A STUDY OF FACTORS INFLUENCING ADOPTION AND CONTINUANCE USAGE OF MOBILE APPS FOR SCHOOL LEVEL LEARNING

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by

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Yashdeep Singh

CANDIDATE'S DECLARATION

I, Yashdeep Singh, hereby certify that the work which is being presented in the thesis entitled "A Study of Factors Influencing Adoption and Continuance Usage of Mobile Apps for School Level Learning", in partial fulfillment of the requirements for the award of the Degree of Doctor of Philosophy, submitted in Delhi School of Management, Delhi Technological University is an authentic record of my own work carried out during the period from July, 2018 to December, 2024 under the supervision of Prof. Pradeep Kumar Suri.

The matter presented in the thesis has not been submitted by me for the award of any other degree of this or any other Institute.

Candidate's Signature

This is to certify that the student has incorporated all the corrections suggested by the examiners in the thesis and the statement made by the candidate is correct to the best of our knowledge.

Signature of Supervisor (s)

CERTIFICATE BY THE SUPERVISOR(s)

Certified that **Yashdeep Singh** (2K18/PHDDSM/08) has carried out the research work presented in this thesis entitled **"A Study of Factors Influencing Adoption and Continuance Usage of Mobile Apps for School Level Learning"**, for the award of **Doctor of Philosophy** from Delhi School of Management, Delhi Technological University, Delhi, under my supervision. The thesis embodies results of original work, and studies are carried out by the student himself and the contents of the thesis do not form the basis for the award of any other degree to the candidate or to anybody else from this or any other University/Institution.

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A Study of Factors Influencing Adoption and Continuance Usage of Mobile Apps for School Level Learning

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ABSTRACT

People today are increasingly getting connected by mobile devices and the Internet. They are overwhelmingly accessing data using wireless networks on their laptops, smartphones, and tablet PCs. Mobile devices have penetrated hitherto inaccessible geographical locations and have become gateways to the world of information and services thereby leading to the empowerment of their users. Technological advancements have reduced the cost of mobile devices and the Internet. In addition, millions of mobile applications (apps) are available on popular mobile app stores such as Google Play, and Apple App Store.

Governments across the world are promoting the use of mobile apps. For example, the Digital India Programme (DIP) of the government of India has a Mobile First approach to the delivery of government services. In addition, governments are committed to achieving the Sustainable Development Goals (SDGs) by 2030. The mobile apps facilitate access to quality education for the masses to accomplish the goal no. 4 of the SDGs i.e., "Quality Education." The New Education Policy (NEP) of India suggests that technology interventions such as mobile apps increase access, equity, and inclusion in education. It recommends research studies in emerging digital technologies for teaching-learning such as mobile apps to evaluate the benefits and mitigate the downsides.

Mobile learning is a popular category of apps available on several mobile app stores. Additionally, governments are increasingly encouraging schools to adopt mobile technology to enhance the teaching-learning process. The mSeva AppStore of the government of India has mobile learning as one of the exclusive categories. The Indian Department of Education's mobile learning apps include DIKSHA - for School Education and ePathshala. The mobile learning apps provide learners the flexibility to choose what, when, where, and how they want to learn. The students can access

anytime, and anywhere a variety of learning resources in different formats (e.g., text, audit, video) to enhance their understanding of concepts. The COVID-19 pandemic during the years 2020 and 2021 expedited the adoption of mobile learning by school students and teachers. The education systems worldwide were disrupted, leading to the closure of schools and other learning spaces. The biological disaster highlighted the crucial role of mobile learning apps in ensuring educational continuity during times of crisis.

Several factors influence the mobile learning experience. The factors influencing adoption are considered to be different from the factors influencing continuance. Retaining learners and facilitating their continuance is critical for m-learning providers and educators. The literature suggests that despite the large number of mobile learning apps, the research in this area is still in the nascent stage.

It is in this context that this study attempts to examine the factors influencing the adoption and continuance intention to use mobile apps for school-level learning. This mixed-methods research identified the influential factors through a literature review including bibliometric analysis of the metadata of relevant publications, content and sentiment analysis of the 2000 reviews and ratings of mobile learning apps, and hermeneutic phenomenological analysis of interview transcripts of 24 school students and 09 teachers. Further, the study proposed and empirically tested a research model of the ten identified factors influencing continuance intention through structural equation modeling analysis of the survey data collected from school students of the National Capital Territory, Delhi, India. The study concluded by presenting the key findings, discussing the research objectives, delineating the implications for research and practice, and outlining limitations and future research directions.

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LIST OF ABBREVIATIONS

AVE	Average Variance Extracted
BEEP	Basic Education Equivalency Programme
BYOD	Bring Your Own Device
COVID	Corona Virus Disease
CR	Composite Reliability
DDMA	Delhi Disaster Management Authority
DIKSHA	Digital Infrastructure for Knowledge Sharing
DIP	Digital India Programme
DOI	Diffusion of Innovation
FT	Flow Theory
IS	Information Systems
ISCM	Information Systems Continuance Model
ISSM	Information Systems Success Model
MACE	Mobile learning Adoption and Continuance in Education
MCA	Multiple Correspondence Analysis
M-LMS	Mobile Learning Management System
NCT	National Capital Territory
PHEIC	Public Health Emergency of International Concern
PLS	Partial Least Squares
SDGs	Sustainable Development Goals
SDT	Self Determination Theory
SEM	Structural Equation Modeling
SWAYAM	Study Webs of Active-Learning for Young Aspiring Minds
TAM	Technology Acceptance Model
TCT	Technology Continuance Theory
TPB	Theory of Planned Behavior
TRA	Theory of Reasoned Action
TTF	Task Technology Fit
UNESCO	United Nations Educational, Scientific and Cultural Organization
UTAUT	Unified Theory of Acceptance and Use of Technology
WoS	Web of Science

CHAPTER 1

INTRODUCTION TO THE STUDY

1.1 Overview of the study

This research study examined factors influencing the adoption and continuance of mobile apps for school level learning. The data were collected from multiple sources including metadata of relevant publications, reviews and ratings of mobile learning apps, semi-structured interviews of school students and teachers, and a survey questionnaire of school students. Further, multiple data analysis techniques such as bibliometric analysis, content analysis, sentiment analysis, hermeneutic phenomenological methods, and structural equation modeling analysis have been used in the study. The research work is presented across seven chapters.

This chapter introduces the research study and has been structured as follows: the next section provides a background of the study. Section three describes the motivation for conducting the study. Further, research questions and research objectives are delineated in sections four and five, respectively. The scope of the study is presented in section six. A methodological overview of the study is a subject matter of section seven. The subsequent section describes the organization of the thesis. Further, expected knowledge outcomes and concluding remarks are outlined in the last two sections of the chapter.

1.2 Background of the study

1.2.1. Mobile devices and people

Mobile devices (e.g., laptops, smartphones, tablet PCs) have become ubiquitous and indispensable, and people globally are embracing their potential. The

society world over has been impacted by the mobile device revolution. People today are increasingly getting connected by mobile devices and the Internet. They are gradually becoming dependent on mobile devices (Tian & Wang, 2023). Many people use more than one mobile device. The number of mobile devices operating worldwide is expected to be 18.22 billion by 2025. Further, 8.6 billion mobile phone subscriptions were reported worldwide in 2022, and their penetration is continuously rising (Statista, 2014, 2021, 2023d). As of 2022, three-quarters of the world population aged 10 and over own a mobile phone. In addition, 66% of the world's population is using the Internet. People overwhelmingly access data using wireless networks (World Bank, 2021). The cost of mobile devices and the Internet has also been decreasing at a fast rate. Therefore, such devices have become accessible to a larger section of society. Mobile devices have penetrated hitherto inaccessible geographical locations and have become gateways to the world of information and services thereby leading to the empowerment of their users. People have benefitted from mobile devices in multiple ways. For example, the devices benefitted immensely during the recent coronavirus disease (COVID-19) crisis which severely affected people's lives (e.g., loss of life, income, and savings) (IMF, 2020). On January 30, 2020, the coronavirus outbreak was declared a public health emergency of international concern (PHEIC). The education systems worldwide were disrupted, leading to the closure of schools and other learning spaces. Using mobile devices to deliver online learning content was very effective, especially in developing countries (Fengchun & Wayne, 2021). While enabling cheaper, faster, and easier access to learning sources, these devices ensure continuity of educational delivery during and after a crisis (Baytiyeh, 2019).

1.2.2. Mobile learning applications (m-learning apps)

The mobile devices have several mobile applications (apps). The apps utilize mobile device features (e.g., GPS, camera, QR code scanner) to deliver a unique and personalized experience to users (McLean, 2018). The leading app stores, include Google Play, Apple App Store, Windows Store, and Amazon Appstore. Around 255 billion apps were downloaded worldwide in 2022. Google Play is the largest app store

in the world followed by Apple App Store. The store had 4.67 million available apps at the end of 2021(Statista, 2023b). It has significantly large downloads (110 billion in 2022) due to its availability on a broader range of mobile devices (Statista, 2023a).

The apps have also penetrated the online learning space and have evoked interest among educators and researchers (G. J. Hwang, Lai, Liang, Chu, & Tsai, 2018; Lai, 2020). The learning app is a popular category in the mobile app stores. The apps make learning "personalized, contextualized, and not hindered by temporal or environmental constraints" (Crompton, 2015), and enhance the learning process (Diacopoulos & Crompton, 2020) through the use of diverse media formats such as audio, video, text, and picture (Shih & Mills, 2007). Therefore, learners have the flexibility to choose what, when, where, and how they want to learn (Alrasheedi, Capretz, & Raza, 2015). The apps make learning an engaging experience. The researchers expect these apps to become more popular, personal, and social in the next ten years (Krull & Duart, 2017). The learner's journey of using these apps is influenced by several considerations such as the type and specifications of the mobile device (e.g., memory, battery life, screen size), access to affordable quality Internet, distractions from learning, and availability of suitable apps (Kaliisa, Palmer, & Miller, 2019).

1.2.3. Technology adoption and continuance

Technology adoption and continuance have emerged as separate streams of research. Technology adoption refers to the acceptance or the first use of an emerging technology or product (Salahshour Rad, Nilashi, & Mohamed Dahlan, 2018). However, continuance intention describes the user's decision to continue using the technology. The success of a technology depends on its continued use (Bhattacherjee, 2001a). The users may not continue using the technology after initial acceptance (Yan, Filieri, & Gorton, 2021). Retaining learners and facilitating their continuance is critical for m-learning providers and educators (S. Yang, Zhou, & Cheng, 2019). M-learning app adoption and continuance is an active area of research and has gained enormous interest among researchers, especially during the COVID-

19 period (Alhumaid, Habes, & Salloum, 2021; Almaiah et al., 2022; Alzaidi & Shehawy, 2022; Matzavela & Alepis, 2021).

1.3. Motivation of the Study

The research work is inspired by India's New Education Policy 2020. According to the policy, learning should be holistic, integrated, enjoyable, and engaging. The policy provides a comprehensive framework for different levels of education and a new paradigm of Internet-based e-learning (K. Kumar, Prakash, & Singh, 2021). It suggests the development of fun-based learning and student-appropriate tools such as mobile apps to enrich the teaching-learning process. Further, it advocates that universal high-quality education is one of the best ways to develop a country's rich talents. Technology interventions such as mobile apps increase access, equity, and inclusion in education. Further, the policy recommends research studies in emerging digital technologies for teaching-learning such as mobile apps to evaluate the benefits and mitigate the downsides (GoI, 2020).

Another source of motivation for this study is the views of the former President of India, the Late Dr. A. P. J. Abdul Kalam that the future of the nation depends on the quality of education imparted. According to Dr. Kalam, education should make learning more interesting and effective through the use of technology. He suggested innovative teaching methods instead of traditional ones. Further, education should be imparted based on the aspirations of the society (Hazarika & Dutta, 2021).

Through mobile learning apps, governments across the world seek to provide access to quality education to the masses. "Quality Education" is goal no. 4 of Sustainable Development Goals (SDGs) to be achieved by 2030. The governments have unanimously agreed on SDGs, which are issues being faced by society globally and requiring urgent attention. This research intends to inquire into the process of adoption and continuance usage of mobile apps for school level learning, thereby developing a better understanding of the factors influencing the process.

1.4. Research questions

The research questions indicate the specific goals of the research. This research work is guided by the following research questions -

RQ1: What are the major themes, and theoretical frameworks in the literature on mobile learning adoption and continuance in education?

RQ2: How do users describe their experiences of using mobile apps for the public and private sector, and higher education and school level learning through reviews and ratings on mobile app stores?

RQ3: What are the 'lived experiences' of using mobile apps for school level learning?

RQ4: How do the insights of an analysis of app reviews and ratings, and 'lived experiences' contribute to an enhanced understanding of factors influencing continuance intention to use mobile apps for school level learning?

RQ5: How a research model can be developed and validated to explain the continuance intention to use mobile apps for school level learning?

1.5. Research objectives

The study addresses the research questions through the following research objectives -

RO1: To analyze the existing literature on m-learning adoption and continuance in the field of education.

RO2: To examine the reviews and ratings of mobile apps for public and private sector, and higher education and school level learning.

RO3: To examine the 'lived experiences' of using mobile apps for school level learning.

RO4: To conceptualize and empirically test a model for continuance intention to use mobile apps for school level learning.

1.6. Scope of the study

The focus of this study is on examining the factors influencing the adoption and continuance usage of mobile apps for school-level learning. The metadata of the relevant publications has been extracted from the Web of Science database. Further, highly downloaded, rated, and most reviewed apps have been considered representative of m-learning apps. Two apps each in the public and private sectors with one app each in school and higher education have been taken to bring out the nuances of m-learning for school students. Further, the students and teachers of schools in the National Capital Territory (NCT), Delhi, India have been taken as representatives of users of mobile apps for school-level learning. The empirical testing and validation of the conceptualized model is limited to the data collected from school students of NCT, Delhi.

1.7. Methodological overview

This study used qualitative and quantitative methods during a multi-year study. Some of the research tools employed are bibliometric analysis, content analysis, hermeneutic phenomenology, and structural equation modeling. A brief description of the research methodologies adopted at different phases of the study is as under:

Bibliometric analysis: Bibliometrics provides systematic, transparent, reproducible, objective, and reliable analyses of literature in a research area (Broadus, 1987). It offers unique opportunities to contribute to theory and practice (Mukherjee, Lim, Kumar, & Donthu, 2022). The metadata for bibliometric analysis of the existing literature on m-learning adoption and continuance in education was obtained from the

Web of Science core collection database. The main bibliographic research methods used in the study include co-authorship analysis, co-citation analysis, conceptual structure map, keyword analysis, source analysis, and thematic map. The analysis was performed using "biblioshiny: the shiny app for bibliometrix" (an R-tool for comprehensive science mapping analysis).

Content analysis and sentiment analysis: Content analysis is a research technique for systematic and replicable examination of the texts (or other meaningful matter). The study analyzed 2000 reviews and ratings of four highly rated, downloaded, and reviewed m-learning apps on the Google Play store. Two apps each in the public and private sectors with one app each in school and higher education were selected for the study. The content analysis was performed by creating a coding scheme that included instructions for coding, a description of each theme, and a scoring rubric. The m-learning app reviews were coded to the identified sub-themes and statistical methods were used to analyze the relationships among the sub-themes. Further, sentiment analysis was used to identify users' attitudes, and emotions toward m-learning apps. Each review was classified as depicting positive, negative, or neutral sentiment. Additionally, the emotions in the reviews were classified as "joy," "sadness," "anger," "fear," "trust," "disgust," "surprise," and "anticipation" (PLUTCHIK, 1980).

Hermeneutic phenomenology: Phenomenology focuses on illuminating details and seemingly trivial aspects within the experience that may be taken for granted in our lives to create meaning and achieve a sense of understanding (Wilson & Hutchinson, 1991). The study described the 'lived experiences' of using mobile apps for school level learning. An in-depth investigation was conducted through semi-structured interviews of school students and teachers. The interviews were transcribed verbatim and interpreted through the "hermeneutic circle" and "fusion of horizons."

Structural equation modeling analysis: Structural equation modeling (SEM) is a multivariate data analysis method for analyzing complex relationships among constructs and indicators (Hair et al., 2021). The research variables of the study were

identified and a model of continuance intention to use the m-learning apps was proposed. The data to test and validate the proposed research model was collected through a paper-based survey questionnaire. Further, the analysis was performed in the SmartPLS 4 software for partial least squares structural equation modeling.

1.8. Organization of the thesis

The thesis is organized into seven chapters (see Figure 1.1). An overview of these chapters is as follows:

Chapter One introduces this research work by describing the study's background. In addition, it provides motivation, purpose, and scope of the study. Further, the chapter presents an overview of the research methodology and concludes with a discussion about the study's expected knowledge outcomes.

Chapter Two is the literature review. An extensive analysis of the existing research studies has been carried out. The chapter describes the status of publications and delineates influential articles, authors, countries, institutions, research areas, and journals in the area of m-learning adoption and continuance in education. Further, the research trends and themes have been discussed. Lastly, the chapter lists the research gaps.

Chapter Three deals with an empirical study using data from four highly rated, downloaded and reviewed mobile learning apps. The data was extracted from the Google Play store and analyzed using quantitative content analysis, sentiment analysis, and statistical analysis.

Chapter Four is the exploratory study. It describes the m-learning 'lived experience' of school students and teachers. In addition, it lists factors influencing m-learning app continuance by analyzing transcribed semi-structured interviews through hermeneutic phenomenological techniques.

Chapter Five is related to the research approach. It describes the research variables, conceptual research framework, research hypotheses, and research methodology.

Chapter Six is about the empirical study of primary data collected from school students. Structural equation modeling analysis was employed to capture the relationships among the factors influencing m-learning continuance.

Chapter Seven synthesizes the learnings and concludes the study through triangulation. In addition, the chapter discusses theoretical and managerial implications, limitations, and future research directions.

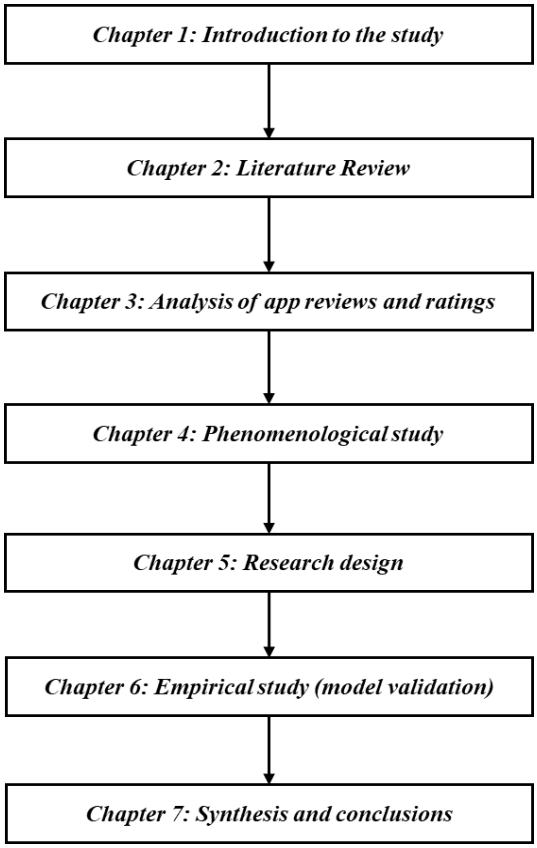

Figure 1. 1 Structure of the thesis

1.9. Expected knowledge outcomes

This research examines the factors influencing the adoption and continuance of mobile apps for school level learning. Some expected knowledge outcomes of the study are as follows:

- The research is expected to provide a comprehensive understanding of the continuance intention to use mobile apps for school level learning. The study has used qualitative methods for in-depth understanding and quantitative methods for empirically testing the relationships among the factors.

- The extensive review of the existing literature on m-learning adoption and continuance can reveal many interesting insights regarding intellectual structures, trends, themes, and future research directions.

- The study extends prior literature and empirically tests and validates a model for m-learning continuance. In addition, the existing theories and factors have been adapted for the study's context.

- The study examines m-learning in the context of school level learning. The product managers of the apps can use the findings of this research to bring about qualitative changes in how mobile apps for school level learning are designed and implemented.

1.10. Concluding remarks

Mobile learning apps have become an integral part of students' lives. The apps utilize anytime and anywhere affordances to deliver quality learning resources to school students. This chapter has discussed the background of the research work, motivation to conduct the study, research objectives, research questions, methodology, the scope of work, and expected knowledge outcomes. Moreover, the study addresses the research objectives through a combination of qualitative and quantitative methods

including bibliometric analysis, content analysis, sentiment analysis, hermeneutic phenomenology, structural equation modeling, and other relevant statistical analysis.

The next chapter will present a review of the literature related to the research areas of mobile learning, and technology adoption and continuance. The chapter will also present a bibliometric review of the literature related to mobile learning adoption and continuance in education. Further, the chapter identifies research gaps that are attempted to be addressed by this research work.

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction

This chapter synthesizes the previous work in the research area of the study. The structure of the chapter is as follows: the next section describes mobile learning. The phenomenon of technology adoption and continuance is a subject matter of section three. Further, a bibliometric review of m-learning adoption and continuance literature is provided in the fourth section. The subsequent section gives details about the mobile apps for school-level learning. The sixth section delineates the identified research gaps. Lastly, concluding remarks are provided in section seven.

2.2. Mobile learning (M-learning)

The researchers have examined several technology tools that assist students and teachers in their learning process. The most common tools include electronic learning (e-learning), mobile learning (m-learning), and digital learning (d-learning). Although the terms are closely related to each other, there are several differences. D-learning is any type of learning that is facilitated by technology, whereas e-learning involves web-based learning. The technology-facilitated learning enhances the learning experience through a wide spectrum of tools such as online and formative assessments, blended learning, and online content and courses (Chitkushev, Vodenska, & Zlateva, 2014). Further, m-learning is derived from e-learning, which in turn is derived from d-learning (Kumar Basak, Wotto, & Bélanger, 2018). E-learning is formal and collaborative. However, m-learning is mostly informal and situated learning (Ozuorcun & Tabak, 2012). Although m-learning is considered an extension of e-learning, it has its own terminology (e.g., spontaneous, intimate, situated) (Korucu & Alkan, 2011). Further, learning with the Internet using different devices in

synchronous or asynchronous environments is referred to as “online learning” (Dhawan, 2020).

