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Digital financial literacy among adults in India: measurement and validation

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GENERAL & APPLIED ECONOMICS | RESEARCH ARTICLE Digital financial literacy among adults in India: measurement and validation

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Abstract: The ongoing COVID-19 pandemic has considerably promoted the usage of Digital Financial Services (DFS) in India. Therefore, exploring the various determinants influencing the DFS users is crucial for the DFS providers to understand their customers better. This study aims to identify, measure, and validate the determinants of Digital Financial Literacy (DFL) from the Indian adults who use Digital Financial Services. A sample of 384 adult DFS users from India was surveyed using a self-administered questionnaire in 2021. A multidimensional scale was developed to measure the Digital Financial Literacy in this study. The results exhibit that Digital Knowledge, Financial Knowledge, Knowledge of DFS, Awareness of Digital Finance Risk, Digital Finance Risk Control, Knowledge of Customer Right, Product Suitability, Product Quality, Gendered Social Norm, Practical Application of Knowledge and Skill, Self-determination to use the Knowledge and Skill and Decision Making are the determinants of DFL among the adults in India. Further, the users of DFS without DFL will face numerous challenges such as inability to complete the transaction, financial loss and privacy breach, etc. Hence, the study concludes that DFL is prerequisite to use DFS effectively.

Subjects: Statistics for Business, Finance & Economics; Educational Psychology; Financial Services Industry

Keywords: Financial services; educational finance; digitization; financial innovation and inventions and financial technology

1. Introduction

ABOUT THE AUTHOR

Adoption and Digital Financial Inclusion Project.

Technological disruptions and rapid digitization of financial services bring a vast number of revolutionary and innovative Digital Financial Services (DFS) into the market (Alliance for

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Financial Inclusion, DFSWG and CEMCWG, 2021). DFS implies access and use of financial services through the digital platform at any time (Pazarbasioglu et al., 2020). DFS uprising is a global phenomenon. In India, a wide variety of digital financial services have been designed and launched and they are being utilized by the customers, thanks to the technology adoption mindset of the customers and the efforts of the Government of India. "Unified Payment Interface" (UPI), "Bharat Interface for Money" (BHIM), Bharat Quick Response (QR) code, National Automated Clearing House (NACH), Rupay cards, National Electronic Toll Collection, and Aadhaar Enabled Payment Services (AePS) are a few digital financial services that are available in India. Digital financial services have changed how individuals, businesses, and households make payments, borrow money, settle transactions, buy financial products, make investments, and make remittances (Yang et al., 2021). Digital financial services improve the financial inclusion of the people who are excluded financially because DFS overcomes the impediments of serving the excluded people (Alliance for Financial Inclusion, DFSWG and CEMCWG, 2021). Digital financial services usage is on the rise. Around 70.3 billion real-time payment transactions were recorded globally in 2020 and this was a 41% increase when compared to 2019 (ACI Universal Payments, 2021). Out of 70.3 billion real-time transactions, 20.5 billion transactions came from India (ACI Universal Payments, 2021). Thus, digital financial services are widely used in recent times and DFS integrates the economy by introducing revolutionary digital financial products and services such as virtual banking, Application Programme Interfaces (APIs), alternative credit scoring mechanism, digital lending, and so on (OECD, 2018). Digital financial services pose many challenges to the users. The users are exposed to risk when they intend to use digital financial services. The risks and challenges include identity theft, privacy concerns, unregulated service providers, security concerns, low digital literacy, low financial literacy, and limited awareness of DFS (Alliance for Financial Inclusion, DFSWG and CEMCWG, 2021).

Digital Financial Literacy (DFL) is an essential requirement for the effective usage of Digital Financial Services (DFS) and DFL is an important component of education in this digital age (Morgan et al., 2020). It is to be noted that DFL is essential to use DFS when DFS are made available to the customers by the government. However, the government does not allow DFS as a part of its policy initiative; then, the prerequisite to use is DFS is the favourable policy decision to allow DFS by the government. Digital financial literacy is a combination of digital literacy, and financial literacy, and DFL is "financially literate on digital platforms" (Lyons & Kass-Hanna, 2021a). Digital financial literacy is measured by metrics of both financial literacy and digital literacy. Financial Literacy (FL) implies awareness about financial products and services and the ability to apply financial knowledge and skills to manage financial resources to achieve good financial health (Xiao et al., 2014). Simply put, digital literacy indicates proficiency to use digital technologies (Alliance for Financial Inclusion, DFSWG and CEMCWG, 2021). Digital literacy (DL) is defined as "the ability to define, access, manage, integrate, communicate, evaluate and create information safely and appropriately through digital technologies and networked devices for participation in economic and social life" (UNESCO, 2018).

Lack of DFL is a constraint for the rational and effective usage of digital financial services. Even a person who has a fair amount of financial literacy cannot use digital financial services effectively when he/she does not have digital literacy. So, both digital literacy and financial literacy are required to deal with digital financial services. In other words, digital financial literacy is a prerequisite for access and usage of digital financial services. Research studies revealed that the users have low financial literacy, limited awareness of DFS, low or nil digital literacy, and distrust of DFS (Alliance for Financial Inclusion, DFSWG and CEMCWG, 2021; Azeez & Akhtar, 2021; Bansal, 2019; Lyons & Kass-Hanna, 2021a; Prasad et al., 2018). However, in addition to these, there are several other determinants that influence the Digital financial literacy among adults. Therefore, this study aims to identify, measure, and validate the determinants of DFL among the adult DFS users in the Indian context. Eventually, the determinants of DFL, as the outcome of this study, will enable the digital financial service providers to understand their customers better.

