seldom

> *upgrade content. Taking a cue from our discussion here, I remember our case study on property rights was about a random ranch in North America. We could have discussed online blog posts that everyone reads, shares, or even copies, every day, or something like that."*

Students believed that course content could be altered to integrate relevant Digital Literacies without a complete overhaul or introduction of new courses. It was iterated throughout that the course content needed to be reconsidered and upgraded as often as the software and tools-specific skillset.

Instructors' awareness and attitudes towards teaching and learning subject-specific content was viewed as important in bringing about the necessary change. It was reasons that the content and context of classroom discussions and course materials were teachers' individual prerogative in most cases. Therefore, their personal approach mattered as much as the institutional policies. Discussions with faculty representatives also hinted at conventional approach to teaching and lack of orientation to the concepts and literacies of the digital.

These observations were in line with the exiting literature that underscored the importance of teaching faculties' digital literacies orientation as a consequential factor in effective DLs education (Coldwell-Neilson, 2018; Gutiérrez-Ángel et al., 2022). It has been argued that teachers' beliefs and attitudes influence their teaching approach and practices (Inan & Lowther, 2010) which ultimately impacts students' learning. Further evidence suggests that teachers' attitudes affect their own digital literacy development (Alanoglu et al., 2022) and integration of digital literacies, related concepts and application, in classroom practices (Sadaf & Johnson, 2017) which has implications for digital literacies education of the students (Coldwell-Neilson, 2018; Littlejoh et al., 2012).

5.2.4 Theme IV: Perspectives on HEIs' Role in Students' DLs Development

5.2.4.1 Faculty Perspectives: The Role of Access and Personal Attributes. Discussions with faculty representatives on higher education's prospective role in developing young adults' digital literacies reflected a bearing of the institutional policies. It was posited that HEIs were responsible for preparing students for the "practical" life awaiting upon graduating. To the end, it was essential that they acquired knowledge in the areas of their academic specialization and built relevant skillsets. In the context of literacies or competences of the digital, there was an across-the-board understanding that students must be familiarized with the latest industry trends in software and technology use.

On the question of non-tools-specific or non-technical domains of digital literacies, access to digital devices and media were seen as the primary requisite. It was argued that the higher education institutions could foster an IT-oriented culture through digitalization of all organizational processes – administrative and educational, which they observed were the case in their institutions. Discussions on the subject implied that students were expected to develop these abilities, attitudes, and practices through exposure and experience. In other words, faculty representatives believed that development of literacies responsible for effective, ethical, and meaningful engagement with digital technologies and spaces followed a natural curve of progression. Besides access, it was argued that students' personal factors, such as attitudes and motivation, played a role in development of relevant abilities of the digital. A Business Administration lecturer commented,

> "Universities teach subject knowledge and prepare them for the field. Besides that, their role is rather limited. Also, young people these days are always surrounded by digital devices, they are always online. They explore and learn a lot on their own."

Corroborating the earlier observations on the significance of instructors' attitudes (Section 5.2.3.2.2), these views affected how digital literacies were taught at the undergraduate level. Information Literacy, which is a core domain of Digital Literacies, was widely recognized by the faculty representatives interviewed for this research. They were able to conceptually identify the ability to "search" and "meaningfully use" information. However, it did not appear that any of the faculty representatives integrated the concept in their in-class discussions beyond its technical domain which remained confined to basic introduction to 'keyword search' for research students across all departments. Furthermore, students were generally given a list of 'databases' or 'research journals' to extract publications for their academic work according to their fields of study. In other words, students were given some understanding of how to search for relevant information and introduced to 'reliable' research and data resources. In addition, it was noted that students were generally oriented to these methods and resources once during their 'research' courses. For any further assistance, students could rely on libraries or the institutions' IT helpdesks. The cognitive elements of Information Literacy, particularly in the digital context, were not focused on. No faculty representative responded positively to questions about instruction on information validation, critical evaluation, et cetera.

5.2.4.2 Student Perspectives Personal Resource Gaps and the Need for Formal DLs Education in HE. Students' views elicited a general understanding of the need for formal introduction to the literacies of the digital at the undergraduate level. It was argued that even if the economic and workspace dimensions of digitalization were considered, while ignoring the increasingly pressing challenges of social digitalization, non-technical skills, and concepts of the digital were essential for all. These competences and concepts were considered absent from the formal learning environment provided by higher education institutions. While the changing nature

of tools, technologies, and software for each industry was considered in formal HE, students felt that the necessity of developing non-technical digital abilities was not comprehended. The ability to find, manage, evaluate, use, and share digital data and information, meaningful communication for ideation, collaboration, and networking, and ethical digital behaviours were seen as essential for all.

However, the interviewed students did not perceive that their fraternity were properly equipped. They noted that non-technical literacies were not accounted for in classroom discussions and formal learning environments. While couple of student representatives believed that these abilities and mindsets could be developed over time., most student representatives believed otherwise. They observed that academic orientation to concepts such as information validity or awareness did not always translate into routine behaviours which has adverse social implications. A Business Administration senior representing the public sector university in the sample shared their perspective saying that,

> *"We engage with digital data and information all day long. It's not always in the academic context. Even if people can find the information they need, I don't think anyone pays attention to its reliability and usability. I don't either. Worse yet, most people don't think it through and that's a problem."*

Students also did not perceive access to be an adequate condition for developing essential literacies of the digital. Their views were based on general observations and experiences in the digital spaces, particularly during the coronavirus pandemic. The overall sentiment was that the lockdown experiences trained the already existent reflex to search for information and problem solutions through digital sources or engage with digital forms of information and data; however, the cognitive aspects of evaluation, assessment, sense-making of the found information did not

develop. Several students noted that increased self-dependence during the lockdowns helped them develop skills for solution search for academic and non-academic needs. However, these observations were embedded with a significantly negative self-perception of individual attitudes or abilities required for evaluation, validation, synthesis, or sense-making processes. Similar observations were drawn out on the subject of communication in the digital environment. Although digitalization of communication and collaboration processes within academic settings provided the required access and exposure, it wasn't seen as sufficient. Introduction to relevant tools did not support effective communication and collaboration in the digital space. Most of the students believed that communication and collaboration in the digital context for expression, ideation, and networking were not emphasized in their academic environments. Unbounded access to digital media and technologies did not foster the creative and critical skills required for meaningful and effective digital communication.

With respect to students' personal attributes and resources for DLs development, students deemed higher education's role as crucial in developing necessary Digital Literacies of the next generation of workforce and citizenry. From their viewpoint, most individual did not have the resources or exposure to understand and invest in developing their Digital Literacies. That gaps in personal resources would lead to gaps in literacies, appropriation, and outcomes. Personal factors such as background, motivation, and attitudes, could be deterministic; however, the role of a conductive learning environment could not be understated. A Business Administration senior representing the private sector HEI in this study shared his thoughts as follows:

> *"If left to individuals, only the aware, or motivated, and capable people will invest in their digital skills, or literacies. People who don't have the resources will be left behind. That*

will affect them and the country as a whole. Higher education can help close these gaps. It has a huge role to play."

Insights from this qualitative assessment indicate that the faculty representatives' opinions on developing students' non-technical Digital Literacies confirm to the Digital Nativity theory (Pensky, 2001a, b). However, existing research provides evidence against general, broad-based assumptions on acquisition of Digital Literacies and related skills based on individuals' age or generation identification (Burton et al, 2015). The perspective on the significance of individual-specific factors is, however, in not uncommon either (Helsper & Eynon, 2013; Selwyn, 2009; Zhao et al., 2021) and aligns with Resources & Appropriation Theory (van Dijk, 2005) (see Section 3.1.2). Gaps in students' perceived significance of digital literacies education and its extent of coverage in undergraduate curriculum is also evidenced in research (Smith & Storrs, 2023). Students' for rethinking amplified focus on tools and devices and embedding of practices in digital literacies education also remains consistent (Miguel-Angel, et al., 2018).

5.3 Summary of Qualitative Findings

Insights drawn from qualitative interviews of two key stakeholders in higher education – teaching faculties and students – illustrated that Digital Literacies landscape in the sector is underdeveloped. The findings could be summarized as follows:

- The term "Digital" itself was not fully understood in its theoretical context as an evolution of an entire ecosystem that overlapped with the conventional ways of life, economic and social.

- Within the HEIs, the focus was narrowly static on "IT Skills" or "Software Skills" which are fundamentally only one dimension of Digital Literacies, in both general and discipline-specific components of the curriculum.
- Computer Science and Business Administration faculties fared relatively better on integration of discipline-specific non-technical literacies of the digital. However, practice was rather non-existent in Economics and Physics departments across both institutions.
- Classroom discussions seemed to take classical approach towards subject matter while the curriculum did not appear to integrate relevant digital concepts.
- Majority of the students got familiarized with concepts of Digital Literacies outside their non-academic spheres.
- Instructors saw higher education's role as confined to developing discipline-specific skills whereas the non-technical literacies followed a natural curve affected primarily by access and exposure.
- Students noted from their experiences, particularly from the coronavirus pandemic lockdowns, that unconstrained access did not improve non-technical DLs.
- Student representatives highlighted gaps in personal resources of individual and saw HE's role as significant in developing general and non-technical Digital Literacies among students as much as the discipline-specific and technical literacies.

It should be noted that despite some differences in opinions and elicited emphasis on Digital Literacies development across disciplines, faculty and student responses were generally aligned and uniform. Moreover, the responses across the two sampled HEIs could not be differentiated.

6. Quantitative Analysis: Findings & Discussion

Following up om the findings of the qualitative component of the research, the acquired levels of digital literacies of the undergraduate students enrolled in the two selected universities were assessed in Phase II. Furthermore, pertinent factors of access, mental, and social factors affecting the said outcomes were also explored. Selection of dimensions of Digital Literacies and determinant factors for this analysis were based on the insights from stakeholders' interviews. The findings presented in this section addressed RQ3 and RQ4 posited in Section 2.6. Respondents' characteristics, summary statistics, and results of the descriptive and multivariate inferential analyses are presented and discussed below.

6.1 Respondents' Characteristics

Utilizing the convenience sampling technique, data for quantitative analysis in this research was collected on 200 undergraduate students. The sample was selected based on the criteria specified in Section 4.2.2. Sample demographics are summarized below.

Table 6.1

Respondents' Demographics

Variable	Category	n (N = 200)	Percentage (%)
HEI	Public Sector	100	50.0
	Private Sector	100	50.0
Field	Hard Sciences (HS)	100	50.0
	Soft Sciences (SS)	100	50.0
Discipline	Computer Science (HS)	59	29.50
	Physics (HS)	41	20.50

	Business/Management (SS)	49	24.50
	Economics (SS)	51	25.50
Year/Grade	Junior Year	71	35.50
	Senior Year	129	64.50
Gender	Female	73	36.50
	Male	127	63.50
Schooling Background	Public Sector	45	22.50
	Private Sector	155	77.50

Note: n = Number of Respondents or Frequency, N = Total Sample Size

The final sample used was balanced across the two selected higher education institutions (one public and one private HEI) and academic fields (hard or soft sciences). By academic discipline, Computer Science students formed the largest part of the sample, followed by Economics and Business Administration, whereas Physics representation was the least. Sample could not be balanced across enrolment year or by gender due to low response rates. Moreover, the mean age of the sample was 21.74 years. Lastly, over two-thirds of the sample had completed their schooling from a private institute.

Table 6.2

Statistics on Digital Access

Variable	**Category**	**n (N = 200)**	**Percentage (%)**
Device Ownership	Smartphone	200	100.00
	Laptop PC	52	26.00
	Desktop PC	81	40.50
	Tablet PC	177	88.50
	Multiple devices	183	91.50

Internet Access	Broadband/Wi-Fi	173	86.50
	Mobile Internet	177	88.50
	Portable Device	98	49.00
	No Internet	4	2.00
Timesharing	No	94	47.00
	Yes	106	53.00
Social Support	Informal Support	178	89.00
	Formal Support	22	11.00

Note: n = Number of Respondents or Frequency, N = Total Sample Size

In terms of digital access, all respondents reported ownership of a smartphone, while only 2% of them reported not to have access to any type of internet connection (broadband/Wi-Fi, mobile internet, or a portable internet device. Less than 10% of the sample did not own more than one digital device. Moreover, over half of the respondents reported that they shared their personal devices (smartphones, laptops, desktops, tablets, or portable internet devices) with parents or siblings. Lastly, a prominent majority of the respondents reported primary or first-choice reliance on informal social support systems, from friends, family members, internet communities or acquaintances, when faced with a problem related to digital technologies and media.

6.2 Summary Statistics: Explanatory Variables

Univariate analysis was conducted for the explanatory variables in the empirical model to describe the sample data. Digital Nativity (DN), Perceived Ease of Use (PEU), Learning Goal Orientation (LGO), and Material Access (MA), measures of central tendency (mean) and dispersion (standard deviation) as well as minimum and maximum values were computed for respective scales. For descriptive analysis, the mean scores for Digital Nativity, Perceived Ease of Use, and Learning Goal Orientation were generated by averaging the summated items score.

Material Access was measured through a score variable from indicators of device ownership (described in the previous section).

Table 6.3

Summary Statistics of Explanatory Variables

Variable	N	No. of Items	Mean	SD	Min	Max
DN	200	5	5.16	1.02	1	6
PEU	200	3	4.86	1.04	1	6
LGO	200	6	4.64	0.92	1	6
MA	200	4	2.55	0.90	1	4

Note: N = Number of Observations, DN = Digital Nativity, PEU = Perceived Ease of Use, LGO = Learning Goal Orientation, MA = Material Access

The sampled individuals enjoyed high levels of access and exposure to digital technologies and media in their daily lives. Furthermore, the level of comfort in interacting with these technologies, measured by Perceived Ease of Use, is also considerably high as illustrated in sample means on Material Access and Digital Nativity. Perceived Ease of Use was fairly high as well. Lastly, in terms of personal motivation to learn and develop skills, the sample fares quite well.

For the explanatory variables of categorical nature i.e., Social Support, Gender, and Schooling Background, the frequency distributions are presented above. Notably, it was found that most of the respondents sought informal social support when encountered with problems using digital tools or media. Delving into it, a bivariate analysis of Social Support with Gender and Schooling Background was conducted. It was done to establish if personal and positional categories affect individuals' reliance on informal versus formal sources of information and

assistance with reference to engagement with digital technologies and media. Results did not illustrate statistically significant variations across genders or schooling backgrounds (at 5% level of significance).

