Digital Learning Challenges in Tertiary Education in Sri Lanka: A Social Capital Perspective

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***Abstract*— This study investigates the underlying factors that contribute to the success of digital learning in higher education using a social capital perspective. It is important to address the issues faced in tertiary education as these students will soon be a part of the workforce. Although digital learning has advanced in developed countries, many developing nations, including Sri Lanka, are still in the early stages of adopting it. Previous research has not adequately explored the relationship between social capital and the challenges of digital learning in the Sri Lankan context. Thus, this study focuses on examining the structural, relational, and cognitive aspects of social capital in relation to the difficulties in digital education in tertiary institutions. The research uses a quantitative approach, and the data were collected through an online survey of students in nonstate universities in Sri Lanka. Structural equation modeling was used to analyze the data, and the results showed that the three dimensions of poor social capital have a negative impact on digital education in tertiary institutions. This study also used multigroup moderation analysis to examine the effect of gender and location. This article will provide new insights into the role of social capital in digital education and will help policy makers to improve the quality and accessibility of digital education for all.**

***Index Terms*— Digital learning, e-learning challenges, gender, learning environment, location, moderation, multigroup analysis, social capital, tertiary education.**

I. Introduction

THE rise of technology has transformed the educational landscape dramatically. The way education and training are conducted has changed significantly, and the use of new technologies has made it possible for anyone to study from any location, at their preferred time, and at their own pace [1]. Digital education is a long-term benefit for students that uses various technology-enhanced teaching methods. These methods include flipped learning, blended learning, personalized learning, and other approaches that utilize digital tools to some extent. Digital education has shown positive outcomes during challenging times such as in conflict, during natural disasters, and during the COVID-19 pandemic [2]. The expanding use of digital education presents both advantages and difficulties related to delivering online lectures, managing course materials, and evaluating assessments accurately.

The technological advancements, robustness, and high-speed internet infrastructure enable to adopt advanced image processing, machine learning, or virtual interactions to effectively complete educational tasks through digital learning [3], [4]. This encourages colleges and universities to place a greater emphasis on digital learning.

Over the last two years, the COVID-19 pandemic has had a significant impact on education systems worldwide, affecting nearly 1.6 billion students in over 200 countries. The closure of schools, colleges, and other learning centers has impacted more than 94% of the world's student population. The effects of this are widespread and have a significant impact on all aspects of our lives [5]. The global education system has undergone a significant shift toward online learning as a result of the temporary closure of educational institutions due to the COVID-19 pandemic [6]. This substantial transformation resulted in a boost in the utilization of various digital tools and applications, including digital educational management systems, massive open online courses (MOOCs), collaboration tools for video communication, and material development tools [7]. During the COVID-19 pandemic, certain digital platforms offered free access to essential services, which was widely utilized by higher education institutions, particularly by academic personnel and students who were proficient in using technology [8]. Although many developed countries have advanced in their adoption of e-learning initiatives, many developing countries, notably Sri Lanka, are still in the initial stages. Digital learning has several challenges, including a lack of resources, access, low Internet bandwidth, insufficient financial assistance, and frequent power outages. These several roadblocks are hindering the widespread implementation of this technology. Researchers regularly proposed various strategies and tools to overcome such difficulties.

The literature in Sri Lanka lacks studies that examine the difficulties of digital learning in nonstate institutions through the lens of a theoretical framework and provide a comprehensive overview. In July 2020, universities in Sri Lanka resumed in-person classes with health precautions and limitations, prioritizing final-year students. Freshmen have not yet started college as a gradual approach is being taken. The restart is determined by the university's vice chancellor and takes into consideration the specific circumstances of each institution [8].

Consequently, online education remains a crucial way of delivering higher education. The Sri Lankan government

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places a high importance on expanding access to top-quality tertiary education as part of its efforts to establish a knowledge-based economy through its new economic plan, "Vistas of Prosperity and Splendor" [9]. Therefore, understanding the new concerns and obstacles in the radical move to online education is crucial. Hence, this study was primarily driven by the fact that online education has emerged as the cornerstone of education in today's fast-changing society of knowledge.

Additionally, despite the abundance of online educational resources and platforms, both students and teachers frequently encounter challenges when using or referring to these tools [5]. In general, some of the difficulties recognized and highlighted by many researchers are e-learning challenges on accessibility, flexibility, life-long learning, cost, educational policy, and learning methodology [10]. Moreover, many countries face challenges in establishing a dependable Internet connection and obtaining access to digital devices [11]. Sri Lanka is confronting several issues in digital learning, which are not yet sufficiently explored where the country is failing to gain the competitive advantage in digital learning. In most of the time, students complain about the difficulties related to digital learning but their real challenges with association to a theoretical framework have not yet been fully identified or adequately addressed. In comparison to the state universities, the nonstate universities tend to adopt digital learning initiatives more rapidly possibly due to their management flexibility, resource availability, and competitiveness. Notably, in the Sri Lankan setting, education is free in state universities even though they must commit a large budget to education [12]. Any adjustments or alterations to education strategies come at a high expense and burden to the government. Therefore, this study aims to examine the challenges that impact the efficiency of digital learning in nonstate sector higher education institutions in Sri Lanka. This study uses a conceptual model based on social capital theory, which has become a widely used concept in the social sciences over the past few decades. There has been a lack of research in the literature that specifically addresses the topic of social capital and a comprehensive multigroup analysis of gender and location in the context of digital education in Sri Lanka.

This lack of research emphasizes the importance of focusing on digital learning in tertiary education, where students can provide valuable feedback on the difficulties and limitations they experience. Identifying challenges in digital learning in tertiary education is crucial in minimizing its impact on education and ensuring that graduates can contribute to the nation's economy. The primary objective of this study is to uncover the challenges that hinder the success of digital learning in nonstate sector higher education institutions in Sri Lanka. This study employs a theoretical framework based on social capital theory, which has been a widely used concept in the social sciences in recent decades. This study aims to determine the challenges of digital learning by using a conceptual model based on social capital theory [13]. Social capital theory is a concept that highlights social relationships are resources that support to enhance the human capital. According to Coleman [14] in the education domain, social capital supports to determine the relationships between students, communities, teachers, physical resources, and other infrastructure toward academic success. The research conducted by Goyette and Conchas [15] examined the influence of family and nonfamily members in secondary education of Mexican-American compared to the Vietnam teens. González et al. [16] adopt social capital to assess the positive influence of family and academic staff for Latinas. At the same time as per Radford and Joseph [17], several technical problems have been detected when machine learning algorithms are employed to examine social interactions. Existing solutions to these technical problems have their limits which made researchers adopt social theories when building, assessing, and comparing machine learning models. Because similar studies effectively used social capital theory to identify the impacts of social interactions instead of machine learning, this article also adopted a similar approach.

This study's key research question is: what social capital elements might help mitigate the difficulties associated with digital learning environments in Sri Lanka's private tertiary education system? This study fills an important gap in the existing literature by utilizing a statistically proven model and providing valuable insights into the challenges of digital learning and its relationship with social capital. Further, these findings are crucial in identifying relevant policymakers and the government to enhance the overall implementation of e-learning in Sri Lanka. More notably, recognizing the challenges in digital education is crucial to realize the National Education Goals (NEGs) of Sri Lanka. The findings of this study will provide insights for the National Education Commission (NEC) and contribute to the Sri Lanka National Education Policy Framework 2020–2030.

II. Literature Review

A. Digital Learning

Digital learning, which involves the use of information and communication technology (ICT) for knowledge and skill development, has been proven to be an effective method of education. The integration of online technology has changed the way we approach, design, and view education. The improvements in technology have led to a better user experience, making digital learning a trend of the future and a rapidly expanding the higher education sector. While it offers numerous advantages over traditional education methods, it also presents certain challenges. The integration of technology into education has made the world of education more complex and challenging [18]. It has been emphasized that successful digital learning requires not only a well-designed learning environment but also the motivation and participation of the students [18]. It helps to overcome the challenges of accessing traditional learning environments.

B. Digital Learning Challenges in Developing Countries

The global pandemic had a variety of effects on people's life, including their employment, education, financial situation, health, and communications. The abrupt and significant disruption of social life and the educational system affected many instructors' works in a various way [19]. According to a

study that analyzed the major difficulties and factors affecting the use of e-learning systems during the pandemic, technical issues were one of the key determinants of the utilization of these systems [20]. A study from rural Alaska (United States) showed that the teacher experienced an increased workload in online teaching during the pandemic and believed that online education should be comprehensive and well-organized [21]. The use of e-learning in underdeveloped nations may be limited due to the lack of literacy and education, the lack of technological expertise, and socioeconomic issues with the people [22].

However, the primary difficulties that have emerged are a lack of ICT infrastructure and poverty. In a South African study, it was highlighted that many rural students are unable to participate in online teaching and learning because they lack access to the Internet, learning management systems (LMSs), and software [23]. In Southeast Asia, a substantial portion of the population lacks access to the Internet or electronic devices. Even among those who have Internet access, the disparity in Internet speeds across different regions has been identified as a challenge. Residents in urban areas often have significantly faster Internet speeds compared to those in less developed locations [24]. The unequal access to the Internet and digital devices remains a barrier to equitable opportunities, particularly in rural areas [25], [26]. Additionally, a study conducted in Nepal found that electricity-related issues (63.2%) and Internet concerns (63.6%) frequently caused students to be distracted during online classes. Furthermore, nearly half of the teachers faced difficulties in their online teaching due to power outages (42.3%) and Internet disruptions (48.1%) [27]. Moreover, in Odisha, electronic and social media platforms have reported that students are resorting to unconventional methods to access digital learning classes, such as sitting in trees, near high places, or along riverbanks [28].

Furthermore, digital learning is rarely discussed in research studies on rural education. They primarily focus on infrastructure requirements or the possibilities for online course accessibility, with little attention given to education, results, or role models. The report based on "Digital Learning Strategies for Rural America" aims to begin redressing that imbalance. The authors go on to discuss rural education issues, how remoteness affects rural schools and students, and how blended and online learning can assist in overcoming these difficulties in the parts that follow [29]. However, this article has not clearly differentiated how digital learning challenges vary in urban and rural regions.

In addition, Zamani et al. [30] categorize the impediments that the emerging states face in integrating digital learning into three types as "personal difficulties" (inner personal characteristics, traits, and behavioral tendencies), "attitudinal inhibitor" (internal features that are more than crucial to user opinions of the components of digital learning), and the "contextual inhibitors" (refers to outside elements that hinder the development of ICTs). The major barriers to sustainable remote learning adoption in developing nations are shown in the following graph (Table I) in reverse-chronological sequence [31].

TABLE I
MAJOR BARRIERS TO SUSTAINABLE REMOTE LEARNING ADOPTION IN DEVELOPING NATIONS [31]

Study	Country	Challenges
Ssekakubo et al. (2011) [32]	Africa	Internet accessibility, Knowledge gap of stakeholders, ICT illiteracy, Undefined strategies, inadequate selection of Learning Management Systems (LMS)s, and inefficient user support.
Khan, Hasan, & Clement (2012) [33]	Bangladesh	ICT infrastructure, Inefficient funds, Unclear plans, Political factors, corruption, Teacher's attitudes, ICT skills and lack of time.
Elzawi & Wade (2012) [34]	Libya	Internet access, Low internet connectivity, Lack of encouragement, English proficiency, training programs, cost of internet, technical skills, disinterest and social restrictions.
Tarus et al. (2015) [35]	Kenya	ICT and e-learning infrastructure, financial support, low internet bandwidth, inadequate policies, technical skills, and time cost to prepare e-resources.
Sife et al. (2007) [36]	Tanzania	A systematic approach, awareness, and attitudes of stakeholders, administrative support, technical support, staff development, transforming Higher education, lack of funds, and ownership
Matar et al. (2010) [37]	Middle East	ICT infrastructure and lack of electronic resources
Mirza & Al-Abdulkareem (2011) [38]	Saudi Arabia	Rate of internet penetration, bandwidth and cost of the internet, and low esteem of public for web-based learning
Al- Shboul (2013) [39]	Jordan	Lack of institutional encouragement and support as well as improper training

The number of analyses concentrating on digital learning integration in emerging nations has lately appeared. Andersson [40] presented important e-learning challenges in the context of developing nations where ICT awareness is restricted, and e-learning courses are few. They also identified both the theoretical and practical aspects that need to be considered when designing and studying e-learning in emerging countries. It is considered significant because education delivery holds

great potential for the benefit of the less fortunate, but it must be implemented with an understanding of the specific challenges involved. Seven major issues were discovered to be present in this condition: undergraduate support, flexibility, availability, learners' academic confidence, learning and instruction methods, content localization, and perceptions toward e-learning [40].

