BUILDING A KNOWLEDGE SOCIETY: LEARNINGS FROM A DIGITAL LITERACY PROGRAM

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BUILDING A KNOWLEDGE SOCIETY: LEARNINGS FROM A DIGITAL LITERACY PROGRAM

Completed Research Paper

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Abstract

The advancements in digital technology are redefining society. In the digital transformation era, lack of digital literacy can result in social exclusion and leave people bereft of employment opportunities. Realizing the significance of a digitally literate society, the Government of India had launched a nationwide initiative, known as Digital Sakshatra Abhiyan (DISHA)/National Digital Literacy Mission (NDLM). The objective of DISHA was to impart basic digital literacy to participants to empower them and improve their lifestyle. In this paper, we build a research model using the Kirkpatrick model to evaluate the key components contributing to the effectiveness of DISHA. We conduct a survey with 2031 participants and use structured equation modelling to validate the research model. We also examine the influence of demographic factors on training. Our findings contribute to the digital literacy literature and inform the adoption and planning of similar digital literacy training initiatives in the future.

Keywords: Digital Literacy, Structured Equation Modelling, Kirkpatrick Model, Research Model
1 Introduction

Rapid innovation and adoption of new technologies are transforming nations (Venkatesh et al., 2014, Correa and Pavez, 2016, Schuetz and Venkatesh, 2020). Governments, businesses, and societies embrace technologies for digital transformation initiatives, significant to grow and survive in the evolving digital world. Technologies such as social networking sites, internet-based applications, streaming digital devices, and smart devices are being adopted to provide essential services such as banking to people (French and Baduqui, 2019, Khokhar, 2016). These technologies have started to play a central and pervasive role in every aspect of our lives, be it the workplace, education, public services, administration, and healthcare. However, many people worldwide are disadvantaged and lack fundamental digital skills essential to operating digital technologies necessary for everyday life and work (Adesola and Olla, 2019, Chetty et al., 2018). Digital exclusion is a severe problem as it prevents people from participating in a digital society (Hsieh et al., 2011). One way to overcome digital inequality is digital literacy.

Digital literacy refers to the “ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital devices and networked technologies for participation in economic and social life” (Antoninis, 2018). Digital literacy has been identified by the United Nations (UN) as one of the Sustainable Development Goals (SDGs) (United Nations, 2018), imperative for the sustainable development of a country. According to Lankshear and Knobel (2011, p. 14), digital literacy is “a precondition of a successful transition to becoming a post-industrial economy and a knowledge society.” Knowledge society makes knowledge available to all community members to improve the human condition (Välimaa and Hoffman, 2008). Digital literacy has been communicated as a prerequisite to eradicating poverty, inequality, and exclusion (Khokhar, 2016, Venkatesh and Sykes, 2013). Furthermore, a digitally literate population enables organizations and governments to undertake digital transformation initiatives (Bunker, 2010). With the greater spread of the internet and penetration level, governments worldwide have started to undertake digital literacy initiatives.

One such initiative was taken by the Indian Government known as Digital Sakshatra Abhiyan (DISHA)/National Digital Literacy Mission (NDLM). India is a country where 68% of the nation’s population and 72% of the workforce live in rural areas (Schuetz and Venkatesh, 2020). Various studies (e.g., Kharade and Sharma, 2011, Schuetz and Venkatesh, 2020, Singh, 2010) have shown that digital literacy levels are lower in rural areas due to the absence of a social support network. However, it is this rural population, which is expected to contribute to India’s economic growth. Hence, the key to India’s growth rests on empowering rural India through technology (Schuetz and Venkatesh, 2020). For the past few years, Information and Communication Technologies (ICT) have been used for several governance-related activities in India, e.g., myGov and other mobile applications, which enable citizens to connect to the Government. However, the lower digital literacy rate inhibits people from using such applications. Considering this situation, DISHA/NDLM was launched, which had the aim of making at least one person in 40% of rural households digitally literate by imparting them with knowledge and skills so that they can access and utilize ICT related services and avail opportunities for employment (Government of India, 2020, ICLT, 2016).

On implementing the digital literacy initiative, the Indian Government was interested in evaluating DISHA’s effectiveness. Understanding the effectiveness of digital literacy approaches is essential for adopting similar initiatives in the future and associated pedagogy (Kambouri et al., 2006, Ragnedda et al., 2019, Jimoyiannis and Gravani, 2010). Appropriately measuring such programs’ effectiveness is also important to understand if the policies designed to address the gap, in this case, digital inclusion, are effective (Antoninis, 2018). Contemporary discourses have focused on the antecedents of digital literacy (Yildiz Durak and Seferoğlu, 2020, Haddon et al., 2020) and consequences of digital literacy (Marsh, 2018, Marini et al., 2020); however, an understanding of the key components of an effective program that contributes to digital literacy remains inconspicuous. In this work, we evaluate a
nationwide digital literacy program to understand what constitutes an effective digital literacy program. Therefore, the research questions that we aim to address are: (i) What factors were effective in imparting digital literacy to target participants in the context of DISHA? and (ii) How can DISHA’s implementation inform the adoption of similar digital literacy training in the future?