Table 6.4

Relationship between Social Support and Personal & Positional Categories

		Social Support		
Variable	**Category**	**Informal Support**	**Formal Support**	**p-value**
Gender	Female	93.15%	6.85%	0.155
	Male	86.61%	13.39%	
Schooling Background	Public Sector	82.22%	17.78%	0.099*
	Private Sector	90.97%	9.03%	

**p < 0.1, **p > 0.05, ***p < 0.01*

6.3 Levels of Digital Literacies

In this descriptive analysis, levels of Digital Literacies of undergraduate students in the sample were elicited through mean scores. Average aggregate levels of Digital Literacies, average levels by constituent dimensions and sub-domains, as well as levels by demographics and disciplines were analysed.

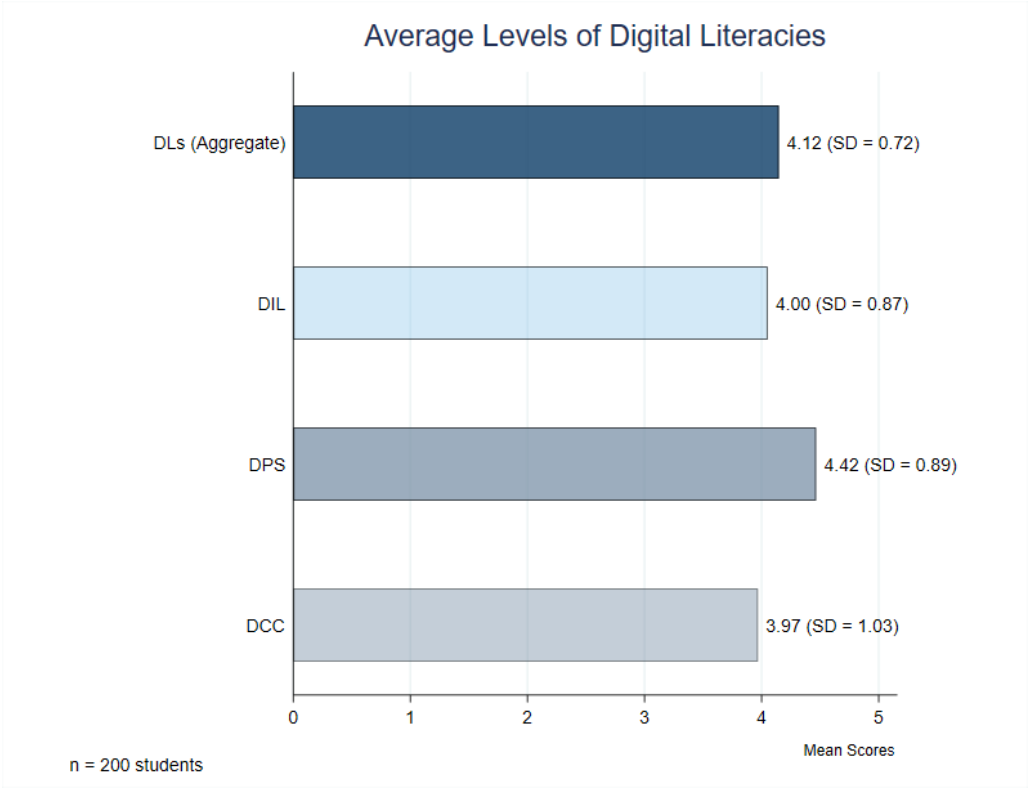
6.3.1 Average Levels of Digital Literacies

For the composite measure of Digital Literacies (DLs) as well as the three dimensions of interest, namely Digital Information Literacy (DIL), Digital Problem Solving (DPS), and Digital Communication and Collaboration (DCC), mean scores were generated by calculating averages of the aggregated item scores. All constituent indicators were measured on 6-point Likert-type items.

Figure 5.1 provides a graphical representation of the Average Levels of Digital Literacies calculated for the total sample.

Figure 6.1

Average Levels of Digital Literacies



Note: DLs: Digital Literacies, DIL: Digital Information Literacy, DPS: Digital Problem Solving, DCC: Digital Communication and Collaboration

For the aggregated or composite variable on Digital Literacies, where all items were measured on a 6-point Likert scale, the mean score was calculated as 4.12 with a standard deviation of 0.72. This indicated that the respondents were fairly digitally literate. Considering the scores across the three selected dimensions of Digital Literacies, aggregated to form the final composite measure, showed some variability. According to the mean scores calculated for each dimension,

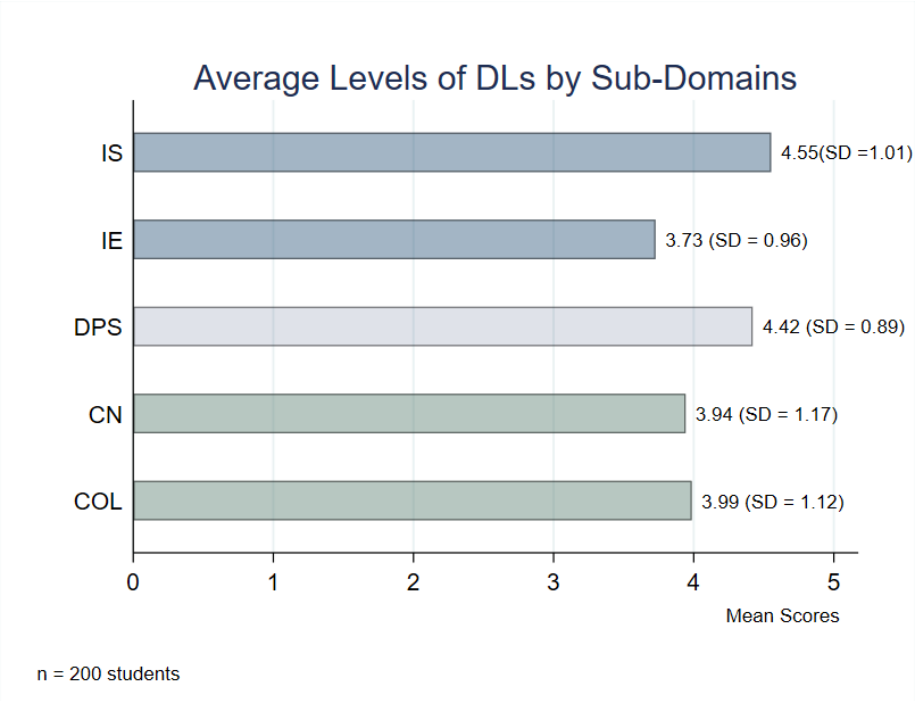
the respondents fared strongest on Digital Problem Solving (mean = 4.42). The average level of Digital Information Literacy for the sample was calculated to be 4.00. The sample fared the weakest on Digital Communication and Collaboration skills with a mean score of 3.96. Standard deviation measures for all scores, for the aggregate variable as well as the constituent dimensions, were lower than one point, except for Digital Communication and Collaboration for which it was measured to be 1.03 points. Standard deviation measures closer to zero indicate small dispersion in the data points and data is less likely to be subjected to outliers or extreme values on both ends. This indicated that the variability in respondents' acquired levels of Digital Literacies was low, and the scores were rather consistent.

6.3.2 Average Levels of Digital Literacies by Sub-domains

To further contextualize the variability in the Average Levels of Digital Literacies, scores across the three dimensions were probed further. To that end, the sub-domains within the dimensions of Digital Information Literacy and Digital Communication and Collaboration were disaggregated (Digital Problem Solving did not comprise of any conceptually distinguishable sub-domains). Digital Information Literacy comprised of two sub-domains, namely the operational domain of Information Search skills (IS) and the cognitive domain of Information Evaluation skills (IE). Digital Communication & Collaboration comprised of the social domains of Networking (CN) and (Creative) Collaboration (COL). Average levels of literacies or skills per domain are graphically presented below.

Figure 6.2

Average Levels of Digital Literacies by Sub-domains



Note: IS: Information Search, IE: Information Evaluation, PS: Problem Solving, CN: (Communication for) Networking, COL: Collaboration

Univariate analysis of Average Levels of Digital Literacies for the sample of interest uncovered the operational domain of Information Search skills (IS) as the respondents' strongest suit while they fared the weakest on the cognitive domain of Information Evaluation skills (IE). Analysis also showed that the students did not have enough adeptness in communication for collaboration and networking. Standard deviation measures in approximation of one point illustrated that there was some variability in the sample scores on each sub-dimensions; however, there was the likelihood of having extreme values or outliers was still limited.

6.3.3 Average Levels of Digital Literacies Across Demographics

To gauge the levels of Digital Literacies across various demographic groups, bivariate analysis was conducted for Average Levels of Digital Literacies on aggregated scale with Gender and Schooling Background. Summary statistics across demographic categories were analysed and the t-test for statistical significance of comparison of means was also carried out. Results showed that the type of educational institutions students were attending at the HE level or had attended prior to their Undergraduate programs were the most significant demographic predictors of their Digital Literacies development. Moreover, within the sample, no statistically significant differences could be found between the average acquired levels of Digital Literacies among the undergraduate juniors and seniors. The result was consistent within the two HEIs as well (see Appendix D).

Table 6.5

Average Levels of Digital Literacies Across Demographics

Variable	N	Category	Mean	SD	p-value
HEI	100	Public Sector	3.86	0.77	0.000***
	100	Private Sector	4.38	0.57	
Year/Grade	71	Junior Tear	4.13	0.09	0.865
	129	Senior Year	4.12	0.06	
Gender	73	Female	4.02	0.89	0.143
	127	Male	4.18	0.68	
Schooling Type	45	Public Sector	3.93	0.71	0.038**
	155	Private Sector	4.18	0.73	

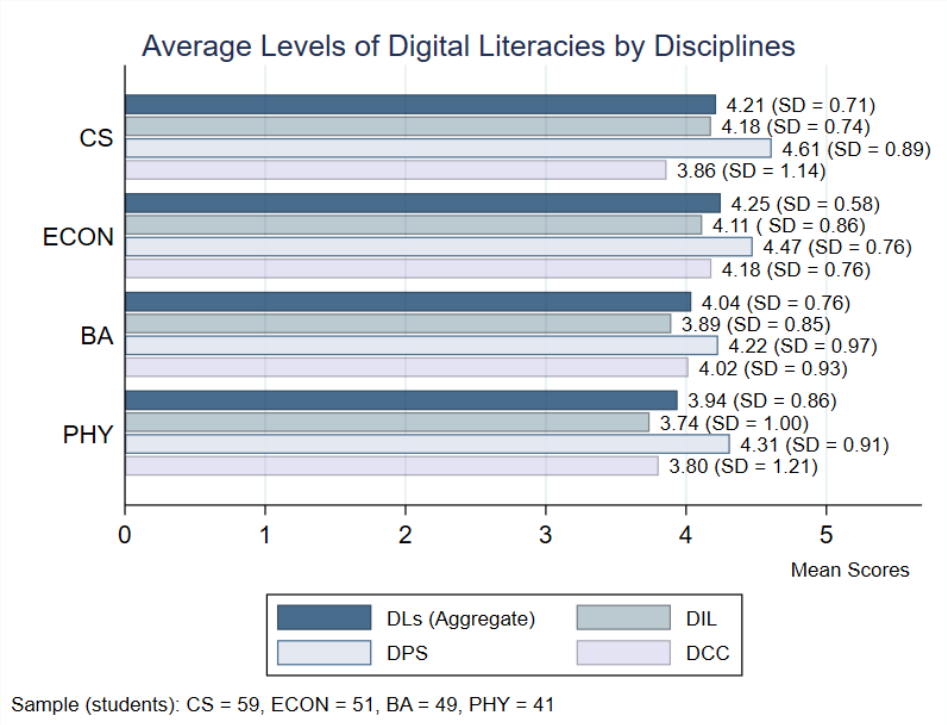
**p < 0.1, **p > 0.05, ***p < 0.01*

6.3.4 Average Levels of Digital Literacies by Disciplines

Variation in average levels of Digital Literacies across disciplines of study, i.e., the undergraduate majors, represented in sample was also examined. Data showed that Economics majors had the highest average levels of Digital Literacies whereas Physics students had the lowest average levels of DLs. For further context, breakdown of average scores by sub-dimensions of Digital Literacies were also explored. As illustrated in Figure 6.3, Computer Science students recorded the highest mean score on Digital Information Literacy and Digital Problem Solving Skills. Economics students had the highest mean score o on Digital Communication and Collaboration scale. While Physics students ranked the lowest on Digital Information Literacy and Digital Communication and Collaboration, Business Administration students scored the lowest on Digital Problem Solving dimension of Digital Literacies.

Figure 6.3

Average Levels of Digital Literacies by Disciplines



Note: CS: Computer Science, ECON: Economics, BA: Business Administration, PHY: Physics, DLs: Digital Literacies, DIL: Digital Information Literacy, DPS: Digital Problem Solving, DCC: Digital Communication and Collaboration

6.4 Scale Reliability and Validity

6.4.1 Reliability Analysis

To test the reliability and internal consistency of respective scales for both outcome and explanatory variables, Cronbach's alpha was analysed. For the outcome variable, Levels of Digital Literacies, sixteen items measuring all three dimensions, i.e., Digital Information Literacy, Digital Problem Solving, and Digital Communication and Collaboration, were accounted for.

Table 6.6 Reliability Analysis

Variable	No/ of Items	Alpha
Outcome Variables		
DLs	16	0.8728
Independent Variables		
DN	5	0.8975
PEU	3	0.8351
LGO	6	0.8473

Cronbach's Alpha coefficient of scale reliability for the outcome variable, i.e., Levels of Digital Literacies was calculated to be 0.8728. For the explanatory variables, Digital Nativity, Perceived Ease of Use, and Learning Goal Orientation, the alpha coefficient was calculated to be 0.8975,0.8351, and 0.8473 respectively. Thus, the coefficient of reliability and internal consistency was found to be meritorious for all scales to be used in the estimation model.

6.4.2 Sampling Adequacy and Sphericity Test

To establish the internal validity of the scales for use in the final estimation model, a confirmatory factor analysis (CFA) was conducted. At the first stage, data suitability for factor analysis was assessed. To that end, Kiser-Meyer-Olkin (KMO) test for sampling adequacy and the Bartlett's Test for sphericity for all relevant scales were conducted.

Table 6.7

KMO and Bartlett\s Test

Variables	**DLs**	**DN**	**PEU**	**LGO**
No. of Items	16	5	3	6
KMO	0.849	0.877	0.701	0.865
Bartlett's Test				
chi-square	1356.857	596.459	240.376	475.096
Degrees of freedom	120	10	3	15
p-value	0.000***	0.000***	0.000***	0.000***

**p < 0.1, **p > 0.05, ***p < 0.01*

KMO statistics for all scales of interest met the criteria for adequacy. The test coefficients were meritorious for the outcome variable Levels of Digital Literacies and the explanatory variables Digital Nativity and Learning Goal Orientation. However, it met the 'average' adequacy criteria only for the independent variable Perceived Ease of Use which was constituted of only three items. The Bartlett's Test results for all scales were statistically significant at 0.01% level of significance. Thus, the null hypothesis that the items are uncorrelated is rejected. This implies that items included in the respective scales of interest are intercorrelated and each specified scale structure is fit for factor analysis.