2. Review of the extant literature

Digital financial inclusion has become a policy initiative for the government of India and so, focus has been given on constructing digital infrastructure in India (RBI, 2021). Digital India has been a flagship programme towards digitisation of India and creating an awareness about utilisation of digital services (Department of Electronics and Information Technology 2014). Usage of digital financial services promotes digital financial inclusion (Shen et al., 2018). Digital technologies and Fintech brought radical changes in the financial services sector and digital financial services have become accessible and affordable across the globe (Lyons & Kass-Hanna, 2021a). Digital technologies integrate the economy and largely impact the financial industry (OECD, 2018). Digital financial services provide "concrete benefits" to consumers and entrepreneurs (OECD, 2018). Digital financial services provide a greater opportunity to promote financial inclusion further (Alliance for Financial Inclusion, 2021).

Digital financial services are defined as "financial operations using digital technology, including electronic money, mobile financial services, online financial services, i-teller, and branchless banking, whether through a bank or non-bank institutions" (OECD, 2018). Digital financial literacy is a prerequisite for the effective usage of digital financial services (Morgan et al., 2020). Digital financial services provide opportunities as well as challenges to financial consumers. Opportunities include customized financial products and services, faster transactions, and convenient access to the financial products and the challenges are adoption of complex technology-based financial products, and handling of sophistication (Alliance for Financial Inclusion, 2021). The pandemic mandated development of innovative digital financial services and products and many countries founded regulatory sandboxes to develop innovative DFS (Global Partnership for Financial Inclusion, 2021). Financial literacy and digital literacy are pre-requisites of DFL (Toronto Centre, 2022). Financial literacy is a basic literacy that persons need (Hayati & Syofyan, 2021). Financial education is to be customized one based on the learners Anita, 2019. Financial literacy facilitates better financial decision-making (Shen et al., 2018). Financial literacy is at low level among Indian adults (Tony & Desai, 2020). Young individuals are less financially literate (Fanta & Mutsonziwa, 2021). There is a need for enhancing financial literacy rate and digital literacy rate in India (Stephen, 2022). Digital literacy improves financial learning experience of the online users (Tiwari et al., 2020).

Effective usage of DFS demands higher levels of digital financial literacy (Morgan et al., 2020). Digital Financial Literacy (DFL) is a construct that combines financial literacy, financial capability, and digital literacy (Alliance for Financial Inclusion, 2021). Digital financial literacy is defined as "acquiring the knowledge, skills, confidence, and competencies to safely use digitally delivered financial products and services, to make informed financial decisions and act in one's best financial interest per individual's economic and social circumstance" (Alliance for Financial Inclusion, DFSWG and CEMCWG, 2021). Digital financial literacy is a new concept, and it is to be focused on by the regulatory bodies and the governments (Alliance for Financial Inclusion, DFSWG and CEMCWG, 2021). Digital financial literacy lies at a point where digital literacy and financial literacy intersects and digital financial literacy enables the users to have full benefits of digital financial services (Melinda Gates Foundation, 2021). Digital financial capability refers to "the knowledge, attitudes, and skills that enable an individual to use digital financial services actively" (Dimova et al., 2021). Access to digital financial services demands a fair amount of digital financial literacy (Morgan et al., 2020). Financial knowledge, digital financial knowledge, and financial attitude impact financial behaviour (Normawati et al., 2021). Digital financial literacy is measured by the researchers from different perspectives. Knowledge of DFS, awareness of the risk associated with DFS, knowledge on controlling digital financial risk, and knowledge on consumer rights and issue redressal are the measures of DFL (Morgan et al., 2020). A more detailed and comprehensive measurement of DFL was advocated by Lyons and Kass-Hanna (2021a). They specified five core dimensions each for FL and DL such as basic knowledge and skill, awareness, practical know-how, decision-making, and self-protection (Lyons & Kass-Hanna, 2021a). Literacy, numeracy, access, consumer awareness, and design are the enablers of DFL (Melinda Gates Foundation, 2021). From

the works of literature examined, it is understood that DFL is a recent concept and still evolving. A first detailed definition for DFL was given by Alliance for Financial Inclusion (2021). DFL is a multidimensional construct that combines FL and DL. The metrics proposed by Morgan et al. (2020), Alliance for Financial Inclusion (2021), and Lyons and Kass-Hanna (2021a), and Melinda Gates Foundation (2021) have considered both financial literacy and digital literacy to measure DFL. In the Indian context, few studies focused on DFL in India (Azeez & Akhtar, 2021; Bansal, 2019; Rajdev et al., 2020), but they adopted the scale of Morgan et al. (2020). So, this tries to identify, measure, and validate the determinants of DFL of the individual users of DFS in the Indian context.