Support pertains to the assistance that a student will need to effectively finish the course. Engaging in conversations and interactions with students, tutors, and other staff members, including the IT help desk, is intended to enhance the learning experience and improve academic performance [41]. Flexibility relates to the conventional e-learning philosophy of "anyone, anytime, anywhere" learning. This factor raises several concerns, like whether undergraduates should be able to understand at their own limit and if they should be given the option of choosing the delivery method. Above all, it has been demonstrated that adaptability in assignment deadlines and course delivery results in positive consequences [41]. Academic confidence describes the undergraduates' former educational knowledge and experience. Educational self-assurance is a strong determinant of a pupil's achievement or breakdown in remote education sessions [41]. Attitudes on IT and e-learning indicate that optimistic or pessimistic mindsets can be shown in how individuals recognize digital learning to be "less excellent" than face-to-face training. If perceptions are not appropriately and genuinely addressed, they may become significant impediments to e-learning [42]. Access refers to the technology availability that may either facilitate or restrict e-learning. The dependability and capacity of the relationship will impact users' capability to access a variety of essential material. Localization of content depends on how the course information is modified to represent the cultural identity, customs, and religious beliefs. To avoid offending the culture or just confusing people, symbols and figures, for instance, should be applicable [43]. Moreover, a key obstacle to learner participation in online learning is the impact of Internet self-efficacy [44]. Self-efficacy has been correlated to enhance online engagement and exam performance, according to Wang and Newlin [45]. Digital learning challenges were significantly impacted by the quality of online interactions, according to Wellman, Haase, Witte, and Hampton's analysis [46] of the correlation between online communications and social capital.

Previous studies have aimed to shed light on the challenges to the successful implementation of digital learning in emerging nations. However, each study focused on a specific case, neglecting the fact that there are notable differences between developing countries in terms of their cultural, educational, and economic backgrounds. Therefore, further research is needed, especially in countries where limited or no investigation has been conducted. Gulati's research [47] found that technology-enhanced learning (TEL) has been applied in several emerging countries and revealed that e-learning initiatives have the potential to enhance their educational systems. However, these difficulties associated with social capital and digital learning are not exactly clear. The impact of integrating social capital into digital learning in a nonstate higher education environment has not been adequately addressed in the Sri Lankan context. This study aimed to link the educational variations by researching the fundamental processes that define the relationship between social capital factors and online educational challenges. Therefore, the key intention of this study was to construct a framework that uncovers and assesses the obstacles associated with online learning in Sri Lankan nonstate sector institutions from the viewpoint of social capital dimensions.

C. Social Capital Theory

According to Putnam, social capital includes behaviors such as involvement in the society, mutual trust, support, and cooperation as well as mutual support [48]. In social capital theory, structural, cognitive, and relational dimensions are most frequently employed in academic discussions to illustrate why relationships are important in education [48]. Nahapiet and Ghoshal [49], in their extensive review of the literature on social capital, have divided the concept into three distinct but interrelated dimensions: structural, cognitive, and relational.

Structural social capital refers to the overall network of social relationships. This dimension encompasses the impersonal aspect of connections between individuals, in which an individual can utilize for benefits such as information and support [49]. The structural dimension encompasses elements of the network, such as the existence or absence of connections between parties, the arrangement of a network, as well as concepts such as the tightness of relationships, gaps in the network structure, the presence or absence of ties between individuals, the formal and informal structure of a network (such as accessible networks), and the intensity and interconnectivity of a network [50]. Structural social capital is a tangible aspect of social capital and is easier to observe compared to the other dimensions. It facilitates the exchange and transfer of knowledge or resources between individuals and provides access to relevant peers who possess the desired knowledge or expertise. The structural dimension of social capital allows for greater opportunities for exchange.

Cognitive social capital refers to the dimension of social capital that encompasses resources that provide common understandings, perceptions, and systems of meaning among individuals [49]. Cognitive social capital is embodied in the shared understanding and language used within a group, organization, or community, which forms the basis for communication. This includes common vocabulary and narratives and helps to establish a shared understanding [51], [52]. Tsai and Ghoshal [53] described cognitive social capital consisting of shared goals or vision and a shared culture. The shared understanding within a group, organization, or community is part of the cognitive dimension of social capital. This dimension is intangible and concerns the shared interpretations and understandings among members.

Relational social capital relates to the quality of the relationships an individual has with others, encompassing elements such as trust, obligations, respect, and even friendship [54]. The quality of relationships that have developed over time is referred to as the relational dimension of social capital. Nahapiet and Ghoshal [49] found that trust and trustworthiness [48], [55], norms and sanctions [48], [56], expectations and

obligations [56], [57], [58], and identification and identity [59], [60] are the crucial elements of relational social capital. Relational social capital is not tangible. This makes it highly subjective and can vary greatly among individuals and in different situations.

D. Social Capital and Academic Achievement

Significance of the social capital for academic performance has been the subject of several investigations. Coleman [14] found that a student's performance in school is influenced by their social network and the relationships they have with their family, friends, and school. Coleman [14] concluded that these factors are key determinants of educational success. A handful of Coleman studies have looked into the social capital influences on obtaining a more advanced education [14], [61], [62]. Additionally, Coleman [14] pointed out that pupils at religious institutions tend to behave in a way that is more trustworthy to the community and more in line with social conventions. The application of social capital theory to education has been further explored in research by Bankston, Field, and Horvat [63]. They have conducted a comprehensive examination of this topic, using evidence from the field of education [64].

The significance of social capital in boosting students' academic success has been emphasized in several studies conducted in various learning environments and stages [65], [66]. A person's access to connections in a network, which enhances their conformity to group standards and trust, is referred to as having online social capital [67]. Putnam's theory forms the foundation of the study's theoretical framework [68]. "Bridging" and "bonding" were the characteristics of Putnam's social capital in 2000. People from different backgrounds can engage on social media due to bridging social capital [68]. In contrast, bonding social capital is characterized as persons' deep expressive interactions and socializing built on a common identity [68], [69]. According to an analysis of the existing literature, online social capital is substantially and favorably correlated with academic achievement [65], [70]. Behtoui and Neergaard [66] found that all three dimensions of social capital in a family setting have a favorable effect on the learners' academic accomplishment from a study on the affiliation between learners' academic accomplishment and social capital. Daly et al. [71] found that teachers' social and human capital has a significant positive impact on students' academic achievement in elementary schools in Southern California. Iqbal et al. [72] indicated that emotional intelligence and academic social networking sites both play a significant role in positively impacting students' academic performance during the COVID-19 pandemic. Islam et al. [73] discovered that social capital, which results from smartphone use, can significantly and favorably affect students' performance.

Zhang et al. [74] conducted an analysis of 363 members of Chinese health Q&A groups and found that social capital has a positive impact on both regular users' and professionals' intentions to exchange information. Through a study involving 312 undergraduate university students in Bahrain, it is suggested that social capital is a crucial method for universities to facilitate knowledge exchange.

The impact of knowledge sharing on students' academic performance has been widely studied with the online social capital. Knowledge sharing refers to the process through which individuals transfer their expertise, knowledge, understanding, or insights, either implicitly or explicitly [75]. Sharing interests, objectives, desires, or practices with others is typically how learning is obtained [76]. A theoretical framework for knowledge sharing developed by Tonteri et al. [77] considers three key advantages of online information exchange, namely, social integrative benefits (SIB), personal integrating benefits (PIB), and cognitive benefits (CB). CB is used to describe an individual's prospects for increasing both his knowledge and his capacity for problem-solving. An individual's prospects for establishing connections with other virtual community partners are referred to as SIB, and their expectations for advancing their status as experts and influencing others are referred to as PIB [77]. Numerous investigations have looked into the connection between the propensity to impart knowledge and educational success [76], [78], [79].

Individuals could acquire and use knowledge while participating in online knowledge sharing [80]. As a matter of fact, technology-aided instructors during the COVID-19 outbreak served as a vital channel for the dissemination of information and education [81]. Furthermore, information sharing provides a major impact on learning outcomes, according to a study by Eid and Al-Jabri [82] that conducted on 308 students at a Saudi Arabian university.

E. Gap in the Literature

Although several studies have investigated the connection between information sharing and students' academic performance, none have explored the impact that different knowledge-sharing advantages, such as SIB, PIB, and CB, may have on scholars' educational accomplishment. Crompton and Burke [83] stated that there is a gap in the research because the significance of digital tools and the obstacles of cyberspace for educational achievements has received slight focus. Despite the importance of social capital in knowledge sharing, there is limited research in the literature that specifically focuses on the concept of social capital in the context of digital education. There have been no direct studies that analyze the relationship between social capital and learners' digital learning challenges with a focus on its structural, cognitive, and relational dimensions. This lack of research is particularly pronounced in developing countries like Sri Lanka. Previous studies have not explored whether low social capital has a significant impact on educational outcomes or if it affects academic challenges. Understanding the challenges faced by students in digital learning in tertiary education is crucial to mitigate its impact on education, as these students will soon be able to contribute to the nation's economy after graduation. Thus, it is important to develop a conceptual model that acknowledges and assesses the educational challenges faced by students in digital learning environments in Sri Lankan nonstate tertiary education, where there is limited literature available. Based on the findings discussed above, the following hypothesis was established to assess the impact of poor social capital on digital learning challenges in Sri Lanka.

F. How Social Capital Can Be Used in Digital Learning

1) Role of Structural Social Capital in Digital Learning: The amount of information sharing among students can impact their performance. The formation of connections between online students exposes them to new knowledge and fresh perspectives, as there is a great diversity among students, each of whom brings unique ideas and concepts to the table. As Chang et al. [84] noted, structural holes and network diversity provide fertile ground for innovation, the generation of new knowledge, and the facilitation of learning outcomes. In addition, a continuous feedback process is critical in an e-learning environment as e-learning platforms do not provide the opportunity for physical interactions and observation of students' performance. These social ties offer more opportunities for students to receive feedback from teachers and peers.

Social interaction can take many forms when it comes to learning, such as peer-to-peer instruction, observing others, and more. Engaging with fellow learners helps organize thoughts and identify gaps in understanding. Collaborative learning through these means has a positive effect on students [85], as it provides a fun and effective way to learn while fostering skills like communication and problem-solving. However, in the context of digital learning, student's and teacher's interaction has been reduced significantly [86] since it lacks the feeling of togetherness and authenticity that an in-person mode may provide. In real classes, teachers and students interact and form an instant and lively educational experience. Less engagement in online learning has a significant influence on students who require the presence of their teacher for confidence, inspiration, and guidance. These are the students who hesitate to reveal emotion or opinions (students who are naturally reserved) and they expect the teacher's support to take risks in their learning or be a part of class discussion. Digital learning has become more challenging for these kinds of students because their interactions and network ties have dropped significantly.

H1: There is a significant impact of poor social interactions on digital learning challenges in Sri Lankan tertiary education.

2) Role of Cognitive Social Capital in Digital Learning: Having a common language in a virtual learning environment is crucial in fostering effective communication between students. This allows individuals to understand each other's goals and methods of communication, reducing the chances of conflicts. Shared language, which is formed through regular interactions, enables the members to comprehend the common goals within the community.