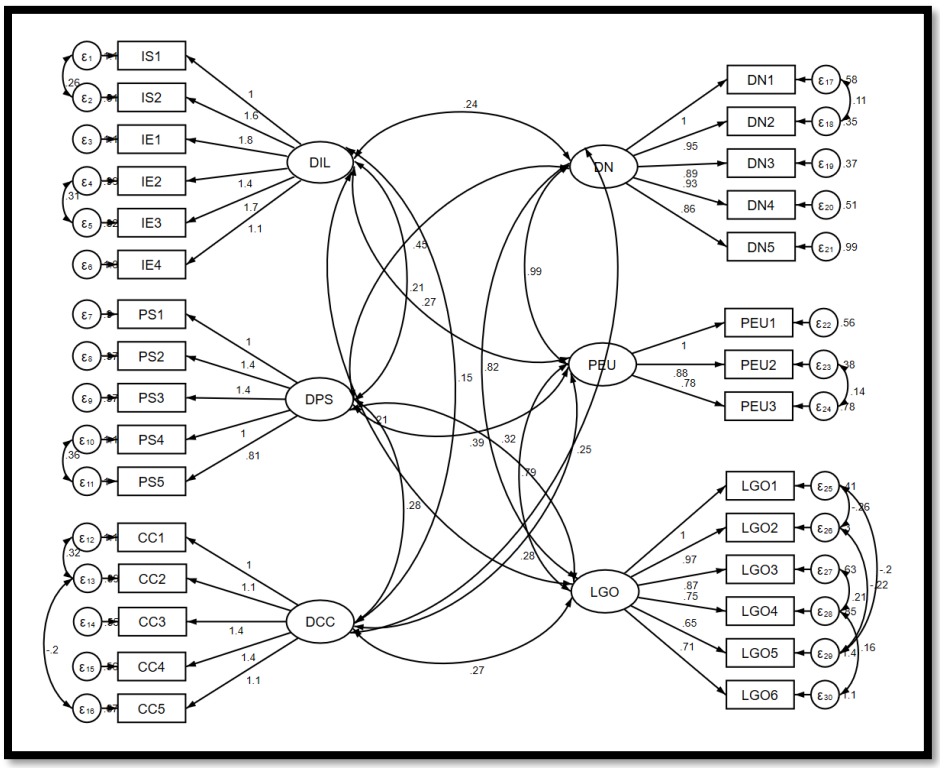
6.4.3 Confirmatory Factor Analysis

As outlined in Section 4.4.2.2, a two-order confirmatory factor analysis was conducted to capture the complete structure of the relevant constructs. Here, the results of both First-order CFA and Second-order CFA are presented graphically. The standardized factor loadings and their statistical significance are also summarized in tabular form, followed by model fit statistics.

6.4.3.1 First-order CFA. Figure 6.4 presents the estimation results for First-order confirmatory factor analysis. It should be noted that the default model provided unstandardized estimates. It fixed the factor loading for the first item of each scale to 1.0 to use it as a reference indicator.

Figure 6.4

First-order Confirmatory Factor Analysis Results (Unstandardized)

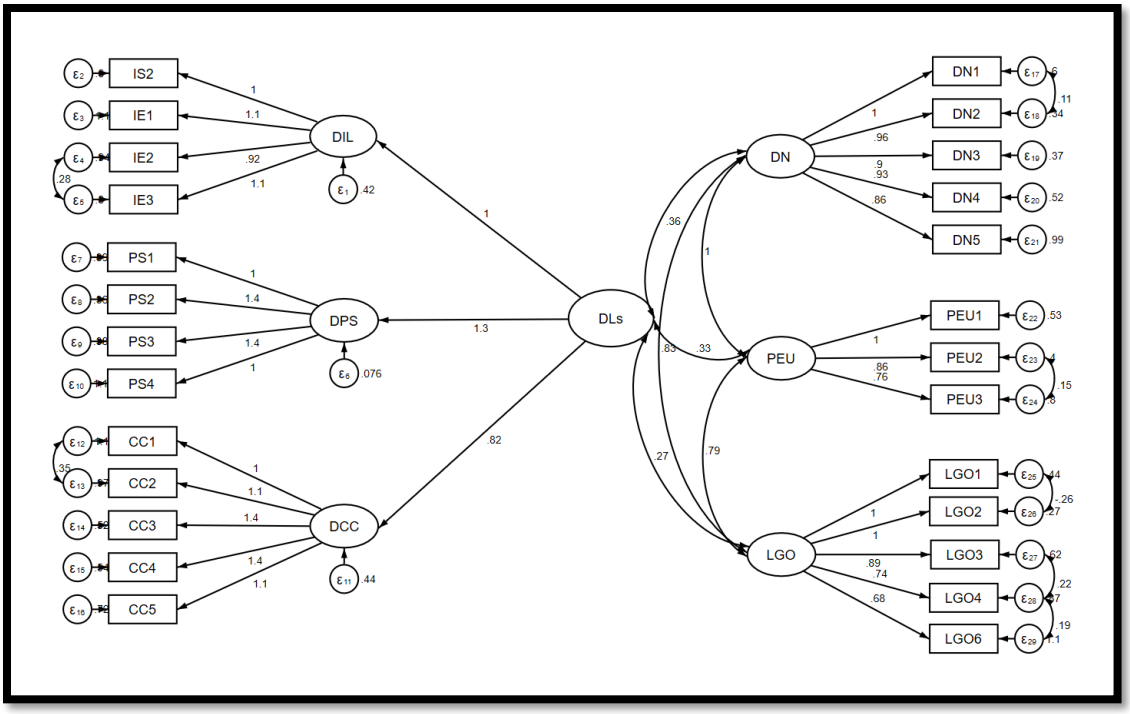


Results of the First-order confirmatory factor analysis showed that all items loaded statistically significantly on the intended latent factors. However, factor loadings for two items in the Digital Information Literacy construct and one item each on the Digital Problem Solving and Learning Goal Orientation scales respectively did not meet the acceptability criteria for standardized factor loadings. The standardized factor loadings for the items IS1, IE4, PS5, and LGO5 were below the benchmark level of 0.5. Therefore, these items would have to be dropped in the final estimation model for the data to confirm the hypothesized scales structures. The model tested in First-order CFA was assessed for goodness-of-fit in post-estimation and met the acceptability criteria. Results are presented in Table 6.8.

6.4.3.2 Second-order CFA. Based on the result of the First-order CFA, the items IS1, IE4, PS1, and LGO5 were dropped from the model. The composite nature of the Digital Literacies variable was set up in the measurement model and the Second-order confirmatory factor analysis was run. Unstandardized results of the model are graphically presented below.

Figure 6.5

Second-order Confirmatory Factor Analysis Results (Unstandardized)



In the Second-order CFA, the complete structure of the outcome variable of interest, Levels of Digital Literacies, was measured as conceptualized. As with eh First-order CFA, measurement coefficients on the paths leading from the latent factors to the observed items represented the unstandardized factor loadings and all possible covariances were also tested.

Standardized factor loadings for the Second-order confirmatory factor analysis showed that all items loaded statistically significantly on the intended latent factors. Moreover, all factor loadings met the benchmark criteria of 0.5. Thus, the results of Second-order CFA evidenced that the data confirms the theorized factor structures. Goodness-of-fit test results for the model used in Second-order CFA are presented below. The model specified for Second-order CFA testing the complete factor structures showed that the model fit was reasonably good.

Table 6.8

First-order and Second-order CFA Model Fit

Index	First-order CFA	Second-order CFA
Baseline Comparison		
CFI	0.938	0.949
Population Mean		
RMSEA	0.047	0.048
pclose (Probability RMSEA <= 0.05)	0.067	0.056
Size of Residuals		
SRMR	0.062	0.059
CD	1.000	0.999

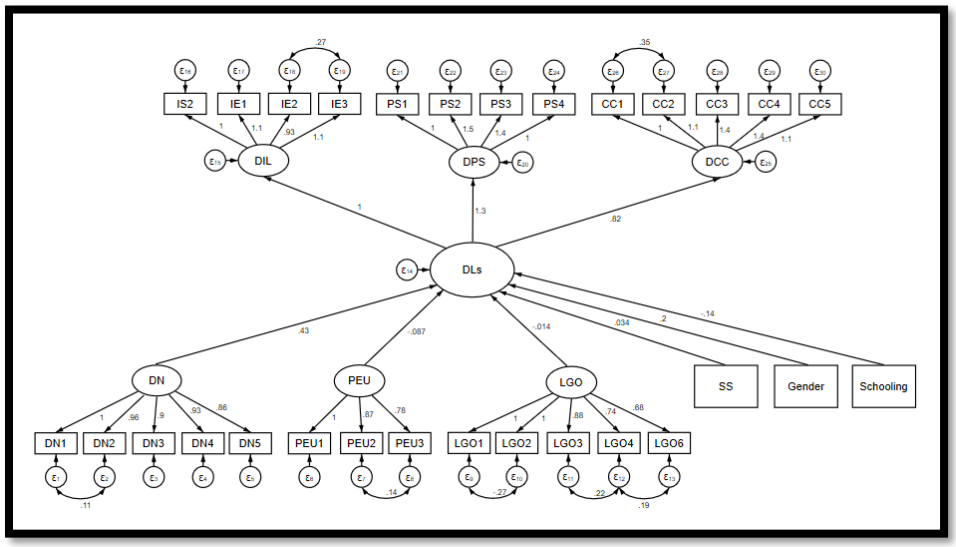
To summarize, based on the results of the two-order confirmatory analysis, it was concluded that the constructs developed for measurement of relevant variables in the final estimation mode, namely Levels of Digital Literacies, Digital Nativity, Perceived Ease of Use, and Learning Goal Orientation were internally valid and confirmed the hypothesized factor structures. The sub-latent constructs of Digital Information Literacy, Digital Problem Solving, and Digital Communication and Collaboration were found to load statistically significantly on the latent construct of Digital Literacies where the factor loadings were also strong enough to meet the acceptance criteria. However, in the final estimation model, items IS1, IE4, PS5, and LGO5 would not be included in their relevant scales.

6.5 Empirical Estimation: Determinants of Digital Literacies

Structural Equation Modelling was used to estimate the theorized relationship between the selected mental, motivational, and social determinants of Digital Literacies per the Resources & Appropriation Theory (van Dijk, 2005). The estimation results for the structural model referenced in Section 4.4.2.3 are illustrated below.

Figure 6.6

Determinants of Digital Literacies Estimation Results (Unstandardized)



The above illustration presents the empirical estimation results for the theorized model of 'determinants of Digital Literacies.' It is to be noted that the error covariances occurred between observed items loading on the same latent factors. Therefore, these did not pose a cause for concern. Furthermore, their inclusion in the structural equation model improved the model fit. Table NUMBER presents the empirical results for four structural models, including path coefficients and model fit statistics. These models include the model of 'determinants of digital literacies' presented in Figure 5.6 (Model I), an extended model including covariate on material access to digital technologies (Model II), and group-level estimation for the HEIs represented in the sample (Model III for the public sector HEI & Model IV for the private sector HEI).

Table 6.9

Estimation Results for Determinants of Digital Literacies (Standardized)

	Model I	**Model II**	**Model III**	**Model IV**
			Public Sector HEI	**Private Sector HEI**
Dependent Variable	**Digital Literacies**	**Digital Literacies**	**Digital Literacies**	**Digital Literacies**
Digital Nativity	0.426	0.454	0.431	1.178
	(0.217) **	(0.222) **	(1.289)	(0.463) **
Perceived Ease of Use	-0.087	-0.112	-0.151	0.215
	(0.187)	(0.191)	(1.266)	(0.236)
Learning Goal Orientation	-0.014	-0.008	-0.051	0.207
	(0.061)	(0.062)	(0.249)	(0.101) **
Social Support	0.034	0.052	0.020	0.379
1. Formal Support	(0.122)	(0.126)	(0.537)	(0.177) **
Gender	0.196	0.194	0.196	-0.081
1. Male	(0.081) **	(0.081) **	(0.102) *	(0.149)
Schooling Background	-0.145	-0.123	-0.144	-0.071
1. Public Sector	(0.074) *	(0.111)	(0.118)	(0.160)
Material Access		0.047	0.055	0.036
1. Yes		(0.036)	(0.047)	(0.064)
N	200	200	100	100
DLs R-squared	0.507	0.522		0.604
p > ch2	0.000	0.000		0.000
RMSEA	0.050	0.049		0.048
Pclose	0.066	0.075		0.355
CFI	0.934	0.930		0.898
SRMR	0.059	0.060		0.088

CD	0.997	0.997	0.998

**** p<0.01, ** p<0.05, * p<0.1*

6.5.1 Full Sample Estimation (Model I & II) Interpretation

Model I estimated structural regression to test the relationship between the selected factors of access, mental, and social resources and the levels of digital literacies acquired by undergraduate students. Digital Nativity was found to have a statistically significant positive effect on acquired levels of Digital Literacies. According to the estimates, an increase of one percent point in Digital Nativity, acquired level of Digital Literacies would increase by 0.426 percentage points while everything else remained constant at 5% level of significance. Perceived Ease of Use and Learning Goal Orientation were estimated as statistically insignificant factors in the model of 'determinants of digital literacies.' Empirical estimates illustrated the significance of gender and schooling background, i.e., personal and positional categories, in determining the levels of digital literacies undergraduate students acquired. It was found that, ceteris paribus, the acquired levels of Digital Literacies were higher for male students by 0.196 percentage points as compared to their female counterparts; and students with public schooling backgrounds had 0.145 percentage points lower levels of digital literacies versus students with private schooling background. Digital Nativity and Gender were found to be significant at 5% level of significance while the statistical support for results on Schooling Background were significant at 10% level of significance only. Results for Model II revealed that material access to digital technologies, measured as ownership of more than one personal digital device, was not a statistically significant determinant of digital literacies. Digital Nativity and Gender, however, still explained variation in the acquired levels of digital literacies of the undergraduate students in the sample as was the case in Model I. Statistically, keeping everything else constant, acquired levels of Digital Literacies were estimated to be 0.454

percentage points higher per one percentage point increase in the level of Digital Nativity, and 0.194 percentage points higher for male versus female students. In other words, estimates of structural regression specifications represented by Model I and II provided statistical evidence to corroborate the hypothesized effects of Digital Nativity and Gender on Digital Literacies levels of undergraduate students. Lastly, it should be noted that the predictors included explained 50.7% and 52.2% variation in the outcome variable in Models I and II respectively.