M-learning refers to the “use of mobile and handheld IT devices such as Personal Digital Assistants (PDAs), mobile telephones, laptops, and tablet PC technologies in teaching and learning” (Alsaadat, 2017). It is a form of e-learning that uses mobile devices to integrate with ubiquitous computing technologies for the teaching-learning process (Y. M. Cheng, 2015). It implies the delivery of learning through wireless Internet and mobile devices (Y. S. Wang, Wu, & Wang, 2009). According to (Crompton, 2015), M-learning involves “learning across multiple contexts, through social and content interactions, using personal electronic devices.” Such learning can be self, or others-directed, academic or non-academic, planned or unplanned, physical or virtual.

M-learning is an important trend in educational technology research (Lai, 2020). The interest of researchers in m-learning has substantially increased during the recent COVID-19 pandemic (Matzavela & Alepis, 2021). The research community has examined this growing field of m-learning with various research topics and methods (Krull & Duart, 2017). It offers new opportunities to students as it enables contingent, situated, authentic, context-aware, and personalized learning (Traxler & Wishart, 2011). Further, Diacopoulos and Crompton (2020) in their study argued that m-learning enhances teaching and learning. In addition, convenient, anytime, and anywhere learning provided by mobile devices facilitates communication, collaboration, and creativity among students (B. A. Kumar & Chand, 2019). Contextualized and personalized learning enhances students’ achievements (Crompton, Burke, & Gregory, 2017). M-learning enhances students’ field trips and fieldwork experiences through increased interaction, collaboration, and engagement (Diacopoulos & Crompton, 2020). It allows the learners to convert their dead time while in transit to productive activity. However, the flexibility of learning anytime and anywhere may lead to interaction and information overload (Motiwalla, 2007). M-learning is a relatively new tool that allows students to access learning contents (e.g.,

learning materials, tests, dictionaries) and conduct personalized curriculum sequencing according to their learning needs (Y. M. Cheng, 2015). The mobile technology is constantly upgraded with new features and applications. It allows adaptive assistance and instant social interaction platforms (Lai, 2020).

2.2.1. Education levels and mobile learning

The levels of education can be broadly categorized as follows: 1) Early childhood care and education; 2) Primary education; 3) Lower Secondary education; 4) Upper secondary education; 5) Higher education (UNESCO, 2013). For this study, school-level education refers to primary, lower secondary, and upper secondary levels. Globally, the governments increasingly aim at universal basic education, which includes primary and lower secondary levels. At the primary level, the learning needs are diverse, demanding flexible teaching-learning strategies. Pedagogical skills specific to different subjects and a high level of knowledge are needed at the secondary level. Further, higher education level seeks advanced knowledge and skills (UNESCO, 2013). The learning styles differ between school and higher education levels. Learners at the school level seek a clear explanation of theories and apply their learning to practical issues. In contrast, learners at higher education levels prefer to explore multiple perspectives and have a functional and experiential learning approach (Matthews & Hamby, 1995). Therefore, the expectations of learners vary with the level of education.

Many studies have examined m-learning for higher education. M-learning apps are promising pedagogical technologies in higher education (Al-Emran, Elsherif, & Shaalan, 2016), leading to increased student learning (Crompton & Burke, 2018). However, they are still at an experimental stage and are being used in limited ways (Kaliisa et al., 2019). (Krull & Duart, 2017) proposed that specific learning experiences utilizing m-learning benefits need to be designed and integrated into the learning process by the faculty. Further, they observed that higher education students often use more than one mobile device to access learning apps. A study of

undergraduate students found that although mobile devices are useful in completing academic tasks, they can be a distraction in achieving learning goals (Tossell, Kortum, Shepard, Rahmati, & Zhong, 2015). Regarding school education, m-learning benefits seem to be limited by the rules that prohibit mobile devices during instructional hours (M. Liu et al., 2014). However, schools that provide mobile devices to students contribute to enhanced learning and reduced socio-educational inequities (Ferrer, Belvís, & Pmies, 2011; W. Y. Hwang & Chen, 2013).

2.2.2. Public and private sector services and apps

People use apps on mobile devices for several aspects of their personal and professional lives. These apps may be owned by the government (public sector) or private companies (private sector). As people use private sector services, they develop similar public sector expectations and vice versa (Gay & Salaman, 1992; Joseph, 2019). Further, Caemmerer and Dewar (2013) found that the service expectations and perceptions are different for both sectors. They argued that the private sector usually overpromises its products and services through marketing communication, whereas politicians' rhetoric and different stakeholder agendas may mislead people regarding the public sector.

Additionally, there are numerous and diverse competing objectives in the public sector. The assessment criteria for aim attainment are not well defined. Further, the public sector organizations are highly interdependent. Other public sector traits include incongruent managerial philosophies, constrained budgets, socio-economic variables, and political processes (e.g., elections) influenced by public opinion. These factors may potentially restrict the public sector from providing useful, trustworthy, and quality services (Joseph, 2019; Kanat & Özkan, 2009; Ward & Mitchell, 2004). In another study on healthcare services, (Alumran, Almutawa, Alzain, Althumairi, & Khalid, 2021) found the private sector's perceived quality to be better than the public and observed the non-profit nature of the public sector might reduce the focus on quality. Further, people's expectations of public services may be low in developing

countries with relatively immature social welfare systems as these services are provided virtually for free (Rhee Seung-Kyu & Rha, 2009). Additionally, the public sector has lower perceived service quality than the private sector, as it does not effectively manage factors influencing quality perception (Kangis & Voukelatos, 1997). However, these perceptions of the low quality of public sector services are not supported by an in-depth analysis. (Poister & Henry, 2014) concluded in their study that people don't tend to rate the quality of public-sector services as better or worse than private-sector services. It is not always clear to people whether a service is of the public or private sector; therefore, it is difficult to distinguish between them (Hvidman & Andersen, 2016). Nevertheless, an increasing number of government-funded programs are being implemented to supplement learning by leveraging mobile technology such as apps (G. J. Hwang et al., 2018; Lai, 2020). The private sector is also offering several mobile learning apps.

2.3. Technology adoption and continuance

Technology adoption and continuance have emerged as separate streams of research. Technology adoption refers to the acceptance or the first use of an emerging technology or product (Salahshour Rad et al., 2018). However, Continuance intention describes the user's decision to continue using the technology. The success of a technology depends on its continued use (Bhattacherjee, 2001a). Technology continuance refers to post-adoptive IT usage. It describes behavioral patterns reflecting continued use (Nabavi, Taghavi-Fard, Hanafizadeh, & Taghva, 2016). The users may not continue using the technology after initial acceptance (Yan et al., 2021). Retaining learners and facilitating their continuance is critical for m-learning providers and educators (S. Yang et al., 2019). M-learning adoption and continuance is an active area of research and has gained enormous interest among researchers during the COVID-19 period (Alhumaid et al., 2021; Almaiah et al., 2022; Alzaidi & Shehawy, 2022; Matzavela & Alepis, 2021). There is no specific model to examine m-learning adoption and continuance. The researchers mostly use generic technology adoption models (Salahshour Rad et al., 2018). The popular theoretical frameworks include a)

diffusion of innovation (DOI), b) flow theory (FT), c) information systems continuance model (ISCM), d) information systems success model (ISSM), e) social cognitive theory (SCT), f) task technology fit (TTF), g) technology acceptance model (TAM), h) technology continuance theory (TCT), i) theory of planned behavior (TPB), j) theory of reasoned action (TRA), k) unified theory of acceptance and use of technology (UTAUT) (B. A. Kumar & Chand, 2019; Xu, Ge, Wang, & Skare, 2021; Yan et al., 2021). Further, the researchers have proposed several theoretical constructs impacting continuance intention to use information systems (IS). These include cognitive involvement, affective involvement, habit, perceived flexibility, self-management of learning, perceived value, personal innovativeness, image, critical mass, negative critical incident, experience, flow, hedonic value, trust, enjoyment (Chang, 2013; Chen, Yen, & Hwang, 2012; Franque, Oliveira, Tam, & Santini, 2021; R. T. Huang, Hsiao, Tang, & Lien, 2014; Lin, 2011; Lu, 2014; Pereira & Tam, 2021; Y. T. Wang & Lin, 2021; S. Yang et al., 2019). The popular theories of technology adoption and continuance are described below.

2.3.1. Diffusion of innovation (DOI)

Diffusion is defined as the process by which an innovation is communicated through certain channels over time among members of a social system (Rogers, 1995). The DOI theory posits that the adoption of an innovation is influenced by the following five factors: relative advantage, complexity, compatibility, trialability, and observability. Relative advantage is the degree to which an innovation is perceived as being better than the idea it supersedes. Further, compatibility refers to the degree to which an innovation fits with the existing values, past experiences, and needs of potential adopters. Moreover, complexity is the degree to which an innovation is perceived as difficult to understand and use. Trialability is the degree to which an innovation may be experimented with on a limited basis. Further, observability is the degree to which the results of an innovation are visible to the adopters.

Roger's work has been considerably used by information systems researchers to examine adoption by users. In addition, some studies applied DOI to analyze m-learning adoption. A study in South Korea used DOI theory to examine m-learning adoption and indicated that the students did not adopt the m-learning system due to its complexity (Han & Han, 2014). Another study indicated that relative advantage significantly impacts behavioral intention to use m-learning (H. J. Kim, Lee, & Rha, 2017).

2.3.2. Flow theory (FT)

Flow theory considers flow a "holistic sensation that people have when they act with total involvement" (M. S. Davis & Csikszentmihalyi, 1977). The nine elements of flow include challenge-skill balance, action-awareness merging, clear goals, unambiguous feedback, concentration on the task at hand, sense of control, loss of self-consciousness, transformation of time, and an autotelic experience (Beard, 2015). It is a promising theory for understanding IS use behavior (Knierim, Rissler, Dorner, Maedche, & Weinhardt, 2017). A study integrated IS success model, network externalities (Katz & Shapiro, 1985), and flow theory to examine the continuance intention of mobile social networking services (Gao & Bai, 2014). Another study proposed an integrated flow framework and analyzed online learners' continuance intention (Guo, Xiao, Van Toorn, Lai, & Seo, 2016).

2.3.3. Information Systems Continuance Model (ISCM)

(Bhattacherjee, 2001a) integrated Expectation Confirmation Theory (ECT)(Oliver, 1980) of marketing area into IS literature to theorize the IS Continuance Model (ISCM). According to ISCM, satisfaction, and perceived usefulness predicts continuance usage. Further, confirmation and perceived usefulness are determinants of satisfaction. An extended model predicted continuance behavior and added the constructs of IT self-efficacy and facilitating conditions (Bhattacherjee, Perols, & Sanford, 2008). Further, a unified model of IT continuance integrated the perspectives

of reasoned action, experiential response, and habitual response into the original ISCM and added subjective norm and habit constructs to the continuance model (Bhattacherjee & Lin, 2015).

2.3.4. Information Systems Success Model(ISSM)

(DeLone & McLean, 1992) proposed information systems success model (ISSM). The model posits six dimensions of IS success: 1) system quality,2) information quality, 3) use, 4) user satisfaction, 5) individual impact, and 6) organizational impact. It was reviewed and updated to include dimensions of service quality, intention to use, and net benefits. Individual impact and organizational impact were collapsed into net benefits (DeLone & McLean, 2003). Numerous empirical studies have examined the model (Petter & McLean, 2009). TAM and ISSM were integrated to analyze the user intention toward e-learning (Mohammadi, 2015a). Another study examined an e-learning system at a public University in Italy through the IS success model (Efiloğlu Kurt, 2019). Further, (Almaiah, Jalil, & Man, 2016) used the model to perform an empirical investigation of the m-learning system.

2.3.5. Social Cognitive Theory (SCT)

The social cognitive theory postulates that environment, cognitive factors, and behavior are reciprocally determined (Bandura, 1986). SCT is a widely researched theory of human behavior. According to the theory, the individual's behavior is guided by outcome expectations (perceived likely consequences of one's behavior), self-efficacy (beliefs about one's ability to perform a particular behavior), goals, and self-evaluations of progress (Denler, Walters, & Denzon, 2009). A recent study integrated SCT and TAM to examine students' acceptance of m-learning (Almogren & Aljammaz, 2022).

2.3.6. Task Technology Fit (TTF)

Task Technology Fit theory has been widely applied in information systems (IS) research (Khan et al., 2018). The theory recognizes that technologies must be utilized and fit the task they support to have a performance impact. Further, TTF is determined by the interaction between task requirements, individual abilities, and functionality of technology (Goodhue & Thompson, 1995). TTF influences a student's attitude toward m-learning (Tu, Hwang, Chen, & Lai, 2021). Further, a recent study among Malaysian students revealed that TTF is a significant predictor of behavioral intention to use m-learning (Al-rahmi et al., 2021).

2.3.7. Technology acceptance model (TAM)

The Technology Acceptance Model of Davis (1989) has become a prevalent model among the researchers of information systems (Granić & Marangunić, 2019). It proposes that perceived ease of use, perceived usefulness, attitude toward use, and behavioral intention will predict the actual usage of technology. The theory has been adapted from the Theory of Reasoned Action (TRA)(Fishbein & Ajzen, 1975) and has undergone several changes through TAM2 and TAM3 (Holden & Karsh, 2010; Venkatesh & Bala, 2008; Venkatesh & Davis, 2000). Several studies have extended the model by adding external variables and factors from other theories/models to examine m-learning (Al-Emran, Mezhuyev, & Kamaludin, 2018). A study proposed a two-stage model drawn from TAM and Expectation Confirmation Theory (ECT) to examine school students' continued use of learning management systems (LMSs)(M. Cheng & Yuen, 2018). Another research integrated TAM and Social Support Theory to examine determinants of continuance intention for massive open online courses (MOOCs) among learners in Taiwan (J. Y. Hsu, Chen, & Ting, 2018).

2.3.8. Technology continuance theory (TCT)

Liao, Palvia, and Chen (2009) integrated TAM, Expectation Confirmation Model (ECM), and Cognitive Model (COG), and proposed Technology Continuance Theory (TCT). According to TCT, continuance intention is determined by satisfaction, attitude, and perceived usefulness. However, the direct effect of perceived usefulness on continuance intention is significant only during the initial adoption of technology. In addition, satisfaction is determined by confirmation and perceived usefulness. The effect of perceived usefulness on satisfaction is significant only for short-term users. Further, the antecedents of attitude are perceived usefulness, perceived ease of use, and satisfaction. Additionally, perceived usefulness is determined by confirmation and perceived ease of use. Rahi, Khan, and Alghizzawi (2021) extended TCT with Task Technology Fit (TTF) theory to examine the continuance usage of Internet banking services. Another study extended TCT to explain travelers' continuance intention to use travel apps (Foroughi, Sitthisirinan, Iranmanesh, Nikbin, & Ghobakhloo, 2023)

2.3.9. Theory of Planned Behaviour (TPB)

The Theory of Planned Behaviour extends TRA and postulates three determinants of intention: attitude toward the behavior, subjective norm, and perceived behavior control (Ajzen, 1991). It is one of the most applied social and behavioral sciences theories and has been used in diverse areas, including mobile learning (Bosnjak, Ajzen, & Schmidt, 2020; E. W. L. Cheng, 2019). Further, Taylor and Todd (1995) suggested decomposing the belief structures of these determinants for improved understanding. Hsu and Chiu (2004) examined the continuance intention of web-based tax filing services through a Decomposed Theory of Planned Behaviour (DTPB). A study extended TPB by adding the construct of perceived value and explained the continuance behavior of people toward Facebook, a social networking site (Al-Debei, Al-Lozi, & Papazafeiropoulou, 2013). Another study investigated mobile data service continuance by combining TPB and ECT (Kim, 2010). Recently,

(Wu & Song, 2021) applied TPB to examine older adults' online shopping continuance behavior.

2.3.10. Theory of reasoned action (TRA)

The Theory of reasoned action (Ajzen & Fishbein, 1980) has been widely used by researchers in several domains including information systems. It is a relatively simple model that predicts and explains user behavior quite well (Sheppard, Hartwick, & Warshaw, 1988). The theory posits that behavioral intention is determined by attitude towards behavior and subjective norms. In addition, attitude toward a behavior is influenced by an individual's beliefs and evaluation of the consequences of performing (or not performing) a behavior. Further, an individual's normative beliefs and motivation to comply influence subjective norms. According to the theory, behavioral intention is an immediate antecedent of actual behavior. (Althunibat, 2015) examined student's intention to use m-learning through several theories including TRA. A recent study extended TRA to examine m-learning adoption during the COVID-19 pandemic (Ebardo & Suarez, 2023).

2.3.11. Unified theory of acceptance and use of technology (UTAUT)

The Unified Theory of Acceptance and Use of Technology (UTAUT) posits that performance expectancy, effort expectancy, social influence, and facilitating conditions are direct predictors of behavioral intention and behavior. Further, gender, age, experience, and voluntariness of use moderate these constructs (Venkatesh, Morris, Davis, & Davis, 2003). The model was extended (UTAUT2) to include hedonic motivation, price value, and habit (Venkatesh, Thong, & Xu, 2012). (Dwivedi, Rana, Jeyaraj, Clement, & Williams, 2019) indicated that UTAUT and its extension UTAUT2 have been widely used to examine information systems usage intention and behavior. They reviewed the UTAUT literature and suggested the inclusion of attitude in the revised UTAUT model. A study integrated UTAUT and Uses and Gratification Theory (UGT) to explain behavioral intention to use m-learning

(Thongsri, Shen, Bao, & Alharbi, 2018). UTAUT and TAM were combined to analyze continuance intention toward online learning (Liu & Pu, 2020).

2.4. Bibliometric review of m-learning adoption and continuance in education (MACE)

A bibliometric review was conducted to analyze the existing literature on m-learning adoption and continuance in education (MACE). The data for the review were collected from the Web of Science (WoS) Core Collection. The database indicated 151,768 documents related to mobile technologies. The search query was refined to include only research pertaining to adoption and continuance. The following query was executed on August 21, 2022, to obtain 4,109 documents:

> ((TI=((m-learning OR mobile learning OR mobile device OR laptop OR smartphone OR personal digital assistant OR PDA OR personal electronic device OR PED OR mobile phone OR mobile telephone OR tab* OR mobile technology OR mobile app* OR mobile software) AND (adopt* OR accept* OR usage OR success OR ((intention OR behaviour) AND (continue OR continuance OR use))))) OR KP=((m-learning OR mobile learning OR mobile device OR laptop OR smartphone OR personal digital assistant OR PDA OR personal electronic device OR PED OR mobile phone OR mobile telephone OR tab* OR mobile technology OR mobile app* OR mobile software) AND (adopt* OR accept* OR usage OR success OR ((intention OR behaviour) AND (continue OR continuance OR use))))) OR AK=((m-learning OR mobile learning OR mobile device OR laptop OR smartphone OR personal digital assistant OR PDA OR personal electronic device OR PED OR mobile phone OR mobile telephone OR tab* OR mobile technology OR mobile app* OR mobile software) AND

(adopt* OR accept* OR usage OR success OR ((intention OR behaviour) AND (continue OR continuance OR use))))

The research area filter of "Education Educational Research" provided by the WoS database was applied to the search query results to obtain 264 documents. Further, seven records categorized as book chapters, proceeding papers, correction, meeting abstracts, and retraction documents were excluded from the study. Only high-quality peer-reviewed research work i.e., articles (review or original) were included (Karakose, Papadakis, Tülübaş, & Polat, 2022). Next, the title and abstract of the documents were examined to exclude 102 records that were not directly related to the topic or were duplicates. Finally, the metadata of 155 documents was extracted for analysis. The data included abstract, authors, citations, keywords, publication year, and title of articles. A timeframe was not specified in the search/extraction. The records till the date of execution of the search query were included. The final records were from 2006 to 2022. The metadata of the publications was exported from the WoS database as plain text and imported into "biblioshiny: the shiny app for bibliometrix" (an R-tool for comprehensive science mapping analysis) (Aria & Cuccurullo, 2017).

Further, the research trends were examined using "Keywords Plus" keywords. In addition, the Author keyword frequencies were analyzed to determine the most popular keywords. The WoS dataset records have two types of keywords i.e., Keywords Plus, and Author keywords. The Keywords Plus terms are extracted from titles of cited references by automatic computer algorithms and provide an in-depth understanding of the article's content. In contrast, Author keywords are terms that authors believe represent the content of their paper. The researchers have used Keyword Plus terms to identify research trends (Yi, Ao, & Ho, 2008; Zhang et al., 2016).

Further, a Word Cloud of the Author keywords was created to examine the most frequently used keywords visually. Terms related to the search string, e.g., "mobile learning," "adoption," and "intention," were removed from the Word Cloud

to enhance comprehensibility. Further, synonyms, e.g., “value,” “perceived value,” and “perceived mobile value,” were treated as one term for calculating the frequency to develop an unambiguous understanding of the importance of terms. Accordingly, lists of terms to be removed and synonyms were uploaded to biblioshiny while preparing the Word Cloud. The lists were prepared by examining all Author keywords. Additionally, Author keywords were grouped manually into the following categories: a) theory/model/framework, b) methodology, c) factor, d) subject, e) country, and f) associated keywords. The grouping enhances the effectiveness of thematic analysis (Karakose et al., 2022).