Having shared norms and goals predisposes learners to collaborate and share knowledge. Learners from different cultural backgrounds tend to share knowledge in different ways [87]. The improvement of students' knowledge sharing in online communities is made possible by online social capital [88]. People tend to exchange knowledge more frequently when their expectations of the online social group are higher [68]. Lefebvre et al. [89] suggest that cognitive social capital and social interactions are significantly and positively associated with knowledge transferring in educational settings. According to Moghavvemi et al.'s [78] study of 170 undergraduate students in Malaysia, the perception of collective benefit was identified as a reason for knowledge sharing which in turn has an impact on students' performance. Asterhan and Bouton [90] discovered that preserving favorable views toward online information sharing and distributing course materials enhance educational achievement.

However, for learners in a highly virtualized learning environment, the lack of face-to-face interaction and the inability to observe body language from other classmates can lead to feelings of loneliness and stress [91]. To establish close ties, students with similar backgrounds and life goals can form close bonds by having frequent interactions and sharing relevant information and resources. This fosters mutual appreciation and enables them to learn from one another.

Due to the global pandemic, educational institutions across the globe had to immediately switch to the emergency remote teaching mode while having no strong prior expertise on how to do so. Having digital literacy skills is crucial for both students and teachers to have a successful online learning experience. This includes the ability to use technology, find and use information critically, and collaborate and engage in online environments by manipulating data and media sources. Unless both student and teacher have a fair amount of shared understanding about the technologies, platforms, and digital learning, it would not be a successful learning experience. A shocking 84% of instructors have reported difficulties in delivering online instruction, with almost half of them facing issues related to the Internet such as signal problems and bandwidth costs [92]. These challenges could have been prevented if both the teachers and students had the proper technical knowledge and experience. Hence, digital literacy skills, along with the willingness to develop them, have become a crucial professional competency for both students and teachers.

H2: There is a significant impact of poor shared understanding on digital learning challenges in Sri Lankan tertiary education.

3) Role of Relational Social Capital in Digital Learning: The relational aspect of social capital deals with the quality of relationships that have developed over time. Social relationships that bind families and communities fueled the children's social and academic development. Social ties within the school community have a direct impact on its operations. In regions with high levels of social capital (strong ties between children and parents, between students and teachers, and feelings of affection for the institution), the procedure of educational growth is straightforward and has a significant impact on educational goals [93]. Individuals who are engaged in social relationships are more likely to have self-awareness and success, as social connections serve as a motivator for them to enhance their lives [94]. Differences in academic achievement can be attributed to a variety of factors, including parental expectations and duties about a child's education, the community's connections, the school's characteristics and academic environment, and cultural norms and ethics that encourage a student's efforts. In other words, social capital is a crucial concept for evaluating students' academic success in various civilizations or countries.

To engage in informal learning networks, they should maintain good personal relationships with their peers. By strong bonds with their peers with trust, obligations, and respect, it will enable higher participation and interactions within social media platforms. Participating in formal platforms such as LMS, zoom, and Microsoft teams (MS teams) as well as social media (such as WhatsApp and Facebook groups) enable students to tailor their learning activities to meet their needs. The strength of relationships and trust among individuals plays a key role in allowing quick access to information, facilitating knowledge transfer between students, providing exposure to different viewpoints, broadening perspectives, and clarifying concepts. These interactions ultimately help develop professional skills, reduce feelings of isolation, and build self-confidence, all of which can impact a student's academic performance both directly and indirectly.

When participants are close to each other, they tend to spend more time interacting, which results in stronger ties. This can lead to a deeper understanding of each other's life events, which helps to strengthen their relationships. In online education, there are difficulties in establishing these relationships between students and teachers due to the physical distance between them. Distant individuals may have difficulty fully understanding each other and providing the same level of participation, support, and encouragement.

Forming a strong relationship involves building trust and reliability. Trust plays a crucial role in creating lasting social connections, which serve as the foundation for effective collaboration. In education, the significance of trustworthy relationships cannot be overemphasized. Whether the learning environment is traditional, remote, hybrid, or constantly changing, one critical factor remains constant: the interaction between students and teachers. According to the American Psychological Association, teachers who establish strong relationships with their students create a more favorable learning environment that meets students' emotional, cognitive, and intellectual needs [95]. A student who has a positive relationship with their instructor is more likely to trust them, be more engaged in studies, have better behavior in class, and perform better academically. Frequent communication and receiving constructive feedback, guidance, and praise from their teacher, rather than just criticism, can lead to the development of a strong personal connection, which can have a positive impact on the student's academic performance [95].

H3: There is a significant impact of poor relationship quality and trust on digital learning challenges in Sri Lankan tertiary education.

G. Moderating Effect of Location

Furthermore, Jafar et al. [96] claimed that students' general capacity and effectiveness for participation in the e-learning program were impacted by their home settings and geographical location. Compared to their urban counterparts, students in rural locations are more likely to face technical and connectivity issues, decreased focus on their studies, physical health problems, social isolation, and limited digital literacy. Although the situation of students in Kuala Lumpur may be unique, this study found that students in rural areas, particularly in Sabah, Perlis, and Malacca, might be considered as vulnerable groups with a higher risk of various health and social issues [96]. Due to a lack of telecommunication facilities, learners in many rural Canadian regions frequently experience increased difficulties with device use and accessibility. In their investigation of learners in rural settings, Hayes et al. [97] highlighted these same problems. Additionally, they pointed out that the limited study on this demographic was occasionally characterized by resistance and ambivalence to incorporating technology into newer interventions. Sparks [98] discussed the issue of digital exclusion in rural areas and described the difference in access and use of digital technology and services between urban and rural areas as the "urban–rural digital gap". Similar findings were uncovered by OConnor et al. [99], who discovered that students in rural regions hardly ever utilize technology.

Inversely, fostering social connections among learners, rural students with computer technology may enhance additional social bonds and further decrease geographical and social isolation. Fundamentally, it was also believed that the excessive cost of Internet access and its inconsistent availability in rural locations created an impediment for both service providers and students, which facilitated greater digital isolation [100]. Overall, it seems that neither the technology nor the theoretical coherence of the intervention appears to guarantee the desired results. However, there is a dearth of literature that examines geography location in relation to the difficulties of digital learning from a more all-encompassing, upbeat, and thorough perspective. Therefore, it is essential to distinguish between the difficulties associated with digital learning in urban and rural settings to persuade important decision-makers and the government to upgrade fundamental facilities and infrastructure so that e-learning is easily accessible to all students in Sri Lanka. Based on the above findings, the following hypothesis was established.

H4: Location moderates the relationship between poor social interaction and digital learning challenges.

H5: Location moderates the relationship between poor shared understanding and trust and digital learning challenges.

H. Moderating Effect of Gender

Gender is one area where social capital literature falls short [101]. The ethnic and gender elements of social capital are still undervalued [102], [103]. Gender-blind social capital is minorly theorized in the literature, with little consideration paid to gendered intrahousehold concerns of authority and hierarchy [104], [105]. According to Silvey and Elmhirst [105], a much more thorough understanding of social capital is essential, one that considers the gender-specific, intergenerational, and hierarchical issues within social networks as well as the larger context of gender variance within which social networks are formed. Additionally, Silvey and Elmhirst [105] hypothesized that since women do not participate in the more robust network of reciprocity and trust that exists among men, social capital may make things more difficult for women.

The authors argue that, adopting Putnam [48], bridging social capital is more likely to have positive externalities than

bonding social capital and that bonding social capital is significantly more likely to face negative externalities. Network analysis has been used by management researchers in business schools to understand both individual and organizational success. They have noticed significant gender differences in the endowments of social capital throughout the process. Theories [106] and actual data show that the connections that men and women make in their work are different. Although both men's and women's networks are homophilous, Ibarra [107] show that women's networks are less homophilous than men's networks, meaning that they contain more people of the opposite sex. In their 2011 study on trust and network size, Bevelander and Page [108] found that women frequently have lower levels of trust than men do in high-risk formal situations. Women were shown to have social networks of the same size, but with increasing levels of trust, their aggregate network size decreases more than men's do. Moreover, Lutter contends that a woman's success strategy depends on her ability to negotiate across many structures, whereas a man's success strategy is supported by his membership in or leadership of strong, coherent network structures [109]. It is still unclear if offering a gendered approach to the social capital and demonstrating disparities by gender in the social accumulation of capital are adequate.

However, there is minimal relevant research that assesses gender moderation in academic contexts, whether it affects digital learning directly or indirectly. Hence, it is important to assess gender variations in social capital and how these affect digital learning challenges. Considering the facts, the following hypothesis was established.

H6: The relationship between the poor shared understanding and the level of challenges in digital learning will be moderated by gender.

H7: The relationship between the poor relationship quality and trust and the level of challenges in digital learning will be moderated by gender.

III. Methodology

The main goal of this study is to provide a theoretical framework that explains how the lack of social capital contribute to the challenges associate with digital learning in higher education in Sri Lanka. The research methodology used in this study was suggested by Tsai and Ghoshal [53]. To produce empirical proof of the model's viability, it first develops measures for the proposed constructs, gathers data from surveys and open-access sources, and uses structural equation modeling (SEM). SEM makes it possible to evaluate intricate theoretical models using gathered data.

A quantitative approach was preferred in this study considering the generalizability of results to larger populations. The quantitative research typically employs deductive reasoning to examine hypotheses where the researcher can gather numerical data using surveys to either confirm or disprove an established hypothesis. For the research, the partial least squares (PLS)-SEM methodology was selected for several reasons. This approach mostly comprises developing a new framework (Fig. 1) from this article as opposed to testing an established theory with an already developed data collection tool. Also,

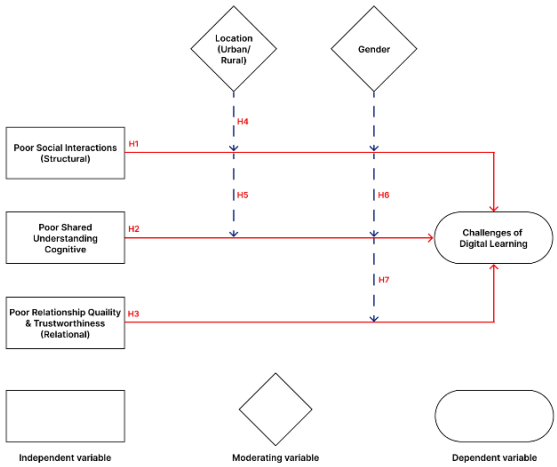


Fig. 1. Theoretical framework.

this study has indicated accuracy and predictability as key elements. Observable indicators for each concept were found in the literature. PLS-SEM is recommended for developing novel theories and prediction applications. It is frequently employed when single-item constructs, multicollinearity issues, nonnormal data, a high requirement for prediction accuracy, exploratory research goals, and the absence of previous theory are present [18].

Initially, an extensive literature study was conducted on digital learning in international conferences, websites, books, and peer-reviewed and indexed journals based on which the conceptual model was developed, and the indicators of social capital dimensions were identified, as listed in Table II.

A. Data Gathering Approach

A survey instrument was developed by the chosen indicators that were mapped to survey questions and the survey was deployed online. This study's objectives were all covered by the questions, which were written to be clear, concise, and easy to understand. They included questions about the frequency of support received, challenges encountered in a digital learning environment, ease of interaction in a digital environment, familiarity with technological functions and platforms, reciprocity in a digital environment, learner engagement in digital platforms, and closeness. The quantitative survey variables were analyzed using a five-point Likert scale with a range of 1–5. To efficiently examine constructs and collect information from a large population, a survey technique was adopted. There were only a limited number of alternatives for answers to the closed-ended questions. To minimize the common method bias, questions were switched up and kept some time delays and increased physical separation of questionnaire items [111]. Once a respondent submits the form, their responses are anonymous, and the data are kept confidential.

For this article, data were collected from students from various faculties (IT, science, and management) in nonstate universities in Sri Lanka since nonstate institutions are more progressive in digital learning than the government sector.