6.5.2 HEI-wise Estimation (Model III & IV) Interpretation

Model III and IV estimation was obtained using the group-level Structural Equation Modelling feature. Model III represented the sample from the public sector higher education represented in the data while Model IV represented its private counterpart. Model III did not find statistical support for any hypothesis, except for the hypothesized higher levels of digital literacies for male individuals (at 10% level of significance). The obtained estimate could statistically be interpreted as: ceteris paribus, male students in the public university included in the sample had acquired 0.196 percentage points higher level of Digital Literacies compared to the female students. Estimation for Model IV revealed that Digital Nativity and Learning Goal Orientation had statistically significant deterministic impact on Digital Literacies. Per the estimation results, keeping all other factors in check, at 5% level of significance, a one percentage point increase in Digital Nativity led to an increase of 1.178 percentage points in the acquired levels of Digital Literacies. Similarly, Learning Goal Orientation stronger by one percentage point would increase the acquired levels of Digital Literacies by 0.379 percentage points (at 5% level of significance). Thus, Model IV, in the context of the private sector HEI, lent statistical support to the hypotheses that higher levels Digital Nativity and Learning Goal Orientation led to development of higher levels of Digital Literacies among undergraduate students. Moreover, the hypothesized

relationship between Social Support and Digital Literacies was also supported for Model IV. Results highlighted that in the context of the private sector university in the sample, students who relied on formal channels of support when encountered with challenges in engaging with digital technologies had acquired 0.379 percentage points higher levels of digital literacies versus those who chose informal channels as their primary support system. Perceived Ease of Use, Gender, and Schooling Background were found to be statistically insignificant in the context of both higher education institutions, public and private, represented in the data. Notably, 60.4% variation in the dependent variable of interest was explained by the explanatory variables included in the group-level estimation (Model III and Model IV).

It should be noted that Peerceived Ease of Use remained statistically insignificant in all models tested through SEM; hoever, it showed a negative impact on average levels of Digital Literacies acquired by the sampled students. Similarly, Learning Goal Orientation was found to be statistically insignificant in three out of four models and was estimated to have a negative effect on DLs. Although insignificant, this negative relationship oppposed the hypoethsized possitive relationships (H2 and H3). This could be attributed to statistically significantly lower levels of Perceived Eae of Use and Learning Goal Orientation in the public sector HEI (see Appendix D) affecting the SEM estimation for the full sample. Moreover, variation in acquired levels of Digital Literacies by Gender was found to be statistically insignificant in the mean comparison test (see Table 6.5); however, it was significant in the SEM estimation in three out of four models. Lastly, These variations in significance and direction of estimated relationships be explained on the basis of SEM's list-wise deletion methodology for maximum likelihood which enables tracing linkages which may not be accounted for in other statistical models.

6.5.3 Goodness-of-Fit

In terms of goodness-of-fit, Models I and II met all criteria for 'close fit'. Model III and IV, estimated through group-level specification met the criteria for close fit on the Root Mean Square Error of Approximation of Population Mean with a value of 0.048. Since the value for the Comparative Fit Index was 0.898, it could only approximate the 0.90 criteria. The value for Standardized Root Mean Squared Residual was 0.088 which exceeded the maximum acceptable value of 0.08. It should be noted that the sample size for Model III and Model IV was 100 observations each, which was the least required sample for successfully executing a structural model. Therefore, the model fit remained a caveat in the HEI-specific analysis for this research.

To summarize, multivariate analysis of determinants of Digital Literacies for this research corroborated strongly the hypotheses on the positive impact of Digital Nativity (H1) and Gender (H5) whereby these hypotheses were supported in three out of four models. Learning Goal Orientation (H3), Social Support (H4), and Schooling Background (H6) were revealed to be significant predictors of Digital Literacies in specific contexts only. Empirical results did not lend any support to hypothesized positive effects of Perceived Ease of Use (H2) and Material Access (H7).

6.6 Discussion: Levels & Determinants of Digital Literacies

A 16-item scale, developed and validated for the purpose of this research, was utilized for gauging the Digital Literacies acquired by undergraduate students representing the two selected HEIs. It constituted of three dimensions or elements of Digital Literacies – Digital Information Literacy, Digital Problem Solving, and Digital Communication and Collaboration, most discussed and reflected in the qualitative interviews, particularly with student representatives, conducted during Phase I. Moreover, this scale was designed to elicit practices instead of measuring skills or competences developed through the how-to approach. Thus, it alluded to Gilster's (1997) idea of

mastering ideas not keystrokes and Beetham and Sharpe's (2011) pyramid model of Digital Literacies which extends from access and awareness to practices, through skills, culminating in identification as a digital literate. validated through a two-order confirmatory factor analysis. To the best of the researcher's knowledge, this was only second such attempt in the Pakistani context after Amin et al.'s (2021) adaptation of Chen's (2015) 9 C's model. A key distinction between the two exercises was that the scale utilized for assessment of acquired levels of Digital Literacies and its antecedents was based on an exploration of stakeholders' perceptions, particularly student's views on the developed and underdeveloped domains.

Results of univariate and bivariate analyses, presented in Section 6.3, illustrated a moderate or fair level of Digital Literacies development among undergraduate students on average (sample-averaged overall mean score stood at 4.12 points on the scale constituent of sixteen 16-point Likert-type items). There exists evidence of moderate-toward-the-upper-bound levels (Koyuncuoglu, 2022; Ozden, 2018; Voda et al.; 2022) in different contexts around the globe. The findings on sub-dimensions were quite insightful as they showed that the surveyed students were quite reliant on digital tools and media to solve problems at hand and had acquired the necessary Information Search Skills for that. However, they did not engage in Information Evaluation behaviours (with a mean score of 3.73 which was the lowest of all domains). These observations paired well with statistics reflecting high levels of access to digital devices and the internet as well as their attitudes towards reliance on digital technology and media for diverse activities proxied by Digital Nativity in this research. These findings were concurrent with existing literature on levels of Digital Literacies wherein individuals exhibited lower levels of literacy in the non-technical domain, particularly in Information Evaluation and Communication, versus the technical domain, such as Information Search and reliance on digital technologies for solving problems at hand (Adeoye &

Adeoye, 2017; Miranda et al., 2018). Moreover, existing literature posits that students' perceived levels of Digital Literacies decline as the complexity of domain or associated skill increases (Zhao et al., 2021). In this research, that complexity could be attributed to a shift from reliance on accessible tools and media as well as functional practices like searching for required information to more complex social and cognitive elements of collaboration, networking, and evaluation of extracted data and information (Martzoukou et al., 2020). The findings of this research underscore the significance of analysing the acquired levels of Digital Literacies across sub-domains by decoupling the Digital Information Literacy and Digital Communication and Collaboration dimensions. The contrast between practices of Information Search and Information Evaluation, together forming the DIL dimension in this research, illustrates the importance of developing mindsets required for addressing the cognitive digital challenges.

A statistically significant difference in DLs development of the students enrolled in public versus private HEIs represented in the sample was also identified. This difference could be explained in terms of variation in access to resource or infrastructure (Jorge-Vázquez et al., 2021; Samani et al., 2019). However, both universities offered comparable levels of access to digital technologies and the internet on-campus (see Section 5.1) as well as similar approach towards digitalization and teaching and learning Digital Literacies at the higher education level (see Section 5.2). Taking the individual attributes perspective (van Dijk, 2020), it could be argued that the differences in attitudes towards reliance on digital technologies and media and their ease-of-use perceptions induce the observed variation across the two HEIs (see Appendix D). Another notable finding of this research in terms of assessment of Digital Literacies development was the observed difference based on pre-undergraduate schooling background. Bivariate analysis showed that students form public schooling background fared weaker compared to their private schooling

background, evidence on which is rather scant in existing research (Silva-Quiroz & Morales-Morgado, 2022).This study also showed existence of variability in Digital Literacies development of undergraduate students across their disciplines of study. Analysis illustrated that on average, students majoring in Economics had the highest level of Digital Literacies, followed by the Computer Science and Business Administration students, whereas the Physics students came out as the least digitally literate among the sample. Interestingly, mean scores on sub-domains also varied which has been observed in a number of studies in other contexts as well (Ozden, 2018; Samani et al., 2019; Yoleri & Anadolu, 2022). However, higher mean scores for Economics students compared to Computer Science students contradicts with commonsense assumption as well some existent evidence that CS and affiliated student generally fare the strongest on Digital Literacies assessments (Lucas et al. 2022; Ozden, 2018). Moreover, it should be noted that comparability of findings on acquired levels of Digital Literacies and variations by specific attributes across the evolving body of work on the subject remains questionable given the diversity in the types of scales used (Spante et al. 2018) and the sample profiles as evaluation studies on undergraduate freshmen samples populate the literature (Zhao et al., 2021).

To study the impact of undergraduate students' personal attributes on their acquired levels of Digital Literacies, a set of attributes proxying for mental, motivational, and social resources was selected following the findings of qualitative interviews conducted in Phase I of this research. The selected attributes or personal resources were theoretically grounded in the Resources & Appropriation Theory (van Dijk, 2020) (see Section 3.1.2). Empirical estimation was conducted using path analysis module of Structural Equation Modelling. Four models were tested to assess the relationships between the selected attributes and acquired DLs levels in specific contexts. The variation in estimation results for the overall sample and the HEI-specific samples were indicative

of context-specific role personal attributes of individuals play in developing Digital Literacies which has been posited by (van Laar et al., 2020). For mental and motivational resources in the form of positive attitudes – conceptualized as Digital Nativity in this research, Perceived Ease of Use, and Learning Goal Orientation, a positive impact on DLs development has been posited in theory (Edmunds et al., 2012; Lilian, 2022; Verhoeven et al., 2016). This analysis of determinants of Digital Literacies for a sample of students serving as a case in point for the Pakistani context, however, lent only contextual support to hypothesized effects of Learning Goal Orientation while corroborating the assumed impact of Digital Nativity in all models except for the public sector HEI. There is evidence available for these findings and variable impact of all these variables when studied for creative industry professionals (van Laar et al., 2019). In sociodemographic set of characterisitcs, Gender was assessed as the most consistent explanatory of Digital Literacies development except in the case of the private sector HEI sample which had the higher mean versus the public sector HEI sample or the full sample itself (see Section 6.3). Reliance on Social Support, on the contrary, was significant only in the higher-DLs sample of the private sector HEI which hints at a base-levvel requirement for informal environment that is conducive to DLs development. This conjecture aligns with the importance of informal learning has been highlighted in Digital Literacies literature (Guzman-Simon et al., 2017). Higher levels of Digital Literacies among male veruss female stuudents was in line with previous studies (Zhao et al., 2021) while an insignificant result has also been evidenced (Galindo-Domínguez & Bezanilla, 2021). Estimates on schooling background where students with private pre-undergraduate schooling background scored better than their public sector counterparts corroborated Silva-Quiroz and Morales-Morgado's (2022) findings in the Chilean context. Based on these observations, this research contributed to the Digital Literacies in Higher Education scholarship by testing the Resources & Appropriation

Theory in an underexplored landscape, i.e., Pakistan. It also illustrated how the dynamics of Digital Literacies development can vary across seemingly comparable educational institutions.

7. Synthesis & Discussion

This research employed the Sequential Exploratory Mixed Methods design to provide a bird's eye view of the Digital Literacies Landscape in the higher education sector of Pakistan. It was executed in two sequential phases where in-depth interviews eliciting stakeholders' perceptions on attitudes towards and practices of were conducted in Phase I followed by questionnaire survey administration for data collection on Digital Literacies development – levels and developments – in Phase II. To put things into perspective and present a more holistic picture, this chapter synthesizes and discusses the key findings of this research.

7.1 Curriculum Focus Relates to Inconsistencies in DLs Development

The findings of this research traced a linkage between curricular or policy focus and the nature of DLs development in undergraduate students. In the bigger picture, a narrow policy focus or unbalanced curriculum implied unbalanced DLs development across sub-domains, technical and non-technical, attitudes and practices.

Qualitative analysis of in-depth interviews of the stakeholders, i.e., undergraduate teaching faculties and student fraternities at the selected HEIs, elicited policy and curricular focus to be confined to tools and software or the 'technical' domain of Digital Literacies. The non-technical or cognitive and conceptual domains of Digital Literacies, however, were not considered much. It was assumed that the non-technical abilities followed a natural curve of development wherein access and personal characteristics served as key determinants. Accordingly, breakdown of DLs scale by sub-domains of the constituent dimensions showed that the highest average scores were recorded for the technical domain of Information Search, followed by Digital Problem Solving indicating the abilities to rely on or use digital technologies and media, particularly digital

information resources. to solve problem at hand. The lowest average score, on the contrary, was recorded for the cognitive or conceptual domain of Information Evaluation. These findings implied translation of policy perspectives and learning environments on development of students' Digital Literacies.

Lower average scores on non-technical domains of Information Evaluation as well as Digital Communication for Collaboration and Networking also aligned with the student representatives' negative perception of their fraternity's abilities of the same. Furthermore, these findings also put into perspective the observations on improvement in 'search for solutions' skills due to increased self-reliance during the pandemic lockdowns, without much development of the non-technical and conceptual or cognitive skills. To summarize, it could be stated that the nature of policy focus and orientation of the learning environment tent to impact the type of Digital Literacies students would acquire. The emphasis on 'technical' Digital Literacies in policy and practice in the higher education system seemed to be producing graduates who had 'technical know-how' of digital technologies and media but would lag in their appropriation. These observations coincide with and provide supporting evidence for existing research that recognizes the curriculum-literacies linkages and calls for rethinking curriculum for well-rounded and balanced Digital Literacies education (Gutiérrez-Ángel et al., 2022). It has been posited that curriculum should categorically recognize digital literacies for systematic instruction (Coldwell-Neilson, 2018), a lack of which renders development of certain abilities of the digital weak and lacking (Miguel-Angel, et al., 2018). Additionally, the need for shifting focus from solitary skills and competences to digital practices in formal education has also been highlighted (Littlejohn et al., 2012; Mayisela, 2022; Miguel-Angel, et al., 2018).

7.2 Physical Access is Not Enough: Attitudes Precede Device Diversity in DLs Development

Access is a complex and multifaceted concept, particularly in the digital sphere (de Haan, 2004; van Dijk, 2005). Whereas baseline access is a pre-requisite to acquisition of any sort of skills, the findings of this research illustrate that for well-rounded development of HE students' Digital Literacies development, digitalization and access to devices and the internet are not enough.