This paper presents an evaluation of the factors contributing to the effectiveness of DISHA, i.e., on achieving the digital literacy of the beneficiary, through the lens of the Kirkpatrick model. Kirkpatrick model is by far the most popular training evaluation model (Bates, 2004, Hamtini, 2008, Ayub et al., 2017). Our findings present exciting insights into relationships among the factors. The influence of different demographic characteristics (i.e., age, income level, educational level, gender, and prior access to the internet) on the training is also examined, providing further insights on the effectiveness of digital literacy training initiatives. The paper also presents a validated measurement instrument that can be used to evaluate similar initiatives in the future. Overall, the findings help understand the critical components of an effective digital literacy program for future planning and implementation of similar initiatives.

2 Background

2.1 Digital Literacy

In recent times, Information and Communication Technologies (ICT) have influenced every facet of life. Henceforth, if individuals need to function in today’s society, they must be digitally literate. Digital literacy is the ability to understand, analyze, assess, organize, and evaluate information using digital technologies (Mohammadyari and Singh, 2015). Gilster and Glistner (1997, p. 17) described digital literacy as “the set of attitudes, understanding and skills to handle and communicate information and knowledge effectively, in a variety of media and formats.” It combines cultural, cognitive, and technical aspects, as is reflected from the definition proposed by Martin (2005, p.135), “digital literacy is the awareness, attitude and ability of individuals to appropriately use digital tools and facilities to identify, access, manage, integrate, evaluate, analyze and synthesize digital resources, construct new knowledge, create media expressions, and communicate with others, in the context of specific life situations, in order to enable constructive social action; and to reflect upon this process.” Digital literacy impacts an individual’s educational, personal, social, and economic aspects of life. It provides the core capabilities to achieve valued outputs in life. It empowers individuals to work more effectively, communicate with others, and increase their productivity (Martin, 2008, Mohammadyari and Singh, 2015). Digital literacy is evidenced to lower individuals’ stress levels and make them more confident about their performance (Mohammadyari and Singh, 2015).

Further, being digitally literate also results in digital inclusion and hence social inclusion. Access to digital technologies enables people to access services that provide a better quality of life. It also allows economic competitiveness and bridges the digital divide (Khokhar, 2016). The digital divide refers to the gap between people concerning access and use of digital and information technology and those who have limited or no access (Tapashi, 2018). The digital divide is one of the leading causes of social exclusion and a new kind of poverty, information poverty (Tapashi, 2018, French and Baduqui, 2019). Realizing the significance of digital literacy, many governments are employing digital literacy initiatives to make their population digitally literate (e.g., Adesola and Olla, 2019, Atieno and Moturi, 2014, Passarelli et al., 2014). One such digital literacy training initiative was undertaken by the Indian Government, which is explained next.

2.2 About DISHA: A Digital Literacy Training Initiative

Digital Sakshatra Abhiyan (DISHA)/National Digital Literacy Mission (NDLM) is an initiative under the ‘Digital India’ flagship program of the Indian Government. India is a country where 72% of the workforce lives in rural areas. Remote and rural areas in India suffer from low digital literacy levels
due to inadequate awareness and a lack of social support networks (Schuetz and Venkatesh, 2020). They are deprived of ICT developments initiated and directed towards their advancement and prosperity (Nedungadi et al., 2018). Hence, the rural areas suffer from a lack of success to digital technologies and hence social exclusion, which is detrimental to the country’s progress and economic growth. To redress this situation, DISHA/NDLM was launched with an objective to make 40% of the rural households digitally literate. The program’s vision was to transform India into a digitally empowered society and knowledge economy (Government of India, 2020). The key area of focus of the program was to empower citizens with digital literacy, digital resources, and collaborative digital platforms and make at least one person in every rural household literate. The training was based on the pretext that digital literacy will enable citizens to exploit digital technologies and help them lead a better life by getting better access to opportunities and being economically secure (Government of India, 2020). The broad objective of the training was to enable a person to operate a computer or any other digital device such as a tablet or mobile phone (also known as fundamental literacy (Antoninis, 2018)) to manage or browse content (also known as information literacy (Antoninis, 2018)) and perform various tasks such as sending or receiving emails, searching for information on the internet, and applying for a passport and jobs (also known as collaborative literacy (Antoninis, 2018)). Each candidate was selected from a non-IT literate household, which is why the benefit was not only for the individual but for the entire household (Patankar et al., 2017).

Common Service Centres e-Governance Services India Limited (hereafter referred to as CSCSPV) had implemented the digital literacy training program through the service centres, telecentres, and other channels such as adult literacy centres and rural self-employment training institutes. The program consisted of 20 hours of training, which provides trainees basic knowledge and familiarity with using computer hardware and IT skills such as internet browsing, using applications, and retrieving information. After the training program, an online exam was conducted (Mukherjee et al., 2019). If completed successfully, the participants were certified. On receiving the certification, the beneficiary was eligible for jobs like data entry operators.