TABLE II
PRELIMINARY LIST OF INDICATORS [110]

Poor Social Interactions (SI)	**SI1:** The frequency of interactions on digital platforms, (How often two or more people connect.) **SI2**: The duration of the interaction **SI3**: The frequency of receiving peer support. **SI4:** Ease of interaction
Poor Shared Understanding (SU)	**SU1:** Level of computer literacy **SU2**: Familiarity with Digital learning platforms and technologies **SU3**: Learner's engagement in digital education **SU4**: Knowledge retention in digital learning
Poor Relationship Quality and Trust (RQ)	**RQ1**: Mutual confiding (trust) **RQ2**: Level of reciprocity in knowledge sharing **RQ3**: Closeness
Digital Learning Challenges (DLC)	**OC1**: Knowledge retention after online sessions **OC2**: Meeting deadlines on time in digital learning **OC3**: Self-evaluation on achieving learning outcomes. **OC4:** Frequency of needing help/clarifications in digital learning.

TABLE III
MEAN AND STANDARD DEVIATION (SD) OF ALL THE INDICATORS

	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Std. Error	Statistic	Statistic
SI_1	5	2.18	0.070	0.899	0.809
SI_2	5	2.21	0.062	0.797	0.635
SI_3	7	2.11	0.128	1.636	2.675
SI_4	5	2.22	0.063	0.807	0.675
SU_1	5	2.62	0.091	1.164	1.355
SU_2	5	2.55	0.084	1.081	1.169
SU_3	5	2.02	0.082	1.048	1.098
SU_4	5	3.07	0.079	1.016	1.032
RQ_1	5	2.62	0.075	0.955	0.913
RQ_2	5	2.66	0.079	1.011	1.022
RQ_3	5	2.66	0.098	1.260	1.588

Students who have already experienced digital learning were the audience who filled out the questionnaire. There are 23 nonstate higher education institutions recognized by the University Grants Commission in Sri Lanka. The survey was shared with students in all nonstate universities and the final dataset included 164 responses covering all institutions because of subsequent follow-ups. The sample was not drawn from a vulnerable population.

This study focused on the social capital theory, which helps define the implicit theory more precisely, rather than utilizing the traditional research approach. The theoretical framework that was put forth made it easier to emphasize the limitations of an observable event and generalize the many aspects of it rather than just describe them. Additionally, it described the researcher's plans for analyzing and evaluating the data they would collect, as well as how they would evaluate and interpret the data they would obtain.

TABLE IV
MEAN AND STANDARD DEVIATION OF ALL MEASUREMENTS

	N	Minimum	Maximum	Mean	Std. Deviation
SI	164	1.00	5.50	2.1799	0.81330
SU	164	1.00	5.00	2.5640	0.92578
RQ	164	1.00	5.00	2.6463	0.91693
DLC	164	1.00	5.00	2.4177	0.76649

TABLE V
GENDER FREQUENCY TABLE

	Frequency	Percent	Valid Percent	Cumulative Percent
Male	103	62.8	62.8	62.8
Female	61	37.2	37.2	100.0
Total	164	100.0	100.0	

IV. DATA ANALYSIS

For the analysis, SPSS software was used to better understand the distribution of the data. Additionally, the impact of social capital components on difficulties with digital learning was evaluated using Smart PLS4. Data analysis for this study is divided into four sections:

1) the analysis of the measurement model.
2) the analysis of the structural model.
3) evaluation of moderator variables.
4) in-depth analysis of multigrouping.

A. Respondents' Profile: Descriptive Analysis

Tables III and IV represent descriptive statistics of all the indicators and measurements. According to Tables III and IV, descriptive statistics for poor social interactions reveal an overall mean score of 2.1799 (SD = 0.81330) and the indicator of the highest mean value is SI_4 (ease of interaction). Moreover, descriptive statistics for poor shared understanding reveal an overall mean score of 2.5640 (SD = 0.92578), and the indicator of the highest mean value is SU_4 (knowledge retention in digital learning). Furthermore, descriptive statistics for poor relationship quality and trust reveal an overall mean score of 2.6463 (SD = 0.91693), and the indicator of the highest mean value is RQ_2 (reciprocity in knowledge sharing) and RQ_3 (closeness).

According to Table V, sample of university students consisted of 103 (62.80%) male and 61 (37.20%) female respondents ($N = 164$). The bar chart given in Fig. 2 validated that there was a more contribution from male than the female students.

Table VI represents the location distribution of the respondents. According to Table VI, sample of university students consisted of 92 (56.10%) rural and 72 (43.90%) urban respondents ($N = 164$). The bar chart given in Fig. 3 validated that there was a more contribution from rural participants than

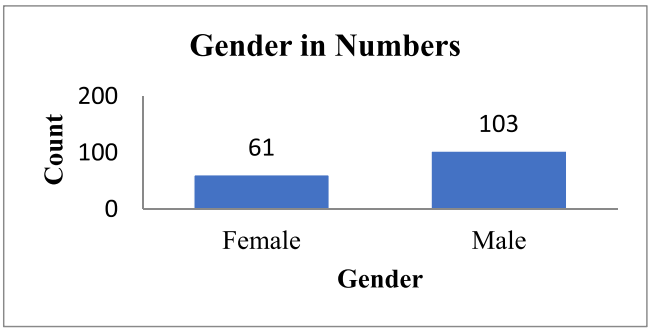


Fig. 2. Gender of respondents.

TABLE VI
LOCATION FREQUENCY TABLE

	FREQUENCY	PERCENT	VALID PERCENT	CUMULATIVE PERCENT
RURAL	92	56.1	56.1	56.1
URBAN	72	43.9	43.9	100.0
TOTAL	164	100.0	100.0	

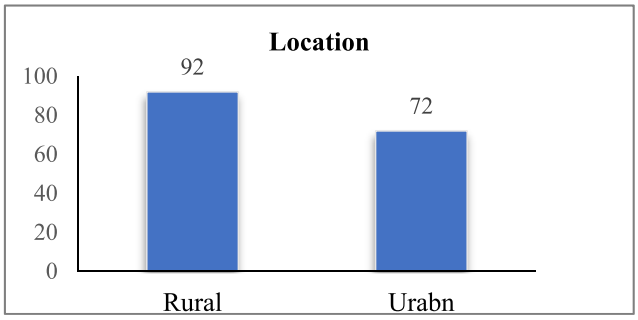


Fig. 3. Location of respondents.

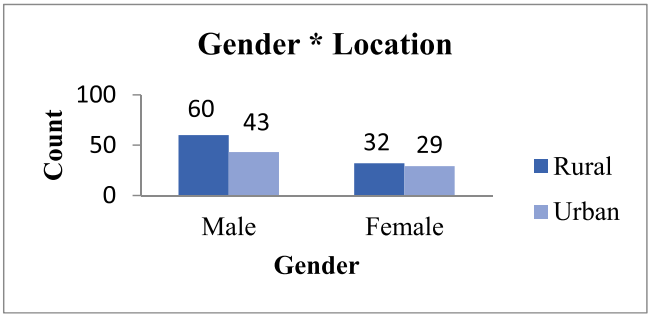


Fig. 4. Bar chart of gender ∗ location.

urban participants, and it depicts the students' contribution to the survey according to the geographical location.

The bar chart given in Fig. 4 demonstrated that more contribution was from a rural male and female participants than the urban male and female participants. Overall, there is a more contribution from rural students than the urban students.

B. Measurement Model Analysis

Fig. 5 demonstrates the analysis of the measurement model.

1) Construct Reliability and Validity: Internal consistency reliability is the degree of correlation between indicators measuring the same construct. Composite reliability (CR) and Cronbach alpha are the two most widely used techniques for evaluating internal consistency in the construct reliability. Measurements for these criteria are given in Table VII. Cronbach's alpha ratings ranged from 0.782 to 0.881, while CR results ranged from 0.802 to 0.918. The dependability statistics for each of the reliability metrics are higher than the threshold of 0.70, as shown in Table VII.

TABLE VII
METRIC SUMMARIZATION [113]

Criterion	Metrics Thresholds
Reflective Indicator Loading	>=0.708
Internal Consistency Reliability	Cronbach's Alpha Minimum: 0.7
Convergent Validity	AVE >0.5
Discriminant Validity	Similar constructs HTMT <0.9 Different constructs HTMT <0.85

TABLE VIII
CONSTRUCT RELIABILITY AND VALIDITY

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
DLC	0.855	0.858	0.902	0.699
RQ	0.816	0.826	0.891	0.733
SU	0.881	0.913	0.918	0.739
SI	0.782	0.802	0.86	0.609

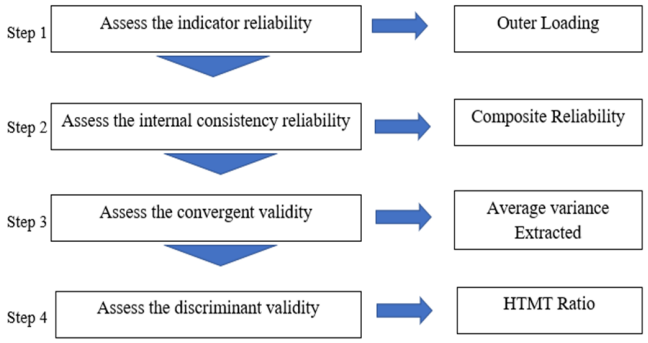


Fig. 5. Reflective measurement model assessment [112].

Construct reliability is thus proved in this study. The average variance retrieved can be used to examine convergent validity. Item coverage to evaluate the underlying idea is achieved when the average variance extracted (AVE) value is equal to or greater than 0.5, and convergent validity is thus demonstrated [114] in Table VII. Convergent validity is not an issue because all of the AVE values, as shown in Table VIII, are higher than 0.5, allowing further investigation. As a result, convergent validity is proven in this article.

C. Structural Model Analysis

The major purpose of the structural model was to determine the significance of hypothesized relationships. The process

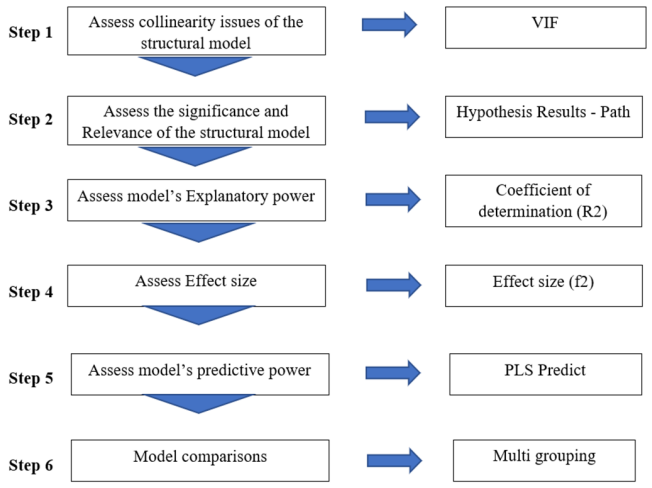


Fig. 6. Process of structural model assessment [112].

TABLE IX
VIF—INNER MODEL

	DLC
DLC	
Gender	1.099
Location	1.559
RQT	2.633
SU	2.809
SI	2.236
Gender x SU	2.324
Gender x RQ	2.308
Location x SU	2.639
Location x SI	2.652

TABLE X
R SQUARE—OVERVIEW

	R-square	R-square adjusted
DLC	0.833	0.824

followed to perform structural model assessment is given in Fig. 6.

1) Assess Collinearity Issues: VIF: Table IX shows that all the inner model variance inflation factor (VIF) values are less than 3.3, demonstrating that collinearity is not a significant concern in the study model.

2) Assess Model Explanatory Power: R^2: The structural model's coefficient of determination R^2, which indicates the overall effect size and variation explained in the endogenous construct, serves as a gauge of how well the model predicts the future, as given in Table X. According to Ringle and Sinkovics [115] and Hair et al. [116], an R^2 score of 0.75 is considered to be strong, 0.50 is considered to be moderate, and 0.26 is considered to be weak. According to the research findings, this study's R^2 score is strong. The main findings showed that social capital, with an 83.3% variance by three major dimensions: structural, cognitive, and relational, has a direct significant impact on the digital learning issues faced by tertiary students.