Next, bibliometric techniques of network analysis were performed. The thematic maps of Keyword Plus terms were created. The thematic maps or strategic diagrams plot themes into two-dimensional space based on their centrality and density rank values. Density represents the strength of the relationship between keywords within a theme, and centrality indicates the external relationships of the themes (Karakose et al., 2022). The themes or clusters of keywords are obtained through co-word analysis. The median and mean values of the two parameters of themes i.e., density and centrality are used for the classification of themes into four groups namely, motor, niche, emerging or declining, and basic (Cobo, López-Herrera, Herrera-Viedma, & Herrera, 2011; Mostafa, 2022). The themes are placed in four quadrants of the diagram. The upper right quadrant comprises strong centrality and high-density “motor” themes. These themes are well developed and most important for the research field. The upper left quadrant indicates highly developed and isolated “niche” themes. The niche themes are very specialized and peripheral. Further, the themes of the lower left quadrant have low density and centrality and are emerging or declining themes. The “basic” themes which are important for a research field but are not well developed are placed in the lower right quadrant.

Subsequently, multiple correspondence analysis (MCA) was performed to create a two-dimensional conceptual map of Keyword Plus terms. It was used for dimensionality reduction to identify underlying structures in the dataset (Huh, 2021).

K-means clustering was used to identify keywords that express common concepts (Aria & Cuccurullo, 2017). The conceptual structure breaks down a research domain into clear “knowledge clusters” (Wetzstein, Feisel, Hartmann, & Benton, 2019). The keywords which are more similar in distribution are closely represented on the map.

The findings of the analysis of the metadata of relevant publications in the area of m-learning adoption and continuance in education are presented below.

2.4.1. Status of publications of MACE research

The 155 publications of MACE research were spread across the years from 2006 to 2022 with an annual growth rate of 18%. Fig. 2.1 shows that annual publications substantially increased to 23 articles in 2021 from 01 in 2006. Since 2018, the researchers have produced at least 14 publications each year. The results indicate growing interest among researchers in examining MACE. However, MACE research is merely 0.1% (n=155/151,768) of the work in the field of mobile technologies. Further, only 4% (n= 155/4109) of the m-learning adoption and continuance studies are in the area of education. A recent study in China examined m-learning continuance intention (Yang, 2024).

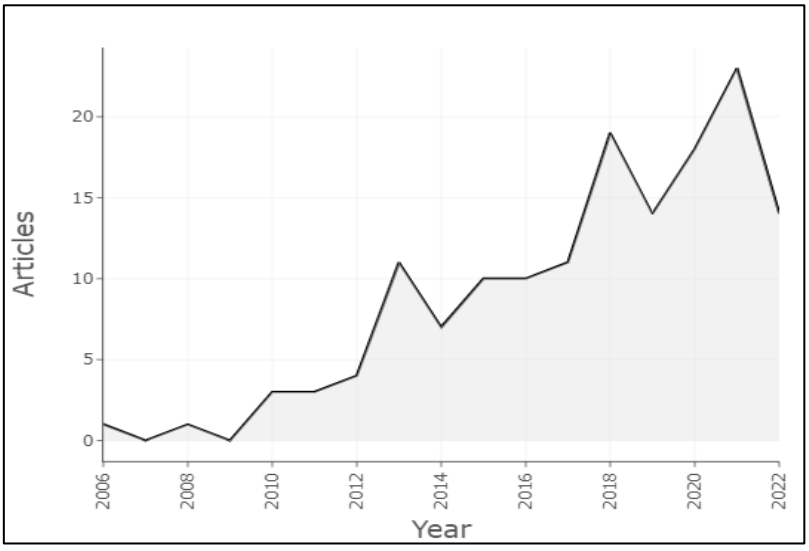

Figure 2. 1 Annual scientific production of MACE research

2.4.2. Influential journals of MACE research

46% (n= 71/155) of the research studies were published by four journals, namely: *Education and Information Technologies, Computers & Education, Journal of Educational Computing Research, International Review of Research in Open and Distributed Learning* (Fig. 2.2). The distribution of publications seems to follow Bradford's law of diminishing returns and scattering, which claims that there are a few very productive periodicals for a given subject area (Nash-Stewart, Kruesi, & del Mar, 2012). The publications for three of the four journals have steadily increased over time. Interestingly, the growth has been exponential for *Education and Information Technologies*, which has published all 31 articles during the last five years (i.e., since 2018). The findings hint that in recent years, MACE has been one of the focus areas of the journal. A recent article published in the journal examined the acceptance of an open-source, collaborative, and free m-learning app (Mascret, Marlin, Laisney, Castéra, & Brandt-Pomares, 2023). Further, *Computers & Education* is the most cited journal (1488 citations) with a 14 h-index (Table 2.1). The journal contributed 38% (n = 1488/3930) of the citations and 16% (n=17/108) of the documents of the top 9 journals.

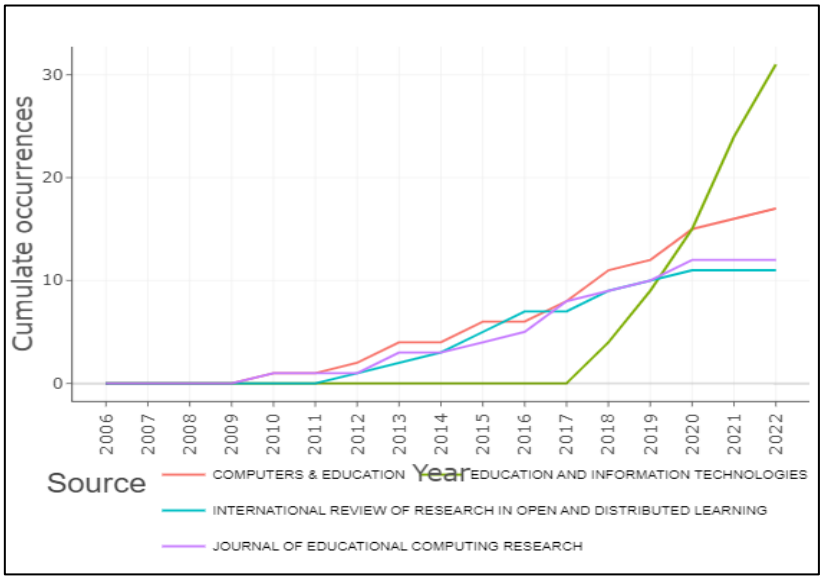

Figure 2. 2 Publication of top 4 sources of MACE research

Table 2. 1 Top nine journals with the most publications of MACE research

Sl. no.	Journal	Documents	Citations	*h*-index
1	Education and Information Technologies	31	451	13
2	Computers & Education	17	1488	14
3	Journal of Educational Computing Research	12	271	8
4	International Review of Research in Open and Distributed Learning	11	432	9
5	British Journal of Educational Technology	8	524	7
6	Educational technology research and development	8	213	5
7	Interactive Learning Environments	8	93	4
8	Australasian Journal of Educational Technology	7	299	6
9	Educational Technology & Society	6	159	4

2.4.3. Influential articles of MACE research

The most influential articles are in Table 2.2. The top two most cited articles were published in 2012. The total citations of these articles in all the research areas were 442 and 336. Additionally, these articles by first authors Jongpil Cheon and Sung Youl Park were also the most cited publications in the research area of MACE. However, the Local citations/Total citations (LC/TC) ratios of these articles were less than 12%. Interestingly, only one article among the top 10 had an LC/TC ratio of more than 20%. The results indicate that the articles are widely cited in other research areas. Further, five out of ten articles with the most citations were published in *Computers & Education.* Only one of the highly cited research works is a review-based study. The review study of the first author Mostafa Al-Emran was published in 2018. Further, yearly average citations peaked in 2012 and have been steadily increasing since 2014 (Fig. 2.3).

Table 2. 2 The ten articles with the highest citations of MACE research

Rank	Document title	TC	TC Per year	LC	LC/TC Ratio %
1	An investigation of mobile learning readiness in higher education based on the theory of planned behavior	442	40.18	40	9.05

Continued on page no. 29

Table 2.2 (continued)

2	University students' behavioral intention to use mobile learning: Evaluating the technology acceptance model	336	30.55	39	11.61
3	Factors driving the adoption of m-learning: An empirical study.	264	20.31	24	9.09
4	Technology Acceptance Model in M-learning context: A systematic review	147	29.4	9	6.12
5	Factors influencing students' acceptance of m-learning: An investigation in higher education	146	14.6	15	10.27
6	Mobile-based assessment: Investigating the factors that influence behavioral intention to use	134	22.33	10	7.46
7	Perceived convenience in an extended technology acceptance model: Mobile technology and English learning for college students.	115	10.45	14	12.17
8	Usage of a mobile social learning platform with virtual badges in a primary school	103	12.88	2	1.94
9	Schools going mobile: A study of the adoption of mobile handheld technologies in western Australian independent schools	99	9.9	4	4.04
10	M-learning adoption: A perspective from a developing country.	92	8.36	20	21.74

Note: TC - Total citations received by an article from documents indexed in WoS, LC - Citations received by an article from the documents included in the collection

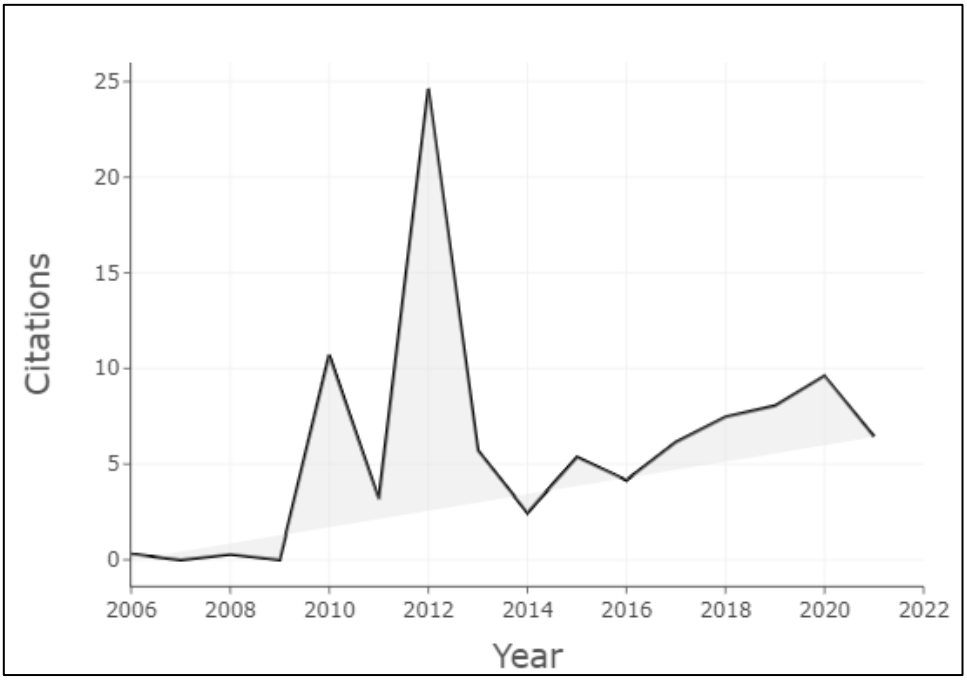

Figure 2. 3 Average citations per year of MACE research

Further, an analysis of the references of the MACE research articles indicated that the research works of Fred D. Davis and Viswanath Venkatesh were the most cited references. The theoretical contributions of these two authors include the Technology acceptance model (TAM) and the Unified theory of acceptance and use of technology (UTAUT). The Word Cloud of the Author keywords also indicated the popularity of these two theories (Fig. 2.5). Other highly cited theories were M. Fishbein and I. Ajzen's theory of reasoned action (TRA), and Icek Ajzen's Theory of planned behavior (TPB).

Interestingly, an article evaluating structural equation models was also among the top 3 cited references (Table 2.3). The findings indicate that the statistical technique of structural equation modeling (SEM) is popular among MACE researchers. Further, the co-citation network of sources indicated that *Computers & Education*, *MIS Quarterly*, *Computers in Human Behavior*, and *British Journal of Educational Technology (BJET)* were the most cited journals (Fig. 2.4).

Table 2. 3 Top nine most cited references of MACE research

Rank	**Document title**	**Citations**
1	Perceived usefulness, perceived ease of use, and user acceptance of information technology	93
2	User acceptance of information technology: Toward a unified view	72
3	Evaluating Structural Equation Models with Unobservable Variables and Measurement Error.	59
4	User Acceptance of Computer Technology: A Comparison of Two Theoretical Models	47
5	Theoretical extension of the Technology Acceptance Model: Four longitudinal field studies. Management Science	46
6	Investigating the determinants and age and gender differences in the acceptance of mobile learning	46
7	An investigation of mobile learning readiness in higher education based on the theory of planned behavior	40
8	University students' behavioral intention to use mobile learning: Evaluating the technology acceptance model	39
9	The theory of planned behavior. Organizational Behavior and Human Decision Processes	38
10	Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research, Reading	28

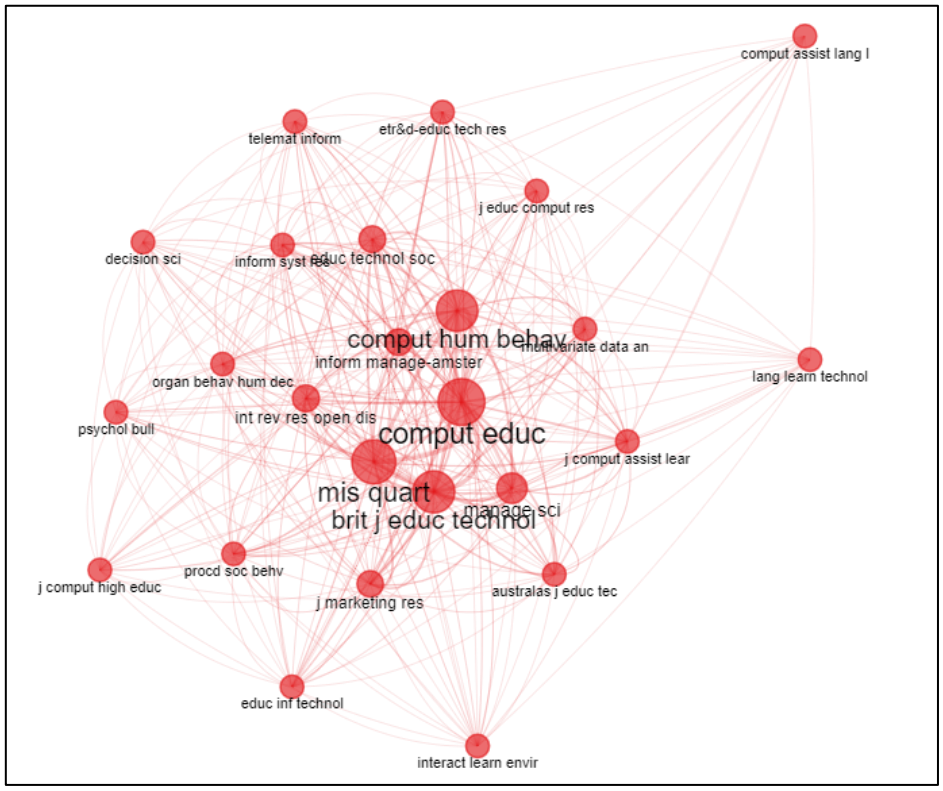

Figure 2. 4 Co-citation network of the sources of MACE research

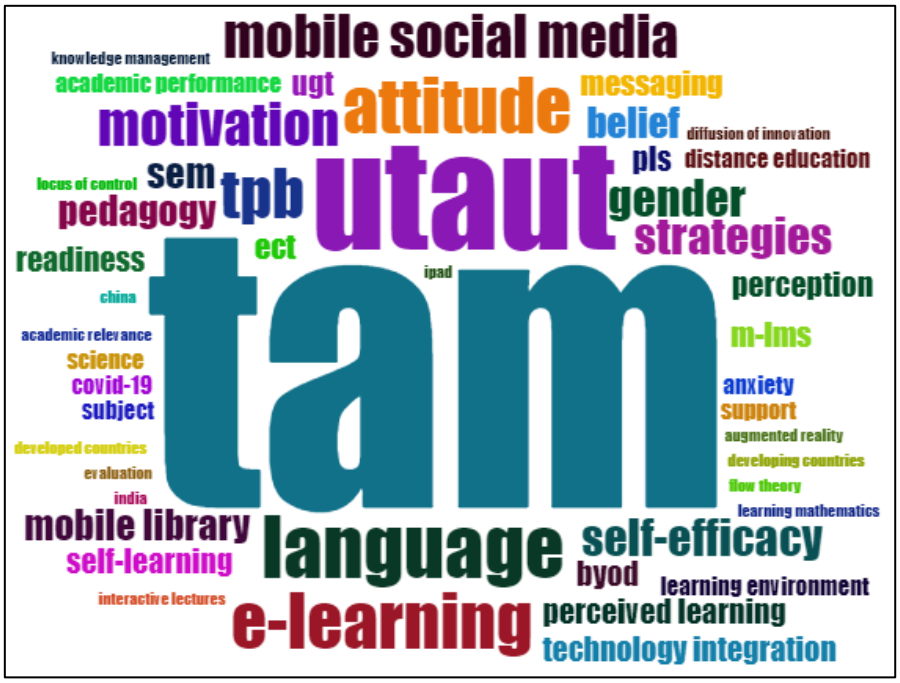

Figure 2. 5 Word Cloud of author keywords of MACE research

2.4.4. Influential authors of MACE research

23% (n=36/155) of the articles were written by 11 authors (Table 2.4). The most productive authors were Mostafa Al-Emran, Shakeel Iqbal, and Yi-Shun Wang. All of them have published four articles each. However, Shakeel Iqbal has the most articles fractionalized. He has collaborated with Zeeshan Ahmed Bhatti in three of his four articles. Further, Mostafa Al-Emran has the highest citations. Four authors published all their articles during the period 2017 – 2021. Two authors (Chi-Cheng Chang, and Chi-Fang Yan) had their last publication in 2013. Interestingly, all authors (except Sung Youl Park) of the top three cited articles have contributed only one article in the area of study. Sung Youl Park has authored two articles. Shakeel Iqbal has consistently contributed to literature since 2012. Further, two authors (Adzhar Kamaludin, and Vitaliy Mezhuyev) have published all their three articles together. The collaboration network of the authors is presented in Fig. 2.6. Recently, a study examined the usage and efficacy of m-learning among school students (Repetto et al., 2023). Two out of six authors of the article (i.e., Daniela Villani, and Giuseppe Riva) have published together three articles in the MACE research area.

Table 2. 4 Top 11 authors of MACE research with the most publications

Author	**Year (20XX)**										**TA**	**AF**	**TC**
	12	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**			
Mostafa Al-Emran							2		1	1	4	1.33	209
Shakeel Iqbal	1			1		1			1		4	2.00	149
Yi-Shun Wang						1		1	1	1	4	1.03	28
Vimala Balakrishnan			1		1	1					3	1.50	36
Zeeshan Ahmed Bhatti				1		1			1		3	1.50	57
Chi-Cheng Chang	1	2									3	0.83	169
Chin Lay Gan			1		1	1					3	1.50	36
Adzhar Kamaludin							2			1	3	1.00	171
Vitaliy Mezhuyev							2			1	3	1.00	171
Mohamed Sarrab					1	1	1				3	1.00	77
Chi-Fang Yan	1	2									3	0.83	169

TA: Total number of articles of authors, AF: Articles fractionalized, TC: Total citations

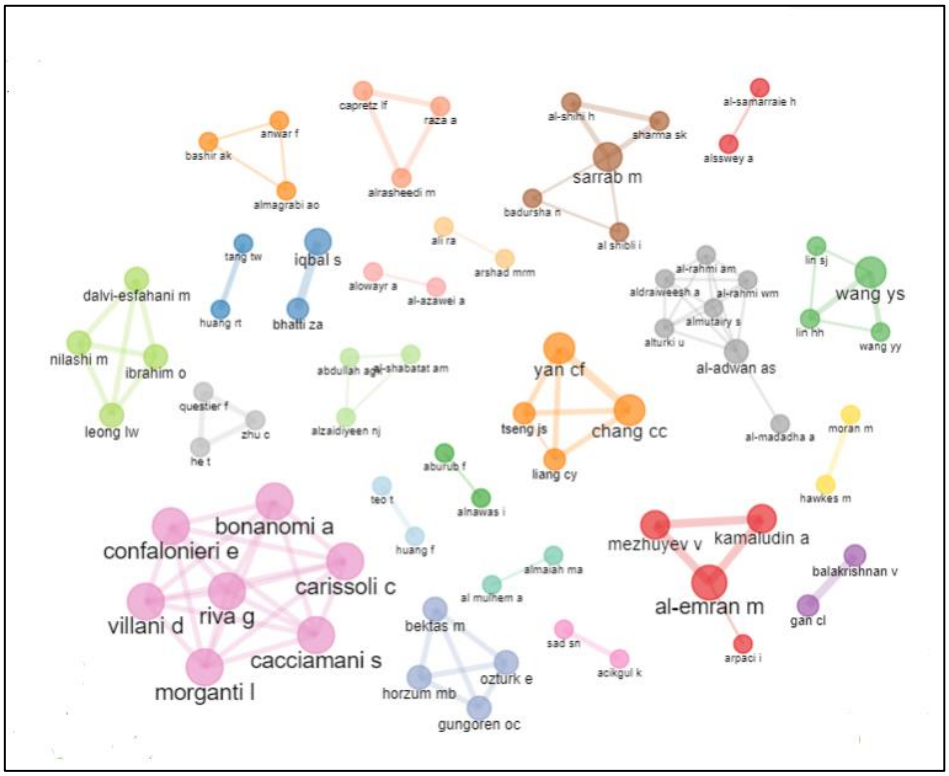

Figure 2. 6 Author collaboration network of MACE research

2.4.5. Influential countries of MACE research

Fig. 2.7 depicts a collaboration network of countries revealing a close association among the countries: China and USA; Saudi Arabia and Pakistan; Pakistan and the United Kingdom; the USA and Korea. Further, China has collaborated with the maximum number of countries (n = 11). It is also the largest producer of articles (n=65), followed by Turkey (n=28) and the USA (n=27). Interestingly, Italy produced all 14 articles in 2018. Additionally, production increased by more than 100% in China and Turkey from 2019 to 2022 (Fig 2.8). The latest Chinese study examined m-learning cyber-loafing (i.e., use of mobile devices for non-academic related tasks) among students (Dang, Kwan, Zhang, & Wu, 2024).