3. Research methods and materials

3.1. Research framework

This descriptive research aims to identify, measure, and validate the determinants of digital financial literacy of DFS users. The correlational investigation is adopted, and primary data is collected using the survey method from the adults who use digital financial services. The target population of the study is digital financial services users in Bangalore, India. The study was conducted in the natural environment and the study environment was not influenced by the researchers. So, it is a non-contrived field study. The study was conducted in one shot from July 2021 to December 2021 and thus it is a cross-sectional study. The sample consists of both male and female respondents belonging to various age generation groups. Financial literacy and digital literacy depend on gender (OECD, 2018) and age (Klapper et al., 2015; Morgan et al., 2020; Rajdev et al., 2020).

3.2. Sample and study procedure

A well-structured questionnaire was prepared and circulated online using google forms with adults who use DFS. An online questionnaire was circulated with 828 adults and 391 questionnaires were filled out by the respondents. Complete information of the questionnaires was checked, and 387 questionnaires had the complete information. The sample size was determined as 384 using Krejcie and Morgon's (1970) formula. Out of 391 questionnaires received, the first 384 questionnaires that have complete information were used for the analysis.

3.3. Measures

This study has measured digital financial literacy by developing a multidimensional scale that is customized to the Indian context. The existing research works conveyed that DFL is a construct that reflects both digital literacy and financial literacy. This research work accepts this view on DFL. Based on the literature survey, it was found that there is no consensus on metrics of DFL. Important metrics of DFL proposed by various researchers (Morgan et al., 2020; Alliance for Financial Inclusion, DFSWG and CEMCWG, 2021; Lyons & Kass-Hanna, 2021b; Melinda Gates Foundation, 2021) are presented below.

The scales presented in Table 1 focused on financial literacy, financial capability, and digital literacy to measure DFL. However, these scales did not consider the quality aspect of DFS. The quality of financial products and services is an essential component of financial inclusion (Alliance of Financial Inclusion, 2016; Ravikumar, 2017). The users, whether they use traditional financial services or digital financial services, look for their quality. The quality of DFS is one of the factors that determine the financial behavior and financial decisions of the users (Alliance of Financial Inclusion, 2016; Ravikumar, 2017). So, this study has considered "Quality" as an explicit subdimension of DFL. Furthermore, theoretical digital financial literacy will not lead to rational financial decision-making. Suppose an individual has a good amount of DFL but does not put his/her theoretical digital financial literacy into action, DFL will not be a complete one. So, the practical application of DFL has been considered as one of the metrics of DFL in this study. Sometimes, there may be some distractions to take a rational financial decision-making. For instance, a non-regulated digital finance company offers credit to the customers at an affordable rate of interest,

Table 1. Existing measures of DFL source: authors Compilation					
	Broader dimensions				
Name of the researcher(s)	considered	Dimensions considered			
Morgan et al. (2020)	Financial literacy and digital	 Knowledge of DFS 			
	literacy	 Awareness of risk associated with DFS 			
		 Knowledge on controlling digital financial risk, and 			
		 Knowledge of consumer rights and issue redressal 			
Lyons and Kass-Hanna (2021b)	Financial literacy and digital literacy	Basic knowledge and skill			
		• Awareness			
		 Practical know-how 			
		 Decision-making and 			
		Self-protection			
Alliance for Financial Inclusion (2021)	Financial literacy, financial capability, and digital literacy	• Nil			
Melinda Gates Foundation (2021)	Financial literacy and digital	• Literacy			
	literacy	• Numeracy			
		• Access			
		• Consumer awareness, and			
		• Design			

but the terms and conditions of the credit are not transparent and there are huge hidden costs. The customer who is good in DFL may also take credit from such a company due to his financial emergency. In this condition, DFL has become a futile literacy. So, self-determination (Zycinska and Januszek, 2021) to apply DFL is essential. It has been documented in the existing research that there is a gender disparity in access to financial services and so, the gendered social norm is considered as a metric in this study (Melinda Gates Foundation, 2021; Ravikumar et al., 2021). Therefore, determination to use DFL is one of the metrics of DFL. Dimensions and subdimensions used in this study to measure DFL are presented in Table 2.

3.4. Construction of items

A questionnaire was prepared which had two sections. Section 1 deals with personal characteristics of the respondents such as gender, age, education, marital status, income, and place of living. Section 2 measured the DFL of the respondents. This section has 47 statements in a 5-point Likert Scale quantified from 1 (Strongly Disagree) to 5 (Strongly Agree) representing 12 dimensions stated in Table 2. Digital knowledge, financial knowledge, knowledge of DFS, awareness of digital financial risk, digital finance risk control, awareness of customer rights, product suitability, product quality, gendered social norm, practical application of knowledge and skill, decision-making, and self-determination are measured using 5, 6, 4, 4, 4, 2, 3, 4, 2, 6, 2, and 5 statements, respectively, in the questionnaire. Detailed descriptions of items of the DFL scale are presented in Table 3.