TABLE XI
HYPOTHESIS TESTING

		Original sample -O	Sample mean -M	STDEV	T statistics	P values
H1	SI> DLC	0.248	0.255	0.063	3.970	0.000
H2	PS> DLC	0.306	0.316	0.080	3.838	0.000
H3	RQ> DLC	0.467	0.454	0.081	5.805	0.000

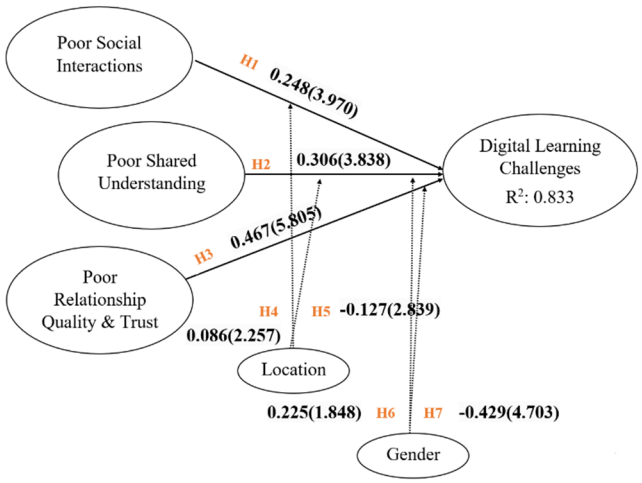


Fig. 7. Estimated research model.

TABLE XII
F SQUARE—MATRIX

	Effect size f^2	Total Effect
RQ	0.498	Strong
SU	0.200	Moderate
SI	0.165	Moderate

3) Evaluate the Significance of Model Relationships—Hypothesis Testing: Table XI represents the significance of model relationships in hypothesis testing. Fig. 7. depicts the measurements for the significance of estimated research model.

H1: There is a significant impact of poor social interactions on digital learning challenges in Sri Lankan tertiary education.

In H1, results revealed that poor social interactions have a significant impact on digital learning challenges. As expected, the results in Table XI and Fig. 7 indicated that the poor social interactions substantially affected digital learning challenges ($\beta = 0.248$, $t = 3.970$, and $p < 0.000$). Hence, H1 was supported.

H2: There is a significant impact of poor shared understanding on digital learning challenges in Sri Lankan tertiary education.

The results from Table XI and Fig. 7 supported this finding ($\beta = 0.306$, $t = 0.838$, and $p < 0.000$), which supported H2.

H3: There is a significant impact of poor relationship quality and trust on digital learning challenges in Sri Lankan tertiary education.

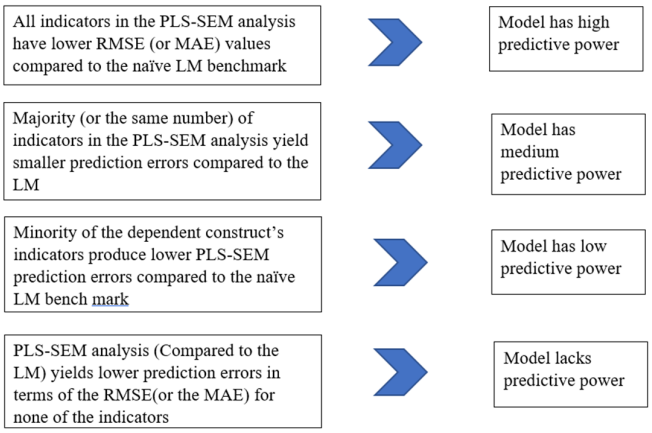


Fig. 8. Criteria to obtain predictive power [112].

TABLE XIII
MULTIVARIATE (MV) PREDICTION SUMMARY

	Q^2	PLS-SEM RMSE	PLS-SEM MAE	LM RMSE	LM MAE
OC1	0.388	0.738	0.528	0.609	0.45
OC2	0.608	0.553	0.412	0.589	0.453
OC3	0.45	0.724	0.541	0.765	0.56
OC4	0.426	0.664	0.437	0.722	0.509

TABLE XIV
HYPOTHESIS TESTING FOR MODERATION ANALYSIS

		Original sample	Mean	ST DEV	T statistics	P value
H4	Location X SI > DLC	0.086	0.085	0.038	2.257	0.012
H5	Location X SU > DLC	-0.127	-0.127	0.045	2.839	0.002
H6	Gender X SU > DLC	0.225	0.205	0.122	1.848	0.032
H7	Gender X RQ > DLC	-0.429	-0.417	0.091	4.703	0.000

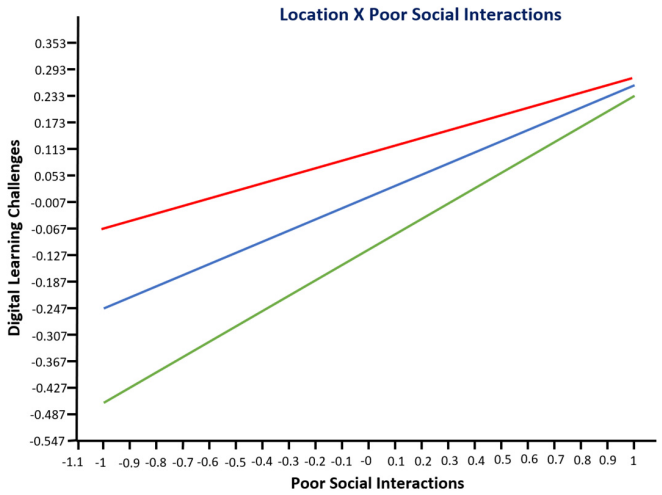
The impact of the poor relationship quality and trust on digital learning issues was significant ($\beta = 0.467$, $t = 5.805$, and $p < 0.000$), demonstrating that H3 was supported.

4) Measuring the Effect Size (F^2): The degree of each exogenous latent construct's impact on the endogenous latent construct is indicated by the f^2 value, as shown in Table XII. The f^2 measurement values of 0.35 (strong effect), 0.15 (moderate effect), and 0.02 (weak effect) are considered as threshold values. The effect size for relationship quality and trust shared understanding, and social interaction factors on digital learning challenges were 0.498 (strong), 0.2, and 0.165 (moderate), respectively. The dependent variable of digital learning challenges had a higher R^2 value (83.3%) than the other two independent latent constructs of social capital in this study.

5) Relevance of the Model for Prediction (Q^2): The quality of the PLS path model, built using blindfolding methods and cross-validation, is evaluated using Q^2. Fig. 8 outlines the criteria necessary for achieving predictive power, while Table XIII provides a concise summary of the study's predictions.

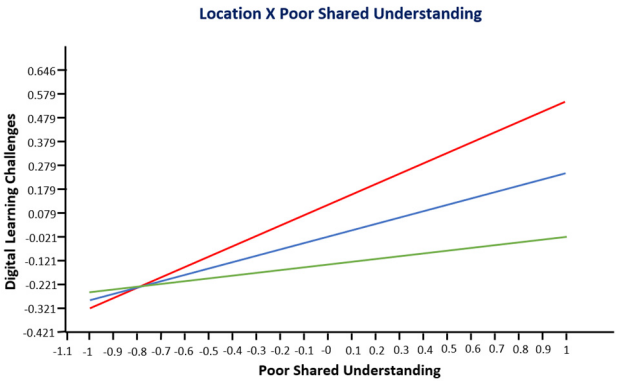
D. Moderation Analysis

The research also examined the moderating role of gender and location on digital learning challenges. Hypothesis testing conducted to evaluate the effect of moderator variables is given in Table XIV.



Red line – Rural, and green line - Urban learners

Fig. 9. Slope analysis for location ∗ poor social interactions.



Red- Rural, Green – Urban

Fig. 10. Slope analysis for location ∗ poor shared understanding.

H4: Location moderates the relationship between poor social interaction and digital learning challenges.

According to Table XIV, location has a significant and positive moderating impact on the relationship between poor social interactions and digital learning challenges ($b = 0.086$, $t = 2.257$, and $p = 0.012$). Hence, the hypothesis of H4 supported. This demonstrates that the impact of poor social interactions on fostering digital learning challenges is positively moderated by location. Based on further analysis, the plot given in Fig. 9 shows a steeper and more positive gradient for urban respondents as compared to rural learners. In conclusion, poor social interactions had a greater impact on fostering digital learning challenges among urban learners than among rural participants.

H5: Location moderates the relationship between poor shared understanding and digital learning challenges.

According to Table XIV, a negative and significant moderating impact of location on the relationship between poor shared understanding and digital learning challenges was revealed by the analysis of the significance of the moderating effect ($b = -0.127$, $t = 0.045$, and $p = 0.002$), supporting H5. This demonstrates that the impact of poor shared understanding on generating digital learning challenges is weaker (since it has a negative effect) in urban locations than in rural ones.

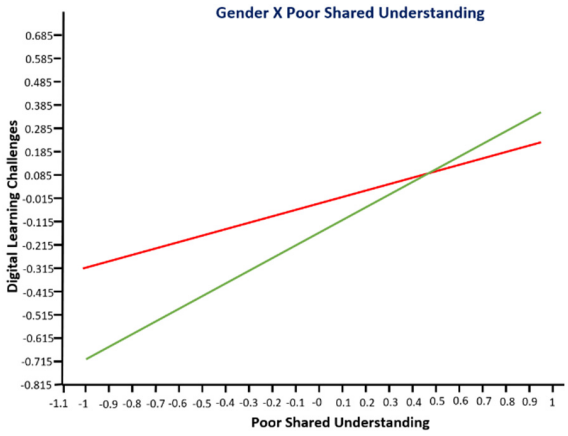
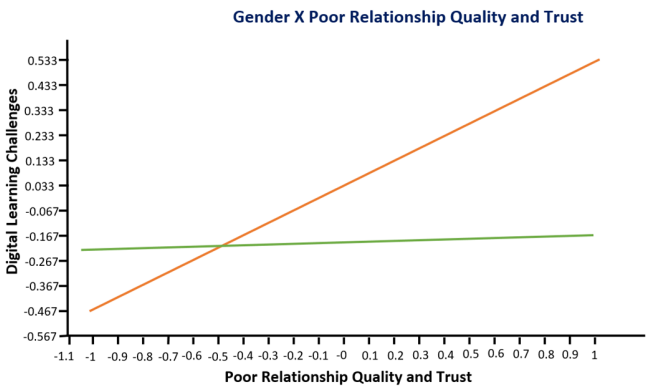


Fig. 11. Slope analysis for gender ∗ poor shared understanding.



Red line – Male (0), and green line – Female (1)

Fig. 12. Slope analysis for gender ∗ poor relationship quality and trust.

Based on the findings Fig. 10 depicts, urban regions have a more negative impact on the relationship than rural areas. In comparison to urban respondents, rural areas demonstrated a substantial positive relationship between poor shared understanding and digital learning challenges. In conclusion, a larger urban sample weakens the impact of poor shared understanding on digital learning challenges as compared to participants from rural locations.

H6: Gender moderates the positive relationship between poor shared understanding and digital learning challenges.

The results revealed a positive and significant moderating impact of gender on the relationship between poor shared understanding and digital learning challenges ($b = 0.225$, $t = 1.848$, and $p = 0.032$), confirming H6. This demonstrates that the impact of poor shared understanding on fostering digital learning challenges is positively moderated by gender.

According to the research, the plot given in Fig. 11 shows a steeper and more positive gradient for females (1) as compared to males (0). Thus, this illustrates that the impact of poor shared understanding is stronger in fostering digital learning challenges among females as compared to males. In conclusion, a higher female sample strengthens the impact of poor SU on digital learning challenges.

H7: Gender moderates the relationship between poor relationship quality, trust, and digital learning challenges.

The results revealed a negative and significant moderating impact of gender on the relationship between poor relationship quality, trust, and digital learning challenges ($b = -0.429$, $t = -4.703$, and $p < 0.001$), establishing H7. This demonstrates that in a sample with an expansion in the gender of females, the relationship between relationship quality and challenge is weakened. the plot given in Fig. 12 has a greater negative impact on the relationship for females (1) than males (0). In contrast to females, men have shown a substantial positive relationship between poor relationship quality and digital learning challenges. However, when the female count increases, the line begins to straighten, indicating that a rise in relationship quality does not result in a corresponding change in digital learning challenges. In conclusion, a higher female sample weakens the impact of poor relationship quality on digital learning challenges compared to males.