2.3 Kirkpatrick Model

Digital literacy is a growing area of research. However, a systematic understanding of the key elements of a digital literacy program remains elusive. This understanding is essential to develop future digital literacy programs and inform policies. Prior studies have focused on the antecedents of digital literacy. For example, Li (2018) found that proficiency in digital skills enhances digital literacy, while Prior et al. (2016) communicated the role of self-efficacy to improve digital literacy. Studies have also researched the consequences of digital literacy. Ayub et al. (2017) revealed that digital literacy enabled greater acceptance of online learning courses, e.g., MOOC. Nguyen et al. (2020) conveyed the significance of digital literacy for digital inclusion. However, what constitutes an effective digital literacy program remains incoherent. Prior researchers have reinstated this need (e.g., Ayub et al., 2017, Ogbonnaya-Ogburu et al., 2019) and have called for future research in this area, which is the motivation for our work. This paper evaluates the effectiveness of a nationwide digital literacy program using the Kirkpatrick model (explained next). It communicates the key elements comprising it to inform future implementation of similar initiatives.

The Kirkpatrick model (Kirkpatrick and Craig, 1967, Kirkpatrick, 2009) is the “most acknowledged and widely used” (Kucherov and Manokhina, 2017, p.123) training evaluation model. The model has become popular because of its ability to break down a complex subject into manageable levels. It is suitable for any training style, both informal and formal (Tamkin et al., 2002), and helps to understand the impact of the training on expected outcomes. The literature presents other training evaluation...
models, such as the CIRO model (Warr et al., 1970) and the Phillips ROI model (Phillips, 1998); however, they are appropriate for particular contexts. For example, the CIRO model is better suited to evaluate management training, whereas the Phillips ROI model is apt to evaluate corporate training. On the contrary, the Kirkpatrick model has been used widely to evaluate digital learning programs (Chang and Chen, 2014, Ayub et al., 2017). Given the suitability of the Kirkpatrick model for this study and its advantages, the model was used to evaluate the effectiveness of DISHA.

The Kirkpatrick model outlines four levels to evaluate training: Reaction, Learning, Behaviour, and Results (Kirkpatrick, 2009). Each level impacts the next level, Reaction impacts Learning, and Learning affects the participants’ behavior (Kirkpatrick and Craig, 1967). Level 1, Reaction, aims to understand if the people found the training valuable. It seeks to measure the participants’ satisfaction or how well they liked training (Kirkpatrick, 2009). In practice, measures of this level have evolved and are directed towards evaluating the participants’ affective response to training quality (Bates, 2004). Level 2, Learning, aims to measure the extent to which attendees could learn the content taught during the training (Kirkpatrick, 2009). Learning goes beyond the participants’ outlook regarding the training content and facilities but on the actual Learning that happened during the course. Evaluation of this stage includes quantifiable indicators related to the program’s content (Bates, 2004, Kirkpatrick and Craig, 1967). Level 3, Behaviour, aims to measure the transfer of knowledge, skills, and attitude to jobs (Hamtini, 2008, Kirkpatrick, 2009). Level 4, Results, intends to assess the impact of training on broader organizational goals and objectives (Kirkpatrick and Craig, 1967). It is crucial to measure the first two levels, Reaction, and Learning, as it enables an understanding of participants’ attitude towards training and the skills learned. In turn, these two influence the transfer of skills to practice for improved performance (Kirkpatrick and Craig, 1967).

3 Research Model and Hypothesis

DISHA aimed at enabling people to gain digital skills that they can apply in looking for jobs (Level 3), which is why we adopt and adapt the first three levels of the Kirkpatrick model to this study’s context.

Level 1, Reaction, includes participants’ perception of the physical environment, the material used, instructor skills, methodology, and content (Hamtini, 2008, Bates, 2004, La Duke, 2017, Beinicke and Bipp, 2018). Examining these factors assist in understanding the perceived value of training by the participants. In this study, we grouped these factors into the Physical Environment and Training Conduct (PETC) and Instructor Training Skills (INST) constructs to evaluate the Reaction of participants to the training. PETC construct captures elements associated with the planning of the physical environment (e.g., power supply in class) and the training proceedings (e.g., the suitability of training time). In contrast, INST captures elements related to the content, teaching methodology, assessment methodology, and instructor skills (e.g., understandability of content, trainer being attentive to queries).

Level 2, Learning, measures the extent to which attendees could learn the content taught during the course. The literature outlines a digital competence framework (Chetty et al., 2018, Van Deursen et al., 2014, Antoninis, 2018), which provides the key components of digital competence. The competencies can be used to measure the digital literacy of the participant. DISHA aimed to impart knowledge related to the first three competencies present in the framework: fundamental literacy, information literacy, and collaborative literacy (ICLT, 2016). Fundamental Literacy (FL) refers to basic knowledge related to digital technologies, such as phones, tablets, and computers. Examples include turning on/off the phone, charging the computer, and other basic knowledge of the software (Antoninis, 2018, Van Deursen and van Dijk, 2014). Information Literacy (IL) refers to the ability to manage, evaluate, and browse digital content (Antoninis, 2018), e.g., being able to apply for a passport. Collaborative Literacy (CL) refers to the ability to use digital applications for collaborative and communication purposes, e.g., being able to use social media platforms (Antoninis, 2018, Van Deursen et al., 2014). We hence used fundamental, information, and collaborative literacy as the three
constructs to assess the Learning (level 2 of Kirkpatrick model) of the participant. Furthermore, the Learning or digital literacy in our case can be evaluated at two levels: (1) knowledge about digital technologies, and (2) confidence or comfort in using digital technologies (Tang and Chaw, 2016, Kirkpatrick, 2009, Hordern, 2016). Knowledge refers to having awareness and familiarity with digital technologies, and comfort refers to applying knowledge and participant’s attitude towards digital technologies. We, therefore, evaluate the Learning of each competence of digital literacy across knowledge and comfort. Hence, the constructs created were: Fundamental Literacy Knowledge (FLK), Fundamental Literacy Comfort (FLC), Information Literacy Knowledge (ILK), Information Literacy Comfort (ILC), Collaborative Literacy Knowledge (CLK), and Collaborative Literacy Comfort (CLC).