4. Results

First, the DFL scale and its customization were validated by the experts qualitatively. Three experts participated in qualitative validation. One expert was from behavioral finance, another was from the financial technology area, and the third expert was from the financial education area. Each expert evaluated the DFL scale dimensions, statements representing dimensions, adequacy of statements representing each dimension, and suitability of statements in the Indian context. Experts advised to rewrite a few statements and to increase the numbers of statements that

Table 2. Proposed measures of DFL	
Dimensions considered	Subdimensions considered
Digital Knowledge	 Usage of digital devices Usage of internet banking & mobile banking Online shopping
Financial Knowledge	 Budgeting Savings Impulsive buying Simple and Compound interest
Knowledge of Digital Financial Services	 Awareness of digital payment methods Knowledge on online trading Knowledge on digital lending models Awareness of online insurance
Awareness of Digital Finance Risk	Awareness of online financial risksProtection against online risksSharing of critical information
Digital Finance Risk Control	 Ability to complete the digital transaction Ability to resolve the errors Preference of DFS Error-free and continuous usage of DFS
Knowledge of Customer Right	 Approaching the right forum against digital risk Awareness of ombudsman for digital transactions
Product Suitability	 Suitability of DFS to financial needs Suitability of DFS to financial goals Customized DFS
Product Quality	Cost of DFSTransparencyAvailability of choices
Gendered Social Norm	• The person administering personal finance
Practical Application of Knowledge and Skill	 Management of daily finance The setting of financial goals Ability to choose the right DFS Usage of digital and financial knowledge Satisfaction with DFS transactions
Decision Making	The practice of a positive financial attitudeBehavior in an abnormal financial situation
Self-determination to use the Knowledge and Skill	 Pride Positive behavior Benefits Amotivation

Table 3. Description of items of DFL scale	
Dimension	Item description
Digital Knowledge (DK)	I can conduct online searches using my digital device(s) (Smartphone/PC/Lop top)
	I can send and receive emails on my own
	I shop online
	I use mobile banking
	I use internet banking
Financial Knowledge (FK)	I prepare a budget for my personal finance every month
	I tend to live for today and do not bother much about tomorrow
	I rarely do impulse purchases
	I prefer to spend money rather than to save
	Suppose you have borrowed Rs 1000 at an annual rate of interest of 12%. The monthly interest payable is Rs 10.
	Suppose you receive 8% interest from the bank deposits when the inflation is at 6%. Your effective rate of return (interest) is 6%.
Knowledge of Digital Financial Services (KDFS)	I am aware of digital payment methods such as Phonepe, GPay, Amazon pay, UPI, and so on
	I know about online trading of financial securities
	I know about digital lending methods such as Peer to Peer lending, App-based lending, supply chain finance, and so on.
	Insurance products can be purchased online.
Awareness of Digital Finance Risk (ADFR)	I am aware that I am exposed to various risks such as phishing, and spyware when I perform a digital financial transaction
	I know how to protect myself against risks such as phishing, spyware, and other risks
	I never share my one-time password with anyone.
	I never share username, password, and PIN with anyone.
Digital Finance Risk Control (DFRC)	I initiate and complete digital financial transactions such as digital payments, remittances on my own
	I can resolve errors that happen in a digital financial transaction
	I prefer to use digital financial transactions rather than conventional ones.
	Continuous use of digital financial products and services makes me confident and error-free.
Knowledge of Customer Right (KCR)	I am aware that I can approach the appropriate forum If I become a victim to any digital risk while doing any digital financial transaction.
	I am aware of the existence of the ombudsman scheme for digital transactions in India since 2019.
Product Suitability (PS)	I find digital financial products or services that suit my financial needs
	I find digital financial products or services that facilitate my financial goals.
	Customized digital financial products or services are available in the market.

(Continued)

Table 3. (Continued)				
Dimension	Item description			
Product Quality (PQ)	Digital financial products or services are expensive to maintain.			
	DFSPs charge more fees to provide digital financial services.			
	DFSPs provide all relevant information on DFS.			
	I have a variety of choices of digital financial products and services.			
Gendered Social Norm (GSN)	My spouse handles personal finance. So, I do not much bother about personal financial management.			
	A female member of my family participates in financial decision-making.			
Practical Application of Knowledge and Skill (PAKS)	I manage the day-to-day finances of my home.			
	I set financial goals for my family			
	I can decide on the type of digital financial products or services that helps in the accomplishment of my financial goals.			
	I can choose the right Digital Financial Service Provider (DFSP).			
	I would like to use the best of my financial and digital knowledge and skill while I deal with DFS.			
	I feel satisfied when I initiate and complete the DFS transactions.			
Decision Making (DM)	I would like to practice positive financial behaviors such as responsible borrowing, savings for emergencies, etc.			
	I never borrow money for the abnormal rate of interest even though my situation compels me.			
Self-determination to use the Knowledge and Skill	I deal with digital financial transactions as it is pride.			
(SDMKS)	I prefer digital financial transaction as it provides rewards, incentives, cash back, and other benefits.			
	I use DFS because other people positively see me.			
	I do not want to practice my financial knowledge and skill even though I am aware of the benefits that I derive from practicing them.			
	I do not want to be rational in digital financial transactions even though I do not have a reason for doing so.			

represent few dimensions considered. The changes suggested were incorporated in the DFL scale. Then, a preliminary study was conducted, and Cron Bach's alpha scores were computed for each dimension of the DFL scale and overall DFL scale. Alpha scores computed are presented in Table 4.

Alpha scores were satisfactory ($\alpha > 0.700$) for all dimensions except awareness of digital finance risk which had an alpha score of 0.691 and the overall alpha score for the scale was 0.923. So, the main study was conducted to measure and validate the DFL scale quantitatively.