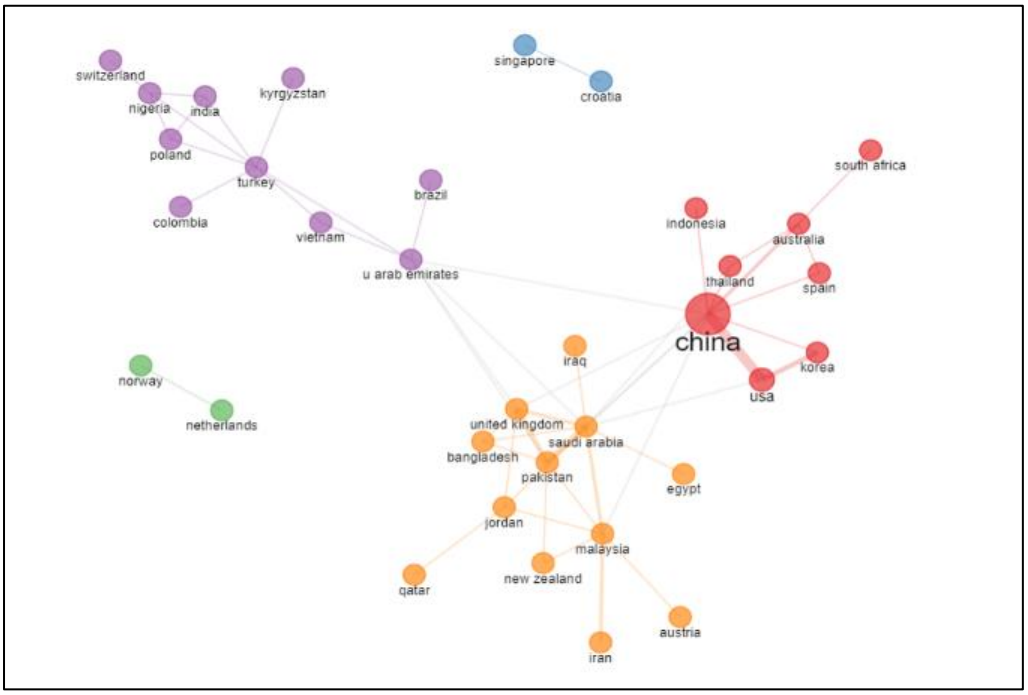

Figure 2. 7 Collaboration network of countries of MACE research

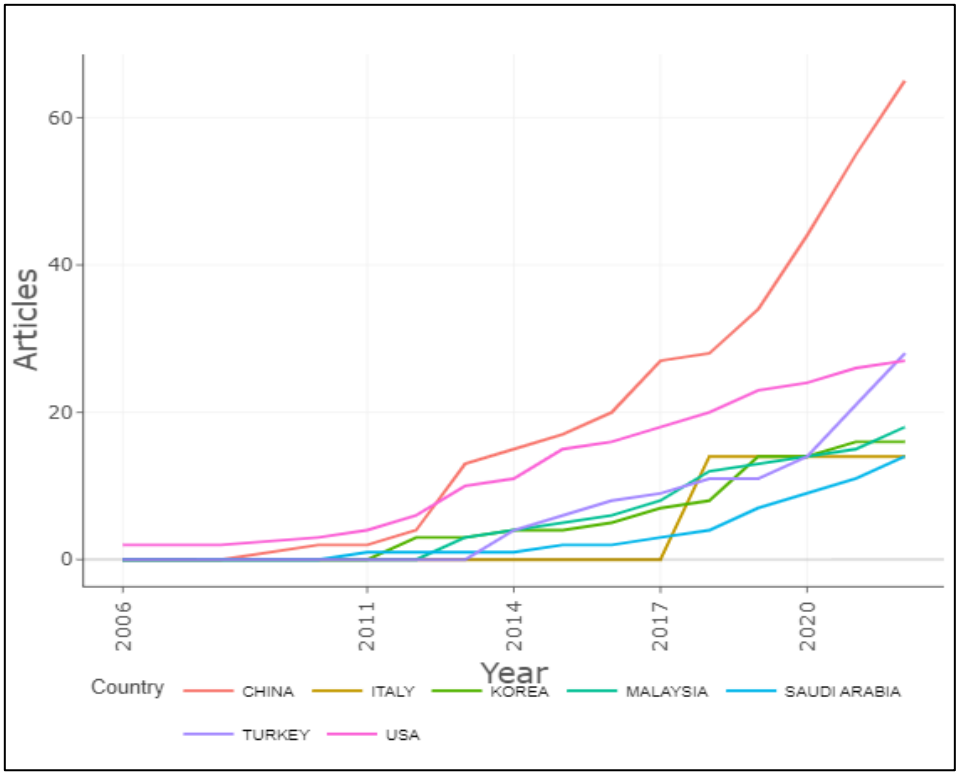

Figure 2. 8 Production of top 7 countries of MACE research over time

2.4.6. Keyword trends of MACE research

The Author's keywords analysis revealed that researchers had used 18 theories/models/frameworks to examine MACE. TAM (including its extensions) is the most frequently mentioned model. The keywords divulge that the studies have investigated 47 factors influencing MACE. Further, it seems that SEM is the most frequently used technique for analysis. SEM is flexible and brings psychometric and econometric theory together in a unified manner, and is being increasingly used for theory building and model testing (Fornell & Larcker, 1981a). Interestingly, only three academic subjects: language, mathematics, and science were used as keywords. The research in m-learning has mostly focused on "science" (Fu & Hwang, 2018). In addition, m-learning studies usually do not specify subjects (Mascret et al., 2023). Further, nine countries, including China, India, Oman, and Saudi Arabia were indicated. Moreover, the results hint at several associated keywords such as e-learning, mobile social media, strategies, mobile library, mobile learning management system (m-lms), bring your own device (BYOD), messaging, and technology integration (Fig. 2.10). A recent study suggested training of students in healthy use of social media (Sánchez-Fernández & Borda-Mas, 2023)

Further, the Keywords Plus trend from 2006 to 2022 indicated a higher frequency of "adoption" and "intention" as compared to "continuance intention" and "usage" (Fig. 2.9). Additionally, "continuance intention" was stagnant during the period from 2016 to 2020. However, the frequency of the keyword has doubled since 2020. The results indicate that m-learning adoption has been examined more than continuance (Nabavi et al., 2016). It may be because m-learning is a relatively new field of study (Crompton, Burke, Gregory, & Gräbe, 2016). Additionally, continuance is a post-adoption stage. Further, the prevalence of "perceptions," "self-efficacy," and "motivation" has rapidly increased since 2019. In addition, "self-determination theory" has become more prominent since 2020. SDT focuses on how people become self-motivated based on their perceptions of the surrounding environment (Deci & Ryan, 1985). A recent study examined the influence of motivation on m-learning

acceptance (Yeh, Wang, Wang, & Liao, 2023). Further, the results indicate an incremental growth in "satisfaction." Several studies report a positive influence of "satisfaction" on continuance intention (Yan et al., 2021).

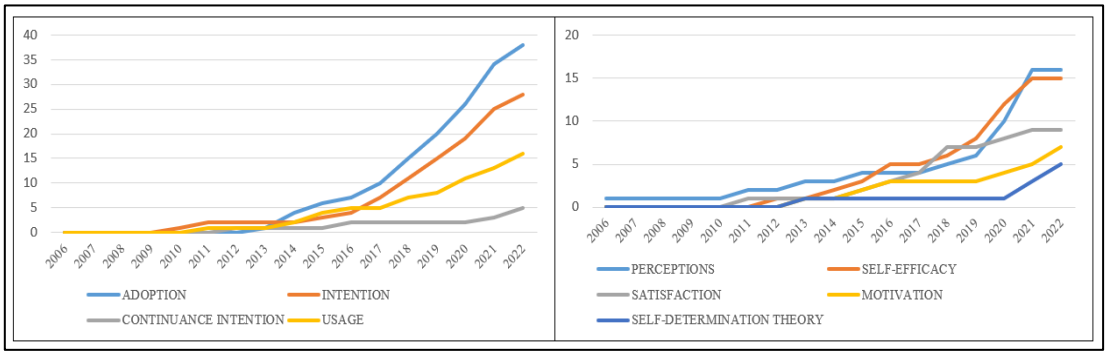

Figure 2. 9 Select keyword trends (keyword plus) of MACE research

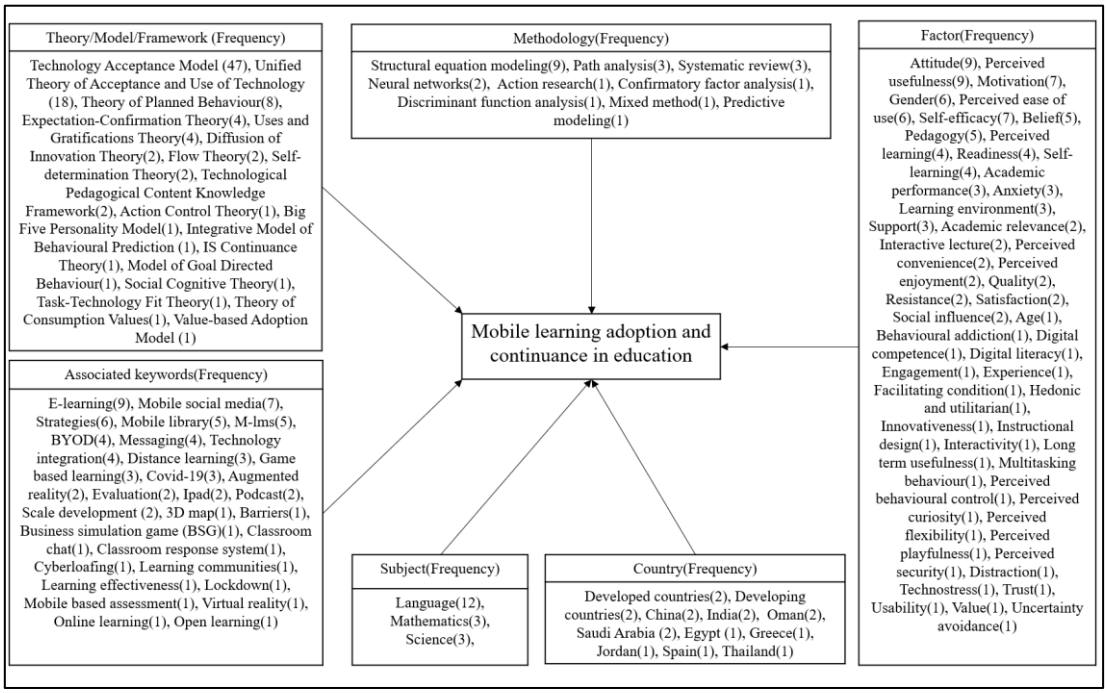

Figure 2. 10 Author keyword categorization of MACE research

2.4.7. Major themes of MACE research

Fig. 2.11 is a thematic map of “Keyword Plus” keywords (Cobo et al., 2011). The keywords in clusters 1,2,3 and 4 were partially or entirely categorized as basic themes. Basic themes are transversal and general. They are important for a research field but not well developed. Further, motor themes comprise keywords from clusters 2,3 and 5. These keywords represent themes that are well-developed and important for this study’s research area. Most of cluster 5 and all keywords of clusters 7 and 8 were categorized as Niche themes (well-developed and isolated). Furthermore, keywords of cluster 6 and some keywords of clusters 4 and 5 were weakly developed and marginal (emerging or declining themes). Interestingly, most keywords belonged to the basic themes. Many clusters were overlapping. Therefore, the keywords representing themes in clusters were analyzed alongside the Author keyword frequencies in Fig. 2.10. The results indicate that the keywords: “impact,” “academic performance,” “lectures,” and “self-regulation” are emerging or declining areas in MACE research. Further, niche research themes include literacy and skills. Literacy is a common domain in m-learning research (Crompton et al., 2017). The themes represented by keywords attitude, gender, motivation, perceived ease, self-efficacy, structural equation models, and technology acceptance model are important and well-developed in MACE research. Moreover, addiction, barriers, engagement, innovativeness, satisfaction, and usability represent important but not well-developed themes in MACE.

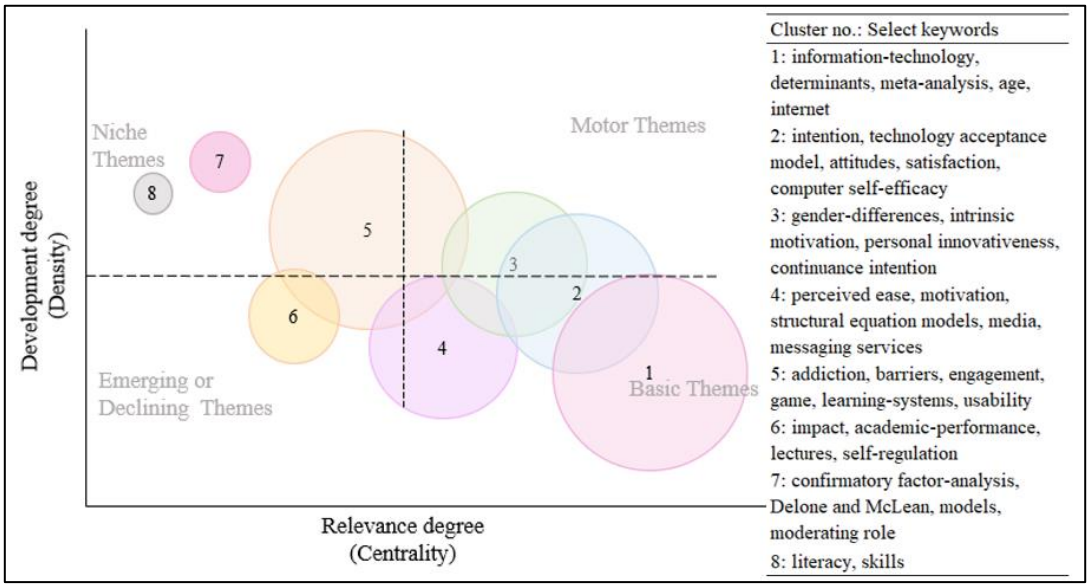

Figure 2. 11 Thematic map (Keyword Plus) of MACE research

2.4.8. Major conceptual structures of MACE research

The conceptual structure map revealed two clusters of keywords (Fig. 2.12). The two dimensions after reduction using MCA account for roughly 40% of the total variability. Clusters represent discriminating profiles (Mostafa, 2022). The blue cluster is on the positive side of both dimensions. It appears to deal with post-adoption and includes keywords such as “continuance intention,” “experience,” and “impact.” “Self-determination theory,” “structural equation models,” and “English” are also part of this cluster. The red cluster is larger and comprises keywords spread across all four map quadrants. The cluster seems to deal with the m-learning adoption ecosystem. The keywords of this cluster on the positive side of dimension 1 seem to deal with factors and models and comprise keywords such as “determinants,” “age,” “motivation,” “behavior,” “unified model,” “acceptance model,” “tam,” “extension,” “perceptions,” “system,” “services” and “model.” Additionally, the keywords on the negative side appear to deal with facilitating conditions and social influence and comprise keywords such as “students,” “University,” “teachers,” “system,” “technologies,” and “devices.” The map reveals that “continuance intention” and “intention” are different constructs

as “intention” is on the negative side and “continuance intention” is on the positive side of both dimensions.

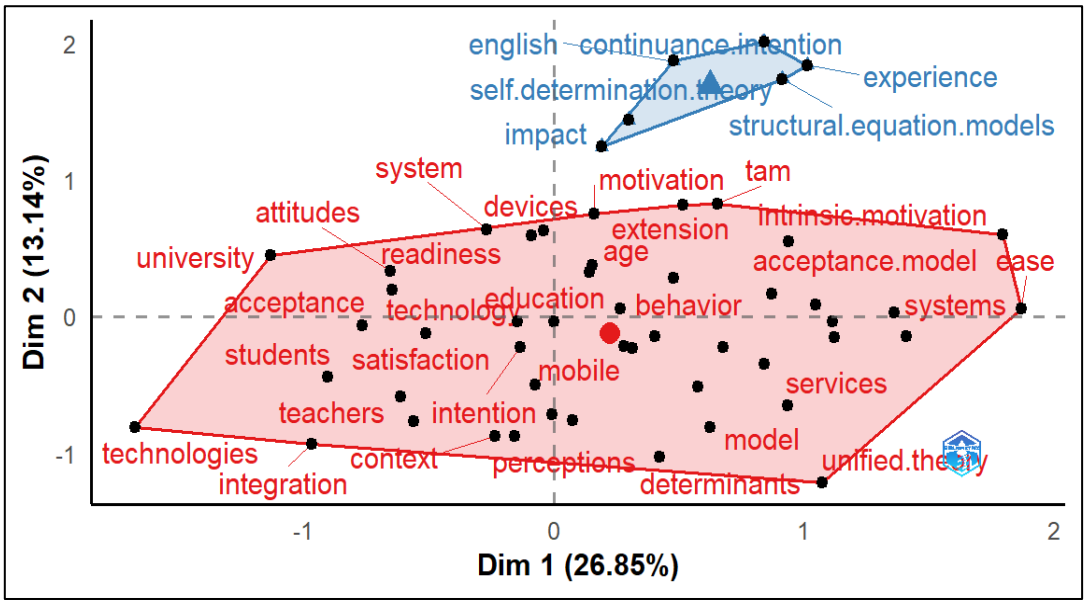

Figure 2. 12 Conceptual structure map of MACE research

2.5. Mobile apps for school-level learning

According to a recent report by Technavio, a market research company, the education apps market is expected to grow at a compounded annual growth rate (CAGR) of 28.61% between 2022 and 2027. The global market size of mobile learning (m-learning) apps in 2022 was $ 37.91 billion and is expected to be $161.48 billion by 2029 (MMR, 2023). The growth is driven by increasing government initiatives, growing demand for Science, Technology, Engineering, and Math (STEM) based apps, and an increase in penetration of cellular networks. The school level education or K-12 segment holds a significant market share of m-learning apps (MWR, 2023). The app market is expected to have exponential growth in the Asia pacific region. In addition, India is expected to be a major market (Technavio, 2022). The mobile learning app downloads in India were more than 560 million in the year 2022 (Statista, 2023c).

Countries across the world are increasingly encouraging schools to adopt mobile technology to enhance the teaching-learning process (G. J. Hwang et al., 2018). The governments of several countries have launched mobile learning initiatives. The South African Department of Basic Education's Ukufunda Virtual School app provides learners, educators and parents access to learning resources and content, counseling and safety services, a central communication and notification hub, and other value-added services and programs via mobile technologies (Roberts, Spencer-Smith, & Butcher, 2016). Further, a study examining the use of mobile apps by the central government in Brazil suggested a rapidly growing use of mobile apps for education (Dutra & Soares, 2019). The "SME app" provided by the government in the city of Rio de Janeiro offers media and audiovisual content to students, at all levels of education (Winter, 2022). Further, the Mobile Mathematics (MoMath) project in South Africa, supports mathematics learning for high school students by delivering content, quizzes, and community messaging via mobile phones (Vosloo, 2012).

The government of Colombia provides phones with a special SIM card that contains self-paced learning modules under the National Literacy Program. Further, the "PSU Movil" (PSU Mobile) app was developed by the Ministry of Education, Chile to provide educational content to students and incorporated exercises and online tests for practice (Lugo & Schurmann, 2012). The Basic Education Equivalency Programme (BEEP) of the Cambodian government allows learners to complete their lower secondary education through free online courses on their mobile devices (UNESCO, 2022). Further, the Cambodian government recently launched an app to offer video content on different subjects for school students (Cambodia Watch News, 2021). The department of education of the government of Queensland, Australia has several mobile apps for students, teachers, and parents. For example, the QTeachers app supports teachers in accessing common school tasks in and out of the classroom (Queensland Government, n.d.).

Further, Plan Ceibal is a national digital education plan of the Uruguayan government. The state provides laptops to school students and teachers and makes

Internet access available to them. The plan includes the generation and dissemination of digital resources, including textbooks, books, multimedia resources (e.g., videos, images, songs), and educational applications (Romaní, Vargas, Miao, & Domiter, 2018). Further, the mSchools program of the government of Catalonia, Spain promotes mobile education. In addition, the Mobile Learning Awards of the program honors innovative teachers and school-led projects for their use of mobile technology in education. In addition, it provides a toolbox of online validated and tested mobile educational content for schools, teachers, and parents (Forn, Castro, & Camacho, 2019). The Saudi Repository for Learning Objects and the Qualification and Training Project provide m-learning training to teachers (Harthi, 2019). Further, the Department of Education of the federal government of the USA offers 10 or more apps (Ganapati, 2015). Moreover, the European Commission has been a major funder of mobile learning initiatives and research (Vosloo, 2012).

The Department of School Education and Literacy of the government of India has several m-learning initiatives. The m-learning apps include DIKSHA - for School Education and ePathshala. DIKSHA (Digital Infrastructure for Knowledge Sharing) is a national platform for school education. The app allows school teachers access to aids like lesson plans, worksheets, and activities. The students can access educational resources such as e-textbooks and e-content on the app (Govt of India, n.d.). Further, the ePathshala app has e-resources including textbooks, audio, video, periodicals, and a variety of other digital resources (NCERT, n.d.).

2.6. Research gaps

The review of the literature indicated several research gaps. These are -

- The review revealed that the adoption and continuance of mobile apps for school level learning is a relatively new field of research. There is a paucity of studies analyzing the m-learning experience (Crompton et al., 2016; Ewing & Cooper, 2021). Further, there is a gap in exploring learners' real challenges in

m-learning (Hossain et al., 2021). Several m-learning apps are available on major app stores. However, research on these apps is still in the nascent stage (M. Liu et al., 2014; Qureshi, Khan, Ahmad Hassan Gillani, & Raza, 2020; Yu, Yan, & He, 2022).