Kirkpatrick’s model suggests that Reaction (i.e., PETC and INST in our case) has an influence on Learning. Research indicates that the classroom’s physical environment influences the Learning of the participant (Grubbaugh and Houston, 1990, Cantero et al., 2016). A good physical classroom environment, such as having good computers and how training is conducted, has been evidenced to positively impact participants’ learning (Salehi et al., 2014, Heydari et al., 2019). Research also conveys that the trainer’s skills positively impact the Learning of the participant (Lim and Morris, 2006, Noe, 1986, Samuelsson, 2008). We hence hypothesize that Physical Environment and Training Conduct positively impact the Learning of digital skills (fundamental, information, and collaborative) of the participant. We also hypothesize that Instructor Training Skills positively impact the Learning of digital skills (fundamental, information, and collaborative) of the participant.

H1a: Physical environment and training conduct positively impacts Fundamental Literacy.
H1b: Physical environment and training conduct positively impacts Information Literacy.
H1c: Physical environment and training conduct positively impact Collaborative Literacy.
H2a: Instructor training skills positively impact Fundamental Literacy.
H2b: Instructor training skills positively impact Information Literacy.
H2c: Instructor training skills positively impact Collaborative Literacy.

In addition to the paths from Reaction to Learning, the literature indicates that fundamental skills of digital technologies are essential to put digital technologies to use (UNESCO, 2014, Antoninis, 2018). We hence hypothesize that Fundamental Literacy has an impact on Information Literacy and Collaborative Literacy.

H3a: Fundamental Literacy positively impacts Information Literacy.
H3b: Fundamental Literacy positively impacts Collaborative Literacy.

Level 3, Behaviour, is about assessing the effectiveness of the training. In the context of DISHA, the aim was to provide participants with digital skills to operate IT-based applications over the internet to do everyday activities. Therefore, following the objectives of DISHA (Government of India, 2020), we assessed the transfer of skills across two constructs: Information Literacy Effectiveness (ILE) and Collaborative Literacy Effectiveness (CLE). It needs to be noted that Fundamental Literacy contributes to Information Literacy and Collaborative Literacy. Therefore, the effectiveness of Fundamental Literacy was indirectly assessed through ILE and CLE, as they could not be demonstrated without Fundamental Literacy. Information Literacy Effectiveness refers to the ability of the participants to use Information Literacy, such as searching and accessing digital content to apply for jobs. Collaborative Literacy Effectiveness refers to the ability of the participants to use Collaborative Literacy skills, such as being able to help family members. Learning digital skills has been researched to positively impact their usage (Yu et al., 2017, Zhong, 2011, Di Giacomo et al., 2017). The impact of Learning on Behaviour has been reinforced by the Kirkpatrick model (Kirkpatrick, 2009), which is why we hypothesize the following:

H4a: Fundamental Literacy positively impacts Information Literacy Effectiveness.
Building a Knowledge Society

$H_{4b}$: Information Literacy positively impacts Information Literacy Effectiveness.

$H_{4c}$: Collaborative Literacy positively impacts Information Literacy Effectiveness.

$H_{5a}$: Fundamental Literacy positively impacts Collaborative Literacy Effectiveness.

$H_{5b}$: Information Literacy positively impacts Collaborative Literacy Effectiveness.

$H_{5c}$: Collaborative Literacy positively impacts Collaborative Literacy Effectiveness.

Figure 1 presents our research model.

4 Research Method

4.1 Data Collection

The CSCSPV had given the research team a database of people who had completed the training and had received certificates. This database was treated as the study population. After a discussion with CSCSPV, we chose a sample of participants that completed their training in 2016, i.e., all participants who completed their training in 2016. This year was the latest year of training and consisted of participants belonging to various demographic factors, as shown in Table 1. CSCSPV and the research team evidenced the participants as comprehensive representatives of the population. We conducted a questionnaire-based telephonic survey in 2017 with the sample participants within twelve months of completing their training. Based on the research model’s constructs (Section 3), a structured questionnaire was developed and used for the survey for data collection. Constructs, items, and the questionnaire were finalized with inputs from the CSCSPV regarding parameters on which the program could be assessed. Information from the stakeholders helped in improving the items related to the constructs.