TABLE XV
HYPOTHESIS ANALYSIS—LOCATION

	Original (Rural)	P value (Rural)	Original (Urban)	P value (Urban)	Invariant
RQ> DLC	0.274	0.001	0.447	0.000	YES
SU> DLC	0.499	0.000	0.274	0.018	YES
SI> DLC	0.263	0.001	0.265	0.005	YES

TABLE XVI
R SQUARE—LOCATION

	R Square
Rural > DLC	0.802
Urban > DLC	0.767

E. Multigroup Analysis

1) Multigroup Analysis—Location: Location based hypothesis analysis in given in Table XV. In both rural and urban locations as shown in Table XV, the research's all intended hypotheses were supported (p-value < 0.05) revealing the fact that poor shared understanding, poor social interaction, and poor relationship quality have an impact on fostering digital learning challenges in both locations. According to the findings of the two groups, there are notable and substantial differences in the effect of poor relationship quality in urban areas and poor shared understanding in rural areas. Overall, poor relationship quality/trust has a significant effect on the urban group, with moderate effects on poor shared understanding and poor social interactions, whereas poor shared understanding has a significant effect on the rural group, with moderate effects on poor relationship quality and poor social interactions.

The findings showed that urban learners are more affected by poor relationship quality and trust in creating difficulties in digital learning (path coefficient 0.447) than the rural group, where it indicated a moderating effect of 0.274. This suggests that they have relationships in the network with low trust and quality. Due to the hustle and bustle of society, it appears that a lack of reciprocity, a poor helping hand, and a desire for less companionship during hardships are prevalent among urban students. According to the findings, while rural learners appear to have decent networking, they have weak shared knowledge, less familiarity with platforms and technologies, and a low computer literacy level as compared to urban learners. Poor

TABLE XVII
HYPOTHESIS ANALYSIS—GENDER

	Original (Female)	P Value (Female)	Original (Male)	P Value (Male)	Invariant
RQ > DLC	0.091	0.075	0.439	0.000	YES
SU > DLC	0.583	0.000	0.334	0.000	YES
SI >DLC	0.305	0.006	0.255	0.000	YES

TABLE XVIII
R SQUARE—GENDER

	R Square
Female> DLC	0.807
Male> DLC	0.795

shared understanding has a stronger effect (0.449) in the rural group in fostering digital learning challenges, whereas the urban group has a moderate impact of (0.274). It can be due to the absence of technological advancement in rural locations, connectivity concerns, and low language comprehension skills relative to urban students. Impact towards the digital learning challenges is shown in Table XVI. As given in Table XVI, $R^2 = 0.802$. Based on this finding, it can be argued that learners in rural regions have more obstacles than those in urban areas since they have fewer technical resources and a poor common understanding of digital platforms/tools.

The above findings recommend that relevant educational authorities concentrate more on enhancing the poor connection quality in urban learners and low levels of shared understanding among rural students since these factors have a significant influence on the challenges associated with digital learning.

2) Multigroup Analysis—Gender: Gender based hypothesis analysis in given in Table XVII. According to the results given in Table XVII, the hypothesis of poor relationship quality contributing to the creation of digital learning challenges is slightly insignificant among the female group and its model is a bit different from that of men, where it exhibits a p-value of (0.075). However, this is only for the dimension of poor relationship quality and trust, while all other p-values, t-values, and coefficients between the two groups are significant. It may be because males are not much close or emotionally attached compared to women where men do not often exchange educational materials and share emotions. Males appear to be more networked where social interaction is strong when compared to other social capital factors. They appear to have extensive social networks and may receive frequent guidance and support whenever confronted with challenges in digital learning. The female group is experiencing a stronger effect from poor shared understanding in fostering challenges of digital learning (path coefficient 0.583) than the male group. Women tend to be very relational, with relationships that are higher quality and more reliable than those with other social capital factors. Being emotional, trusting, and overthinking, on the other hand, seems to contribute to their inadequate shared understanding. Findings demonstrate less familiarity with digital platforms and technologies as well as a low degree of computer literacy, which would create difficulties in digital learning. However, gender differences in terms of the impact of poor relationship quality and trust on challenges are notable. Therefore, it is critical to concentrate on minimizing the weak shared understanding in the female group and poor relationship quality in the male group since they have the strongest influences on creating challenges in a digital learning context.

More notably, the results given in Table XVII reveal that the female group has a higher R^2 of 0.807 in creating digital learning challenges than the male group, which has an R^2 of 0.795. Tables XV–XVIII used to conduct in-depth analysis on multi grouping.

V. RECOMMENDATIONS

Universities are encouraged to maintain high standards, establish networks, and enhance the confidence of academics to promote knowledge sharing [117]. This study serves as a catalyst for government bodies to formulate effective policies, strategies, and interventions aimed at elevating the quality of the education sector. Simultaneously, it empowers educational institutions to cultivate inclusive and supportive learning environments, thereby enhancing student engagement, fostering collaboration, and ultimately optimizing the overall learning outcomes.

To promote digital literacy skills, universities can offer comprehensive training programs for students and educators, encompassing workshops, online courses, and other relevant resources. Implementing interactive learning platforms, online discussion forums, and virtual group projects that facilitate social interactions and the exchange of ideas would be beneficial. Initiating online communities and mentoring programs can further contribute to fostering a sense of belonging, providing peer support, and encouraging knowledge sharing. It is equally important to educate students on responsible digital behavior, online ethics, and privacy issues while encouraging them to engage in online platforms in a respectful and responsible manner.

Furthermore, forging partnerships with industry organizations and employers is crucial to align digital learning programs with current industry needs and trends. This collaborative approach ensures that students acquire the skills and knowledge that are highly relevant in the job market. By involving students, educators, administrators, and policymakers in decision-making processes pertaining to digital learning initiatives, the perspectives and needs of all stakeholders can be duly considered. This inclusive approach ensures that initiatives are designed to address the specific challenges faced by the tertiary education system in Sri Lanka. Additionally, based on the obtained results, it is advisable to promote the sharing of best practices and success stories regarding the implementation of digital learning. This exchange of experiences can inspire and guide other institutions and educators in overcoming challenges associated with digital learning.

Overall, the implementation of the approaches is highly recommended to overcome the digital learning challenges within the Sri Lankan tertiary education system. By doing so, it will ultimately foster a dynamic and thriving educational landscape.

VI. CONCLUSION

The digital revolution has significantly changed the face of education. New technologies today enable anyone to learn

anywhere, at any time, and at their own pace, marking a significant shift in how education and training are approached. At all educational levels, digital learning has shown to be an effective and cutting-edge technique for delivering online education. The challenges of digital learning in tertiary education are difficult to describe and evaluate using a theoretical framework, even though numerous academics have connected social capital theory to education. The connection between social capital and digital learning issues in the Sri Lankan setting has not been effectively addressed.

This study discusses the results of a study that aimed to evaluate digital learning issues in Sri Lanka's tertiary education system by utilizing a theoretical framework that incorporates social capital components. The data were collected from nonstate university students in Sri Lanka through a Google Forms questionnaire using nonprobability convenience sampling. This study found that a poor social capital directly and significantly impacts tertiary students' digital learning issues, as demonstrated by an 83.3% variance across three dimensions: structural, cognitive, and relational. The research successfully developed a conceptual model that recognizes and evaluates the difficulties of the digital environment in Sri Lankan tertiary education. The findings suggest that subobjectives of the research could be established by identifying different social capital theory-related dimensions that impact digital education and their interconnections.

Moreover, the researcher conducted an in-depth analysis, employing moderation and multigrouping on gender and hometown location to identify the key differences in the moderating roles. As per the results of gender moderation, males appear to be more networked where social interaction is strong when compared to other social capital factors. They appear to have extensive social networks and may receive frequent guidance and support whenever confronted with challenges in digital learning. However, in the digital learning context, poor relationship quality and trust have a significant effect on the male group. It may be because males are not much close or emotionally attached compared to girls where men do not often exchange educational materials and share emotions. More notably, the results reveal that the female group has a higher R^2 of 0.807 in creating digital learning challenges than the male group, which has an R^2 of 0.795. Therefore, it is critical to concentrate on minimizing the weak shared understanding in the female group and poor relationship quality in the male group since they have the strongest influences on creating challenges in a digital learning context. Furthermore, location moderation results demonstrate a significant and noticeable impact of inadequate shared understanding in rural regions and poor relationship quality in urban areas.

Poor shared understanding, poor social interaction, and poor relationship quality have an impact on creating digital learning challenges in both locations, with apparent effect differences in cognitive and relational dimensions. In both cases, the research's all intended hypotheses were supported (p-value < 0.05). According to this article, digital learning issues in Sri Lankan tertiary settings were directly caused by weak social connections, a lack of shared understanding of learning management systems/platforms/technological skills, and poor relationship quality and trust. It advises academic administrators to place more emphasis on students' levels of reciprocity, trust, ease of contact, comfort with platforms and technology, and knowledge sharing. To increase students' performance with digital learning, teachers should also encourage them to develop their friendships with their classmates and broaden their knowledge with their peers.

In summary, the authors were successful in validating all the established hypotheses using a theoretical framework connected to social capital theory, by presenting valid responses to the research questions identified. More importantly, by including tried-and-true helpful insights and suggestions, this study will fill the gap in the literature regarding the difficulties of digital learning and social capital. The results of this study are critical to acknowledge by the government and the appropriate policymakers in order to enhance the overall implementation of e-learning in Sri Lanka. Additionally, this study provides information on the variations of student gender and geographic location, particularly in relation to low social capital dimensions, to help the government and relevant policymakers improve fundamental strategies, infrastructure, and facilities so that e-learning is easily accessible to all students in Sri Lanka. This article focuses on the higher education system of Sri Lanka. Like this, by collecting and analyzing feedback from users in other regions of the world, it would also be possible to identify digital learning challenges in relation to social capital perspective.

More importantly, the findings of this study will contribute to strengthening the Sri Lankan education system, in terms of regulatory frameworks, resources, and systems and procedures, and will provide valuable insights for the NEC and contribute to the improvement and deployment of the National Education Policy Framework 2020–2030. Ultimately, the findings will assist in reducing the difficulties faced by the students and ensure that all students have the same privileges and chances in digital education.

In future directions, further investigations may be required to mitigate the challenges specific to social interactions. As Lu et al. [118] stated, it is possible to mitigate the challenges that occur due to social interactions using computational models and simulations. Therefore, this article is possible to extend in the future to mitigate the identified digital learning challenges via social computing by adaptation of computational models and simulations.

REFERENCES

[1] (Apr. 12, 2021). *Digital Learning: What is This Type of training?* Accessed: Oct. 15, 2022. [Online]. Available: https://www.ipag.edu/en/blog/definition-digital-learning

[2] A. W. Muzaffar, M. Tahir, M. W. Anwar, Q. Chaudry, S. R. Mir, and Y. Rasheed, "A systematic review of online exams solutions in e-learning: Techniques, tools, and global adoption," *IEEE Access*, vol. 9, pp. 32689–32712, 2021.

[3] M. B. Abisado et al., "Modeling Filipino academic affect during online examination using machine learning," in *Proc. 20th Annu. SIG Conf. Inf. Technol. Educ.*, Sep. 2019, p. 167.

[4] J. Gu, J. Wang, X. Guo, G. Liu, S. Qin, and Z. Bi, "A metaverse-based teaching building evacuation training system with deep reinforcement learning," *IEEE Trans. Syst., Man, Cybern., Syst.*, vol. 53, no. 4, pp. 2209–2219, Apr. 2023.

[5] S. Pokhrel and R. Chhetri, "A literature review on impact of COVID-19 pandemic on teaching and learning," *Higher Educ. Future*, vol. 8, no. 3, pp. 133–141, 2021.

[6] *Policy Brief: Education During COVID-19 and Beyond*, United Nations, New York, NY, USA, 2020.