The main study conducted reveals certain characteristics of the sample population. Female adults are slightly more in the sample population (50.7%) than male adults (49.3%). Generation Z adults (19 years to 24 years) are dominant in the sample with 78.5% followed by Millennials (25 years to 40 years) with 14.8%. Generation X (41 years to 56 years) and baby boomers (more than 56 years) represent 5.3% and 1.4%, respectively, in the sample. Further, the predominant

Table 4. Alpha scores				
Particulars	α Score			
Digital knowledge	0.823			
Financial knowledge	0.716			
Knowledge of digital financial services	0.721			
Awareness of digital finance risk	0.691			
Digital financial risk control	0.792			
Knowledge of consumer right	0.720			
Product suitability	0.837			
Product quality	0.818			
Gender social norm	0.853			
Practical application of knowledge and skill	0.799			
Decision making	0.743			
Self-determination to use the knowledge and skill	0.760			
Digital financial literacy (Overall)	0.923			

Table 5. Descriptive statistics					
Particulars	Mean	Std. deviation	Skewness	Kurtosis	
Gender	1.5072	.50115	029	-2.019	
Age	1.2967	.63400	2.288	4.971	
Education	2.2057	.76634	.666	.411	
Marital status	1.1196	.32529	2.361	3.610	
Annual Income	1.7847	1.15048	1.080	479	
Place of Residence	1.7608	.42764	-1.231	489	
Digital Knowledge	4.4545	.66354	-1.189	.664	
Financial Knowledge	3.0335	.63228	.927	1.585	
Knowledge of DFS	3.7727	.87899	481	085	
Awareness of Financial Risk	4.2261	.63787	939	.926	
Digital Financial Risk Control	3.9294	.82011	584	.225	
Knowledge of Customer Right	3.4833	1.01359	157	288	
Quality	3.4539	.70728	.084	.345	
Practical application	3.2823	.83959	.141	590	
Decision making	3.9282	.83615	250	718	
Determination	3.1292	.86267	.255	.227	
Digital Financial Literacy	3.6693	.53996	.091	.020	

sample of adults are single and reside in an urban area with undergraduate education and income of not exceeding INR 1,00,000. Table 5 exhibits descriptive statistics of the variables considered.

Differences between components of DFL and personal and economic characteristics of the respondents are analysed. No variances exist between components of DFL and gender, marital status, and place of residence of the respondents. However, financial knowledge and practical application of knowledge and skill significantly vary based on age of the respondents. All other components of DFS do not significantly base on age. Mean scores convey that Baby boomers have

Table 6. KMO and bartlett's test				
Kaiser-Meyer-Olkin measure of sam	0.838			
Bartlett's Test of Sphericity	5502.697			
	Significance	0.000		

more financial knowledge and practical application of knowledge and skill. Similarly, financial knowledge and practical application of knowledge and skill significantly vary based on education of the respondents. The respondents who have completed master's degree possess more financial knowledge and practical application of knowledge and skill. Financial knowledge and digital financial risk control differ significantly based on income of the respondents. Financial knowledge is more among the respondents who belong to middle-income group (more than Rs1,00,000, but less than Rs 4,00,000). Digital financial risk control is high among the respondents whose income is lower (Up to Rs 1,00,000 per year).

Among the variables chosen to measure DFL in this study, digital knowledge and financial knowledge may closely relate to knowledge of digital financial services variable. In other words, digital knowledge, financial knowledge, and knowledge of digital financial services have a potential to be autocorrelated. Autocorrelation is statistically checked and measured using Durbin-Watson statistic. Durbin-Watson test identifies and measures autocorrelation in the residuals of regression analysis. Durbin-Watson test statistic ranges from 0 to 4. If Durbin-Watson test statistic is around 2, it indicates that autocorrelation does not exist between the chosen variables. In this study, autocorrelation is checked by Durbin-Watson test in the regression analysis. Durbin-Watson test score for digital knowledge and knowledge of digital financial services is 2.095 and the score for financial knowledge and knowledge of digital financial services is 1.960. So, autocorrelation between these variables does not exist in this study.

"Factor analysis is a multivariate statistical method for data reduction and for determination of common factors through correlations" (Hayton et al., 2004). Exploratory Factor Analysis (EFA) is more appropriate for scale development. EFA has been applied to investigate the inter-correlation of the variables considered and the results are presented here.

Since the KMO test (Table 6) score is 0.838, the data is meritorious for factor analysis. Further, Bartlett's test p-value indicates rejection of the existence of the identity matrix. So, the variables considered are related and are suitable for factor analysis.

In this study, 47 statements of twelve variables are loaded in the factor analysis. The correlation technique is employed to understand the interrelationship among the variables and to find common factors. Twelve factors extracted and their eigenvalues and proportions of variance are presented in Table 7. These twelve factors extracted significantly account for 70.87% of the variance in the scale and all other factors are insignificant. Factor one accounts for 29.62% variance in the scale, the second factor explains 9.09% variance in the scale, and the third factor contributes 5.17% variance.