- The studies most often use generic theoretical models of information systems adoption and usage (e.g., TAM, UTAUT, TRA, and TPB) to understand mobile learning (Krull & Duart, 2017; B. A. Kumar & Chand, 2019; Suliman, Zhang, & Sleiman, 2023). There is a need to understand the factors and variables that impact both the use and effectiveness of these apps (Crompton & Burke, 2018). Further, there is a need to understand how learners use these apps (Al-Emran, Arpaci, & Salloum, 2020).

- The review suggested that a higher number of publications examined m-learning adoption as compared to continuance. Limited studies have examined the post-adoption behavior of school students and teachers (S. Yang et al., 2019; X. Yang, 2024; Yildiz et al., 2020).

- The review indicated China to be a leading country in the research area of m-learning adoption and continuance. Although the studies in mobile learning have been geographically skewed, with a higher proportion of studies in the Asian region (Crompton & Burke, 2018), very few studies have been conducted in the Indian context (Ojha & Yadav, 2023).

2.7. Concluding remarks

The literature review presented in this chapter examined the existing literature on m-learning, technology adoption and continuance, and m-learning adoption and continuance in education. Bibliometric review techniques were used to analyze the metadata of the relevant publications. The differences between the public and private sector and school and higher education levels have also been discussed. In

addition, the chapter described several mobile learning apps. Further, this chapter identified key theories and variables used by researchers to examine the area of m-learning adoption and continuance. Based on the extensive literature review, the research gaps were identified.

The next chapter builds on the understanding developed through the literature review presented in this chapter and analyses the reviews and ratings of four highly rated, reviewed, and downloaded m-learning apps. The chapter attempts to identify the relevant factors influencing m-learning app usage among learners. Further, it compares public and private sector and school and higher education level m-learning apps.

CHAPTER 3

AN ANALYSIS OF REVIEWS AND RATINGS OF MOBILE LEARNING APPS

3.1. Introduction

Mobile learning apps form a popular category in the leading app stores such as Google Play, and Apple App Store. The students download and use apps on their mobile devices to supplement their learning. The app stores provide a description of the apps, including the reviews and ratings given by users of apps. This chapter examines the reviews and ratings of four popular mobile learning apps available on the Google Play store. A comparison between government (public) and private sector apps, and higher education and school level apps have been done to draw insights for the overall context of the study, i.e., mobile apps for school level learning.

The chapter has been structured as follows: section two presents the reviews and ratings of the four selected m-learning apps. A description of the data analysis techniques used to examine the reviews and ratings of apps is provided in section three. Further, the findings and discussion are presented in section four and five, respectively. The last section of this chapter provides the concluding remarks.

3.2. Reviews and ratings of select m-learning apps

The m-learning apps available on the popular mobile app stores may be owned by the government (public) or the private sector. In addition, the apps may be designed for different levels of education including school level and higher education level. It would be interesting to understand how the apps differ based on ownership (public and private) and level of education (school and higher education). Accordingly, two apps each in the public and private sectors with one app each in school and higher

education levels were selected. The reviews and ratings data of the four highly rated, downloaded, and reviewed m-learning apps were extracted from the Google Play app store. The apps are -

a) **DIKSHA – for School Education**
b) **BYJU'S – The learning app**
c) **SWAYAM**
d) **Coursera**

A description of the apps is provided in Table 3.1. All four apps had downloads of more than 1 million, and star ratings greater than 4 on the Google Play app store. The star ratings are indicative of the level of satisfaction with m-learning apps. The data regarding each selected app's top 500 most relevant reviews were extracted, cleaned, and transformed. Further, five reviews were removed from the analysis as they were either incomprehensible or irrelevant. A large proportion of the reviews pertained to May 2020 (the period of lockdown due to the COVID-19 pandemic) and were rated 5-star (Fig. 3.1).

Table 3. 1 Details of mobile learning apps selected for this study

Sl. No.	**Name of App**	**Sector**	**Level of education**	**Brief description**	**Number of downloads**	**Number of reviews**	**Ratings**
1	DIKSHA (Digital Infrastructure for Knowledge Sharing) - for School Education	Public	School education	DIKSHA is a national platform for school education, an initiative of the Ministry of Education, Government of India. The app offers teachers, students, and parents free learning material.	10,000,000+	200,000+	4.4

Continued on page no. 46

Table 3.1 (continued)

2	BYJU'S – The Learning App	Private	School education	BYJU'S, founded by Byju Raveendran, is India's ed-tech company. The App provides comprehensive learning programs for school students (classes 1-12 (K-12)). The app charges fees for the courses.	50,000,000+	1,400,000+	4.4
3	SWAYAM (Study Webs of Active-Learning for Young Aspiring Minds)	Public	Higher education	SWAYAM is an initiative by the Government of India. The app has courses till post-graduation and is free of cost for learning. However, the app charges fees for completion certificates.	1,000,000+	30,000+	4.2
4	Coursera	Private	Higher education	Coursera was founded by Daphne Koller and Andrew Ng. The app provides courses from colleges and universities worldwide. The app allows one to join free and charges a fee for course enrolment and completion certificates.	10,000,000+	100,000+	4.3

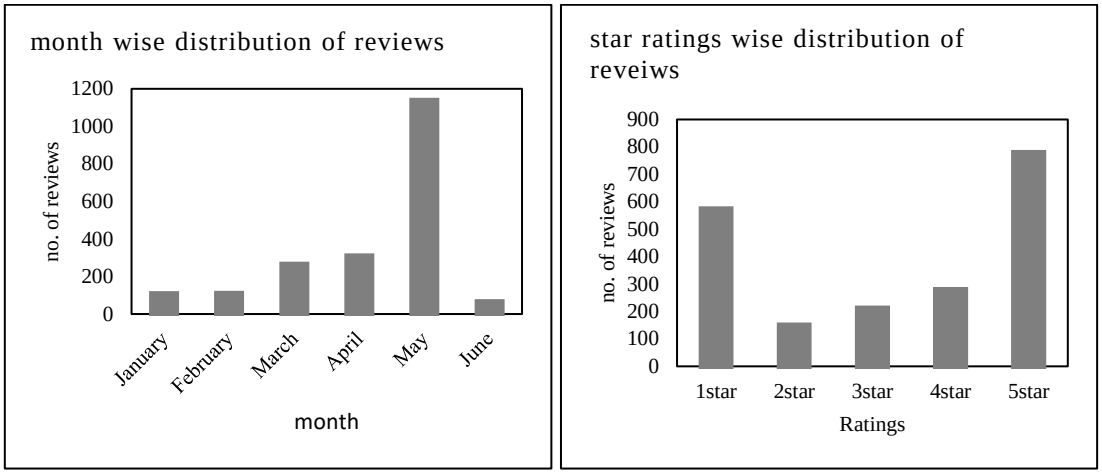

Figure 3. 1 Month-wise and star ratings-wise distribution of reviews

3.3. Analysis of reviews and ratings of apps

The reviews and ratings of the four m-learning apps were analyzed through content analysis, sentiment analysis, and statistical analysis.

3.3.1. Content analysis

According to Riffe, Lacy, and Fico (2014), content analysis is the "systematic and replicable examination of symbols of communication, which have been assigned numeric values according to valid measurement rules, and the analysis of relationships involving those values using statistical methods, to describe the communication, draw inferences about its meaning, or infer from the communication to its context, both of production and consumption."

A coding scheme consisting of three broad themes and ten sub-themes was developed after examining 300 random reviews (Cavazos-Rehg et al., 2016). Further, the coding scheme was refined through discussion with students who had used the selected mobile learning apps in the past year to learn a subject or complete at least one course from these apps. The coding scheme components include instructions for coding, a description of each theme, and a scoring rubric (Table 3.2). The scheme consisted of three themes namely, app quality (AQ), app suitability (AS), and influence

to use (IU)). In addition, the following ten sub-themes were identified: 1) technical quality (TLQ); 2) customer support quality (CSQ); 3) content quality (CQ); 4) teaching quality (TGQ); 5) usefulness (US); 6) comparison (CN); 7) compatibility (CY); 8) requests & suggestions (RS); 9) learner influencing others (LIO); 10) others influencing learner (OIL).

TLQ refers to the technical aspects of the app and has been adapted from the construct "system quality." According to (Seddon, 1997), "System quality is concerned with whether or not there are 'bugs' in the system, the consistency of the user interface, ease of use, quality of documentation, and sometimes, quality and maintainability of the programme code". CSQ is concerned with the "service quality," i.e., "overall support delivered by the service provider, applies regardless of whether this support is delivered by the IS department, a new organizational unit, or outsourced to an Internet service provider" (DeLone & McLean, 2003). Further, CQ pertains to the quality of teaching and learning resources and has been adapted from "information quality". The measures of this construct include "accuracy, relevance, understandability, completeness, currency, dynamism, personalization, and variety" (DeLone & McLean, 2003). The sub-theme teaching quality(TQ) refers to "some or all aspects of teacher-student relationships in the classroom" (Cornelius-White, 2007). The domains to teaching quality include "safe and stimulating learning climate, efficient classroom management, clarity of instruction, activating learning, adaptive learning and teaching learning strategies" (Maulana, Helms-Lorenz, & van de Grift, 2015). Further, "US" has been adapted from the construct "perceived usefulness," which is referred to as the "degree to which a person believes that using a particular system would enhance his or her job performance" (F. D. Davis, 1989). The construct "relative advantage," i.e., "the degree to which an innovation is seen as being superior to its predecessor" (Rogers, 1995), has been adapted as the sub-theme CN for this study. The sub-theme CY refers to "the degree to which an innovation is seen to be compatible with existing values, beliefs, experiences, and needs of adopters" (Rogers, 1995). Further, RS includes requests and suggestions related to the app. The sub-themes LIO and OIL pertain to "social influence," which is defined as the "degree to

which an individual perceives that important others believe he or she should use the new system" (Venkatesh et al., 2003).

The app reviews were coded to the identified sub-themes.

Table 3. 2 Coding scheme for reviews of m-learning apps

Broad theme	**Sub-theme**	**Operational Definition and common markers**	**Reference(s); Examples**
1.app quality (AQ)	i)technical quality (TLQ)	mention of technical aspects such as loading time, login, registration, audio/video quality, upload/download, updates, notifications, user interface, Internet connectivity/usage, and features such as QR code scan, face recognition, chromecast, and live classes	(Seddon, 1997)
	low (1) (LTLQ)	slow, crashing, audio/video not clear, complicated to use, not able to upload/download, lousy interface, broken navigation links	"It's very poor app. It automatically crashes when you are working on it"
	medium (2) (MTLQ)	mention of both high and low performance	"… sometimes the videos stop working"
	high (3) (HTLQ))	fast, smooth login, good audio/video quality, easy to use, quick upload/download, user-friendly interface, intuitive navigation	"It has got the arrangement of live classes and a user-friendly interface"
	ii)customer support quality (CSQ)	mention of customer support quality aspects such as visibility/accessibility of helpline contact details, response time, and problem resolution	(DeLone & McLean, 2003)
	low (1) (LCSQ)	inaccessible helpline contact details, no or inappropriate response to users' inquiries, the problem not resolved, insufficient troubleshooting	"…customer service is the worst i have ever seen."
	medium (2) (MCSQ)	mention of both high and low performance	"…Have to wait for hours to get a reply for your query..."
	high (3) (HCSQ)	easily accessible helpline contact details, prompt response, quick problem resolution, and troubleshooting	"Online support is very fast and reliable..."
	iii)content quality (CQ)	mention of the quality of teaching and learning resources in terms of availability, variety (language, format-text, audio, video, visual, games), conciseness, clarity, accuracy, detail, updated, uniqueness, and other such quality attributes	(DeLone & McLean, 2003)

Continued on page no. 50

Table 3.2 (continued)

	low (1) (LCQ)	relevant teaching and learning resources unavailable, unclear, inaccurate, outdated, and of low quality	"…when u click on it the contents are unavailable..."
	medium (2) (MCQ)	mention of both high and low performance	"in this App only pdf of chapters are given"
	high (3) (HCQ)	relevant teaching and learning resources available in desired language and format, concise, clear, accurate, detailed, updated, unique	"I like assignment the most, they are unique and challenges u to push yourself forward"
	iv)teaching quality (TGQ)	mention of teaching quality in terms of explanation of concepts, instructor attributes (e.g., experience, enthusiasm, speed of delivering sessions, clarity of voice, pronunciation), learning/understanding, encouragement to study, interaction, grading, and teaching methods/techniques (e.g., use of games, quizzes, graphics)	(Cornelius-White, 2007), (Maulana et al., 2015)
	low (1) (LTGQ)	concepts not clearly explained, slow and tedious instructors, old school teaching methods	"…bigger concepts are being explained in not clearly. "
	medium (2) (MTGQ)	mention of both high and low performance	"Teachers are good but quality and techniques are old…"
	high (3) (HTGQ)	excellent instructors, concepts well explained, excellent teaching methods	"Very good method of teaching...and explaining to the children…"
2.app suitability	i)usefulness (US)	specific mention of the words such as useless, wastage (of time, effort, money, data), useful, help(s), helpful, beneficial, and similar words indicating the usefulness	(F. D. Davis, 1989)
	low(1) (LUS)	wastage (of time, effort, money, data), useless	"It's a useless aap…."
	high(2) (HUS)	mention of useful, helpful, help(s), beneficial	"…it help me improve my teaching skills…"
	ii)comparison (CN)	mention of offline modes of teaching and learning, other apps/websites/desktop version/older version	(Rogers, 1995); "The updated version with live classes is best…"

Continued on page no. 51

Table 3.2 (continued)

	iii)compatibility (CY)	mention of operating system/android version; hardware functionalities of the mobile device such as battery life, memory, screen, other APPs installed in the mobile device; lifestyle-related aspects such as Internet access/speed, existing email id, social media accounts, data usage, health, age, price or fee, etc.	(Rogers, 1995) "…The problem is that your videos consume a lot of Internet. I have a metered connection and therefore i am not able to watch more than four to five videos a day"
	iv)requests and suggestions (RS)	direct and indirect requests for assistance/help and suggestions for different aspects of the app (e.g., content, user interface)	"The app should also support landscape mode anywhere, not just only on some pages…"
3.influence to use (IU)	i)learner influencing others (LIO)	suggestion/recommendation to use the app by the user to others, including readers of app reviews on the app store	(Venkatesh et al., 2003); "… I've also suggested this app to my friends..."
	ii)others influencing learner (OIL)	suggestion/recommendation/compulsion to use the app to the user by others, including family members, friends, relatives, teachers, school, college, and government bodies.	(Venkatesh et al., 2003); "...My school suggested this app to all students…."

3.3.2. Sentiment analysis

Sentiment Analysis is a text-based computational analysis that identifies people's opinions, attitudes, and emotions toward an entity. The sentiments may be expressed as positive, negative, or neutral. A lexicon-based approach was used to analyze the app reviews (Medhat, Hassan, & Korashy, 2014). The emotions in the reviews were identified based on the (PLUTCHIK, 1980) classification of emotions as "joy," "sadness," "anger," "fear," "trust," "disgust," "surprise," and "anticipation." Further, the sentiment scores and emotion scores were calculated for the reviews using the 'sentimentr' R-package (Rinker, 2019).

3.3.3. Statistical analysis

Cramér's V values were calculated to examine the strength of the association between star ratings and the identified sub-themes; and between the sub-themes. The relationship among the sub-themes was further examined through cross-tabulated frequencies. In addition, the Kruskal-Wallis Test was conducted to examine

the difference in star ratings based on ownership (private, and public) and education level (higher education, and school level). Further, The strength of association between the emotions was examined by calculating values of the Phi-coefficient.

3.4. Findings of the analysis of apps' reviews and ratings

Cramér's V values were calculated for the chi-square test of independence between star ratings (SR) and the identified sub-themes (Table 3.3) and the strength of association was examined (Kotrlik, Williams, & Jabor, 2011). The results found a significant and relatively strong association between TLQ and SR. Further, the pairs: US and SR, and RS and SR were significantly moderately associated. The association was significant and weak for the pairs: CSQ and SR; CQ and SR; TGQ and SR; CY and SR; LIO and SR. Additionally, the association between OIL and SR was significant and negligible. However, the association was not significant for CN and SR.

Table 3. 3 Strength of association between star ratings (SR) and sub-themes

Sub-themes	chi-square (χ2)	Cramér's V	Themes	chi-square (χ2)	Cramér's V
1. TLQ	1397.97***	0.48	6. CN	2.77	0.04
2. CSQ	78.74***	0.11	7. CY	55.1***	0.17
3. CQ	244.08***	0.2	8. RS	174.67***	0.3
4. TGQ	249.34***	0.2	9. LIO	69.49***	0.19
5. US	268.41***	0.26	10. OIL	11.87*	0.08

Note: *p<0.05, **p<0.01, ***p<0.001

With the intent to develop further insights, the cross-tabulated frequencies were analyzed (Table 3.4). The SR of 1 or 2 was considered to be low and 4 or 5 to be high. The data revealed that 79% (n = 598/760) of the reviews coded to LTLQ were also rated low. Further, 95% (n = 62/65) of the reviews with HTLQ were rated high. Additionally, it was observed that 65% (n = 95/146) of the reviews rated 4-star and 47% (n = 67/144) of the reviews rated 5-star were coded to MTLQ. 85% (n = 35/41) of the reviews with LCSQ were rated 1-star. Further, it was observed that for LCQ, 73% (n = 22/30) of the reviews were rated 1-star, and for HCQ, 83% (n = 251/304) of the reviews were rated high. Furthermore, 64% (n = 63/98) of the reviews having MCQ also rated the apps high. Additionally, a majority (70%, n =304/432) of the reviews

coded to CQ indicated high quality. 92% (*n* = 260/284) of the reviews with HTGQ rated the apps high. Further, a large proportion (92%, *n* =284/310) of the reviews coded to TGQ indicated high quality. The majority of the reviews (82%, *n* = 287/348) indicating US found the apps useful. Further, 92% (*n* = 264/287) of such reviews rated the app high. Also, 77% (*n* =47/61) of the reviews, which hinted LUS, rated the apps low. The data revealed that 28% (*n* = 550/1995), 11% (*n* = 218/1995) and 6% (*n* = 127/1995) of the total reviews suggested the sub-themes in the reviews as RS, CY and CN respectively. Only 1% (*n* = 19/1995) of the reviews indicated the theme IU.

Table 3. 4 Cross-tabulated frequencies of star ratings and themes

Sub-themes		**1Star**	**2Star**	**3Star**	**4Star**	**5Star**	**Sub-themes**		**1Star**	**2Star**	**3Star**	**4Star**	**5Star**
TLQ	Absent(0)	47	11	42	134	635	US	Absent(0)	524	142	198	230	553
	LTLQ	488	110	96	44	22		LUS	43	4	2	1	11
	MTLQ	38	29	72	95	67		HUS	7	4	12	49	215
	HTLQ	1	0	2	7	55	CN	Absent(0)	541	138	195	261	735
CSQ	Absent(0)	537	147	208	275	771		Present(1)	33	12	17	19	44
	LCSQ	35	2	4	0	0	CY	Absent(0)	483	123	180	250	741
	MCSQ	1	0	0	2	1		Present(1)	91	27	32	30	38
	HCSQ	1	1	0	3	7	RS	Absent(0)	406	95	109	157	678
CQ	Absent(0)	521	131	167	203	541		Present(1)	168	55	103	123	101
	LCQ	22	2	5	1	0	LIO	Absent(0)	565	150	210	273	706
	MCQ	9	7	19	35	28		Present(1)	9	0	2	7	73
	HCQ	22	10	21	41	210	OIL	Absent(0)	563	150	212	280	771
TGQ	Absent(0)	560	143	192	239	551		Present(1)	11	0	0	0	8
	LTGQ	6	1	3	2	0							
	MTGQ	2	2	3	1	6							
	HTGQ	6	4	14	38	222							

The relationship among the factors was examined by calculating the strength of the association between the sub-themes (Table 3.5). The findings indicate a significant and moderate association between the sub-theme pairs: TLQ and US; TLQ and RS; CQ and RS. The association was significant but weak for the sub-theme pairs: CQ and TLQ; TGQ and TLQ; TGQ and CQ; US and TGQ; CY and TLQ; CY and TGQ; RS and TGQ; RS and US; RS and CY; LIO and TLQ; LIO and CY; LIO and TGQ. Interestingly, CSQ had a significant but very weak association only with

TLQ, and US. The association of CSQ with all the other factors was insignificant. Similarly, CN had a significant but weak association with CQ, CY, RS, and LIO. Its association with all other factors is insignificant. Moreover, OIL had an insignificant association with all other factors. Further, the relationship between dichotomous sub-themes and other sub-themes was examined through cross-tabulated frequencies. 73% (*n* = 404/550) of reviews which mentioned RS also mentioned L/MTLQ. Additionally, 20% (*n* = 112/550) of the reviews mentioned both RS and M/HCQ. Further, 41% (*n* = 223/550) and 41% (*n* = 224/550) of the RS were associated with low and high SR, respectively. The majority of the reviews (79%, *n* = 173/218) coded to CY, indicated L/MTLQ, and 42% (*n* = 91/218) were rated 1 star. With regard to the sub-theme CN, 51.2 % (*n* = 64/125), 19% (*n* = 24/125) and 16 % (*n* = 20/125) of the reviews coded to CN were also coded to L/MTLQ, M/HCQ and HTGQ respectively. Further, 35% (*n* = 44/125) and 26% (*n* = 33/125) of these reviews were rated 5-star and 1-star respectively. The data further revealed that most reviews (58%, *n* = 11/19) indicating OIL, were rated 1-star. Additionally, 80% (*n* = 73/91) of the reviews coded to LIO rated the app 5-star.