Qualitative analysis of stakeholders' perceptions elicited that digitalization of processes within HE settings thus granting unbounded access to digital technologies to the students, was perceived as the most important factor affecting DLs development from the institutional perspective. Quantitative evidence found in this research illustrated that, at the backdrop of baseline physical access available to all, access in terms of attitudes (measured by Digital Nativity) tend to be viable explanatory of Digital Literacies acquisition compared to material access or device diversity.

It has been argued that the physical access divide on the baseline extends to a material access divide and has similar repercussions for DLs development and usage (van Deursen & van Dijk, 2019). However, tested for a sample boasting hundred-percent single device or physical access, the material access hypothesis could not be supported. This finding suggests that device diversity may be secondary to baseline reliance on or usage of digital technology and media when studied in the context of digital literacies as modelled in the Digital Literacies scale utilized in this analysis. This conjecture itself is embedded in the Resources & Appropriate Theory of Digital Divide which recognizes "motivational access" as an antecedent to material access (van Dijk, 2005, 2020). Furthermore, it reflects van Deursen and van Dijk's (2019) work where they found diverse diversity as a significant predictor of internet use diversity and internet outcomes but not skills.

The incremental impact of positive attitudes towards digital technologies, as measured by Digital Nativity, is consistent with existing evidence on relationship between attitudinal access and literacies of the digital among university students (Aswathi & Mohamed, 2020; Zhao et al., 2021). The contextual relevance of this factor across the two selected HEIs, however, mandates a look at the non-digitalization and non-access characteristics that are discussed in the next section. It should be duly noted here that it varied definitionally from the Theory of Digital Nativity by (Pensky, 2001a, b) which emphasizes on physical access to digital technologies and defines Digital Natives strictly in terms of age or generation by birth year. Lastly, broad-based impact of access, whether physical or attitudinal, on acquired levels of Digital Literacies by constituent dimensions could not be assessed. As outlined in the previous section, the students' acquired levels of nontechnical Digital Literacies were rather low. However, the access-related research findings, on material as well as attitudinal access, delineated above provide important insights into the complexity and nonlinearity of the phenomenon of access in terms of Digital Literacies development of HE students. Therefore, further research on the subject is essential.

7.3 Contextual Nature of Personal Attributes and the Need for Systematic Formal DLs Education

This research illustrates the contextual nature of personal attributes and community-level factors at play. Essentially, it underscores the importance of HE's role as a leveller in the Digital Literacies development sphere by showing that students' personal motivation may be secondary to their personal experiences in which their educational environment has a critical role to play. Regardless of similarities in curriculum focus and in-class practices, positive attitudes or motivation may not come into play as significant drivers of DLs development unless the on-

campus environment and influence are not conducive. These observations further emphasize the need for systematic formal DLs education in universities.

In this study, sampled institutions that were identified to have comparable levels of digitalization, similar policy focus and in-class learning experiences arguably hosted communities differentiable by levels of literacies and attitudes of the digital. Although levels of physical access to digital technologies was roughly the same, one HEI (private sector) hosted a community also had acquired higher levels of Digital Literacies on average. Furthermore, this community also boasted considerably stronger inclination towards reliance on and use of digital technologies, as measured by Digital Nativity (see Appendix D). Notably, in HEI-wise analysis, personal and positional categories, or demographics, proxied by gender (weakly significant in the public sector HEI which had lower average levels of DLs in the overall sample) and type of pre-undergraduate schooling by sector (public versus private) did not explain statistically significant variation in the acquired levels of literacies. Thus, it could be argued that a "community" served as the foreground for individual-specific mental and social resources, i.e., Learning Goal Orientation and access to formal channels of social support, to enable development of Digital Literacies.

From existing literature, this observation could be explained through the domains of learning lens whereby literacies develop in multiple interactive domains, formal and informal, academic and social (De Pourbaix, 2005; Guzman-Simon et al., 2017; Meyers et al., 2013). This implies that students exposed to more digitally literate communities or digitally conducive environments outside and within the HEIs tend to be more digitally literate. While outside environment is generally explained on the basis of socioeconomic background of students, the informal learning environment within the HEIs could be attributed to social and community engagements outside the classroom where students may be engaged in diverse digital practices

Goodfellow (2011) who are not engaged as stakeholders in DL education. Peer networks could have significance on individuals' literacies development (Eynon & Malmberg, 2012); thus, community characteristics could be instrumental in shaping students' Digital Literacies development outside the classroom but within the institution. However, peer networks may not provide a sufficient support system constrained by other personal factors (Eynon & Geniets, 2016). A lack of learning in both these settings puts the onus on the higher education institutions to develop curriculum and in-class culture that promotes well-rounded and holistic development of all essential Digital Literacies elements addressing the gaps in personal resources and opportunities available to individuals. In light of Amartya Sen's Capability Approach, the need for Digital Literacies education could be understood through the lens of opportunity gaps prevalent in the society driven by factors beyond individuals' control, such as social capital (Sen, 1995). Accordingly, provision of basic facilities, access to digital technologies and the internet in this context, is not the end but merely means to an end wherein inabilities to appropriate available resources for desirable outcomes remain constrained by inadequate levels of Digital Literacies. Thus, the need for formal and systematic Digital Literacies education at the university level becomes more pronounced (Corrin et al., 2018). It also calls for rethinking Digital Literacies education and integrating practices with tools and skills.

8. Conclusion

Rapid proliferation of digital technologies has shaped and continues to alter the ways of life in the twenty-first century. Reliance on digital technologies and media for participation in economic, social, and civic activities has eventually become naturalized even in the developing world. However, access to any kind of technology does not equate with appropriation for desirable outcomes. Consequently, the world now faces challenges of economic and social digitalization, the most pressing of which is the need to rethink literacies and literacy practices for the future workforce and citizenry. Moreover, the scope of what can be defined as Digital Literacies also evolves. Thus, the challenge at hand is complex and dynamic. As higher education institutions act as frontrunners of economic, social, and human development, their role in producing digitally literate citizenry, adequately equipped to meet the challenges of its time, is pivotal. Therefore, it is essential to assess if the higher education institutions in Pakistan prepared for the Digital Literacies challenge as the country strives to compete and integrate with the global community.

8.1 Summary of the Research Findings

8.1.1 Pakistani HEIs' attitudes towards Digital Literacies education

The first of the four research questions explored in this mixed methods study was pertinent to the higher education institutions' general perceptions of or attitudes towards Digital Literacies. Perceptions were elicited through familiarity with relevant terminologies and concepts of the digital and opinions elicited through qualitative interviews of faculty and student representatives. Findings suggested that, at the policy level, the term "digital" and related concepts and literacies were not fully understood in its theoretical context as an evolution of an ecosystem that overlapped with the conventional ways of life, economic and social. Although the HEIs perceived Digital

Literacies as essential for student success as the future workforce, the focus was confined to the technical knowledge of discipline-specific software. The faculty members perceived Digital Literacies education at the undergraduate level to be adequate as non-technical or cognitive and metacognitive literacies of the digital would develop naturally because of exposure and physical access. However, most student representatives held a contrary view. They felt that development of non-technical Digital Literacies, such as information evaluation, sensemaking, and communication for ideation, required more than access to devices and media. Pertinent to that, the need for developing cognitive domain of literacies through educational intervention was not understood by the higher education policymakers and professionals.

8.1.2 Integration of Digital Literacies concepts with curriculum and instruction in the Pakistani HEIs

On the question of integration of Digital Literacies concepts with curriculum and instruction per the second research question, curricular focus and in-class practices were assessed. It was assessed that curriculum and instruction were largely focused on developing "software skills" relevant to each field of study. The reason highlighted was that the curriculum policy and program objectives were aimed at meeting "industry demands" and ensuring graduate employability. General component of the courses, represented by introductory courses on ICT offered to all undergraduate students, focused on essential software. Subject-specific courses, on the other hand, focused on sophisticated, advanced software. Findings related to familiarity with non-technical concepts of the digital, such as Digital Ethics, Digital Storytelling, etc. revealed that Business Administration and Computer Science departments incorporated discipline-specific concepts in the curriculum wherein the Business Administrative curriculum provided better coverage of concepts. Student representatives of the respective departments, however, opined that

only those non-technical digital concepts which formed essential components of the contemporary subject knowledge in their fields were taught in their departments. Moreover, it was noted that the instruction at the undergraduate level took a conventional approach to teaching subject matter. Therefore, literacies and challenges of the digital spaces did not feature in in-class discussions or learning materials. Students emphasized the need to rethink undergraduate curriculum to integrate the essential concepts and literacies of the digital.

8.1.3 Levels of Digital Literacies acquired by undergraduate students in Pakistan

To address the research question on levels of Digital Literacies of undergraduate students, sixteen-item scale measuring literacies across three dimensions – Digital Information Literacy, Digital Problem Solving, and Digital Communication and Collaboration – was used. Average score on the 6-point Likert-type items comprising the scale was computed to be 4.12 points. This indicated a moderate-high levels of Digital Literacies among the surveyed students. Moreover, breakdown of average scores by sub-domains illustrated that students fared well on technical literacies, with highest mean score of 4.55 points calculated for Information Search, versus the non-technical or cognitive domains as the lowest mean score of 3.73 points was computed for the Information Evaluation sub-scale. Descriptive statistics showed that the students from the public sector HEI in the sample scored statistically significantly lower than their private sector counterparts. Moreover, Economics students recorded the highest means cores on the aggregate Digital Literacies score while the Physics students had the lowest scores. HEI-specific and discipline-wise variation in average acquired levels of Digital Literacies of undergraduate students were, thus, highlighted. Notably, no statistically significant variation in acquired DLs levels between undergraduate juniors (semester 5 and 6) and seniors (semester 7 and 8) was found.

8.1.4 Impact of personal attitudes on Digital Literacies development of undergraduate students in Pakistan

To answer the fourth research question pertinent to determinants of Digital Literacies, empirical analysis identifying the mental, motivational, and social antecedents of Digital Literacies, Structural Equation Modelling (SEM) was used. Estimation results provided support for the hypothesized positive relationship between Digital Nativity, a proxy for positive attitudes towards reliance on and use of digital technologies and acquired levels of Digital Literacies. Moreover, gender was identified as a key determinant where, keeping everything else constant, male students acquired higher levels of Digital Literacies compared to female undergraduate students. HEI-wise regression results provided some more information on the selected determinants. No statistical evidence could be found to support the effectiveness of individual-level mental, motivational, or social factors of interest as determinants of Digital Literacies in the case of the public sector HEI represented in the sample. Besides Digital Nativity, the mental and motivational resource of Learning Goal Orientation and access to (formal) Social Support (such as institutional helpdesks or assistance from instructors) were estimated as statistically significant predictors of Digital Literacies for the private sector HEI in the sample. Based on these findings, it could be stated that curricular focus on technical domains translated into the type and nature of Digital Literacies acquired by undergraduate students. Moreover, individual-specific mental, motivational, and social factors' contribution to the development of Digital Literacies may well be contextual. These insights should be studied through further research.

8.2 Limitations of the Study

This research adopted the mixed methods approach to facilitate a broad-based enquiry addressing the limitations of both quantitative and qualitative research methods. However, it remained challenged by multiple bottlenecks in its execution and was, thus, restricted in its scope.

- In the context of qualitative enquiry, the research did not account for perspectives of the higher education administrators or stakeholders responsible for defining vision and policies for institutions. Academic deans or chancellors could not be interviewed to assess more directly the policy approach towards teaching and learning Digital Literacies in undergraduate education. Indirectly, however, the in-depth discussions with both faculty and students provided important insights into the practical aspects of the learning environment, an output of policymakers' perspectives itself.

- Quantitative analysis could not cover variations in the acquired levels of Digital Literacies by sub-dimensions or across disciplines to model convergence challenges in SEM. Due to low response rate and data quality checks, the final sample for quantitative analysis was restricted to 200 students which may have been inadequate. Selecting a different estimation method could have enabled the dimension-wise or discipline-wise analysis. However, structural equation model, comprising of both measurement and path components, was the most appropriate for analysing variables constituting of sub-dimensions and scales.

8.3 Policy Implications

This study aimed at providing an overview of the scope of Digital Literacies attitudes and practices prevalent in undergraduate education in Pakistan. It drew insights from two selected higher education institutions in the district of Lahore, and thus be challenged with respect to

generalizability of its results; however, it provided some interesting insights with policy implications for the subject.

- In line with the findings of this research, institutions should engage in studies of the digital ecosystem to understand its theoretical and practical evolution and the resultant literacies challenge it poses for the economy as well as the society. Such exercises might prove fruitful in shifting the focus from the notion of "industry skills" to "foundational literacies of the digital" that may well be the first step towards addressing the higher education's digital challenge.

- It is recommended to devise frameworks that enable inclusion of non-technical domains of digital literacies, such as digital information literacy, digital goods, etc. into the curriculum. Multiple departments, such as computer science, economics, sociology, media studies, etc. may collaborate for the same.

- This research underscored the need for reconsidering the classical approach towards teaching subject matter. Integrating concepts of the digital with the conventional topics of discussion can create an environment conductive to development of Digital Literacies. It may shape attitudes and create "digitally literate" communities that can bridge attitudinal access and practices gaps as digitalization of processes closes the physical access gaps in an educational institution.

- Holistic DLs education would require resource development in the form of Digital Literacies education for teaching faculties and other HE staff.

- HEIs could assess the Digital Literacies gaps and needs of their student fraternities. Not only the acquired DLs should be evaluated formally but students should be engaged as stakeholders in understanding the university-specific context.

8.4 Recommendations for Future Research

This research was designed and executed as an exploration of the Digital Literacies landscape in the higher education system of Pakistan. Therefore, its findings could be terms as preliminary insights which require further research for detailed analysis and corroboration. Moreover, as outlined previously, this study was subject to some caveats as is primary research in general. In line with these observations, some recommendations for future research are outlined below.

- This study was based on two institutions in Lahore district only. For better more generalized findings, future studies should include more institutions and disciplines, such sociology, languages, law, engineering, etc., should also be explored.

- Future research should also engage HEC representatives, as higher education regulators, for better insights into the policy outlook.

- Socioeconomic backgrounds of students and informal learning environment should also be studied as determinants of students' DLs development. Studies analysing course content should be conducted to supplement the stakeholders' insights on curriculum focus drawn from this research. Content analysis of curriculum or syllabus as well as learning aids, particularly for the introductory ICT courses offered to students across the board, can inform interpretation of the scope and policy focus of current Digital Literacies education.

In summary, digitalization or physical access to digital technologies was elicited as a necessary but insufficient condition for acquisition of adequate levels of Digital Literacies for undergraduate students in Pakistan. This was particularly relevant to the non-technical and cognitive literacies of the digital. The Digital Literacies landscape in the higher education sector of Pakistan could be seen as underdeveloped. While this research faced limitations (see Section 8.2), it provided the preliminary insights to move the discussion from Digitalization to Digital Literacies in the higher education sector of Pakistan. It posits in favour of rethinking curriculum and instruction for holistic Digital Literacies education through a paradigm shift from solitary functional skills to practices.