Generally, Kaiser greater than 1 (K1) criterion and Scree test are used to decide the number of factors that are to be retained in the factor analysis (Hayton et al., 2004). K1 criterion has certain issues and it sometimes overestimates the number of factors (Horn, 1965). Scree test experiences subjectivity and ambiguity (Hayton et al., 2004). Horn's Parallel Analysis (PA) is another method used to determine factors to be retained (Dinno, 2013). PA overcomes the K1 criterion problem of overestimation of factors due to sampling error (Horn, 1965). Horn's parallel analysis helps to decide the number of factors to be retained in principal component analysis in EFA (Dinno, 2013). The parallel analysis uses randomly generated eigenvalues to determine the number of factors to be considered (Cokluk & Kocak, 2016). The parallel analysis provides good results in an accurate

Table 7. Total variance explained by extracted factors					
Component	Eigenvalues	Proportion of variance	Cumulative proportion of variance		
1	13.330	0.2962	0.2962		
2	4.092	0.0909	0.3872		
3	2.326	0.0517	0.4389		
4	2.166	0.0481	0.4870		
5	1.757	0.0368	0.5238		
6	1.697	0.0310	0.5549		
7	1.593	0.0309	0.5858		
8	1.521	0.0293	0.6152		
9	1.512	0.0250	0.6403		
10	1.462	0.0242	0.6646		
11	1.406	0.0222	0.6867		
12	1.357	0.0220	0.7087		

Extraction Method: Principal Component Analysis.

number of factors to be retained (Cokluk & Kocak, 2016). Real eigenvalues are to be compared with random eigenvalues to decide on factor retention. Those factors that have higher real eigenvalues than average random eigenvalues and 95 percentiles of random eigenvalues are retained (Hayton et al., 2004).

According to parallel analysis results (Table 8), 12 components are to be retained out of 47 items in this study as unadjusted (real) eigenvalues of twelve factors are more than average random eigenvalues and 95 percentiles of random eigenvalues. Item loadings are presented in Table 9. Items are entered under the component where they have the highest loading. Items are expressed in terms of their respective codes followed by the statement numbers as per Table 3.

Twelve components extracted are named considering items loaded in the component. Component 1 is termed as "Quality of DFS" because this component is filled with DFS Product Suitability and Product Quality statements. Component 2 is "Knowledge of DFS and Digital

Table 8. Parallel analysis					
Component	Unadjusted data eigenvalues	Average random eigenvalues	95 percentiles of random eigenvalues		
1	13.330	2.0188	2.1369		
2	4.092	1.9059	1.9823		
3	2.326	1.8205	1.8867		
4	2.166	1.7488	1.8097		
5	1.757	1.6814	1.5821		
6	1.697	1.6233	1.2473		
7	1.593	1.5651	1.2389		
8	1.521	1.5130	1.1412		
9	1.512	1.4647	1.0463		
10	1.462	1.4174	0.9821		
11	1.406	1.3712	0.9185		
12	1.357	1.3257	0.9055		

Table 9. Rotated component loading					
C1	C2	С3	C4	С5	C6
PS1 PS2 PS3 PQ4 PAKS6 SDMKS1	KDFS2 KDFS3 KDFS4 PAKS3 PAKS4 KCR2 PQ3	ADFR1 ADFR2 DFRC2 DFRC4 KCR1 SDMKS2	DK1 DK2 DK3 KDFS1	FK1 PAKS1 PAKS2	DK4 DK5 DFRC1 DFRC3
C7	C8	С9	C10	C11	C12
SDMKS3 SDMKS4 SDMKS5	ADFR3 ADFR4	PQ2 PAKS5 DM1	FK2 FK4 GSN1	FK6 PQ1 DM2 GSN2	FK3 FK5

Financial Service Providers (DSPs). Component 3 is named "Awareness of Digital Finance Risk and Risk Control". Component 4 is labeled as "Digital Knowledge". Component 5 is described as "Practical Application of Knowledge and Skill". Component 6 is identified as "Digital-Savvy". Component 7 is classed as "Self-determination to use the knowledge and skill". Component 8 is characterized with "Digital Security Awareness". Component 9 is identified as "Positive Financial Attitude". Component 10 relates to "Gendered Financial Knowledge". Component 11 deals with "Rational Financial Behavior", and Component 12 is termed as "Financial Knowledge".

Reliability values indicate the replicability of the components. Factor determinacy index is a "measure of variance or the correlation of factor score predictor with the corresponding factor (Beauducel & Hilger, 2017)". Factor determinacy value facilitates evaluation of the validity of factor score predictor (Beauducel & Hilger, 2017). Factor determinacy values and reliability values presented in Table 10 for the extracted components are appropriate and good. So, the extracted components are expected to be reliable, and the extracted components contribute to the variance in the corresponding factor. Thus, the extracted twelve components are statistically strong.