Table 3. 5 Strength of association (Cramér's V) between the sub-themes

sub-themes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1. TLQ									
2. CSQ	0.08***								
3. CQ	0.2***	0.04							
4. TGQ	0.2***	0.04	0.17***						
5. US	0.25***	0.06*	0.1***	0.12***					
6.CN	0.05	0.02	0.08*	0.04	0.01				
7. CY	0.19***	0.05	0.01***	0.11***	0.1***	0.01			
8. RS	0.28***	0.03	0.26***	0.12***	0.15***	0.01	0.11***		
9. LIO	0.2***	0.02	0.12***	0.14***	0.1***	0.04	0.05*	0.09***	
10. OIL	0.05	0.02	0.08	0.02	0.04	0	0.02	0.01	0.05

Note: *p<0.05, **p<0.01, ***p<0.001

Further, the Kruskal-Wallis Test was conducted to examine the difference in SR between the private and public sectors. The results indicated a statistically significant difference in SR between the sectors, $H(1) = 19.45$ ($p < 0.001$), with a median score of 4 for private and 3 for public. The difference was further examined

through cross-tabulated frequencies (Table 3.6). The data revealed that the majority (60%, *n* = 345/574) of the 1-star ratings were given to public sector apps. Regarding 3-star ratings, 58% (*n* = 122) belong to the private sector. Further, 42% (*n* = 416/998) of the private sector app ratings were 5-star as compared to 36% (*n* = 363/997) of the public sector.

Table 3. 6 Cross-tabulated frequencies of star ratings, sector, and education level

sector	**1star**	**2star**	**3star**	**4star**	**5star**	**education level**	**1star**	**2star**	**3star**	**4star**	**5star**
private	229	79	122	152	416	higher	289	88	137	127	356
public	345	71	90	128	363	school	285	62	75	153	423

Further, the strength of the association between the sector and the sub-themes was calculated (Table 3.7). The association between the sector and TGQ was moderate and significant. The association was significant but weak for the pairs: sector and TLQ; sector and CN; sector and CY. Further, there was a significant and negligible association between the pairs: sector and CQ; sector and US; sector and LIO; sector and OIL. The association was not significant for pairs: sector and CSQ; sector and RS.

Table 3. 7 Strength of association between sector and sub-themes

sub-themes	**chi-square (χ2)**	**Cramer's V**	**sub-themes**	**chi-square (χ2)**	**Cramer's V**
1. TLQ	62.03***	0.18	6. CN	26.71***	0.12
2. CSQ	1.64	0.03	7. CY	48.35***	0.16
3. CQ	19.31***	0.1	8. RS	0	0
4. TGQ	103.05***	0.23	9. UIO	18.38***	0.1
5. US	7.17*	0.06	10. OIL	7.66**	0.07

Note: *p<0.05, **p<0.01, ***p<0.001

The relationship between sector and sub-themes was further examined using cross-tabulated frequencies (Table 3.8). It was observed that 78% (*n* = 450/578) of the public sector app reviews mentioning TLQ found the quality low. Further, 57% (*n* = 450/578) of the reviews indicating HTLQ belonged to private-sector apps. 56% (*n* =23/41) of the reviews indicating LCSQ belonged to the public sector. The data shows that 58% *(n* = 176/304) of the reviews with HCQ and 63% *(n* = 19/30) of the

reviews with LCQ were linked to private and public sector apps, respectively. Most (78%, *n* = 221/284) reviews suggesting HTGQ were associated with private-sector apps. 66% (*n* = 40/61) of the reviews indicating LUS belonged to the public sector. Further, 72% (*n* = 158/218) of reviews indicating CY, 73% (*n* = 91/125) indicating CN, and 73% (*n* = 91) indicating LIO were linked to private-sector apps. Further, 84% (*n* = 16/19) of the reviews indicating OIL, and 50% (*n* = 274/550) indicating RS were related to public sector apps.

Table 3. 8 Cross-tabulated frequencies of sector and sub-themes

sub-themes		**private**	**public**	**sub-themes**		**private**	**public**
1.TLQ	Absent(0)	450	419	5.US	Absent(0)	840	807
	LTLQ(1)	310	450		LUS(1)	21	40
	MTLQ(2)	201	100		HUS(2)	137	150
	HTLQ(3)	37	28	6.CN	Absent(0)	907	963
2.CSQ	Absent(0)	973	965		Present(1)	91	34
	LCSQ(1)	18	23	7.CY	Absent(0)	840	937
	MCSQ(2)	1	3		Present(1)	158	60
	HCSQ(3)	6	6	8.RS	Absent(0)	724	721
3.CQ	Absent(0)	749	814		Present(1)	274	276
	LCQ(1)	11	19	9.LIO	Absent(0)	932	972
	MCQ(2)	62	36		Present(1)	66	25
	HCQ(3)	176	128	10.OIL	Absent(0)	995	981
4.TGQ	Absent(0)	767	918		Present(1)	3	16
	LTGQ(1)	4	8				
	MTGQ(2)	6	8				
	HTGQ(3)	221	63				

The difference between SR for the two education levels (ELs) was examined using the Kruskal-Wallis Test. The results indicated a statistically significant difference, $H(1) = 7.01$ ($p < 0.01$), with a median score of 4 for school education (SE) and 3 for higher education (HE) apps. The difference was further examined through cross-tabulated frequencies (Table 3.6). 65% (*n* =137/212) of the reviews rated 3-star were related to HE. Further, 42% (*n* = 423/998) of the reviews of SE apps were rated 5-star compared to 36% (*n* = 356/997) for HE apps. Further, we calculated the strength of association between EL and the sub-themes (Table 3.9). The

association between EL and TGQ was moderate and significant. The association was significant but weak for the pairs: EL and TLQ; EL and CQ; EL and US; EL and LIO. Further, there was a significant and negligible association between the pairs: EL and CY; EL and RS; EL and OIL. The association was not significant for the pairs: EL and CSQ; EL and CN.

Table 3. 9 Strength of association between education level and sub-themes

sub-themes	**chi-square (χ2)**	**Cramer's V**	**sub-themes**	**chi-square (χ2)**	**Cramer's V**
1. TLQ	31.96***	0.13	6. CN	1.69	0.03
2. CSQ	3.6	0.04	7. CY	11.43***	0.08
3. CQ	57.99***	0.17	8. RS	12.56***	0.08
4. TGQ	184.3***	0.3	9. UIO	24.32***	0.11
5. US	39.78***	0.14	10. OIU	5.30*	0.06

Note: *p<0.05, **p<0.01, ***p<0.001

The relationship between EL and sub-themes was further examined using cross-tabulated frequencies (Table 3.10). The data revealed that 57% (*n* = 434/760) of the reviews with LTLQ were associated with HE apps. Further, 77% (*n* = 17/22) of the reviews indicating CSQ in HE suggested LCSQ. 83% (*n* = 130/157) of the reviews indicating CQ in HE suggested HCQ compared to 63% (*n* = 174/275) in SE. It was found that 87% (*n* = 248/284) of the reviews indicating HTGQ were linked to SE apps. Further, 71% (*n* = 36/51) of the reviews mentioning TGQ in HE found HTGQ. The data revealed that 67% (*n* = 193/287) of the reviews indicating HUS were related to SE apps. Additionally, 75% (*n* = 94/126) of the HE app reviews assessing US found the app useful. A higher proportion of reviews, 61% (*n* = 133/218) and 56% (*n* = 70/125) indicating CY and CN, respectively, were linked to HE apps. Further, a majority (57%, *n* = 311/550) of the reviews indicating RS were linked to SE apps. The proportion of LIO and OIL was very high for school education apps (76%, *n* = 69/91 and 79%, *n* = 15/19).

Table 3. 10 Cross-tabulated frequencies of education level and sub-themes

sub-themes		**HE**	**SE**	**sub-themes**		**HE**	**SE**
1.TLQ	Absent(0)	389	480	5.US	Absent(0)	871	776
	LTLQ(1)	434	326		LUS(1)	32	29
	MTLQ(2)	134	167		HUS(2)	94	193
	HTLQ(3)	40	25	6.CN	Absent(0)	927	943
2.CSQ	Absent(0)	975	963		Present(1)	70	55
	LCSQ(1)	17	24	7.CY	Absent(0)	864	913
	MCSQ(2)	1	3		Present(1)	133	85
	HCSQ(3)	4	8	8.RS	Absent(0)	758	687
3.CQ	Absent(0)	840	723		Present(1)	239	311
	LCQ(1)	7	23	9.LIO	Absent(0)	975	929
	MCQ(2)	20	78		Present(1)	22	69
	HCQ(3)	130	174	10.OIL	Absent(0)	993	983
4.TGQ	Absent(0)	946	739		Present(1)	4	15
	LTGQ(1)	7	5				
	MTGQ(2)	8	6				
	HTGQ(3)	36	248				

The sentiment analysis revealed that a large proportion of reviews (67%, n = 1337) exhibited positive sentiment. The findings indicate that the majority of the learners had a positive attitude toward m-learning apps. In addition, trust (55%, n = 1104), anticipation (49%, n = 985), and Joy (48%, n = 967) were found to be the prominent emotions in the reviews, followed by surprise (29%, n = 572), sadness (24%, n = 485) and fear (23%, n = 463).

Further, the strength of the association between SR and emotions was calculated (Table 3.11). The relationship of star ratings with all eight emotions individually was found to be significant. The findings indicated a moderate association between SR and the emotions of “joy,” “trust,” “disgust,” and “sadness.” The highest Cramer’s V values were between SR and joy. The association was weak when SR was paired with “anger,” “fear,” and “surprise.” However, there was a negligible association between SR and “anticipation.”

Table 3. 11 Association between star ratings and emotions

emotion	chi-square (χ2)	Cramer's V	emotion	chi-square (χ2)	Cramer's V
joy	174.21***	0.3	disgust	99.73***	0.22
trust	133.96***	0.26	fear	56.87***	0.17
anticipation	16.56**	0.09	sad	127.76***	0.25
anger	77.57***	0.2	surprise	81.72***	0.2

Note: *p<0.05, **p<0.01, ***p<0.001

Further, the cross-tabulated frequencies were analyzed (Table 3.12). The data revealed that 68% (*n* = 526/779) of the reviews with 5-star ratings expressed trust. 64% (*n* = 702/1104) of reviews indicating trust were rated high. Further, 39% % (*n* = 380/985) and 26% % (*n* = 253/985) of the reviews showing anticipation were rated 5-star and 1-star respectively. Across all star ratings, anticipation was observed for 44% to 59% of the reviews. The majority of the reviews (67%, *n* = 645/967) identified with the emotion joy were rated high. On the contrary, in 72% (*n* = 414/574) of the reviews rated 1-star, the expression of joy was absent. Further, 51% (*n* = 114/222) of the reviews expressing anger were rated 1-star. Surprisingly, 80% (*n* = 460/574) of the reviews rated 1-star did not indicate anger. Overall, anger was present in just 11% (*n* = 222/1995) of the total reviews. Further, the expression of disgust was 10% (*n* = 206/1995) of the total reviews. Although a majority (54%, *n* = 112/206) of the reviews exhibiting disgust were rated 1-star, this proportion was only 20% (*n* = 112/574) of all the 1-star rated reviews. The data revealed that 23% (*n* = 463/1995) of the total reviews expressed fear. 39% (*n* = 179/463) and 25% (*n* = 115/463) of the reviews indicating fear were rated 1-star and 5-star respectively. These numbers formed 31% (*n* = 179/574) of 1-star ratings and 15% (*n* = 115/779) of 5-star ratings. Therefore, a higher proportion of reviews rated 1-star exhibited fear. Further, 24.31% (*n* = 485/1995) of the total reviews indicated sadness. 42% (*n* = 204/485) of the reviews indicating sadness were rated 1-star. We found that 29% (*n* = 572/1995) of all the reviews indicated "surprise." A majority (65%, *n* = 371/572) of the reviews expressing surprise were rated high. The indication of surprise was found in only 15% (*n* = 88/574) of the reviews rated 1-star.

Table 3. 12 Cross-tabulated frequencies of star ratings and emotions

emotion		1Star	2Star	3Star	4Star	5Star	emotion		1Star	2Star	3Star	4Star	5Star
joy	0	414	97	103	111	303	disgust	0	462	130	186	256	755
	1	160	53	109	169	476		1	112	20	26	24	24
trust	0	358	84	92	104	253	fear	0	395	109	151	213	664
	1	216	66	120	176	526		1	179	41	61	67	115
anticipation	0	321	73	87	130	399	sad	0	370	101	140	208	691
	1	253	77	125	150	380		1	204	49	72	72	88
anger	0	460	131	184	259	739	surprise	0	486	115	134	173	515
	1	114	19	28	21	40		1	88	35	78	107	264

Note: 0 = emotion absent; 1 = emotion present

The strength of association among the emotions was determined by the calculation of the Phi coefficient (Table 3.13). The results indicate a significant and strong association between the emotion pairs: trust and joy; sad and fear. The association between the pairs: anticipation and joy; anticipation and trust; surprise and joy; surprise and trust; surprise and anticipation; disgust and anger were significant and relatively strong. Further, the emotion pairs: fear and anger; fear and disgust; sad and anger; sad and disgust were significant and moderately associated. There was a significant and weak association between fear and anticipation. The association was significant and negligible for anger and anticipation; disgust and anticipation; sadness and anticipation; fear and joy; fear and trust; surprise and fear.

Table 3. 13 Correlation between the emotions (Phi coefficient)

	1	**2**	**3**	**4**	**5**	**6**	**7**
1.joy							
2.trust	0.68***						
3.anticipation	0.54***	0.42***					
4.anger	0.02	0.04	0.08***				
5.disgust	-0.01	0.02	0.06[b]	0.58***			
6.fear	0.05*	0.05*	0.14***	0.36***	0.32***		
7.sad	-0.04	0.02	0.1***	0.32***	0.31***	0.61***	
8.surprise	0.58***	0.5***	0.52***	0.03	0.01	0.07**	0.01

Note: *p<0.05, **p<0.01, ***p<0.001

3.5. Discussion

The reviews and ratings of four highly rated and downloaded m-learning apps were examined in the context of factors influencing m-learning continuance intention among the learners. The findings suggested that app usage was influenced by the learner's perceptions of app quality (e.g., technical quality, customer support quality, content quality, and teaching quality), usefulness, compatibility, and influence to use or social influence. Further, most users of the four selected apps were satisfied and had a positive attitude towards the apps. Moreover, public and private sector apps and school and higher education apps were compared. In addition, sentiment analysis revealed that the emotion of joy had the highest association with star ratings given by the learners using the m-learning apps. The analysis presented in this chapter uncovered several interesting aspects of the relationships between the identified factors and the star ratings of the apps.

The findings suggested that the learners may rate an app high, even when they perceive its technical quality and content quality to be medium. Further, many learners perceive the teaching and content quality to be high and the app to be useful. Moreover, the majority of the learners' requests and suggestions relate to different aspects of technical quality. When learners refer to compatibility with the apps, it is mostly related to technical aspects and is usually associated with a 1-star rating. Further, when learners explicitly give recommendations to use the app, they often rate it 5-star. Surprisingly, in cases where others recommend learners to use the app, they usually rate it 1-star.

The learners perceive and rate public sector apps lower as compared to the private sector. The majority of the learners assess the technical quality and content quality of private-sector apps to be better. Interestingly, although many learners perceive the teaching quality of public sector apps to be high, only a few express it in the reviews. On the contrary, learners like to explicitly mention their satisfaction with teaching quality in private-sector apps, especially for school education. More people tend to compare and refer to compatibility in their reviews regarding the private sector

than the public sector. A few learners give explicit recommendations in their reviews to use the apps and even fewer for public sector apps. The learners rarely indicate the influence of others in using the app. Interestingly, such an impact was more pronounced in the case of the public sector.

Learners tend to give higher star ratings for school-level education apps. Interestingly, a higher proportion of learners appreciate teaching quality and content quality for school education apps than higher education apps. However, teaching quality seemed to matter more for school education and content quality for higher education. Further, in comparison to higher education, more learners find school education apps to be useful. Additionally, learners using higher education apps seem to make comparisons and assess compatibility more than school education apps. When it comes to school education, learners seem to show higher involvement, as evidenced by a higher number of requests and suggestions. Further, more learners tend to recommend and follow recommendations regarding using the app for school education than higher education.

The results indicated that many learners had positive sentiments and exhibited emotions of trust, anticipation, and joy towards mobile learning platforms. The learners express in their reviews the emotions of trust, joy, and surprise when they rate the apps high. Further, anger, disgust, fear, and sadness were discernible in the reviews that rated 1-star. Surprisingly, even though learners rated 1-star, the expression of anger and disgust was missing in most reviews. When learners fear something, quite often they rate the app 1-star. However, learners may have some fear even when they rate 5-star.

3.6. Concluding remarks

The mobile learning apps' reviews and ratings data provided several insights into the factors influencing m-learning apps' usage. The four apps examined in this chapter were owned by the public and private sectors and pertained to school and higher education levels. The reviews of the app users were publicly available and

were extracted from one of the popular mobile app stores. Now, it would be interesting to understand the m-learning ‘lived experiences’ of students and teachers for learning at the school level of education. The next chapter attempts to enhance the understanding of the factors influencing m-learning continuance intention through hermeneutic phenomenological analysis of verbatim transcripts of semi-structured interviews of the school students and teachers.

CHAPTER 4

‘LIVED EXPERIENCES’ OF USING MOBILE APPS FOR SCHOOL LEVEL LEARNING

4.1. Introduction

This chapter describes the m-learning experiences of school students and teachers and explores the factors influencing the continuance intention to use mobile apps for school level learning. Semi-structured interviews of 24 students and 09 teachers of schools in NCT Delhi, India were conducted over 03 months and transcribed verbatim. The education systems worldwide were disrupted for nearly two years (i.e., 2020-21) due to the COVID-19 outbreak. The pandemic resulted in the closure of schools and other learning spaces. The interviews were conducted during the period of school closures. Several students and teachers adopted mobile learning to ensure educational continuity during the period of school closure. Further, a hermeneutic phenomenological design is used to interpret the text to bring out the “lived experiences” of m-learning and reveal factors influencing the continuance intention of m-learning.

The chapter is organized as follows: a description of the interviewed school students and teachers is provided in section two. Further, section three deals with the analysis technique used to examine the verbatim transcripts of the interviews. A description of the themes identified through the analysis is provided in section four followed by concluding remarks in section five.

4.2. Selection of students and teachers for interviews

Purposive sampling method was used to select participants from the National Capital Territory (NCT) of Delhi, India. A diverse group of 24 students and

09 school teachers who lived the m-learning experience and expressed willingness to share their experiences were selected to enhance the possibilities of rich and unique stories (Laverty, 2003). The researchers recommend interviewing from 5 to 25 individuals who have all experienced the phenomenon (Creswell, 2007). The average age of the students and teachers was 16.58 years (SD = 1.63) and 46.67 years (SD = 10.71), respectively. The student's academic performance ranged from 55% to 95% in the examinations. The profiles of the students are in Table 4.1. The 09 teachers in this study had an average teaching experience of 20.56 years (SD = 9.02) and taught different subjects in classes from 9^{th} to 12^{th}. Subjects include Accounts, Computer science, Economics, English, Hindi, Mathematics, Sanskrit, and Science (Table 4.2).

An in-depth investigation was conducted through semi-structured interviews of the participants over three months (April – June 2021) until saturation, when no new ideas surfaced. The semi-structured interview questions for students and teachers are provided in Appendices I and II, respectively. Each interview was recorded with permission from the participants and transcribed verbatim. The participants were assured of confidentiality and anonymity. A Word Cloud of the interview transcript was created in R-studio using the "wordcloud2" package to visually represent the word frequencies (Fig 4.1).