References

Abbas, Q., Hussain, S., & Rasool, S. (2019). Digital Literacy Effect on the Academic Performance of Students at Higher Education Level in Pakistan. *Global Social Sciences Review, 4*(1), 108-116.

Acock, A. C. (2013). *Discovering Structural Equation Modeling Using Stata, Revised Edition.* Texas: Stata Press.

Adeoye, A. A., & Adeoye, B. J. (2017). "Digital Literacy Skills of Undergraduate Students in Nigerian Universities. *ibrary Philosophy and Practice (e-journal), 1665*.

Ala-Mutka, K. (2011). *Mapping digital competence: Towards a conceptual understanding.* Sevilla: Institute for Prospective Technological Studies.

Alexander, B., Adams Becker, S., & Cummins, M. (2016). *Digital Literacy: An NMC Horizon Project Strategic Brief Volume 3.3.* Austin, Texas: The New Media Consortium.

Alkali, Y., & Amichai-Hamburger, Y. (2004). Experiments in digital literacy. *Cyber Psychol. Behav, 7*, 421-429.

Ameen, K., & Gorman, G. E. (2009). Information and digital literacy: a stumbling block to development? *Library Management, 30*(1), 99-112. doi:http://dx.doi.org/10.1108/01435120910927565

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*, 24-43.

Aswathi, P., & Mohamed, H. K. (2020). Attitude towards Information Technology and Digital Divide: A Study among Students in Universities in Kerala, India. *Library Philosophy and Practice (e-journal)*, 4437. Retrieved from https://digitalcommons.unl.edu/libphilprac/4437?utm_source=digitalcommons.unl.edu%2Flibphilprac%2F4437&utm_medium=PDF&utm_campaign=PDFCoverPages

Bandura, R., & Leal, E. M. (2022). *The Digital Literacy Imperative.* Center for Strategic and International Studies. Retrieved from https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/220718_Bandura_DigitalLiteracy_Imperative.pdf?VersionId=Kfakvovv6BncGYojmrowNFqG7KlH0fAP

Bartlett, M. S. (1951). he effect of standardization on a Chi-square approximation in factor analysis. *Biometrika, 38*, 337-344.

Bawden, D. (2008). Origins and concepts of digital literacy. *Digital literacies: Concepts, policies and practices, 30*(2000), 17-32.

Bawden, D. (2008). Origins and concepts of digital literacy. In C. Lankshear, & M. Knobel (Eds.), *Digital literacies: Concepts, policies and practices* (Vol. 30). Peter Lang.

Beetham, H. (2009). Academic values and web cultures: points of rupture. *Paper to ESRC Literacies in the Digital University Sseminar.* Edinburgh University.

Beetham, H., & Sharpe, R. (2011). Digital Literacies Workshop. *JISC Learning Literacies Workshop*.

Bejaković, P., & Mrnjavac, Ž. (2020). The importance of digital literacy on the labour market. *Employee Relations, 42*(4), 921-932. doi: https://doi.org/10.1108/ER-07-2019-0274

Belshaw, D. (2017). *The Essential Elements of Digital Literacies.* Retrieved January 2022, from https://dougbelshaw.com/essential-elements-book.pdf

Bennett, S., & Maton, K. (2010). Beyond the 'digital natives' debate: Towards a more nuanced understanding of students' technology experiences. *Journal of Computer Assisted Learning, 26*(5), 321-331. doi:http://dx.doi.org/10.1111/j.1365-2729.2010.00360.x

Bennett, S., Maton, K., & Kervin, L. (2008). *British Journal of Educational Technology,, 39*(5), 775-786.

Bollen, K. A. (1989). *Structural Equations with Latent Variables.* New York: Wiley.

Bollen, K., & Lennox, R. (1991). Conventional Wisdom on Measurement: A Structural Equation Perspective. *Psychological Bulletin, 110*(2), 305-314. doi:https://psycnet.apa.org/doi/10.1037/0033-2909.110.2.305

Bryman, A. (2012). *Social Research Methods* (4th ed.). Oxford University Press.

Burton, L. J., Summers, J., Lawrence, J., Noble, K., & Gibbings, P. (2015). igital Literacy in Higher Education: The Rhetoric and the Reality. In H. M.K., H. H., & D. P.A. (Eds.), *Myths in Education, Learning and Teaching.* London: Pelgrave Macmillan. doi:https://doi.org/10.1057/9781137476982_9

Chan, B. S., Churchill, D., & Chiu, T. K. (2017). Digital literacy learning in higher education through digital storytelling approach. *Journal of International Education Research, 13*(1), 1-16. doi:https://doi.org/10.19030/jier.v13i1.9907

Chen, A. (2015). *The 9 C's of Digital Literacy.* Retrieved from Alice in Wonder Tech: http://wondertechedu.blogspot.com/2015/02/the-9-cs-of-digital-literacy.html

Choi, M. (2016). A Concept Analysis of Digital Citizenship for Democratic Citizenship Education in the Internet Age. *Theory & Research in Social Education, 44*, 565-607. doi:https://doi.org/10.1080/00933104.2016.1210549

Coldwell-Neilson, J. (2018). Digital Literacy Expectations in Higher Education. In M. Camopbell, J. Willems, C. Adachi, D. Blake, I. Doherty, S. Krishnan, . . . J. Tai (Eds.), *Open Oceans: Learning without borders* (pp. 103-112). Geelong: Proccedings ASCILITE 2018.

Corrin, L., Apps, T., Beckman, K., & Bennett, S. (2018). The Myth of the Digital Native and What It Means for Higher Education. In A. Attrill-Smith, C. Fullwood, M. Keep, & D. J. Kuss (Eds.), *The Oxford Handbook of Cyberpsychology.* Oxford University Press. doi:10.1093/oxfordhb/9780198812746.013.7

Creswell, J. W., & Cresswell, J. D. (2017). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (5th ed.). SAGE.

Creswell, J., & Plano Clark, V. (2017). *Designing and Conducting Mixed Methods Research* (3 ed.). Sage Publications, Inc.

Cronbach, L. I. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*, 297–334. doi:https://doi.org/10.1007/BF02310555

de Haan, J. (2004). A multifaceted dynamic model of the digital divide. *IT & Society, 1*(7), 66–88.

de Obesso, M. M., Núnez-Canal, M., & P´erez-Rivero, C. A. (2023). How do students perceive educators' digital competence in Higher Education? *Technological Forecasting & Social Change, 188*. doi:https://doi.org/10.1016/j.techfore.2022.122284

De Pourbaix, R. (2005). Emergent literacy practices in an electronic community. In *Situated Literacies* (pp. 141-164). Routledge.

Dondi, M., Klier, J., Panier, F., & Schubert, J. (2021). *Defining the skills citizens will need in the future world of work.* McKinsey & Company. Retrieved from https://www.mckinsey.com/~/media/mckinsey/industries/public%20and%20social%20sector/our%20insights/defining%20the%20skills%20citizens%20will%20need%20in%20the%20future%20world%20of%20work/defining-the-skills-citizens-will-need-in-the-future-of-work-final.

Du, H., Zhou, N., Cao, H., Zhang, J., Chen, A., & King, R. (2021). Economic Inequality is Associated with Lower Internet Use: A Nationally Representative Study. *Social Indicators Research, 155*, 789-803. doi:https://doi.org/10.1007/s11205-021-02632-8.

Edmunds, R., Thorpe, M., & Conole, G. (2012). Student attitudes towards and use of ICT in course study, work and social activity: A technology acceptance model approach. *British Journal of Education Technology, 43*(1), 71-84. doi:https://doi.org/10.1111/j.1467-8535.2010.01142.x

Eshet-Alkalai, Y. (2004). Digital literacy: a conceptual framework for survival in the digital era. *Journal of Multimedia and Hypermedia, 13*(1), 93-106.

Evans, C., & Robertson, W. (2020). The four phases of the digital natives debate. *Hum Behav & Emerg Tech, 2*, 269-277. doi:https://doi.org/10.1002/hbe2.196

Eynon, R., & Geniets, A. (2016). The digital skills paradox: how do digitally excluded youth develop skills to use the internet? *Learning, Media and Technology, 41*(3), 463-479. doi:https://doi.org/10.1080/17439884.2014.1002845

Eynon, R., & Malmberg, L. E. (2012). Understanding the online information-seeking behaviours of young people: The role of networks of support. *Journal of Computer Assisted Learning, 28*(6), 514-529. doi:http://doi.org/10.1111/j.1365–2729.2011.00460.x

Farias-Gaytan, S., Aguaded, I., & Ramirez-Montoya, M. S. (2023). Digital transformation and digital literacy in the context of complexity within higher education institutions: a systematic literature review. *Humanit Soc Sci Commun, 10*, 306. doi:https://doi.org/10.1057/s41599-023-01875-9

Galindo-Domínguez, H., & Bezanilla, M. (2021). Digital competence in the training of pre-service teachers: Perceptions of students in the training of pre-service teachers: Perceptions of students in the degrees of early childhood education and primary education. *J. Digit. Learn. Teach. Educ., 37*(4), 262-278. doi:https://doi.org/10.1080/21532974.2021.1934757

Gilster, P. (1997). *Digital Literacy.* New York: Wiley.

Gobel, P., & Kano, M. (2013). Student and Teacher Use of Technology at the University Level. *IADIS International Conference on Cognition and Exploratory Learning in Digital Age* , (pp. 17-24).

Goodfellow, o. (2011). Literacy, Literacies, and the Digital in Higher Education. *16*(1), 131-144. doi:https://doi.org/10.1080/13562517.2011.544125

Gourlay, L., Hamilton, M., & Lea, M. R. (2013). Textual practices in the new media digital landscape: Messing with digital literacies. *Research in Learning Technology, 21*.

Gutiérrez-Ángel, N., Sánchez-García, J. N., Mercader-Rubio, I., García-Martín, J., & Brito-Costa, S. (2022). Digital literacy in the university setting: A literature review of empirical studies

between 2010 and 2021. *Frontiers in Psychology, 13*, 896800. doi:https://doi.org/10.3389/fpsyg.2022.896800

Guzman-Simon, F., García-Jimenez, E., & Lopez-Cobo, I. (2017). Undergraduate students' perspectives on digital competence and academic literacy in a Spanish University. *Computers in Human Behaviour, 74*, 196-204. doi:http://dx.doi.org/10.1016/j.chb.2017.04.040

Hague, C., & Payton, S. (2010). *Digital literacy across the curriculum.* United Kingdom: FutureLab.

Hall, R., Atkins, L., & F. J. (2014). Defining a self-evaluation digital literacy framework for secondary educators: the DigiLit Leicester project. . *Res. Learn. Technol., 7*, 21440.

Harmes, M., Huijser, H., & Danaher, P. (2015). Demythologizing Teaching and Learning in Education: Towards a Research Agenda. In M. Harmes, H. Huijser, & P. Danaher (Eds.), *Myths in Education, Learning and Teaching.* London: Pelgrave Macmillan. doi:https://doi.org/10.1057/9781137476982_1

HEC. (2018). *Curriculum of Economics (BS).* Islamabad: Higher Education Commission of Pakistan. Retrieved from https://www.hec.gov.pk/english/services/universities/RevisedCurricula/Documents/2017-2018/Economics%20BS.pdf

HEC. (2020). *Undergraduate Education Policy 2020.* Higher Education Commission of Pakistan. Retrieved February 2022, from https://www.hec.gov.pk/english/services/students/UEP/Pages/UEP-2020.aspx

HEC. (2022, December 8). *HEC PARTNERS WITH COURSERA TO OFFER FREE TRAINING TO THOUSANDS OF PAKISTANI YOUTH*. Retrieved from Higher Education Commission of Pakistan: https://www.hec.gov.pk/english/news/news/Pages/DLSEI-Phase-III.aspx

HEC. (2022, January). *HEC Recognised Universities and Degree Awarding Institutions*. Retrieved from Higher Education Commission, Pakistan: https://hec.gov.pk/english/universities/Pages/recognised.aspx

HEC. (2022, December 15). *HEC, MICROSOFT LAUNCH LARGEST FREE SKILLS INITIATIVE FOR STUDENTS*. Retrieved from Higher Education Commission of Pakistan: https://www.hec.gov.pk/english/news/news/Pages/Skills-Initiative.aspx

Helsper, E., & Eynon, R. (2013). Digital natives: Where is the evidence? *British Educational Research Journal, 36*(3), 503-520. doi:http://dx.doi.org/10.1080/01411920902989227

Hinrichsen, J., & Combs, A. (2014). The five resources of critical digital literacy: a framework for curriculum integration. *Research in Learning Technology, 21*, 21334-. doi:https://doi.org/10.3402/rlt.v21.21334

Inan, F. A., Lowther, & L., D. (2010). Laptops in the K-12 classrooms: Exploring factors impacting instructional use. *Computers & Education, 55*(3), 937–944. doi:http://doi.org/10.1016/j.compedu.2010.04.004

Janssen, J., Stoyanov, S., Ferrari, A., Punie, Y., Pannekeet, K., & Sloep, P. (2013). Experts' views on digital competence: Commonalities and differences. *Computers& Education, 68*, 473-481. doi:http://dx.doi.org/10.1016/j.compedu.2013.06.008

Johnson, B. R., Onwuegbuzie, A. J., & Turner, L. A. (2007). Toward a definition of mixed methods research. *Journal of Mixed Methods Research., 1*, 112-133.

Jones, B., & Flannigan, S. (2006). Connecting the digital dots: literacy of the 21st century. *Educause Q, 29*, 8-10.

Jorge-Vázquez, J., Náñez Alonso, S. L., Fierro Saltos, W. R., & Pacheco Mendoza, S. (2021). Assessment of Digital Competencies of University Faculty and Their Conditioning Factors: Case Study in a Technological Adoption Context. *Education Sciences, 11*(10), 637. doi:https://doi.org/10.3390/educsci11100637

Judd, T. (2018). The rise and fall (?) of the digital natives. *Australasian Journal of Educational Technology, 34/5*. doi:http://dx.doi.org/10.14742/ajet.3821

Khan, A., Fatima, H., & Rashid, N. (2023). *Digital Now: A Guide to Pakistan's Digital Transformation.* Islamabad: Tabadlab. Retrieved from http://creativecommons.org/licenses/by/3.0

Khan, M. Y., Shahzad, A. K., & Mahar, G. Y. (2018). New Technologies and Digital Literacy in Education: A Shifting Paradigm. *Pakistan Social Sciences Review, 2*(1), 108-118.