[7] UNESCO. *Distance Learning Solutions*. Accessed: Oct. 4, 2022. [Online]. Available: https://en.unesco.org/covid19/educationresponse/solutions

[8] R. Hayashi, M. Garcia, A. Maddawin, and K. P. Hewagamage, "Online learning in Sri Lanka's higher education institutions during the COVID-19 pandemic," ADB Briefs, 2020, p. 12.

[9] *Sri Lanka's Vistas of Prosperity and Splendour: A Critique of Promises Made and Present Trends*, Centre Policy Alternative (CPA), Colombo, Sri Lanka, 2021.

[10] I. J. Maria, D. Thirupathi, R. Rajendran, and B. Velumani, "Technologies, challenges and tools for digital learning," in *Proc. IEEE 10th Int. Conf. Technol. Educ. (T4E)*, Dec. 2019, pp. 268–269.

[11] C. N. Blundell, K.-T. Lee, and S. Nykvist, "Digital learning in schools: Conceptualizing the challenges and influences on teacher practice," *J. Inf. Technol. Educ., Res.*, vol. 15, pp. 535–560, 2016.

[12] (2017). *Verité Research*. Accessed: Jan. 10, 2023. [Online]. Available: https://www.veriteresearch.org/publication/private-sector-participation-in-sri-lankas-tertiary-education/

[13] T. Claridge. *Social Capital Research*. Accessed: Oct. 6, 2022. [Online]. Available: https://www.socialcapitalresearch.com/what-is-social-capital/

[14] J. S. Coleman, "Social capital in the creation of human capital," *Amer. J. Sociol.*, vol. 94, pp. S95–S120, Jan. 1988.

[15] K. A. Goyette and G. Q. Conchas, "Family and non-family roots of social capital among Vietnamese and Mexican American children," in *Schooling and Social Capital in Diverse Cultures* (Research in the Sociology of Education), vol. 13. 2002, pp. 41–72.

[16] K. P. González, C. Stoner, and J. E. Jovel, "Examining the role of social capital in access to college for Latinas: Toward a college opportunity framework," *J. Hispanic Higher Educ.*, vol. 2, no. 2, pp. 146–170, Apr. 2003.

[17] J. Radford and K. Joseph, "Theory in, theory out: The uses of social theory in machine learning for social science," *Frontiers Big Data*, vol. 3, p. 18, May 2020.

[18] A. Grubišić et al., "A common model for tracking student learning and knowledge acquisition in different e-learning platforms," *J. E-Learn. Knowl. Soc.*, vol. 16, no. 3, pp. 10–23, 2020, doi: 10.20368/1971-8829/1135235.

[19] P. L. Fagell, "Career confidential: Teacher wonders how to help students during coronavirus shutdown," *Phi Delta Kappan*, vol. 101, no. 8, pp. 67–68, May 2020.

[20] M. A. Almaiah, A. Al-Khasawneh, and A. Althunibat, "Exploring the critical challenges and factors influencing the e-learning system usage during the COVID-19 pandemic," *Educ. Inf. Technol.*, vol. 25, pp. 5261–5280, May 2020.

[21] U. Kaden, "COVID-19 school closure-related changes to the professional life of a K–12 teacher," *Educ. Sci.*, vol. 10, no. 6, p. 165, 2020.

[22] N. Babu and B. Reddy, "Challenges and opportunity of e-learning in developed and developing countries—A review," *Int. J. Emerg. Res. Manage. Technol.*, vol. 4, p. 259, Jun. 2015.

[23] B. Dube, "Rural online learning in the context of COVID-19 in South Africa: Evoking an inclusive education approach," *Multidisciplinary, J. Educ. Res.*, vol. 10, no. 2, pp. 135–157, 2020.

[24] N. Jalli, "Lack of internet access in Southeast Asia poses challenges for students to study online amid COVID-19 pandemic," Universiti Teknologi MARA, 2020. Accessed: Oct. 16, 2022. [Online]. Available: https://phys.org/news/2020-03-lack-internet-access-southeast-asia.html

[25] P. McLaren, *Life in Schools: An Introduction to Critical Pedagogy in the Foundations of Education*. Albany, NY, USA: Allyn & Bacon, 2003.

[26] A. P. Azano and T. T. Stewart, "Exploring place and practicing justice: Preparing pre-service teachers for success in rural schools," *J. Res. Rural Educ.*, vol. 30, no. 9, pp. 1–12, 2015.

[27] S. Subedi, S. Nayaju, and S. Subedi, "Impact of e-learning during COVID-19 pandemic among nursing students and teachers of Nepal," *Int. J. Sci. Health Care Res.*, vol. 5, no. 3, pp. 68–76, 2020.

[28] Sambad English Bureau. (2020). *Just 15 Km Away From Smart City Bhubaneswar Students Perch on Trees for Online Classes*. Accessed: Oct. 20, 2022. [Online]. Available: https://sambadenglish.com/just-15-km-from-smart-city-bhubaneswar-students-perch-on-trees-for-online-classes/

[29] G. Butch, B. Smith, L. Vashaw, J. Watson, C. Harrington, and E. S. LeBlanc. Digital learning strategies for rural America: A scan of policy and practice in K-12 education. ERIC. Accessed: Oct. 1, 2022. [Online]. Available: https://eric.ed.gov/?id=ED588911

[30] B. E. Zamani, A. Esfijani, and S. M. A. Damaneh, "Major barriers for participating in online teaching in developing countries from Iranian faculty members' perspectives," *Australas. J. Educ. Technol.*, vol. 32, no. 3, 2016.

[31] A. Al-Azawei, P. Parslow, and K. Lundqvist, "Barriers and opportunities of e-learning implementation in Iraq: A case of public universities," *Int. Rev. Res. Open Distrib. Learn.*, vol. 17, no. 5, pp. 3–16, Sep. 2016.

[32] G. Ssekakubo, H. Suleman, and G. Marsden, "Issues of adoption: Have e-learning management systems fulfilled their potential in developing countries?" in *Proc. Int. Conf. Ser.*, 2011, pp. 231–238.

[33] M. S. H. Khan, M. Hasan, and C. K. Clement, "Barriers to the introduction of ICT into education in developing countries: The example of Bangladesh," *Int. J. Instruct.*, vol. 5, no. 2, 2011.

[34] A. Elzawi and S. Wade, "Barriers to ICT adoption in quality of engineering research in Libya: How to bridge the digital divide?" in *Proc. Queen's Diamond Jubilee Comput. Eng. Annu. Res.' Conf.*, 2012, pp. 98–103.

[35] J. K. Tarus, D. Gichoya, and A. Muumbo, "Challenges of implementing e-learning in Kenya: A case of Kenyan public universities," *Int. Rev. Res. Open Distrib. Learn.*, vol. 16, no. 1, 2015.

[36] A. Sife, E. T. Lwoga, and C. A. Sanga, "New technologies for teaching and learning: Challenges for higher learning institutions in developing countries," *Int. J. Educ. Develop. Using Inf. Commun. Technol.*, vol. 3, no. 2, 2007.

[37] M. Fernando and R. Pendakur, "Social capital formation and diversity in Canadian cities," 2010.

[38] A. A. Mirza and M. Al-Abdulkareem, "Models of e-learning adopted in the Middle East," *Appl. Comput. Inform.*, vol. 9, no. 2, pp. 3–93, 2011.

[39] M. Al-Shboul, "The level of e-learning integration at The University of Jordan: Challenges and opportunities," *Int. Educ. Stud.*, vol. 6, pp. 93–113, 2013.

[40] A. Andersson, "Seven major challenges for e-learning in developing countries: Case study eBIT, Sri Lanka," *Int. J. Educ. Develop. Using ICT*, vol. 4, no. 3, pp. 45–62, 2008.

[41] C.-S. Li and B. Irby, "An overview of online education: Attractiveness, benefits, challenges, concerns and recommendations," *College Student J.*, vol. 42, no. 2, pp. 449–459, 2008.

[42] G. Deidra, "Learning the write way," *Reading Teacher*, vol. 59, no. 8, pp. 754–762, 2006.

[43] M. Tîrziu and C. Vrabie, "Education 2.0: e-learning methods," *Procedia—Social Behav. Sci.*, vol. 186, pp. 376–380, 2015.

[44] A. Vaskuri, H. Baumgartner, P. Kärhä, G. Andor, and E. Ikonen, "Modeling the spectral shape of InGaAlP-based red light-emitting diodes," *J. Appl. Phys.*, vol. 118, no. 20, pp. 203103–1, Nov. 2015.

[45] N. Vargafik, J. Wiebelt, and J. Malloy, "Radiative transfer," in *Convective Heat*. Melbourne, VIC, Australia: Engineering Education Australia, 2011, pp. 379–398.

[46] B. Wellman, A. Q. Haase, J. Witte, and K. Hampton, "Does the internet increase, decrease, or supplement social capital? Social networks, participation, and community commitment," *Amer. Behav. Scientist*, vol. 45, no. 3, pp. 436–455, 2001.

[47] R. Gulati, "Network location and learning: The influence of network resources and firm capabilities on alliance formation," *Strategic Manag. J.*, vol. 20, no. 5, pp. 397–420, 1999.

[48] R. D. Putnam, "Bowling alone: America's declining social capital," *J. Democracy*, vol. 6, no. 1, pp. 65–78, 1995.

[49] J. Nahapiet and S. Ghoshal, "Social capital, intellectual capital, and the organizational advantage," *Acad. Manage. Rev.*, vol. 23, no. 2, pp. 242–266, Apr. 1998.

[50] J. Tuner. (2011). *Social Capital: Measurement, Dimensional Interactions, and Performance Implications*. [Online]. Available: https://tigerprints.clemson.edu

[51] S. Davenport and U. Daellenbach, "'Belonging' to a virtual research centre: Exploring the influence of social capital formation processes on member identification in a virtual organization," *Brit. J. Manage.*, vol. 22, no. 1, pp. 54–76, Mar. 2011.

[52] A. C. Inkpen and E. W. K. Tsang, "Social capital, networks, and knowledge transfer," *Acad. Manage. Rev.*, vol. 30, no. 1, pp. 146–165, Jan. 2005.

[53] W. Tsai and S. Ghoshal, "Social capital and value creation: The role of intrafirm networks," *Acad. Manage. J.*, vol. 41, no. 4, pp. 464–476, Aug. 1998, doi: 10.2307/257085.

[54] G. K. Stahl and I. Björkman, *Handbook of Research in International Human Resource Management*. Cheltenham, U.K.: Edward Elgar Publishing, Jun. 2007, p. 581, 2007.

[55] F. Fukuyama, *Trust: The Social Virtues and the Creation of Prosperity*. New York, NY, USA: The Free Press, 2005.

[56] J. Coleman, *Foundations of Social Theory*. Cambridge, MA, USA: Harvard Univ. Press, 1990.

[57] E. Lazega and R. S. Burt, "Structural holes: The social structure of competition," *Revue Française de Sociologie*, vol. 36, no. 4, 1995.

[58] M. Granovetter, "Economic action and social structure: The problem of embeddedness," *Amer. J. Sociol.*, vol. 91, no. 3, pp. 481–510, Nov. 1985.

[59] H. Håkansson and I. Snehota, *Developing Relationships in Business Networks*. London, U.K.: Routledge, 1995.

[60] R. Merton, *Social Theory and Social Structure*. New York, NY, USA: The Free Press, 1968.

[61] J. S. Coleman and T. Hoffer, *Public and Private High Schools: The Impact of Communities*. 1987.

[62] J. Epstein and M. Sanders, "Connecting home, school, and community," in *Handbook of the Sociology of Education*. Boston, MA, USA: Springer, 2000, pp. 285–306.

[63] E. M. Horvat, E. B. Weininger, and A. Lareau, "From social ties to social capital: Class differences in the relations between schools and parent networks," *Amer. Educ. Res. J.*, vol. 40, no. 2, pp. 319–351, 2003.

[64] E. Acar, "Effects of social capital on academic success: A narrative synthesis," *Educ. Res. Rev.*, vol. 6, no. 6, pp. 456–461, 2011.