The questionnaire started with some demographic information, particularly age, gender, marital status, state of residence, educational qualification, and prior access to the internet. Next, there were questions related to each construct and associated items. The survey questionnaire is present at [https://tinyurl.com/disha-ecis-survey](https://tinyurl.com/disha-ecis-survey). We used a four-point Likert scale for responses to each item in a construct. Four-point Likert scale was suitable as we wanted a definite opinion from respondents (and not neutral) as neutral information would not be informative in this study. Additionally, four-point
Likert scale is considered suitable for studies where opinion on service that user experienced, which is true for this study (Asún et al., 2016). In total, we received 2031 responses, which was sufficient to conduct PLS-SEM analysis. All the respondents received training during the same period of one year.

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Value</th>
<th>Frequency</th>
<th>Percent</th>
<th>Demographics</th>
<th>Value</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
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<td>700</td>
<td>35%</td>
<td>Education</td>
<td>Middle school</td>
<td>531</td>
<td>26%</td>
</tr>
<tr>
<td></td>
<td>18-20</td>
<td>817</td>
<td>40%</td>
<td></td>
<td>High School</td>
<td>1118</td>
<td>55%</td>
</tr>
<tr>
<td></td>
<td>21 or higher*</td>
<td>514</td>
<td>25%</td>
<td></td>
<td>Bachelor’s Degree</td>
<td>382</td>
<td>19%</td>
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<tr>
<td>Gender</td>
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<td>58%</td>
<td>Income Level</td>
<td>Low Income</td>
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<td>57%</td>
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<td>42%</td>
<td></td>
<td>Not Low Income</td>
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<td>Access to Mobile Internet</td>
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<td>63%</td>
<td>*21 or higher includes 96% respondents aged between 21 and 30.</td>
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<tr>
<td></td>
<td>No</td>
<td>750</td>
<td>37%</td>
<td></td>
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</table>

*Table 1: Demographic Overview of Participants.*

### 4.2 Assessment of Measurement Model

The reliability and validity of the constructs were assessed to test the measurement model. All constructs in the model are modelled as reflective and measured using multiple indicators. Measuring all the constructs with the same instrument could cause a common threat to validity known as common method bias (CMB) or common method variance (CMV). We assessed the correlation matrix of the first-order constructs and observed all values in the matrix were below 0.90, indicating the absence of CMB (Pavlou et al., 2007). As shown in Table 2, the internal consistency of the scales is validated using the values of Cronbach’s Alpha for all the first-order constructs that range from 0.706 to 0.965, and the composite reliability (CR) ranges from 0.815 to 0.965. For all constructs, the values exceeded 0.7, confirming the reliability of data (Bland and Altman, 1997). The convergent validity is supported by the average variance extracted (AVE) values, which range from 0.525 to 0.852 and exceed the suggested minimum value of 0.5 (Fornell and Larcker, 1981). The correlation of each first-order construct with all other constructs is lower than the square root of AVE, thus confirming discriminant validity (Table 2).

### 4.3 Assessment of Structural Model

Partial least squares structural equation modelling (PLS-SEM) was used to validate the hypotheses. PLS-SEM works well for exploratory research (Gefen et al., 2011). We meet the sample size requirement for an acceptable statistical power of 0.8, the effect size ($f^2$) of 0.1, the number of indicators, and the significance level ($p<0.05$) (Cohen, 2013). We used SmartPLS3 software (Ringle et al., 2015). Fundamental Literacy, Collaborative Literacy, and Information Literacy were modelled as reflective-reflective second-order constructs composed of two first-order constructs. It was reflectively measured by the first-order constructs that include the respective knowledge and comfort constructs – Fundamental Literacy Knowledge (FLK) and Fundamental Literacy Comfort (FLC) for Fundamental Literacy. Similarly, Information Literacy and Collaborative Literacy were reflectively measured using their knowledge and comfort constructs. Considering the higher-order model of reflective-reflective type enables operationalizing the construct of three types of literacies at a high level of abstraction. The higher-order constructs are modelled using the repeated indicator approach (Hair et al., 2011). In SmartPLS, the parametric bootstrapping technique with 5000 subsamples was used to assess the structural model. The results of hypotheses testing are shown in Figure 2(a), and the results of higher-order constructs are reported in Figure 2(b). The path coefficients indicate the
strength of the relationship and the $R^2$ values shown indicate the proportion of the variance in the endogenous factors explained by the exogenous factors.

<table>
<thead>
<tr>
<th></th>
<th>CLK</th>
<th>CLC</th>
<th>FLK</th>
<th>FLC</th>
<th>ILK</th>
<th>ILC</th>
<th>PETC</th>
<th>CLE</th>
<th>ILE</th>
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<tr>
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<td>0.526</td>
<td>0.592</td>
<td>0.357</td>
<td>0.517</td>
<td>0.541</td>
<td>0.577</td>
<td>0.797</td>
<td>0.406</td>
<td>0.469</td>
<td>0.802</td>
</tr>
</tbody>
</table>

CA = Cronbach’s alpha; CR = Composite reliability; AVE = Average Variance Extracted; Bolded cells = Square root of AVE

| AVE  | 0.657| 0.788| 0.604| 0.682| 0.852| 0.823| 0.525| 0.684| 0.685| 0.643|
| CR   | 0.905| 0.949| 0.884| 0.914| 0.959| 0.962| 0.815| 0.896| 0.897| 0.9   |
| CA   | 0.869| 0.933| 0.835| 0.882| 0.948| 0.953| 0.706| 0.845| 0.847| 0.861|

Table 2. Latent Property Variables.