Khan, N., Sarwar, A., Chen, T. B., & Khan, S. (2022). Connecting digital literacy in higher education to the 21st century workforce. *Knowledge Management & E-Learning, 14*(https://doi.org/10.34105/j.kmel.2022.14.0041), 46-61. doi:https://doi.org/10.34105/j.kmel.2022.14.004

Kline, R. C. (2016). *Principles and Practice of Structural Equation Modeling.* New York: Guilford Press.

Kopp, M., Groblinger, O., & Adams, S. (2019). Five Common Assumptions That Prevent Digital Transformation at Higher Education Institution. *INTED2019 Proceedings*, (pp. 1448-1457). Retrieved from https://library.iated.org/publication_series/INTED

Koutropoulos, A. (2011). Digital Natives : Ten Years After. *Journal of Online Learning and Teaching, 7*(4).

Koyuncuoglu, D. (2022). Analysis of digital and technological competencies of university students. *International Journal of Education in Mathematics, Science, and Technology (IJEMST), 10*(4), 971-988. doi:https://doi.org/10.46328/ijemst.2583

Lankshear, C., & Knobel, N. (Eds.). (2007). *Digital Literacies: Concepts, Policies and Practices.* New York: Oxford: Peter Lang.

Law, N. W., Woo, D. J., de la Torre, J., & Wong, K. W. (2018). *A global framework of reference on digital literacy skills for indicator 4.4. 2.* Montreal, Canada: UNESCO Institute for Statistics. Retrieved from https://uis.unesco.org/sites/default/files/documents/ip51-global-framework-reference-digital-literacy-skills-2018-en.pdf

Lilian, A. (2022). Motivational beliefs, an important contrivance in elevating digital literacy among university students. *Heliyon,, 8*(12), e11913. doi:https://doi.org/10.1016/j.heliyon.2022.e11913

Littlejohn, A., Beetham, H., & McGill, L. (2012). Learning at the Digital Frontier: A Review of Digital Literacies in Theory and Practice. *Journal of Computer Assisted Learning, 28*, 547-556. doi:doi: 10.1111/j.1365-2729.2011.00474.x

Lucas, M., B.-h. P., Santos, S., Figueiredo, H., Ferreira Dias, M., & Amorim, M. (2022). Digital proficiency: Sorting real gaps from myths among higher education students. *British Journal of Education Technology, 53*, 1885–1914. doi:https://doi.org/10.1111/bjet.13220

Alanoglu, M., Aslan, S., & Karabatak, S. (2022). Do teachers' educational philosophies affect their digital literacy? The mediating effect of resistance to change. *Educ Inf Technol (Dordr), 27*(3), 3447-3466. doi:http://doi.org/10.1007/s10639-021-10753-3

Malik, M., Raziq, M. M., Allen, M. M., & Ahmad, M. (2021). The Digitalization of Pakistan's Universities? An Opportunity to Re-Focus and Re-Purpose Towards Hybrid Learning. In A. Zhuplev, & R. Koepp (Eds.), *Global Trends, Dynamics, and Imperatives for Strategic Development in Business Education in an Age of Disruption* (pp. 171-188). IGI Global.

Martin, A. (2006). A European framework for digital literacy. *Nordic Journal of Digital Literacy, 1*(2), 151-161.

Martzoukou, K., Fulton, C., Kostagiolas, P., & Lavranos, C. (2020). A study of higher education students' self-perceived digital competences for learning and everyday life online participation. *Journal of Documentation, 76*(6), 1413-1458. doi:https://doi.org/10.1108/JD-03-2020-0041

Mayisela, T. (2022). A Practice-Based Approach to Developing First-Year Higher Education Students' Digital Literacy: A Case Study in a Developing Country. *International Journal of Mobile and Blended Learning, 14*(3), 1-14. doi:https://doi.org/10.4018/IJMBL.314582

Meyers, E. W., Erickson, I., & Small, R. V. (2013). Digital literacy and informal learning environments: an introduction. *Learning, Media and Technology, 38*(4), 355-367. doi:https://doi.org/10.1080/17439884.2013.783597

Miguel-Angel, S., García-Barriocanal, E., Sánchez-Alonso, S., Różewski, P., Kieruzel, M., Lipczyński, T., . . . Hamill, C. (2018). Digital skills training in Higher Education: insights about the perceptions of different stakeholders. *Proceedings of the Sixth International Conference on Technological Ecosystems for Enhancing Multiculturality.* 781-787: Association for Computing Machinery. doi:https://doi.org/10.1145/3284179.3284312

Miranda, P., Isaias, P., & Pifano, S. (2018). Digital Literacy in Higher Education. In P. Zaphiris, & A. Ioannou (Eds.), *Learning and Collaboration Technologies. Learning and Teaching. LCT 2018.* Springer, Cham. doi: https://doi.org/10.1007/978-3-319-91152-6_6

Miranda, P., Isaias, P., & Pifano, S. (2018). Digital Literacy in Higher Education. In Z. P., & I. A. (Eds.), *Learning and Collaboration Technologies. Learning and Teaching. LCT 2018. Lecture Notes in Computer Science* (Vols. Lecture Notes in Computer Science, vol 10925). Springer, Cham. doi:https://doi.org/10.1007/978-3-319-91152-6_6

MOITT. (2018). *Digital Pakistan Policy.* Islamabad: Ministry of Information Technology & Telecommunication. Retrieved from https://moitt.gov.pk/SiteImage/Misc/files/DIGITAL%20PAKISTAN%20POLICY.pdf

Monteiro, A. R., & Leite, C. (2021). Digital literacies in higher education: skills, uses, opportunities and obstacles to digital transformation. *Revista de Educación a Distancia, 21*(65). doi:https://doi.org/10.6018/red.438721

Murray, M. C., & Pérez, J. (2014). Unraveling the digital literacy paradox: How higher education fails at the fourth literacy. *Issues in Informing Science and Information Technology, 11*, 58-100. Retrieved from http://iisit.org/Vol11/IISITv11p085-100Murray0507.pdf

Murray, M. C., Pérez, J., & Fluker, J. (2022). Digital Literacy in the Core: The Emerging Higher Education Landscape. *Issues in Informing Science and Information Technology , 19*, 001-013. doi:https://doi.org/10.28945/4957

Ng, W. (2012). Can we teach digital natives digital literacy? *Computers & Education, 59*(3), 1065-1078. doi:https://doi.org/10.1016/j.compedu.2012.04.016

Nunnally, J. C., & Bernstein., I. H. (1994). *Psychometric Theory.* (3rd, Ed.) New York: McGraw–Hill.

Ornellas, A., & Sancho, J. (2015). Three Decades of Digital ICT in Education: Deconstructing Myths and Highlighting Realities. In M. K. Harmes, H. Huijser, & P. Danaher (Eds.), *Myths in Education, Learning and Teaching.* London: Pelgrave Macmillan. doi:https://doi.org/10.1057/9781137476982_8

Ozden, M. (2018). Digital Literacy Perceptions of the Students in the Department of Computer Technologies Teaching and Turkish Language Teaching. *International Journal of Progressive Education, 14*(4), 26-36. doi:https://doi.org/10.29329/ijpe.2018.154.3

PBS. (2021). Pakistan Bureau of Statistics. Retrieved February 2022, from https://www.pbs.gov.pk/node/3339

Pensky, M. (2001a). Digital Natives, Digital Immigrants Part 1. *On the Horizon, 9*(5), 1-6. doi:http://dx.doi.org/10.1108/10748120110424816

Pensky, M. (2001b). Digital Natives, Digital Immigrants Part 2: Do They Really Think Differently? *On the Horizon, 9*(6), 1-6. doi:http://dx.doi.org/10.1108/10748120110424843

Pensky, M. (2006). *Don't bother me mom- -I'm learning!* Saint Paul, Minnesota: Paragon House.

Pensky, M. (2009). H. sapiens digital: From digital immigrants and digital natives to digital wisdom. *Innovate: Journal of Online Education, 5*(3), 11.

Pirzada, K., & Khan, F. N. (2013). Measuring Relationship between Digital Skills and Employability. *European Journal of Business and Management, 5*(24).

Rayna, T. (2008). Understanding the challenges of the digital economy: The nature of digital goods. *Communications & Strategies, 71*, 13-16.

Reynolds, C., Altmann, R., & Allen, D. (2021). Reliability. In *Mastering Modern Psychological Testing.* Cham: Springer. doi:https://doi.org/10.1007/978-3-030-59455-8_4

Robin, B. R. (2016). The power of digital storytelling to support teaching and learning. *Digital Education Review, 30*, 17-29.

Sa, M. J., & Serpa, S. (2020). COVID-19 and the Promotion of Digital Competences in Education. *Universal Journal of Educational Research, 8*(10), 4520-4528. doi:10.13189/ujer.2020.08102

Sadaf, A., & Johnson, B. (2017). Teachers' Beliefs About Integrating Digital Literacy Into Classroom Practice: An Investigation Based on the Theory of Planned Behavior. *Journal of Digital Learning in Teacher Education, 33*, 129-137. doi:https://doi.org/10.1080/21532974.2017.1347534

Samani, 1., Noordin, N., & KarimZadeh, A. (2019). Socio-Demographic Related Difference in Digital Literacy among Undergraduate Students of State universities in Iran. *Iranian Journal of English for Academic Purposes, 8*(2), 34-50.

Sánchez-Caballé, A., Gisbert Cervera, M., & Esteve-Món, F. (2021). Integrating digital competence in higher education curricula: An institutional analysis. *Educar, 57*(1), 241-258.

Sánchez-Caballé, A., Gisbert Cervera, M., & Esteve-Mon, F. M. (2020). The digital competence of university students: a systematic literature review. *Aloma: Revista de Psicologia, Ciències de l'Educació i de l'Esport, 38*(1), 63-74. doi:https://doi.org/10.51698/aloma.2020.38.1.63-74

Satorra, A., & Bentler, P. M. (1994). orrections to test statistics and standard errors in covariance structure analysis. In A. von Eye, & C. C. Clogg (Eds.), *Latent variables analysis: Applications for developmental research* (pp. 399-419). Sage Publications, Inc.

Scheerder, A. J., van Deursen, A. J., & van Dijk, J. A. (2017). Determinants of Internet skills, uses and outcomes. A systematic review of the second-and third-level Digital Divide. *Telematics and Informatics, 34*(8), 1607-1624. doi:https://doi.org/10.1016/j.tele.2017.07.007

Scheerder, A., van Deursen, A., & van Dijk, J. (2017). Determinants of Internet Skills, Use and Outcomes. A Systematic Review of the Second- and Third-Level Digital Divide. *Telematics and Informatics, 34*(8), 1607-1624. doi:https://doi.org/10.1016/j.tele.2017.07.007

Scherer, R., & Siddiq, ,. F. (2019). The relation between students' socioeconomic status and ICT literacy: Findings from a meta-analysis. *Computers & Education, 138*, 13-32. doi:https://doi.org/10.1016/j.compedu.2019.04.011

Schumacker, R. E., & Lomax, R. G. (2010). *SchumA Beginner's Guide to Structural Equation Modeling: Fourth Edition* (3rd ed.). New York: Routledge. doi:https://doi.org/10.4324/9780203851319

Schwab, K. (2019). *The Global Competetiveness Report 2019.* Switzerland: World Economic Forum. Retrieved from https://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf

Selwyn, N. (2009). The digital native – myth and reality. *Aslib Proceedings, 61*(4), 364-379.

Silva-Quiroz, J., & Morales-Morgado, E. (2022). Assessing digital competence and its relationship with the socioeconomic level of Chilean university students. *Int J Educ Technol High Educ, 19*. doi:https://doi.org/10.1186/s41239-022-00346-6

Smith, E. E., & Storrs, H. (2023). Digital literacies, social media, and undergraduate learning: what do students think they need to know? *Int J Educ Technol High Educ, 20*, 29. doi:https://doi.org/10.1186/s41239-023-00398-2

Soroya, S., Ahmad, A., & Ahmad, S. S. (2021). Mapping internet literacy skills of digital natives: A developing country perspective. *PLoS, 16*(4). doi:https://doi.org/10.1371/journal.pone.0249495

Spante, M., Hashemi, S. S., Lundin, M., & Algers, A. (2018). Digital competence and digital literacy in higher education research: Systematic review of concept. *Cogent Education, 5*(https://doi.org/10.1080/2331186X.2018.15191431). doi:https://doi.org/10.1080/2331186X.2018.1519143

Teichler, U. (2009). *). Higher education and the world of work. Conceptual frameworks, comparative perspectives, empirical findings.* The Netherlands: Sense Publishers.

Teo, T. (2013). An initial development and validation of a Digital Natives Assessment Scale (DNAS). *Computers & Education, http://dx.doi.org/10.1016/j.compedu.2013.02.01267*, 51-57. doi:http://dx.doi.org/10.1016/j.compedu.2013.02.012

Tinmaz, H., Lee, Y.-T., Fanea-Ivanovici, M., & Baber, H. (2022). Systematic review on digital literacy. *Smart Learning Environments, 9*(21). doi:https://doi.org/10.1186/s40561-022-00204-y

Tsai, M.-J., & Tsai, C. C. (2003). Information searching strategies in web-based science learning: The role of Internet self-efficacy. *Innovations in Education and Teaching International, 40*(1), 43–50.