Table 4. 1 Profile of students interviewed

Pseudonym	**Gender**	**Age**	**School type (Government (G), Private (P))**	**School Class or Grade**	**Percentage of marks scored during the last three years (%)**	**Type of mobile device used**	**Daily mobile device usage for learning (hrs.)**	**Overall daily mobile device usage (hrs)**	**Daily mobile device usage before COVID-19 (hrs)**
STU1	F	18	G	12th	85 to 90	Tablet	2 to 4	4 to 6	0 to 2
STU2	M	14	P	10th	70 to 75	Smartphone	0 to 2	6 to 8	2 to 4
STU3	F	17	G	12th	80 to 85	Smartphone, Tablet	2 to 4	6 to 8	2 to 4
STU4	M	17	G	12th	75 to 80	Smartphone, Tablet	2 to 4	8 to 10	2 to 4
STU5	M	17	G	12th	80 to 85	Smartphone, Tablet	6 to 8	>10	4 to 6
STU6	F	13	P	9th	75 to 80	Smartphone, Laptop	2 to 4	4 to 6	0 to 2

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Table 4.1 (continued)

STU7	F	18	G	12th	60 to 65	Tablet	2 to 4	8 to 10	0 to 2
STU8	F	18	G	12th	75 to 80	Tablet	6 to 8	>10	4 to 6
STU9	M	17	G	11th	85 to 90	Smartphone, Tablet	6 to 8	6 to 8	0 to 2
STU10	M	18	G	12th	85 to 90	Smartphone	2 to 4	2 to 4	4 to 6
STU11	F	18	P	12th	55 to 60	Smartphone	4 to 6	>10	2 to 4
STU12	M	17	G	12th	70 to 75	Smartphone	2 to 4	2 to 4	0 to 2
STU13	M	18	G	12th	65 to 70	Smartphone	2 to 4	2 to 4	2 to 4
STU14	F	17	G	12th	60 to 65	Smartphone	2 to 4	>10	0 to 2
STU15	M	16	P	11th	-	Smartphone	0 to 2	8 to 10	0 to 2
STU16	F	17	G	11th	70 to 75	Smartphone	2 to 4	2 to 4	0 to 2
STU17	F	15	P	11th	90 to 95	Smartphone, Laptop	8 to 10	8 to 10	0 to 2
STU18	F	17	G	11th	70 to 75	Smartphone	2 to 4	4 to 6	2 to 4
STU19	M	19	G	12th	70 to 75	Smartphone	4 to 6	>10	0 to 2
STU20	F	16	G	10th	70 to 75	Smartphone	4 to 6	4 to 6	0 to 2
STU21	M	14	P	9th	65 to 70	Smartphone	4 to 6	8 to 10	0 to 2
STU22	M	16	P	11th	85 to 90	Laptop, Smartphone	4 to 6	>10	0 to 2
STU23	M	13	P	9th	90 to 95	Smartphone	4 to 6	6 to 8	0 to 2
STU24	F	18	P	12th	85 to 90	Laptop, Smartphone	4 to 6	6 to 8	2 to 4

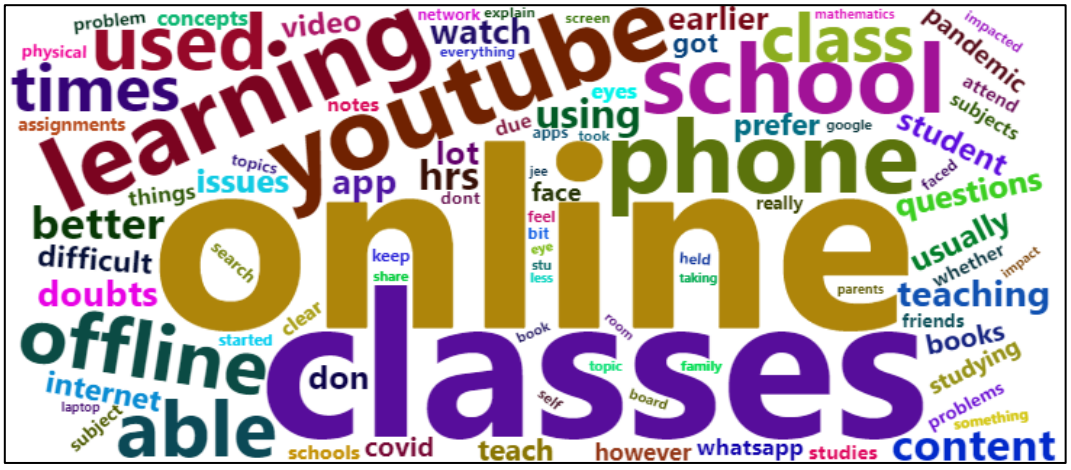

Figure 4. 1 Word Cloud interview transcripts of the participants

Table 4. 2 Profile of teachers interviewed

Pseudonym	Gender	Age	School type (Government (G), Private (P))	Class(es) or Grade(s) taught	Subject(s) taught	Total teaching experience (years)	Type of mobile device used	Daily mobile device usage for teaching and learning (hrs)	Overall daily mobile device usage (hrs)	Daily mobile device usage before COVID-19 (hrs)
THR1	F	58	G	11th, 12th	Sanskrit	28	Tablet, Smartphone	4 to 6	8 to 10	2 to 4
THR2	F	53	G	11th, 12th	Economics	25	Tablet, Smartphone	4 to 6	6 to 8	0 to 2
THR3	F	55	G	11th, 12th	Hindi	30	Tablet, Smartphone	2 to 4	4 to 6	0 to 2
THR4	M	57	G	11th, 12th	English	28	Tablet, Smartphone	2 to 4	4 to 6	0 to 2
THR5	M	54	G	9th, 10th	Science	26	Tablet, Smartphone	4 to 6	6 to 8	0 to 2
THR6	M	29	P	9th,10th	Mathematics	4	Smartphone	4 to 6	6 to 8	0 to 2
THR7	M	34	P	11th, 12th	Accounts	11	Smartphone	2 to 4	8 to 10	2 to 4
THR8	F	46	P	9th, 10th	Science	23	Laptop, Smartphone	2 to 4	6 to 8	0 to 2
THR9	F	34	P	11th, 12th	Computer Science	10	Laptop, Smartphone	2 to 4	6 to 8	0 to 2

4.3. Analysis techniques for interview transcripts

The following analysis was performed. Firstly, mobile device usage before and during the pandemic, the type of mobile device (e.g., laptops, tablet PCs, smartphones), type of school (government, and private), and word frequency as depicted in Word Cloud of interview transcripts (Fig. 1) were analyzed, and interpreted. A Word Cloud of the interview transcript was created in R-studio using the “wordcloud2” package to visually represent the word frequencies. Secondly, the interview transcripts were analyzed and interpreted based on hermeneutic phenomenological methods and procedures (van Manen, 2016). Hermeneutic phenomenology is a qualitative technique to describe a socially constructed, complex, and ever-changing phenomenon (Sloan & Bowe, 2014). Hermeneutic phenomenology describes research as oriented toward lived experience (phenomenology) and interpreting the “texts” of life (hermeneutics) (Creswell, 2009; van Manen, 2016). It has evolved into a relatively mature empirical science and methodology. Scholars in the field of education frequently use this methodology to bridge the gap between

theory and everyday pedagogical practice (Bartscht, 2013; Friesen, Henriksson, & Saevi, 2012). The attempt is to unfold meanings as they are lived in everyday existence and perhaps uncover new or forgotten meanings(Laverty, 2003).

The wholistic or sententious, selective or highlighting and detailed or line-by-line approaches were used to uncover emerging themes. Each approach was focused on conducting a different level of analysis based on the text scale. The interview transcripts were interpreted using a "hermeneutic circle" within the context of factors influencing m-learning continuance intention (Debesay, Nåden, & Slettebø, 2008; Longxi, 2018). Interpretive understanding is integral to a hermeneutic study (Boell & Cecez-Kecmanovic, 2010). Following the process of the "hermeneutic circle", understanding and engagement with the text were deepened by moving from parts of the experience to the whole of the experience and back and forth again and again. The process is widely accepted by researchers to interpret texts and uncover a realistic description of a phenomenon (Klostermaier, 2008). The understandings, beliefs, biases, assumptions, presuppositions, and theories should be made explicit as they may persistently creep back into the researcher's reflections when it is attempted to forget or ignore them (van Manen, 2016). The researchers' prejudices and presuppositions are acknowledged and considered valuable in hermeneutic phenomenological research. The prejudices, biases, and presumptions were self-reflected and continuously examined in the analysis and interpretation stages. The interpretive process incorporated a "fusion of horizons" through a dialectical interaction between the researcher's expectations and the meaning of the text (Laverty, 2003). The fusion marks the birth of a new understanding of the text (i.e., interview transcripts of the school students and teachers). However, the new meaning is only one of the many possibilities that might have come into being (Informa et al., 2009).

4.4. Identified themes from interview transcripts

Interpretation and reasoning through "hermeneutic circle" and "fusion of horizons" within the context of m-learning continuance revealed the following 12 themes: attitude, facilitating conditions, habit, perceived compatibility, perceived

content quality, perceived enjoyment, perceived teaching quality, perceived technical quality, perceived usefulness, perceived value, satisfaction, and social influence. The themes represent the factors influencing m-learning continuance intention.

4.4.1. Attitude

The participants indicated difficulty adopting m-learning. The smartphone was perceived as a blessing and essential during the COVID-19 pandemic. Under the abnormal circumstances, the participants expressed excitement about m-learning. However, the students and teachers indicated that they faced several issues such as communication lag, distracted learning, health issues, ineffective assessment, login issues, low video quality, mobile device addiction, and social media addiction. The quotes below explain the views of the participants.

> *"...Although mobile learning is an innovative idea, I will rate it less than offline learning..."*(STU11)

> *"...Generally, I don't like m-learning. I prefer to study offline with a teacher taking sessions in physical mode…"* (STU12)

4.4.2. Facilitating conditions

The analysis suggested that the m-learning of the participants was influenced by the availability of appropriate mobile devices, reliable Internet, and power supply. Further, some participants suggested that m-learning was adversely impacted by inadequate, costly, and unreliable Internet. In addition, power cuts hampered Internet connection. Many students mentioned getting distracted as they studied on their mobile devices. The distractions were phone calls, messages, social media app notifications, advertisements, and mobile games. Other distractions included background noise, household work during the pandemic, Internet interruption, multiple students switching ON their microphones (mic) simultaneously, pranks by students, and students forgetting to turn OFF their mics during live online classes. Further, the teachers indicated using whiteboards or blackboards, tripods,

webcams, microphones, and Bluetooth headphones. They ensured that the mobile devices were sufficiently charged and the background was noise-free and well-illuminated while taking online classes on mobile devices.

Further, the participants indicated receiving training from friends, relatives, colleagues, and institutions. A few students hinted at getting learning support from their parents and siblings as the learning space (e.g., study table, room) at home was shared among family members. The quotes below explain the views of the participants.

> *"…There was a problem of Internet connectivity also. 10-15% of students did not have smartphones, so they could not be connected in online classes..."* (THR5)
>
> *"…Sometimes there is no electricity at home, so no Internet..."* (STU2)

4.4.3. Habit

Most participants suggested being habitual in using m-learning apps. Table 4.1 revealed that most students (67%, *n* = 16/24) interacted with their mobile devices for more than 6 hours per day during the pandemic. However, most (58%, *n* = 14/24) used mobile devices for less than 2 hours per day before the pandemic. Further, 75% (*n* = 18/24) of students did m-learning for 2 to 6 hours per day. Further, Table 4.2 indicated that the teachers used a mobile device for teaching and learning for 2 to 6 hours per day. Overall mobile device usage for most (78%, *n* = 7/9) teachers was more than 6 hours per day during the pandemic. However, usage was less than 2 hours per day for the majority (78%, *n* = 7/9) of teachers before the pandemic. The quotes below explain the views of the participants.

> *"…Everything happens on mobile phone…Even if I don't want to use then also I have to use … school classes, assignments, solutions everything is on mobile…"* (STU11)
>
> *"…I use apps like DIKSHA, NCERT Books & Solutions, myCBSEguide..."* (STU16)

4.4.4. Perceived content quality

The participants shared that they performed Internet searches on their mobile devices and found relevant content from multiple sources in numerous formats (e.g., audio, video, text, etc.). Many students preferred to study through YouTube as it provided free, diverse, and vast content. However, a few others hinted the YouTube video lectures were outdated, confusing, incomplete, and lacked detailed syllabus coverage. Further, the participants mentioned using several apps such as DIKSHA, Physics Wallah, and Unacademy. They evaluated the content through the number of likes, dislikes, subscribers, syllabus coverage, accuracy and simplicity of explanation, and desired language. The quotes below explain the views of the participants.

> *"…The content quality is just fine and not very great..." (*STU17)

> *"…All the learning resources are available on the app. The app has covered all the syllabus of 12th class…"* (STU9)

4.4.5. Perceived compatibility

A few students indicated following a selected teacher's YouTube channel for the past many years. Some of them preferred YouTube videos over tuition or coaching. On the contrary, one student mentioned requiring personal tuition to understand the content. Some students indicated that learning could only happen when teaching is face-to-face. Further, a few participants indicated that m-learning might benefit students with good learning capabilities. One student expressed frustration over the lack of after-class discussions. However, a few students hinted at getting more time to think as discussion on mobile apps is usually asynchronous. Further, a few participants indicated that m-learning was not compatible with their mobile devices. In addition, some participants hinted inability to use m-learning for longer durations

due to health issues such as eye strain, and back pain. The quotes below explain the views of the participants.

> *"....my earlier phone had little RAM and other technical specifications such as low battery backup. So, I was not able to run heavy apps on the mobile."* (STU5)
>
> *"...I have a problem with my eyes. They pain if I use a mobile phone screen for a long time. My eyesight is otherwise normal 6/6. I don't know why I have such pain..."* (STU12)

4.4.6. Perceived enjoyment

The study suggested that most students enjoy the physical school environment as they get more freedom to explore, experience, and experiment. Concerningly, one student observed a lack of confidence and fear of interaction among fellow students when schools re-opened partially. Some students expressed awkwardness during online doubt-clearing sessions and discussions. On the contrary, a few students indicated enjoyment with m-learning. The quotes below explain the views of the participants.

> *"...I totally enjoy mobile learning..."* (STU1)
>
> *"...In school it is fun, I don't really enjoy m-learning..."* (STU21)

4.4.7. Perceived teaching quality

Many teachers hinted lack of rich discussions in m-learning. Most teachers observed that they modified their teaching pedagogy for conducting online classes on mobile devices. They conducted innovative and exciting activities (e.g., quizzes, and real-life problem solving). In addition, the students mentioned that teachers leveraged mobile apps' features in their teaching method and taught creatively and interestingly in a friendly manner. They explained through smartboards and animations and shared PDF notes and links for additional questions and practice sheets in the description section of their videos. The teachers responded to the doubts of students in the

comment section and created Telegram groups to clarify doubts. However, doubt clearing in the comment section was indicated to be effective only when the number of doubts was less, and the reply was prompt. Two students sometimes hinted at difficulty describing, explaining, and communicating their doubts in the comments section of the apps. Additionally, one teacher mentioned that teaching-learning is successful only when a close relationship exists between students and teachers. However, the findings indicated that such a relationship was difficult to establish in m-learning. Further, the teachers hinted that identifying and encouraging shy students to participate in class discussions was challenging. The quotes below explain the views of the participants.

> *"…On mobile apps, they teach creatively. I also like it..."* (STU9)
>
> *"…There is one teacher who never clears doubt. She just keeps on teaching in her own way. It does not matter to her whether the students are understanding or not…"* (STU6)

4.4.8. Perceived technical quality

The participants indicated evaluating the mobile app quality as they engaged with m-learning. A few participants hinted that searching on mobile apps to find appropriate content is time-consuming. In addition, one student suggested customizing the apps for the learning needs of the students. Most participants indicated the m-learning apps to be easy to use and user-friendly. However, they revealed several issues including app freeze, lagging and buffering of audio and video content, and a considerable number of ads and promotions. Further, one teacher hinted at high lecture preparation time and low actual content delivery due to technical issues. The quotes below explain the views of the participants.

> *"…The app buffers and lags sometimes … The app otherwise is user friendly..."* (STU1)
>
> *"…I am able to use mobile apps comfortably and easily find the content I want to study..."* (STU13)

4.4.9. Perceived usefulness

The participants of this study evaluated m-learning for its usefulness in enhancing their learning. A few students indicated that m-learning enhanced their understanding of the subject and could be customized to their needs and interests. Most participants found m-learning to be useful, especially during the school closures due to the pandemic. Further, the participants mentioned using mobile apps of Google Classroom, Google Meet, Microsoft Teams, Telegram, WhatsApp, YouTube, and Zoom. Besides, a few students also used other educational apps such as Byju's and Unacademy. A few students mentioned using subject-specific apps (e.g., Commerce Baba, Mathway, Physics Wallah), education board-specific apps (e.g., myCBSEguide, Ncert Books & Solutions), and goal-specific apps (e.g., Doubtnut, Rankers). Some government school teachers mentioned using ChalkLit, DIKSHA, and ePathshala apps. Further, some students hinted to prefer video lectures for some subjects (e.g., Accounts, Economics, Mathematics, Science) and text notes (e.g., word, pdf) for others (e.g., English, Business Studies). A few students used m-learning for all the subjects, including physical education and fine arts, to develop new skills and understand advanced topics (e.g., YouTube marketing). The quotes below explain the views of the participants.

> *"...I find the mobile learning apps useful..."* (STU19)
>
> *"...I use mobile learning...to better understand concepts. Some concepts are not clear to me and I could not understand them in school..."* (STU16)

4.4.10. Perceived value

The findings suggested that students used m-learning to prepare for examinations (including competitive examinations), develop a detailed and comprehensive understanding of topics, and self-assessment. Further, most aspects of student life (e.g., classes, assignments, evaluation, co-curricular activities, entertainment, and social interactions) converged into smartphones. A few students

suggested that m-learning is essential for students to improve their skills and capabilities. The quotes below explain the views of the participants.

> *"... I find the mobile learning apps…reliable…Mobile learning provides such a big platform that you can search any content. You are able to explore in detail about a particular topic…"* (STU19)
>
> *"...I can learn using my mobile phone anytime I want…saves time…if I don't understand from one teacher, there are several other teachers from whom I can understand the topic..."* (STU4)

4.4.11. Satisfaction

The participants rated their satisfaction with m-learning on a scale from 1 to 10. The majority of the students (67%, *n* = 16/24), and teachers (86%, *n* = 6/7) rated in the range from 6 to 8 indicating a moderate level of satisfaction. Further, only a few participants (9%, *n* = 3/33) were highly satisfied. Interestingly, no teacher was highly satisfied with m-learning. In addition, a few participants (5 students, and 1 teacher) expressed low levels of satisfaction as they rated below 6. One of the unsatisfied students indicated that m-learning is depressing as there is no physical interaction with fellow students and teachers. The student expressed frustration over staring at a mobile device screen. Further, the unsatisfied teacher expressed concerns about several issues faced by students during m-learning. Even one of the highly satisfied students suggested a low preference for m-learning. In addition, most teachers shared that students turned off the mic and webcam, were not disciplined, and had a casual attitude towards studies. Further, the teachers hinted that m-learning limited their ability to sense students' needs, expectations, level of understanding, and responses through students' facial expressions and body language. The quotes below explain the views of the participants.

> *"…The overall experience of mobile learning is good…"* (STU4)
>
> *"……I like learning from the apps because they explain pretty well all the methods. They also clear all my doubts..."* (STU20)

4.4.12. Social influence

The findings suggest the influence of teachers, friends, and family members including parents and siblings. Further, the teachers revealed that they formed subject-specific virtual groups to share ideas, thoughts, and learning resources. Many students shared that their parents allowed limited or no mobile device usage before the pandemic. On the contrary, during the pandemic, parents perceived m-learning as a way to ensure educational continuity. They supervised students' m-learning and closely collaborated with teachers. However, the parents were worried about excessive mobile device usage. The quotes below explain the views of the participants.

> *"...My father encouraged me to use a mobile phone for studying..."(*STU4)
> *"...My sister advises me which YouTube channels to watch for studies. Some of the apps like CBSE and NCERT solutions I got to know from my teachers and friends..."* (STU18)

4.5. Concluding remarks

This chapter described the mobile learning 'lived experiences' of school students and teachers. The verbatim transcripts of semi-structured interviews of school students and teachers were analyzed through hermeneutic phenomenological methods. The findings indicated increased mobile device usage and adoption of m-learning during the COVID-19 pandemic. However, the participants expressed difficulty adapting to the abrupt transition to m-learning due to COVID-19. The participants built a "learner-constructed learning environment" and used several apps. They reported several issues as they experienced m-learning. Some expressed anxiety, sadness, and depression. The teachers shared modifying their teaching pedagogy and using technology aids (e.g., microphone, tripods) and provided support and scaffolding to students. However, they were not satisfied teaching on mobile devices. M-learning

lacks face-to-face interaction and has several distractions (e.g., app notifications, messages, and phone calls). The participants shared accessing learning resources anytime, anywhere, and in any format (e.g., text, audio, video). Further, the students could customize m-learning as per their learning style. However, the parents were worried about students' excessive usage of mobile devices and their adverse impact on their eyes.

Further, the analysis revealed 12 themes or factors influencing m-learning continuance intention. The factors are attitude, habit, facilitating conditions, perceived compatibility, perceived content quality, perceived enjoyment, perceived teaching quality, perceived technical quality, perceived usefulness, perceived value, satisfaction, and social influence. The factors of perceived content quality, perceived technical quality, and perceived teaching quality can be represented by a single factor of the perceived quality of the m-learning app.

The comprehensive analysis of existing literature in chapter two, mobile learning app reviews and ratings in the previous chapter, and verbatim interview transcripts in this chapter suggest that the following ten variables influence the m-learning app continuance intention among school students: a) attitude, b) facilitating conditions, c) habit, d) perceived compatibility, e) perceived enjoyment, f) perceived quality, g) perceived usefulness, h) perceived value, i) satisfaction, and j) social influence. The next chapter deals with the research design and proposes a conceptual research framework for the identified research variables.

CHAPTER 5

RESEARCH DESIGN

5.1. Introduction

The present study is based on a pragmatism research paradigm. It offers a logical ground, methodological flexibility, and an in-depth understanding (Maxwell, 2016). The pragmatism research paradigm is extensively used in educational technology research as it provides the best understanding of the research problem by combining the strengths of quantitative and qualitative approaches while making up for the weaknesses of both approaches (Khaldi, 2017). It has become a prevalent worldview in educational technology research due to its potential to address complex educational problems (Peters & Fàbregues, 2023).

Guided by the philosophical underpinnings of pragmatism, the mixed methods research design has been used in this study to examine the phenomenon of mobile app adoption and continuance for school-level learning (Creswell, 2014; Doyle, Brady, & Byrne, 2016). The mixed methods design resides in the middle of the continuum with qualitative and quantitative as two ends. The qualitative methods provide the depth and quantitative methods provide the breadth of the research study. Therefore, the mixed methods design provides a comprehensive understanding of the research problem and a holistic view of a phenomenon (Carter, Bryant-Lukosius, Dicenso, Blythe, & Neville, 2014). An integration and synthesis of multiple data sources and the use of mixed research methods allow the researchers to view a complex phenomenon from multiple perspectives (Shorten & Smith, 2017).

The mixed methods research design has been used in the present study in the following manner. The quantitative analysis of the bibliometric data of the relevant publications on m-learning adoption and continuance in education was presented in

section 2.4 chapter two. Further, quantitative content analysis, sentiment analysis, and statistical analysis of the reviews and ratings of the m-learning apps are dealt with in chapter three. A qualitative inquiry into the m-learning "lived experiences" of school students and teachers has been conducted in chapter four. Moreover, a quantitative analysis of the research variables of this study is a subject matter of chapter six.

This chapter is structured as follows: the next section describes the research variables of the study. Further, a conceptual research framework of the study has been depicted in the third section. The fourth section deals with the research hypotheses. Subsequently, the methodology of the research study is presented in section five. The next section i.e., section six deals with the roadmap of the study. Further, the last section provides the concluding remarks.