New components are identified based on item loadings in EFA, and the final model is built for the measurement of DFL among adults in India. The final model is tested for its goodness-of-fit. Confirmatory Factor Analysis (CFA) is applied to find the goodness-of-fit of the model. The

	Tuble 10. Explained variance and reliability of fotated components						
Component	Variance	Proportion of variance	Reliability	Factor determinacy index			
1	2.954	0.066	0.921	0.960			
2	1.960	0.044	0.870	0.933			
3	4.851	0.108	0.946	0.973			
4	1.335	0.030	0.806	0.898			
5	1.156	0.026	0.780	0.883			
6	2.145	0.048	0.852	0.923			
7	1.757	0.039	0.820	0.905			
8	4.242	0.094	0.897	0.947			
9	4.119	0.092	0.920	0.959			
10	2.881	0.064	0.899	0.948			
11	2.891	0.064	0.898	0.947			
12	1.551	0.034	0.860	0.927			

Table 10. Explained variance and reliability of rotated components

Table 11. Goodness of fit										
	χ²	GFI	RMSEA	AGFI	NFI	CFI	IFI	RFI	PCFI	PNFI
Accepted value	< 5	> 0.90	< 0.10	> 0.80	> 0.90				> 0	.50
Model value	3.26	0.961	0.091	0.921	0.94	0.923	0.941	0.962	0.563	0.513

Goodness-of-fit results (Table 11) indicate an overall acceptable fit of the model. Figure 1 provides a pictorial representation of latent variables and their observed variables.

Thus, Quality of DFS, Knowledge of DFS and Digital Financial Service Providers, Awareness of Digital Finance Risk and Risk Control, Digital Knowledge, Practical Application of Knowledge and Skill, Digital-Savvy, Self-determination to use the knowledge and skill, Digital Security Awareness, Positive Financial Attitude, Gendered Financial Knowledge, Rational Financial Behavior, and Financial Knowledge are the determinants of DFL among the adults in India.

Further, with the twelve standardized factors that measure DFL, this study measured the differences in DFL of the adults based on the personal characteristics of the respondents. Table 12 presents the results (p-values) of the differences measured by the Mann-Whitney test and Kruskal Wallis Test. These tests are applied as the factors are not normally distributed.

Table 12. Differences in determinants of DFL and DFL									
Factors	Condor	A	Education	Marital	Incomo	Place of			
Fuctors	Gender	Age	Education	status	Income	residence			
Quality of DFS	0.455	0.907	0.200	0.890	0.041	0.091			
Knowledge of DFS and DFSPs	0.907	0.272	0.253	0.663	0.505	0.948			
Awareness of DFR and RC	0.069	0.331	0.669	0.820	0.021	0.419			
Digital knowledge	0.090	0.449	0.482	0.283	0.097	0.067			
Practical Application of Knowledge and Skill	0.548	0.001	0.000	0.018	0.389	0.486			
Digital Savvy	0.174	0.207	0.241	0.172	0.042	0.467			
Self-determination	0.971	0.155	0.463	0.936	0.694	0.845			
Digital Security Awareness	0.413	0.175	0.015	0.039	0.548	0.813			
Positive Financial Attitude	0.174	0.350	0.207	0.309	0.038	0.133			
Gendered Financial Knowledge	0.634	0.392	0.075	0.450	0.631	0.736			
Rational Financial Behaviour	0.018	0.067	0.009	0.629	0.568	0.776			
Financial Knowledge	0.753	0.014	0.005	0.655	0.021	0.263			
Digital Financial Literacy	0.126	0.615	0.034	0.294	0.158	0.409			

The level of significance is 0.05.

5. Discussions

This study has measured digital financial literacy of the adults and its determinants. Among the determinants of DFL, rational financial behavior significantly differs based on gender. Female adults possess more rational financial behavior (Mean score: 3.346) than male adults (Mean score: 3.143). This result confirms the result of Rai and Sharma (2019). Financial knowledge and practical application of knowledge and skill significantly vary based on the age of the adults. Mean scores convey that the adults who are aged more than 56 years (Baby boomers) have more

Figure 1. Confirmatory factor analysis: digital financial literacy model.



financial knowledge (Mean score: 4.500) and more practical application of knowledge and skill (Mean score: 4.222) than Generation X, Millennials, and Generation Z adults. Practical application of knowledge and skill, digital security awareness, rational financial behavior, and financial knowledge differ significantly based on education. Adults who have completed master's degrees possess more practical application of knowledge and skill (Mean score: 3.628), digital security awareness (Mean score: 3.726), and rational financial behavior (Mean score: 4.897). Financial knowledge is more among undergraduate qualified adults (Mean score: 3.371). Practical application of knowledge and skill and digital security awareness significantly vary based on the marital status of the adults. Married respondents apply their knowledge and skill more (Mean score: 3.546) and they possess more awareness of digital security (Mean score: 4.900). Quality of DFS, awareness of digital finance risk and risk control, digital savy, positive financial attitude, and

financial knowledge significantly differ based on income. More income (more than Rs 6,00,000), more consciousness for quality of DFS (Mean score: 3.774), awareness of digital finance risk, and risk control (Mean score: 4.250), and digital savvy (Mean score: 3.833). However, financial knowledge is more among those adults who have an annual income of Rs 1,00,001 to 4,00,000 (Mean score: 3.923). All other differences between dimensions of DFL and the personal characteristics of the adults are insignificant. Overall, digital financial literacy differs only according to education. Those who qualified for masters have more DFL than other adults in the sample. Thus, this study measured digital financial literacy among Indian adults and validated the determinants of DFL. Based on the study results, twelve components were identified through EFA, and those components were confirmed using CFA. Further, this study analyzed whether DFL and its determinants vary from adult to adult or not.