UNESCO. (2018). *Quick guide to education indicators for SDG 4.* Montreal, Quebec, Canada: UNESCO-UIS.

van Deursen, A. J., & van Dijk, J. A. (2019). The first-level digital divide shifts from inequalities in physical access to inequalities in material access. *New Media & Society, 21*(2), 354-375. doi:https://doi.org/10.1177/1461444818797082

Van Dijk, J. (2017). Digital Divide: Impact of Access. In P. Rössler, C. A. Hoffer, & L. Zoonen (Eds.), *The International Encyclopedia of Media Effects.* John Wiley & Sons Inc.

van Dijk, J. A. (2005). *The deepening Divide: Inequality in the information society.* SAGE Publications. doi:https://doi.org/10.4135/9781452229812

van Dijk, J. A. (2020). *The Digital Divide.* Polity Press.

van Dijk, J. A. (2020). *The Digital Divide.* Polity Press.

van Dijk, J. A. (2020). *The Digital Divide.* Polity Press.

van Laar, E., van Deursen, A. J., van Dijk, J. A., & de Haan, J. (2017). The relation between 21st-century skills and digital skills: A systematic literature review. *Computers in Human Behavior, 72*, 577-588. doi:http://dx.doi.org/10.1016/j.chb.2017.03.010

van Laar, E., van Deursen, A. J., van Dijk, J. A., & de Haan, J. (2019). Determinants of 21st-century digital skills: A large-scale survey among working professionals. *Computers in Human Behavior, 100*, 93-104. doi:https://doi.org/10.1016/j.chb.2019.06.017

van Laar, E., van Deursen, A., van Dijk, J., & de Haan, J. (2020). Determinants of 21st-Century Skills and 21st-Century Digital Skills for Workers: A Systematic Literature Review. *SAGE Open*. doi:https://doi.org/10.1177/2158244019900176

van Laar, E., van Deursen, A., van Dijk, J., & de Haan, J. (2020). Determinants of 21st-Century Skills and 21st-Century Digital Skills for Workers: A Systematic Literature Review. *SAGE Open*. doi:https://doi.org/10.1177/2158244019900176

Verhoeven, J. C., Heerwegh, D., & De Wit, K. (2016). CT learning experience and research orientation as predictors of ICT skills and the ICT use of university students. *Education and Information Technologies, 21*(1), 71–103. doi:https://doi.org/10.1007/s10639-014-9310-3

Voda, A., Cautisanu, C., Gradinaru, C., Tanasescu, C., & de Moraes, G. (2022). Exploring Digital Literacy Skills in Social Sciences and Humanities Students. *Sustainability, 14*, 2483. doi:https://doi.org/10.3390/su14052483

Vuorikari, R., Punie, Y., Carretero Gomez, S., & Van Den Brande, G. (2016). *DigComp 2.0: The Digital Competence Framework for Citizens. Update Phase 1: The Conceptual Reference Mode.* : Luxembourg; Brussels, Belgium: Publications Office of the European Union.

WEF. (2023). *The Digital Economy*. Retrieved from World Economic Forum: https://intelligence.weforum.org/topics/a1Gb0000001SH21EAG

WEF, & Media, F. (2023). *Top 10 Emerging Technologies of 2023.* World Economic Forum. Retrieved from https://www3.weforum.org/docs/WEF_Top_10_Emerging_Technologies_of_2023.pdf?_gl=1*1kisdpz*_up*MQ..&gclid=EAIaIQobChMIiJz-xJSRgQMVhAGLCh16KQhgEAMYASAAEgJKS_D_BwE

Weiser, M. (1991). The computer for the 21st century. *Scientific American, 265*(3), 94-104.

Wiley. (2021). *Digital Skills Gap Index 2021.* Retrieved from Wiley: https://dsgi.wiley.com/

Wolff, H. G., & Moser, K. (2010). Do specific types of networking predict specific mobility outcomes? A two-year prospective study. *Journal of Vocational Behavior, 77*(2), 238-245. doi:https://doi.org/10.1016/j.jvb.2010.03.001

World Population Review. (2023). *Median Age by Countryhttps://worldpopulationreview.com/country-rankings/median-age*. Retrieved September 2023, from World Population Review: https://worldpopulationreview.com/country-rankings/median-age

Yi, M. Y., & Hwang, Y. (2003). Predicting the use of web-based information systems: Self-efficacy, enjoyment, learning goal orientation, and the technology acceptance model. *International*

Journal of Human-Computer Studies, 59(4), 431-449. doi:https://doi.org/10.1016/S1071-5819(03)00114-9

Yoleri, S., & Anadolu, Z. N. (2022). Examination of digital literacy skills of undergraduate students according to various variables. *Advanced Education,*, 121-134.

Zhao, Y., Llorente, A. M., & Sanchez, M. C. (2021). Digital competence in higher education research: A systematic literature review. *Computers & Education, 168*, 104212. doi:https://doi.org/10.1016/j.compedu.2021.104212

Zhao, Y., Sánchez Gómez, M., Pinto Llorente, A., & Zhao, L. (2021). Digital Competence in Higher Education: Students' Perception and Personal Factors. *Sustainability, 13*, 12184. doi:https://doi.org/10.3390/su132112184

Appendices

Appendix A: Interview Guides

Interviews with faculty and students were guided by a set of questions/topics to ensure all essential areas of interest were covered in the in-depth discussions.

A1 Faculty Interview Guide

- Do you recognize the following terms?
    - Digital Skills
    - Digital Competences
    - Digital Literacies
- What do these terms mean in your understanding, particularly Digital Literacies?
- What are the institutional and departmental policies on Digital Literacies education?
- Is there a formal Digital Literacies framework for curriculum development?
- Are there specific courses on Digital Literacies offered to all students?
- Are Digital Literacies concepts included in subject-specific courses?
- Do you recognize and understand the following concepts?
    - Digital Citizenship?
    - Digital Ethics?
    - Digital Goods?
    - Digital Storytelling?
    - Digital Information Literacy?
- Are these concepts included in subject-specific courses you teach, or others offered by your department?

- Are teachers offered any trainings or workshops on integration of Digital Literacies education in their curriculum and instruction practices?
- What are your perceptions on Digital Literacies levels of undergraduate students, particularly UG juniors and seniors who are halfway through their degrees?
- What do you think are the key factors in Digital Literacies development of young students?
- What are your opinions on higher education and universities' role in Digital Literacies development of young adults?
- Has COVID-19 and related experiences of online work and education affected your personal opinions as well as institutional or departmental approach towards Digital Literacies Education?

A2: Students Interview Guide

- Do you recognize the following terms?
    - Digital Skills
    - Digital Competences
    - Digital Literacies
- What do these terms mean in your understanding, particularly Digital Literacies?
- Where did you first lean about these terms?
- Do you recognize and understand the following concepts?
    - Digital Citizenship?
    - Digital Ethics?
    - Digital Goods?
    - Digital Storytelling?

    - Digital Information Literacy?

- Where did you first lean about these terms?
- Are these concepts included in your curriculum?
- What sort of Digital Literacies or related concepts are covered in your general curriculum, for instance the Introduction to ICTs course mentioned in your program outline?
- What sort of Digital Literacies or related concepts are covered in your subject-specific curriculum?
- Do you think your department and institute differentiate between functional knowledge and other important Digital Literacies?
- In your personal opinion, are you and your peers prepared to efficiently and meaningfully navigate the digital spaces?
- What do you think are the key factors in Digital Literacies development of young students?
- What are your opinions on higher education and universities' role in Digital Literacies development of young adults?
- Has COVID-19 and related experiences of online work and education affected your personal opinions as well as institutional or departmental approach towards Digital Literacies Education?

Appendix B: Survey Questionnaire

The following questionnaire survey was administered for data collection on levels and determinants of Digital Literacies among the sampled UG students.

Part I: Personal Demographic Information

1. Name: _____	
2. Age: _____	
3. Gender	a) Male b) Female c) Non-binary
4. Schooling Background	a) Matric b) O-Levels
5. Type of School	a) Public b) Private
6. Undergraduate Major	a) Business Administration b) Computer Science c) Economics d) Physics
7. Current Year/Grade Level	a) Semester 5 b) Semester 6 c) Semester 7 d) Semester 8
8. Father's Education Level	a) No education b) Primary c) Secondary d) Matric or equivalent e) F. Sc. Or equivalent f) Bachelors' or equivalent g) Masters' or equivalent h) Ph. D. or equivalent
9. Mother's Education Level	a) No education b) Primary c) Secondary d) Matric or equivalent e) F. Sc. Or equivalent f) Bachelors' or equivalent g) Masters' or equivalent h) Ph. D. or equivalent
10. Estimated Monthly Household Income	a) Less than 50,000 b) 50,000 – 100,000 c) 100,000 – 150,000 d) 150,000 – 200,000 e) More than 200,000

Part II: Digital Access

1. Please select the appropriate device ownership status

Device	Bought Due to COVID	Had it Before COVID Too	Don't Own It
Smartphone	1	2	3
Tablet	1	2	3
Laptop	1	2	3
PC (Desktop Computer)	1	2	3
Broadband Internet (Wi-Fi) at home	1	2	3
Mobile Internet	1	2	3
Personal Internet Device like Zong 4G	1	2	3

2. Do you share your devices (smartphone, laptop, computer, etc. EXCEPT the WIFI) with anyone at home (parents or siblings)?

a) Parents
b) Siblings
c) Both
d) None

Part III: Digital Literacies

Please answer the following questions about your daily experience of using digital technologies and digital media. Read the questions carefully and select the most appropriate option on a scale of 1 to 6.

	Never	Very Rarely	Rarely	Occasionally	Frequently	Very Frequently
Digital Information Literacy						
1. How often do you know which search tools or options to use for information search on different digital media like Google Images, Twitter, LinkedIn, etc.?	1	2	3	4	5	6
2. How often do you know which keywords to use when searching online for information on a specific topic?	1	2	3	4	5	6

3. How often do you check the reliability of a website?	1	2	3	4	5	6
4. How often do you compare information found on different websites?	1	2	3	4	5	6
5. How often do you evaluate the relationship between information found on different websites/media? For example: assessing similarities, differences, or logical relationships between information found online.	1	2	3	4	5	6
6. How often do you organize and present the data online?	1	2	3	4	5	6
Digital Problem Solving						
7. How often do you solve a problem using digital tools or through the web / digital media?	1	2	3	4	5	6
8. How often does the internet / digital media help you find ways to solve a problem?	1	2	3	4	5	6
9. How often do you resolve your problems based on information found online?	1	2	3	4	5	6
10. How often do you search for a different database on the internet when you cannot get information on one database?	1	2	3	4	5	6
11. How often do you try different tools, websites, or databases to solve a problem which seems complex and difficult to solve?	1	2	3	4	5	6
Digital Communication & Collaboration						
12. How often do you communicate or network with people from your field of study or interest through internet social platforms?	1	2	3	4	5	6

13. How often do you use online platforms to connect with people from other disciplines or fields?	1	2	3	4	5	6
14. How often do you use your online network to get help?	1	2	3	4	5	6
15. How often does your online network help you generate new ideas?	1	2	3	4	5	6
16. How often does your network help you find resources for your work?	1	2	3	4	5	6

Part IV: Personal Attributes

The following statements relate to your perceptions and attitudes towards the use of digital technologies and media. Read the questions carefully and select the most appropriate option on a scale of 1 to 6.

	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
Digital Nativity						
1. I use internet every day.	1	2	3	4	5	6
2. I use digital tools and digital media for many things in my life.	1	2	3	4	5	6
3. When I need to know something, I search the internet first.	1	2	3	4	5	6
4. I use digital technology for leisure every day.	1	2	3	4	5	6
5. I keep in contract with my friends through internet every day.	1	2	3	4	5	6
Perceived Ease of Use						
6. I feel comfortable using digital technologies and digital media.	1	2	3	4	5	6
7. I can teach myself the things I need to know about digital	1	2	3	4	5	6

technologies and applications.						
8. If I get problems using digital media or applications, I can usually solve them myself.	1	2	3	4	5	6
Learning Goal Orientation						
9. I look for opportunities to develop new skills and knowledge.	1	2	3	4	5	6
10. I think learning and developing new skills is important.	1	2	3	4	5	6
11. I enjoy challenging tasks that I can learn a lot from.	1	2	3	4	5	6
12. I enjoy working in situations where I need many skills.	1	2	3	4	5	6
13. When I don't understand something, I do not avoid asking questions due to fear of seeming incompetent.	1	2	3	4	5	6
14. I am willing to take risks to develop my skills.	1	2	3	4	5	6

15. Who do you generally ask for help first when you have problems with digital tools and services?

1. Classmates / Colleagues
2. Instructors / Teachers
3. Institute's IT or library helpdesk
4. Friends from other disciplines
5. Friends/Family outside of your institution
6. Internet friends/contacts
7. Other: _____

Appendix C: Goodness-of-Fit Criteria for SEM

SEM models were assessed for goodness of fit. Goodness—of-fit is measure of how closely the sample data fits to the theoretical model tested. For baseline comparison, Comparative Fit Index (CFI) was examined. For approximation of population mean, the Root Mean Square Error of Approximation (RMSEA), and for size of residuals, Standardized Root Mean Squared Residual (SRMR) along with the Coefficient of Determination (CD) were assessed. Since the items were measured on a 6-pointt Likert-type scale, generating ordinal data, it was deemed appropriate to report Satorra-Bentler scaled statistics of fit. The rationale was to ensure that the non-normal distribution of the data was accounted for (Satorra & Bentler, 1994)

Table A1

SEM Model Goodness-of-Fit Criteria

Index	Value	Criteria
Baseline Comparison		
CFI	Above 0.95	Preferred
	Above 0.90	Acceptable/Reasonably Good Fit
Population Mean		
RMSEA	Less than 0.08	Reasonably Close Fit
	Less than 0.05	Good Fit
pclose (Probability RMSEA <= 0.05)	$p > 0.05$	Good Fit (fail to reject H_0)
Size of Residuals		
SRMR	Less than 0.08	Good Fit
CD	Close to 1.00	Good Fit

Appendix D: Summary Statistics

D1: Summary Statistics on Independent Variables by HEIs

Table A2

Summary Statistics on Independent Variables by HEIs

Variable	HEI	N	Mean	SD	p-value
DN	Public Sector HEI	100	4.72	1.22	0.000***
	Private Sector HEI	100	5.61	0.48	
PEU	Public Sector HEI	100	4.40	1.13	0.000***
	Private Sector HEI	100	5.32	0.67	
LGO	Public Sector HEI	100	4.52	1.09	0.053*
	Private Sector HEI	100	4.77	0.69	

**p < 0.1, **p > 0.05, ***p < 0.01*

D2: Average Levels of Digital Literacies by Frequency Distribution

Supplementing the findings on average acquired levels of Digital Literacies presented in Section 6.3.1; a tabular distribution of data is presented here.

Table A3

Frequency Distribution of Average Acquired Levels of Digital Literacies

DLs	Frequency	Percentage	Cumulative
1-2	0	0%	0%
2-3	18	9.00%	9.00%
3-4	68	34.00%	90.50%
4-5	95	47.50%	90.50%
5-6	19	9.50%	100.00%
Total	200	100%	

D3: Average Levels of Digital Literacies Across Demographics by HEIs

Table A4

Average Levels of Digital Literacies Across Demographics by HEIs

HEI	Variable	Category	N	Mean	SD	p-value
Public	**Year**	Junior Year	44	3.93	0.71	0.471
		Senior Year	56	3.82	0.82	
	Gender	Female	45	3.83	0.81	0.661
		Male	55	3.90	0.75	
	Schooling Type	Public Sector	34	3.76	0.62	0.352
		Private Sector	66	3.92	0.84	
Private	**Year**	Junior Year	27	4.47	0.69	0.347
		Senior Year	73	4.35	0.53	
	Gender	Female	28	4.34	0.71	0.646
		Male	72	4.40	0.53	
	Schooling Type	Public Sector	11	4.42	0.79	0.807
		Private Sector	89	4.38	0.55	

Note: **N = 100 for both HEIs.**