The results show that Physical Environment and Training Conduct (PETC) has a positive influence on Fundamental Literacy ($\beta = 0.207, p < 0.001$) supporting the hypotheses H1b. PETC does not have a positive influence on Information Literacy ($\beta = -0.103, p < 0.01$), and has no significant influence on Collaborative Literacy failing to support H1a and H1b. Further data collection in the form of follow-up interviews is required to understand the reason for this correlation. Instructor Training Skills (INST) has a positive influence on Information Literacy ($\beta = 0.369, p < 0.001$), Fundamental Literacy ($\beta = 0.333, p < 0.001$), and Collaborative Literacy ($\beta = 0.257, p < 0.001$), supporting H2a, H2b, and H2c. Fundamental Literacy has a significant positive influence on Information Literacy ($\beta = 0.564, p < 0.001$) and Collaborative Literacy ($\beta = 0.689, p < 0.001$), validating hypotheses H3a and H3b.

We further validate the hypotheses that account for the relationship between the Learning constructs and their influence on the Behaviour constructs of the research model. The hypotheses of Learning positively influencing Behaviour is validated with Information Literacy positively influencing Collaborative Literacy Effectiveness (CLE) ($\beta = 0.152, p < 0.001$), and Information Literacy Effectiveness or ILE ($\beta = 0.371, p < 0.001$), hence supporting H4a, H5a. Similarly, Fundamental Literacy positively influences CLE and ILE ($\beta = 0.148, p < 0.001$, $\beta = 0.270, p < 0.001$) supporting H4b, and H5b. Collaborative Literacy positively influences CLE and ILE ($\beta = 0.212, p < 0.001$, $\beta = 0.119, p < 0.01$), thus supporting H4c, H5c. The results of the PLS analysis provide considerable support to the research model as most of the research hypotheses were supported.

4.4 Multi-group Analysis

In addition to applying the Kirkpatrick model and testing it in the context of DISHA, we also examined the influence of demographic factors on the paths of the research model to provide further guidance on adopting similar training initiatives. We compared the significance of the path coefficient differences among various groups of participants using the multi-group analysis of SEM for statistical tests on the differences. The results are presented in Table 3 and Appendix A. Only significant values are presented. There are substantial differences in the influence of Instructor Training Skills on
Learning Information Literacy across different groups of gender, income level, access to the internet, age, and education level. The influence of Information Literacy on Information Literacy Effectiveness significantly varies across the demographic groups.

![Diagram of Learning Information Literacy across different groups of gender, income level, access to the internet, age, and education level. The influence of Information Literacy on Information Literacy Effectiveness significantly varies across the demographic groups.]

Figure 2. Result of Hypotheses Testing.

<table>
<thead>
<tr>
<th>No</th>
<th>Paths</th>
<th>Gender (Female – Male)</th>
<th>Income level (Low- Not Low)</th>
<th>Access to Mobile Internet (Yes - No)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Difference</td>
<td>p-value</td>
<td>Difference</td>
</tr>
<tr>
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<td>PETC -&gt; IL</td>
<td>0.145</td>
<td>0.01</td>
<td>0.103</td>
</tr>
<tr>
<td>2</td>
<td>INST -&gt; CL</td>
<td>-0.084</td>
<td>0.034</td>
<td>-0.085</td>
</tr>
<tr>
<td>3</td>
<td>INST -&gt; IL</td>
<td>-0.229***</td>
<td>**0.000</td>
<td>-0.192**</td>
</tr>
<tr>
<td>4</td>
<td>FL -&gt; ILE</td>
<td>0.123</td>
<td>0.087</td>
<td>0.273***</td>
</tr>
<tr>
<td>5</td>
<td>IL -&gt; ILE</td>
<td>-0.222**</td>
<td>0.003</td>
<td>-0.333***</td>
</tr>
<tr>
<td>6</td>
<td>FL -&gt; CL</td>
<td>0.025</td>
<td>0.236</td>
<td>-0.016</td>
</tr>
<tr>
<td>7</td>
<td>FL -&gt; IL</td>
<td>0.111***</td>
<td>0.000</td>
<td>0.012</td>
</tr>
</tbody>
</table>

Table 3: Results of Multi-group analysis (Gender, Income Level, Access to Mobile Internet).

5 Discussion

Our findings convey many interesting aspects related to DISHA. The results indicate that Reaction does positively impact Learning of the beneficiary; however, each construct in Reaction impacts the Learning differently. It is evidenced that the Physical Environment and Training Conduct (PETC) only impacts Fundamental Literacy (FL). To enable Learning of other competencies, Information Literacy (IL) and Collaborative Literacy (CL), in this case, the Instructor Training Skills (INST), have a greater impact. These results, therefore, suggest that future planning of similar initiatives should give considerable thought to the trainers employed in the program. Trainers should be carefully selected by evaluating how they teach, their skills, and their ability to clarify doubts. However, even though PETC
is not witnessed to influence IL and CL directly, results indicate the influence mediated through FL corroborated through a significant impact of FL on IL ($\beta=0.556$) and CL ($\beta=0.689$). These insights bring forth the significance of having components that provide FL to the participants in a digital literacy program, failing which IL and CL may not develop. According to UNESCO (2014), for digital literacy, participants must gain fundamental knowledge about digital technologies. Gaining basic knowledge will enable participants to appreciate their use to gather information and promote usage for collaborative purposes, which is evidenced in DISHA’s context. Hence, it is suggested that future training programs should not assume participants to have FL but impart FL to foster the Learning of other digital literacy competencies.