6. Conclusions

This study aims at measuring digital financial literacy and its determinants among the adults. As there is no consensus on determinants of DFL in the existing literature and there are limited studies on the measurement of DFL in India. Few researchers identified certain variables such as digital knowledge, financial knowledge, digital finance risk, digital finance risk control, knowledge of consumer rights, decision-making, and self-protection. This study has employed a few additional variables such as knowledge of DFS, quality of DFS, practical application of knowledge and skill, and self-determination to apply knowledge and skill. Forty-seven statements covering 12 variables were measured in the questionnaire. EFA reveals the existence of twelve factors that are named as Quality of DFS, Knowledge of DFS and Digital Financial Service Providers, Awareness of Digital Finance Risk and Risk Control, Digital Knowledge, Practical Application of Knowledge and Skill, Digital-Savvy, Self-determination to use the knowledge and skill, Digital Security Awareness, Positive Financial Attitude, Gendered Financial Knowledge, Rational Financial Behavior, and Financial Knowledge. Further, the results of EFA are confirmed through CFA. So, these twelve factors are determinants of the DFL of adults in India. It is found that the DFL of the adults varies based on education, and no other personal characteristics of the adults account for the variance in DFL.

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Data Availability

The data that support the findings of this study are available from the corresponding author(s) upon reasonable request.

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Appendix Questionnaire						
Section – A (1) Gender	Male	Female				
(2) Age						
19 years to 24 y	/ears					
25 years to 40 y	/ears					
41 years to 56 y	/ears					
More than 56 ye	ears					
(3) Marital status	Married	Single				
(4) Education						
School educatio	n					
Bachelor's degre	26					
Master's degree						
Others						
(5) Annual income						
Up to Rs 1,00,00	00					
Rs 1,00,001 to F	Rs 1,00,001 to Rs 4,00,000					
Rs 4,00,001 to 6	5,00,000					
More than Rs 6,	00,000					
(6) Place of business	Rural	Urban				
(7) I have smartphone	Yes	No				
(8) I have access to interne	et Yes	No				
(9) I own a personal comp or a laptop	uter Yes	No				

Section – B

(10) Choose the most suitable choice given against each statement

SDA - Strongly Disagree, DA - Disagree, N - Neutral, A - Agree, SA - Strongly Agree

Statements	SDA	DA	Ν	Α	SA
I can conduct online searches using my digital device(s) (Smartphone/PC/Lop top)					
I can send and receive emails on my own					
I shop online					
I use mobile banking					
I use internet banking					
I prepare a budget for my personal finance every month					
I tend to live for today and do not bother much about tomorrow					
I rarely do impulse purchases					
I prefer to spend money rather than to save					
Suppose you have borrowed Rs 1000 at an annual rate of interest of 12%. The monthly interest payable is Rs 10.					
Suppose you receive 8% interest from the bank deposits when the inflation is at 6%. Your effective rate of return (interest) is 6%.					
I am aware of digital payment methods such as Phonepe, GPay, Amazon pay, UPI, and so on					
I know about online trading of financial securities					
I know about digital lending methods such as Peer to Peer lending, App-based lending, supply chain finance, and so on.					
Insurance products can be purchased online.					
I am aware that I am exposed to various risks such as phishing, and spyware when I perform a digital financial transaction					
I know how to protect myself against risks such as phishing, spyware, and other risks					
I never share my one-time password with anyone.					
I never share username, password, and PIN with anyone.					
I initiate and complete digital financial transactions such as digital payments, remittances on my own					
I can resolve errors that happen in a digital financial transaction					
I prefer to use digital financial transactions rather than conventional ones.					
Continuous use of digital financial products and services makes me confident and error-free.					
I am aware that I can approach the appropriate forum If I become a victim to any digital risk while doing any digital financial transaction.					
I am aware of the existence of the ombudsman scheme for digital transactions in India since 2019.					
I find digital financial products or services that suit my financial needs					
I find digital financial products or services that facilitate my financial goals.					
Customized digital financial products or services are available in the market.					
Digital financial products or services are expensive to maintain.					
DFSPs charge more fees to provide digital financial services.					
DFSPs provide all relevant information on DFS.					
I have a variety of choices of digital financial products and services.					
My spouse handles personal finance. So, I do not much bother about personal financial management.					

(Continued)

(Continued)					
Statements	SDA	DA	Ν	Α	SA
A female member of my family participates in financial decision-making.					
I manage the day-to-day finances of my home.					
I set financial goals for my family					
I can decide on the type of digital financial products or services that helps in the accomplishment of my financial goals.					
I can choose the right Digital Financial Service Provider (DFSP).					
I would like to use the best of my financial and digital knowledge and skill while I deal with DFS.					
I feel satisfied when I initiate and complete the DFS transactions.					
I would like to practice positive financial behaviors such as responsible borrowing, savings for emergencies, etc.					
I never borrow money for the abnormal rate of interest even though my situation compels me.					
I deal with digital financial transactions as it is pride.					
I prefer digital financial transaction as it provides rewards, incentives, cash back, and other benefits.					
I use DFS because other people positively see me.					
I do not want to practice my financial knowledge and skill even though I am aware of the benefits that I derive from practicing them.					
I do not want to be rational in digital financial transactions even though I do not have a reason for doing so.					

Thank you



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