[65] M. I. Ahmed, C. S. Mustafa, and N. S. A. Rani, "Responding to COVID-19 via online learning: The relationship between Facebook intensity, community factors with social capital and academic performance," *PalArch's J. Archaeol. Egypt/Egyptol.*, vol. 17, no. 6, pp. 779–806, 2020.

[66] A. Behtoui and A. Neergaard, "Social capital and the educational achievement of young people in Sweden," *Brit. J. Sociol. Educ.*, vol. 37, no. 7, pp. 947–969, Oct. 2016.

[67] S. R. Paige et al., "Examining the relationship between online social capital and eHealth literacy: Implications for Instagram use for chronic disease prevention among college students," *Amer. J. Health Educ.*, vol. 48, no. 4, pp. 264–277, Jul. 2017.

[68] G. Salimi, E. Heidari, M. Mehrvarz, and A. A. Safavi, "Impact of online social capital on academic performance: Exploring the mediating role of online knowledge sharing," *Educ. Inf. Technol.*, vol. 27, no. 5, pp. 6599–6620, Jun. 2022.

[69] K. C. H. Fong, C. H. Au, E. T. H. Lam, and D. K. W. Chiu, "Social network services for academic libraries: A study based on social capital and social proof," *J. Academic Librarianship*, vol. 46, no. 1, Jan. 2020, Art. no. 102091.

[70] N. O. Oranye, P. Ezeah, and N. Ahmad, "Elements of social capital and academic performance of undergraduate students," *Social Indicators Res.*, vol. 131, no. 1, pp. 305–319, Mar. 2017.

[71] A. J. Daly, Y.-H. Liou, and C. Der-Martirosian, "A capital idea: Exploring the relationship between human and social capital and student achievement in schools," *J. Prof. Capital Community*, vol. 6, no. 1, pp. 7–28, Dec. 2020.

[72] J. Iqbal, N. Qureshi, M. A. Ashraf, S. F. Rasool, and M. Z. Asghar, "The effect of emotional intelligence and academic social networking sites on academic performance during the COVID-19 pandemic," *Psychol. Res. Behav. Manage.*, vol. 14, pp. 905–920, Jun. 2021.

[73] M. M. Islam, E. M. Habes, and M. M. Alam, "The usage and social capital of mobile phones and their effect on the performance of microenterprise: An empirical study," *Technol. Forecasting Social Change*, vol. 132, pp. 156–164, Jul. 2018.

[74] X. Zhang, S. Liu, X. Chen, and Y. Gong, "Social capital, motivations, and knowledge sharing intention in health Q&A communities," *Manage. Decis.*, vol. 55, no. 7, pp. 1536–1557, Aug. 2017.

[75] D. P. Ford and S. Staples, "Are full and partial knowledge sharing the same?" *J. Knowl. Manage.*, vol. 14, no. 3, pp. 394–409, Jun. 2010.

[76] C. M. Chiu, M. H. Hsu, and E. T. Wang, "Understanding knowledge sharing in virtual communities: An integration of social capital and social cognitive theories," *Decis. Support Syst.*, vol. 42, no. 3, pp. 1872–1888, 2006.

[77] L. Tonteri, M. Kosonen, H.-K. Ellonen, and A. Tarkiainen, "Antecedents of an experienced sense of virtual community," *Comput. Hum. Behav.*, vol. 27, no. 6, pp. 2215–2223, Nov. 2011.

[78] S. Moghavvemi, M. Sharabati, A. Sulaiman, and J. Klobas, "Effect of trust and perceived reciprocal benefit on students' knowledge sharing via Facebook and academic performance," *Electron. J. Knowl. Manag.*, vol. 16, no. 1, pp. 23–35, 2018.

[79] S. R. Shah and K. Mahmood, "Contributing factors in knowledge sharing for performance of university students in teachers' training programs," *Library Manage.*, vol. 37, nos. 8–9, pp. 496–506, Nov. 2016.

[80] W. Ma and A. Yuen, "Understanding online knowledge sharing: An interpersonal relationship perspective," *Comput. Educ.*, vol. 56, pp. 210–219, 2011.

[81] I. M. Suparsa, M. Setini, D. Asih, and N. L. W. S. Telagawathi, "Teacher performance evaluation through knowledge sharing and technology during the COVID 19 pandemic," Tech. Rep., 2021.

[82] M. I. M. Eid and I. M. Al-Jabri, "Social networking, knowledge sharing, and student learning: The case of university students," *Comput. Educ.*, vol. 99, pp. 14–27, Aug. 2016.

[83] H. Crompton and D. Burke, "The use of mobile learning in higher education: A systematic review," *Comput. Educ.*, vol. 123, pp. 53–64, Aug. 2018.

[84] Y.-C. Chang, H.-T. Chang, M.-H. Chen, H.-R. Chi, and L.-L. Deng, "How do established firms improve radical innovation performance? The organizational capabilities view," *Technovation*, vol. 32, no. 7, pp. 441–451, 2012.

[85] (2021). *10 Benefits of Collaborative Learning*. Accessed: Sep. 29, 2022. [Online]. Available: https://www.indeed.com/career-advice/career-development/benefits-of-collaborative-learning

[86] J. Munslow. (2020). *Is Online Learning the Future of Higher Education?* Accessed: Oct. 1, 2022. [Online]. Available: https://news.yahoo.com/is-online-learning-the-future-of-higher-education-143207283.html

[87] M. M. Sharabati, "The impact of knowledge sharing through Facebook on students' academic performance in Palestine," *Int. J. Bus. Inf.*, vol. 13, no. 2, pp. 1–36, 2018.

[88] P. García-Sánchez, N. L. Díaz-Díaz, and P. De Saá-Pérez, "Social capital and knowledge sharing in academic research teams," *Int. Rev. Administ. Sci.*, vol. 85, no. 1, pp. 191–207, Mar. 2019.

[89] V. M. Lefebvre, D. Sorenson, M. Henchion, and X. Gellynck, "Social capital and knowledge sharing performance of learning networks," *Int. J. Inf. Manag.*, vol. 36, no. 4, pp. 570–579, 2016.

[90] E. Bouton, S. B. Tal, and C. S. C. Asterhan, "Students, social network technology and learning in higher education: Visions of collaborative knowledge construction vs. the reality of knowledge sharing," *Internet Higher Educ.*, vol. 49, Apr. 2021, Art. no. 100787.

[91] A. P. Rovai, "Building classroom community at a distance: A case study," *Educ. Technol. Res. Develop.*, vol. 49, no. 4, pp. 33–48, Dec. 2001.

[92] India Today Web Desk. (2021). *84% of Teachers Facing Challenges During Online Classes: Survey*. Accessed: Oct. 14, 2022. [Online]. Available: https://www.indiatoday.in/education-today/latest-studies/story/84-of-teachers-facing-challenges-during-online-classes-survey-1780816-2021-03-18

[93] F. Fukuyama, *Trust: The Social Virtues and the Creation of Prosperity*. New York, NY, USA: Free Press, 1996.

[94] A. S. Bryk and B. Schneider, *Trust in Schools: A Core Resource for Improvement*. New York, NY, USA: Sage, 2002.

[95] *Teacher and Student Relationships: The Power of Trust*, Trauma Learn. Policy Initiative, Cambridge, MA, USA, 2020.

[96] A. Jafar et al., "Assessing the challenges of e-learning in Malaysia during the pandemic of COVID-19 using the geo-spatial approach," *Sci. Rep.*, vol. 12, no. 1, p. 17316, Oct. 2022.

[97] N. Hayes, L. Introna, and M. Smith, "Ensembles of practice: Older adults, technology, and loneliness and social isolation in rural settings," in *Proc. 52nd Hawaii Int. Conf. Syst. Sci.* Maui, HI, USA: Grand Wailea, 2019, pp. 4287–4296.

[98] C. Sparks, "What is the 'digital divide' and why is it important?" *Javnost, Public*, vol. 20, no. 2, pp. 27–46, Jan. 2013.

[99] M. OConnor, H. Fuller, and F. Cortez, "Technology use among older adults in rural areas," *Innov. Aging*, vol. 2, p. 679, Nov. 2018.

[100] L. Philip, C. Cottrill, J. Farrington, F. Williams, and F. Ashmore, "The digital divide: Patterns, policy and scenarios for connecting the 'final few' in rural communities across Great Britain," *J. Rural Stud.*, vol. 54, pp. 386–398, Aug. 2017.

[101] K. Patrick, *Social Capital and Civil Society*. Canberra, ACT, Australia: National Centre for Development Studies at ANU, 2022, pp. 1–15.

[102] F. Jonathan and J. Gershman, "The World Bank and social capital: Lessons from ten rural development projects in the Philippines and Mexico," *Policy Sci.*, vol. 33, pp. 399–419, Dec. 2000.

[103] J. Molinas, "The impact of inequality, gender, external assistance and social capital on local-level cooperation," *World Develop.*, vol. 26, no. 3, pp. 413–431, Mar. 1998.

[104] A. Norton, "The market for social capital," *Policy, J. Public Policy Ideas*, vol. 17, pp. 40–44, 2001.

[105] R. Silvey and R. Elmhirst, "Engendering social capital: Women workers and rural–urban networks in Indonesia's crisis," *World Develop.*, vol. 31, no. 5, pp. 865–879, May 2003.

[106] R. S. Burt, "The gender of social capital," *Rationality Soc.*, vol. 10, no. 1, pp. 5–46, 1998.

[107] H. Ibarra, "Paving an alternative route: Gender differences in managerial networks," *Social Psychol. Quart.*, vol. 60, no. 1, pp. 91–102, 1997.
[108] D. Bevelander and M. J. Page, "Ms. Trust: Gender, networks and trust—Implications for management and education," *Acad. Manage. Learn. Educ.*, vol. 10, no. 4, pp. 623–642, Dec. 2011.
[109] M. Schröder, M. Lutter, and I. Habicht, "Publishing, signaling, social capital, and gender: Determinants of becoming a tenured professor in German political science," *PLoS ONE*, vol. 16, no. 1, 2021.
[110] *GHKC Knowledge Management Indicator Library*. Accessed: May 14, 2022. [Online]. Available: https://www.globalhealthknowledge.org/taxonomy/term/69#:~:text=Indicators%20that%20measure%20social%20interaction%20are%20grouped%20into%20four%20subcategories,%2C%20and%204%29%20social%20learning
[111] B. Cho. *Prolific*. Accessed: Mar. 12, 2023. [Online]. Available: https://www.prolific.co/blog/tips-for-reducing-common-method-bias
[112] J. F. Hair, Jr., G. T. M. Hult, C. M. Ringle, M. Sarstedt, N. P. Danks, and S. Ray, "Partial least squares structural equation modeling (PLS-SEM) using R," *Inf. Technol. Develop.*, vol. 25, no. 1, pp. 49–68, 2021.
[113] W. L. Neuman, *Basics of Social Research: Qualitative and Quantitative Approaches*, 2nd ed. Boston, MA, USA: Pearson, 2007.
[114] C. Fornell and D. F. Larcker, "Structural equation models with unobservable variables and measurement error: Algebra and statistics," *J. Marketing Res.*, vol. 18, no. 3, pp. 382–388, 1981.
[115] C. M. Ringle and R. R. Sinkovics, "The use of partial least squares path modeling in international marketing," *Adv. Int. Marketing*, vol. 20, pp. 277–319, Mar. 2009.
[116] J. F. Hair, C. M. Ringle, and M. Sarstedt, "Partial least squares structural equation modeling: Rigorous applications, better results and higher acceptance," *Long Range Planning*, vol. 46, nos. 1–2, pp. 1–12, Feb. 2013.
[117] M. A. Al-Ansari, A. Hamdan, A. Razzaque, S. Reyad, and A. Al-Sartawi, "The moderating role of M-learning activities in the relationship between students? Social capital and knowledge sharing," in *Proc. Int. Conf. e-Learn.*, Porto, Portugal, Jul. 2019, pp. 139–146.
[118] P. Lu, Y. Li, F. Wen, and D. Chen, "Social knowledge enhances collective safety: Computational models and simulations," *IEEE Trans. Computat. Social Syst.*, vol. 10, no. 2, pp. 807–818, Apr. 2023.

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