We gained additional insights related to the influence of demographic factors from Reaction to Learning. Table 3 and Appendix A provides results of multi-group analysis across different demographic factors used in this study. We learn that INST has a greater influence on IL for males than females (row 3 of Table 2). This finding may be attributed to the fact that females are intrinsically more motivated to learn than males, which is why training skills may not be as crucial to females as males (Mubeen et al., 2013, Iwaniec, 2019). The results also convey that the influence of INST on IL and CL is stronger for people with not low income (row 2 and 3 of Table 2). These findings confirm that socio-economic status does influence the Learning of digital literacy skills an individual (Urbancikova et al., 2017, Tapashi, 2018), in this case, the Learning of Information Literacy and Collaborative Literacy. Having a better socio-economic status provides the advantage of having prior access to services and technologies, which makes Learning Information and Collaborative Literacy easier than those who yet have to learn the primary use of digital technologies. Interestingly, we also observe that INST has a greater influence on IL on people with no prior access to the internet (row 2 and 3 of Table 2). People with no prior access to the internet may find the capabilities of digital technologies interesting and new, which is why there seems to be a more significant influence of INST on them. Furthermore, an inspection of education level indicates that the impact of Reaction on Learning, in particular, FL and CL, was greater for participants with low education levels (row 1, 2, 3, and 4 of Table A.1). Graduates or people with high education levels are less likely to be influenced by PETC and INST when learning digital skills. Therefore, the results indicate that INST and PETC are important for people with low educational qualifications, which can be related to not having prior exposure to educational activities, unlike people with higher education. In terms of age, we evidenced that INST has a more significant influence on FL for participants of lower age groups but FL and CL for higher age groups (row 2, 3, and 4 of Table A.2). This may be because lower age groups are less exposed to digital technologies than higher groups, which is why lower age groups are still trying to gain basic knowledge. In contrast, higher age groups learn more than basic knowledge. The results convey the benefit of having training sessions tailored for different age groups.

The results also communicate a positive impact of Learning to Behaviour. We find IL to have the maximum positive effect on Information Literacy Effectiveness (ILE) ($\beta=0.371$). In contrast, FL and CL are evidenced to have the maximum positive impact on Collaborative Literacy Effectiveness (CLE) ($\beta=0.270$ and $\beta=0.212$, respectively). The results of the study confirm that imparting Fundamental, Information, and Collaborative Literacy enabled participants to meet the objective of DISHA, which we refer to as Information Literacy Effectiveness and Collaborative Literacy Effectiveness. The program has familiarized participants with basic digital technologies and provided them the competency to use them to apply for jobs, access online services (e.g., applying for passport), and develop new learning skills.

Multi-group analysis brought forth other interesting insights from Learning to Behaviour. The results show that the impact of IL on ILE is greater for males than females (row 5 of Table 2), which may be because females in rural India are less exposed to work and opportunities than males (Venkatesh and Sykes, 2013). Limited exposure to opportunities may be why females take time to put the skills they learned to practice. We also understand that the ILE of people with not low income and access to the internet is impacted strongly by IL (row 4 and 5 of Table 2), demonstrating that people with better socio-economic status can put IL to use than the other group (Scherer and Siddiq, 2019). Further, FL
has a substantial impact on ILE for people with low income, which can be related to the fact that people with low socio-economic status do not have prior access to technologies, which is why FL is perceived as of much value. Like people with low income, we see that FL has a greater impact on ILE for people with low education level, whereas, IL had a greater impact on ILE for people with higher education level (row 5, 6, and 7 of Table A.1). Additionally, we also observe that for young adults the impact of IL on ILE and CLE is more significant (row 5, 6, and 7 of Table A.2). One possible explanation could be that young adults are more involved in society and desire to be socially included in mainstream activities (Steelman and Wallace, 2017, Mocanu, 2018). Further, we also learn that the impact of FL on IL is higher for females, for people with prior access to the internet, and for people of lower age.

Understanding the influence of different demographic factors on the different paths of the research model brings forth many interesting learnings. These learnings can be used in future planning and implementation of similar initiatives. For example, one may consider gathering demographic information of the participants beforehand and design the training modules accordingly. E.g., people with no prior access to the internet may be provided more knowledge about FL. At the same time, that component may not be prominent for people with earlier access to the internet. Application of such and other similar measures can enable the planning and implementation of effective digital literacy training programs in the future.

Overall, the application of the Kirkpatrick Model in the context of DISHA brought forth many interesting findings, augmenting digital literacy and Kirkpatrick model literature. However, we acknowledge certain limitations. First, we chose a sample of participants who had taken the survey, resulting in an unknown bias in the results. However, we mitigate this by choosing all participants for an entire year, as suggested by the stakeholders. The sample covered all the groups of demographic factors, and the size was sufficient to undertake PLS-SEM analysis considering the number of factors. Second, the survey required participants to report based on their memory of training. To handle this bias, we completed the survey within twelve months of completion of training. Finally, one may argue the generalizability of the results as the training was conducted in an Indian context. Nonetheless, our sample of participants provides rich insights informing the implementation of similar initiatives. We also call for future research to apply the research model in different contexts to increase the generalizability of results.

6 Conclusion and Outlook

With digital transformation gaining pace across countries around the world, the significance of digital literacy is well-argued. People need digital skills to work, live, and communicate productively. The absence of digital skills can create social exclusion and also jeopardize the ability of people to access employment opportunities. Given the need for a digitally literate workforce, the Indian Government had employed a digital literacy initiative, DISHA/NDLM, which had an objective of making 40% of rural households digitally literate (Government of India, 2019) across three competencies: Fundamental Literacy, Information Literacy, and Collaborative Literacy. The overarching aim is to empower rural people to contribute to the country’s economic growth positively. In this paper, we evaluated the factors effective in imparting digital literacy skills using the Kirkpatrick model. PLS-SEM was used. Further, we evaluated the influence of different demographic factors (i.e., age, gender, education level, income level, and prior access to the internet) on the training.

The insights from this study enable an understanding of the important components of a digital literacy program. The Kirkpatrick model was applied in the context of DISHA, which brought forth various interesting insights into the constructs pertaining to the three levels: Reaction, Learning, and Behaviour, and the relationships among them. Pedagogical insights related to demographic factors were obtained from multi-group analyses. These insights can inform the planning and implementation of similar digital literacy initiatives in the future. This paper also presents a validated measurement instrument, which can be used to assess similar digital literacy training initiatives in the future.
This study’s outcomes contribute to digital literacy and the Kirkpatrick model (Kirkpatrick and Craig, 1967) literature and open avenues for future research. We urge future researchers to test the research model and measurement instrument in the context of other digital literacy training programs that would help in re-specification of the research model. Next, other constructs related to the context of digital literacy need to be investigated and added to the different levels of the Kirkpatrick model. Furthermore, since the research model presented in the study was in the context of DISHA, we had considered three competencies of digital literacy. Other competencies can be added and investigated to obtain a holistic digital literacy training evaluation model. We also call for further research to understand the underlying reasons explaining the differences among groups for each demographic factor. Researchers could also compare the impact of DISHA over years. Overall, this study presents rich insights related to the factors contributing to the effectiveness of a large-scale digital training program, DISHA, which can inform the planning of similar digital literacy programs and foster the transition to a knowledge society.

Appendix A: Multi-Group Analysis

This appendix provides results of the multi-group analysis for education level and age.

<table>
<thead>
<tr>
<th>No</th>
<th>Paths</th>
<th>Education Level: Mid School - High School</th>
<th>Difference</th>
<th>p-value</th>
<th>Education Level: High School - Graduate</th>
<th>Difference</th>
<th>p-value</th>
<th>Education Level: Mid School - Graduate</th>
<th>Difference</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
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<td>PETC -&gt; CL</td>
<td></td>
<td>-0.019</td>
<td>0.358</td>
<td>0.274***</td>
<td>0.000</td>
<td>0.255***</td>
<td>0.000</td>
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<td>2</td>
<td>PETC -&gt; IL</td>
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<td>0.01</td>
<td>0.191*</td>
<td>0.025</td>
<td>0.177</td>
<td>0.075</td>
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<td>INST -&gt; FL</td>
<td></td>
<td>0.204***</td>
<td>0.001</td>
<td>0.082</td>
<td>0.294</td>
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<td>0.001</td>
<td></td>
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<tr>
<td>4</td>
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<td>0.056</td>
<td>0.034</td>
<td>-0.135*</td>
<td>0.018</td>
<td>-0.079</td>
<td>0.229</td>
<td></td>
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<td>5</td>
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<td>0.191*</td>
<td>0.030</td>
<td>-0.076</td>
<td>0.334</td>
<td>0.115</td>
<td>0.245</td>
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<td>0.386***</td>
<td>0.000</td>
<td>-0.001</td>
<td>0.987</td>
<td>0.384***</td>
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<tr>
<td>7</td>
<td>IL -&gt; ILE</td>
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<td>-0.280**</td>
<td>0.003</td>
<td>0.073</td>
<td>0.383</td>
<td>-0.208</td>
<td>0.112</td>
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Table A1. Results of Multi-group analysis with education level.

<table>
<thead>
<tr>
<th>No</th>
<th>Paths</th>
<th>Age: (18-20 years) - (&lt; 17 years)</th>
<th>Age: (&gt;21 years) - (&lt; 17 years)</th>
<th>Age: (18-20 years) - (&gt;21 years)</th>
<th>Difference</th>
<th>p-value</th>
<th>Difference</th>
<th>p-value</th>
<th>Difference</th>
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<td>0.004</td>
<td>0.067</td>
<td>0.234</td>
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<td>-0.246***</td>
<td>0.001</td>
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<td>0.274*</td>
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<td>0.014</td>
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<td>0.000</td>
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<td>0.001</td>
<td>0.036</td>
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Table A2. Results of Multi-group analysis with Age.
References