5.2. Research variables

The analysis conducted in the previous chapters suggested the following ten variables influencing continuance intention to use mobile apps for school level learning: a) attitude, b) facilitating conditions, c) habit, d) perceived compatibility, e) perceived enjoyment, f) perceived quality, g) perceived usefulness, h) perceived value, i) satisfaction, and j) social influence. The variables are discussed below.

5.2.1. Attitude (ATT)

Attitude is referred to as the degree of a school student's pleasure or displeasure with m-learning apps (Liao et al., 2009). It refers to the overall evaluation of m-learning apps by students. The attitude of students toward m-learning apps changes slowly over time, based on the judgment of the experience of using m-learning apps (Oliver, 1980). Several theories of IS/IT adoption mention Attitude as a key construct influencing behavioral intention (Davis, 1989; Fishbein & Ajzen, 1975; Taylor & Todd, 1995). In addition, many researchers suggest that attitude has a significant association with continuance intention (Al-Debei et al., 2013; Liao et al., 2009). A study of m-learning among students in Taiwan indicated a significant positive

effect of attitude on behavioral intention (J. H. Huang, Lin, & Chuang, 2007). Another study examining m-learning continuance intention among students indicated similar findings (Al-Emran et al., 2020). The existing studies indicate a significant positive effect of attitude on continuance intention.

5.2.2. Facilitating Conditions (FC)

Facilitating conditions determine the extent to which a school student believes that resources exist to support the use of m-leaning apps (Venkatesh et al., 2003). According to the extended information technology continuance theory (Bhattacherjee et al., 2008), facilitating conditions are a significant predictor of continuance behavior. Several studies indicate that facilitating conditions strongly influence mobile learning usage (Ameri, Khajouei, Ameri, & Jahani, 2020). In mobile learning, facilitating conditions positively affect perceived usefulness (Alyoussef, 2021; Hao, Dennen, & Mei, 2017). Further, an m-learning study revealed a significant positive effect of facilitating conditions on perceived enjoyment (Kaisara, Atiku, & Bwalya, 2022). The existing studies suggest that facilitating conditions influence several factors influencing continuance intention. Therefore, it can be assumed that facilitating conditions influence the perceived value of m-learning apps.

5.2.3. Habit (HBT)

Habit refers to the extent to which a school student believes the usage behavior of m-learning apps to be automatic due to previous experience (Venkatesh et al., 2012). Bhattacherjee and Lin (2015) proposed a unified model of information technology continuance and suggested a significant influence of habit on continuance behavior. Existing studies suggest the influence of habit in the usage of m-learning apps (Ameri et al., 2020). A review of the literature indicated a significant positive effect of habit on continuance intention to use information systems (Franque et al., 2021). Several scholars have empirically validated the positive influence of attitude on

behavioral intention. It would be interesting to examine the association between habit and attitude.

5.2.4. Perceived Compatibility (PC)

Perceived compatibility is the degree to which m-learning apps fit with the school student's existing values, previous experiences, and current needs (Taylor & Todd, 1995). A study indicated that perceived compatibility influences continuance intention to use m-learning (Cheng, 2015). Further, a study examining essential factors affecting the intention to use mobile learning apps suggested that perceived compatibility significantly influences students' behavioral intention to use m-learning apps (Almaiah & Al Mulhem, 2019). Another study of Yemeni students suggested that perceived compatibility has a positive influence on satisfaction (Isaac, Aldholay, Abdullah, & Ramayah, 2019). The existing body of knowledge suggested that perceived compatibility positively influences satisfaction from using mobile apps for school level learning.

5.2.5. Perceived Enjoyment (PE)

Perceived enjoyment is the extent to which a school student perceives m-learning apps to be enjoyable in their own right, aside from any performance consequences (F. D. Davis, Bagozzi, & Warshaw, 1992). It is an intrinsic hedonic motivator (Y. M. Cheng, 2015). The students may perceive a sense of pressure during the learning process. Hence, they may continue enjoyable activities (Liu, Han, & Li, 2010). Emotions such as enjoyment play a critical role in learning (O'Regan, 2019). Perceived enjoyment is one of the significant factors influencing m-learning (Franque et al., 2021; B. A. Kumar & Chand, 2019). A study of users of mobile instant messaging suggested that perceived enjoyment has a significant positive effect on satisfaction (Oghuma, Libaque-Saenz, Wong, & Chang, 2016). Another recent study indicated a significant positive influence of perceived enjoyment on satisfaction, and an insignificant effect on continuance intention (Pereira & Tam, 2021).

5.2.6. Perceived Quality (PQ)

Perceived quality refers to the school student's judgment about m-learning apps' overall excellence or superiority (Zeithaml, 1988). It takes into consideration how well the m-learning app facilitates student's learning (Venkatesh & Davis, 2000). It is an important antecedent to satisfaction (Oghuma et al., 2016). A study among students in Jordan indicated a significant influence of perceived quality on the m-learning process (Althunibat, 2015). (Liu et al., 2010) suggested that perceptions of students regarding the different aspects of quality (e.g., content and technical) influence their satisfaction with m-learning apps. Another study among learners in Taiwan suggested that attributes of quality such as information and system quality are significant predictors of satisfaction (Chiu, Chiu, & Chang, 2007). The existing literature hinted that perceived quality is a significant antecedent of a student's satisfaction with m-learning apps.

5.2.7. Perceived Usefulness (PU)

Perceived usefulness is the degree to which a school student believes that using m-learning apps would enhance his or her performance (F. D. Davis, 1989). The construct has been extensively examined in the technology adoption and continuance literature. It positively affects the m-learning process (Bhattacherjee, 2001a; Huang et al., 2014; Wang & Lin, 2021). The studies suggest that the association between perceived usefulness and intention to use m-learning is significant only during the initial stages of usage and becomes insignificant as the usage increases (Liao et al., 2009). Further, a study examining m-learning among Korean students indicated an insignificant direct effect of perceived usefulness on continuance intention (Joo, Lee, & Ham, 2014). Moreover, a study of mobile Internet indicated that perceived usefulness has a significant positive influence on perceived value (Kim, Chan, & Gupta, 2007). Another study in China suggested a significant positive effect of perceived usefulness on perceived value (Wang, 2014). Based on the existing research,

it can be assumed that a school student's perceived value of an m-learning app is influenced by his or her perception of the app's usefulness.

5.2.8. Perceived Value (PV)

Perceived value refers to a school student's total evaluation of m-learning apps based on losses and benefits (Kim et al., 2007; Wang & Teo, 2020; Zeithaml, 1988). It is associated with cognitive, task-oriented, and non-emotional outcomes and significantly influences students' m-learning satisfaction (Yoo & Cho, 2020). It has a significant positive association with continuance intention (Al-Debei et al., 2013; Wang, Teo, & Liu, 2020). Further, (S. Yang, Jiang, Yao, Chen, & Wei, 2018) suggested that perceived value influences the continuance intention of mobile government microblogging services in China. Moreover, a meta-analysis of information systems continuance intention literature indicated a significant influence of perceived value on continuance intention (Franque et al., 2021). In addition, a study exploring the determinants of continuance intention of e-learning systems in academic libraries suggested that perceived value significantly influences satisfaction and continuance intention (Chang, 2013). The researchers suggest a positive effect of perceived value on continuance intention. Moreover, the association between perceived value and attitude may be examined.

5.2.9. Satisfaction (SAT)

Satisfaction is the extent to which a school student believes that m-learning apps meet his or her requirements (Thong & Yap, 1996). It is a post-consumption evaluation of the performance of m-learning apps. Satisfaction is a transient and experience-specific effect. It is one of the predominant antecedents of continuance intention (Bhattacherjee, 2001b; Panigrahi, Srivastava, & Sharma, 2018). According to (Liao et al., 2009), satisfaction has a significant positive effect on continuance intention. A study examining the continuance intention of a web-based learning system supported the association between satisfaction and continuance intention (Chiu et al.,

2007). Similarly, a study of m-learning among students in Iran suggested a positive influence of satisfaction on intention (Mohammadi, 2015b). However, a recent study examining continuance intention to use m-learning among students in the United Arab of Emirates (UAE) suggested that the influence of satisfaction on continuance intention is not significant (Al-Emran et al., 2020). In addition, a study examining continuance intention suggested that satisfaction has a significant positive effect on attitude (Lin, 2011). Another longitudinal study of participants from Hong Kong indicated a significant influence of satisfaction on attitude (Venkatesh, Thong, Chan, Hu, & Brown, 2011). The literature indicates a mixed opinion regarding the influence of satisfaction on continuance intention. It would be interesting to examine this relationship in the context of mobile apps for school-level learning. In addition, the existing research suggests that satisfaction is a significant predictor of attitude.

5.2.10. Social influence (SI)

Social influence is the extent to which a school student perceives that important people (e.g., family, friends, teachers) believe he or she should use mobile learning apps (Venkatesh et al., 2012). The student's opinions may be influenced by peers, teachers, and educational institution policies (Abdullah & Ward, 2016). Several researchers have empirically tested the relationship between social influence and continuance intention and found it significant, especially for social networking and e-commerce platforms. However, the relationship is not well established for other technologies (Yan et al., 2021). Social influence is also a significant predictor of perceived usefulness (Alyoussef, 2021; Liu & Pu, 2020). (Al-Azawei & Alowayr, 2020) empirically tested the relationship between social influence and perceived enjoyment and found it insignificant. On the contrary, a study of school students in Indonesia found a significant positive effect of social influence on perceived enjoyment (Pratama, 2021). The existing studies indicate mixed results regarding the influence of social influence on several variables influencing continuance intention. Therefore, the study attempts to examine the relationship between social influence and perceived value.

5.3. Conceptual research framework

A conceptual framework provides a frame of reference for a study. It is the basis of research hypotheses (Hymovich, 1993). The framework includes all of the concepts, theories, and beliefs that the researcher holds about the phenomenon to be studied (Joseph Alex Maxwell, 2023). According to (Antonenko, 2015), a conceptual framework is "a theory-based and evidence-driven argument that is developed to justify the significance of the problem, define relevant concepts, establish theoretical and empirical rationale, guide selection of appropriate methods, and scaffold data analysis and interpretation." In this study, a review of the relevant literature about the identified variables influencing continuance intention to use mobile apps for school level learning was performed to articulate the study's variables and their relationships (Luft, Jeong, Idsardi, & Gardner, 2022). Fig. 5.1 depicts the conceptual research framework for the present study.

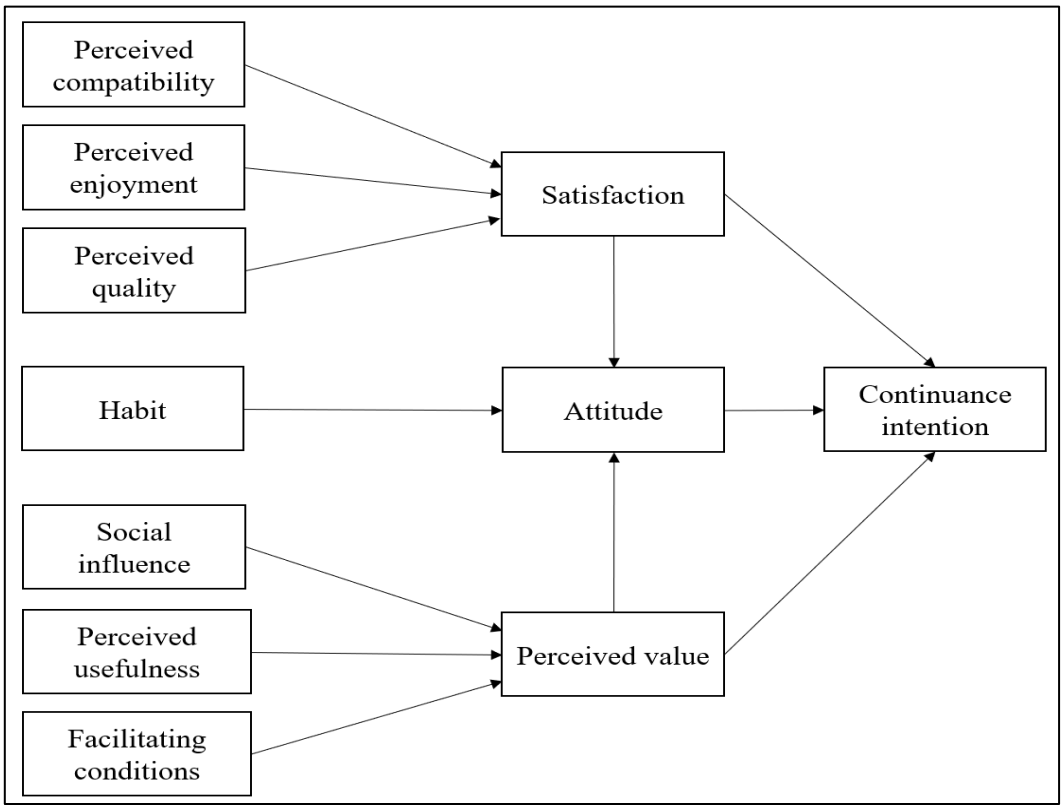

Figure 5. 1 Conceptual research framework of the study

5.4. Research hypotheses

The proposed alternative hypotheses against the corresponding null hypotheses are as follows:

5.4.1. Social influence

Alternative Hypothesis: HA1: *'Social influence' influences a school student's 'Perceived value' of m-learning apps.*

Null Hypothesis: H01: *'Social influence' does not influence a school student's 'Perceived value' of m-learning apps.*

5.4.2. Perceived usefulness

Alternative Hypothesis: HA2: *'Perceived usefulness' influences a school student's 'Perceived value' of m-learning apps.*

Null Hypothesis: H02: *'Perceived usefulness' does not influence a school student's 'Perceived value' of m-learning apps.*

5.4.3. Facilitating conditions

Alternative Hypothesis: HA3: *'Facilitating conditions' influences a school student's 'Perceived value' of m-learning apps.*

Null Hypothesis: H03: *'Facilitating conditions' does not influence a school student's 'Perceived value' of m-learning apps.*

5.4.4. Perceived quality

Alternative Hypothesis: HA4: *'Perceived quality' influences a school student's 'Satisfaction' with m-learning apps.*

Null Hypothesis: H04: *'Perceived quality' does not influence a school student's 'Satisfaction' with m-learning apps.*

5.4.5. Perceived enjoyment

Alternative Hypothesis: HA5: *'Perceived enjoyment' influences a school student's 'Satisfaction' with m-learning apps.*

Null Hypothesis: H05: *'Perceived enjoyment' does not influence a school student's 'Satisfaction' with m-learning apps.*

5.4.6. Perceived compatibility

Alternative Hypothesis: HA6: *'Perceived compatibility' influences a school student's 'Satisfaction' with m-learning apps.*

Null Hypothesis: H06: *'Perceived compatibility' does not influence a school student's 'Satisfaction' with m-learning apps.*

5.4.7. Habit

Alternative Hypothesis: HA7: *'Habit' influences a school student's 'Attitude' towards m-learning apps.*

Null Hypothesis: H07: *'Habit' does not influence a school student's 'Attitude' towards m-learning apps.*

5.4.8. Perceived value

Alternative Hypothesis: HA8: *'Perceived value' influences a school student's 'Attitude' towards m-learning apps.*

Null Hypothesis: H08: *'Perceived value' does not influence a school student's 'Attitude' towards m-learning apps.*

Alternative Hypothesis: HA9: *'Perceived value' influences a school student's 'Continuance intention' to use m-learning apps.*

Null Hypothesis: H09: *'Perceived value' does not influence a school student's 'Continuance intention' to use m-learning apps.*

5.4.9. Attitude

Alternative Hypothesis: HA10: *'Attitude' influences a school student's 'Continuance intention' to use m-learning apps.*

Null Hypothesis: H010: *'Attitude' does not influence a school student's 'Continuance intention' to use m-learning apps.*

5.4.10. Satisfaction

Alternative Hypothesis: HA11: *'Satisfaction' influences a school student's 'Attitude' towards m-learning apps.*

Null Hypothesis: H011: *'Satisfaction' does not influence a school student's 'Attitude' towards m-learning apps.*

Alternative Hypothesis: HA12: *'Satisfaction' influences a school student's 'Continuance intention' to use m-learning apps.*

Null Hypothesis: H012: *'Satisfaction' does not influence a school student's 'Continuance intention' to use m-learning apps.*

5.5. Research methodology

Methodology refers to a systematic process adopted to conduct a research study. The methodological considerations include participants, instruments for data gathering, techniques for data analysis, assumptions made, limitations encountered, and their mitigation or minimization (Khatri, 2020). The methodological questions that guide the researcher include: "How can the inquirer (would-be knower) go about finding out whatever he or she believes can be known?" (Guba & Lincoln, 1994). Simply put, the methodology describes how to conduct a well-planned research investigation (Keeves, 1997). The various methodologies adopted for the qualitative and quantitative inquiries of the present mixed methods research design (see Table 5.1) are described below.

5.5.1. Data collection

The metadata (e.g., authors, citations, journals) of relevant publications for bibliometric analysis presented in section 2.4 of chapter two was extracted from the Web of Science database. Further, the mobile learning app reviews and ratings data for the quantitative inquiry of chapter three were collected from the Google Play mobile app store. Two thousand publicly available comments from the users of four m-learning apps were extracted, cleaned, and transformed. Furthermore, semi-structured in-depth interviews with school students and teachers were conducted, and verbatim transcripts were created to collect data for the qualitative inquiry presented in chapter four. The participants expressed their lived experiences of using m-learning apps. Moreover, a paper-based survey questionnaire was designed and circulated among students to capture data for the quantitative investigation brought out in chapter six.

Table 5. 1 Mixed methods research design of the study

Sl. no.	Research objective	Type of inquiry	Relevant section/ chapter of the study	Data collection	Data analysis	References
1	To analyze the existing literature on m-learning adoption and continuance in the field of education.	Quantitative	Section 2.4 of chapter two	metadata of relevant publications in the field of m-learning adoption and continuance in education	Bibliometric techniques of performance analysis, science mapping, and network analysis.	(Yi, Ao, & Ho, 2008); (Karakose, Tülübaş, & Papadakis, 2022); (Lim & Kumar, 2023); (Donthu, Kumar, Mukherjee, Pandey, & Lim, 2021)
2	To examine the reviews and ratings of mobile apps for the public and private sector, and higher education and school level learning.	Quantitative	Chapter three	m-learning apps' reviews and ratings	Quantitative content analysis, sentiment analysis, and statistical analysis	(Harwood & Garry, 2003); (Shelley & Krippendorff, 1984); (Boettger & Palmer, 2010); (Schreier, 2012); (Krippendorff, 2004).
3	To examine the 'lived experiences' of using mobile apps for school level learning.	Qualitative	Chapter four	Verbatim transcripts of semi-structured interviews of school students and teachers	Hermeneutic phenomenological methods of "hermeneutic circle" and "fusion of horizons"	(Gadamer, 2004); (Wilson & Hutchinson, 1991); (Koch, 1995); (Langdridge, 2007); (Guillen, 2019).
4	To conceptualize and empirically test a model for continuance intention to use mobile apps for school level learning.	Quantitative	Chapter six	Survey questionnaire filled out by school students	Structural equation modeling analysis	(Byrne, 2013; Schumacker & Lomax, 2004); (Weston & Gore, 2006); (Efiloğlu Kurt, 2019); (Hair et al., 2012); (Gefen & Straub, 2000); (Fornell & Larcker, 1981b); (Tabri & Elliott, 2012); (Anderson & Gerbing, 1988)

5.5.2. Data analysis

The bibliometric methods were used to analyze the metadata of relevant publications. The methods have become popular among scholars due to the advancement, availability, and accessibility of bibliometric softwares (e.g., Bibliometrix R, BibExcel, and VOSviewer) and scientific databases (e.g., Scopus and Web of Science). It facilitates quantitative analysis of a large volume of scientific data related to a specific domain to produce impactful research as it uncovers emerging trends, collaboration patterns, and intellectual structures. A proactive interpretation of bibliometric results may be achieved through the sensemaking approach (scanning, sensing, and substantiating) (Lim & Kumar, 2023). The techniques for analysis of metadata of publications can be categorized as follows: a) performance analysis, b) science mapping, and c) network analysis. The performance analysis involves publication and citation-related matrices (e.g., total publications, average citations, h-index), whereas science mapping includes citation, co-citation, co-word, and co-authorship analysis and bibliographic coupling. Further, network metrics (e.g., degree of centrality, betweenness centrality), and clustering (e.g., hierarchical clustering, multidimensional scaling) form part of network analysis (Donthu, Kumar, Mukherjee, Pandey, & Lim, 2021).

Further, the mobile app reviews and ratings data of the study were analyzed using quantitative content analysis, sentiment analysis, and statistical analysis. A variety of data (textual, visual, or aural) can be analyzed through content analysis. The text is reduced to defined categories which facilitates analysis and interpretation. It can be both qualitative and quantitative (Harwood & Garry, 2003). Both versions involve a systematic description of data through coding and are indispensable for the analysis of data (Shelley & Krippendorff, 1984). The qualitative content analysis focuses on providing a detailed description of the material under study. The qualitative content analysts evaluate the texts for emergent and recurring themes. The method allows deeper inferences about the implicit and explicit meanings. However, the quantitative form focuses on the manifest meaning and involves

statistical analysis. The quantitative content analysts examine the texts for predefined terms or phrases and use inferential statistics to make conclusions about their presence and offer insights into the relationships among the variables. The quantitative method involves the following steps: a) identify the corpus of texts that will explore the research questions, b) sample identification, c) collecting and categorizing data, d) building a coding scheme and traning of coders, e) data analysis, and h) presenting and interpreting the findings (Boettger & Palmer, 2010; Schreier, 2012). The categories are the patterns or themes expressed in the data. Further, a coding scheme is a translation device that includes a code book for defining and illustrating the variables being evaluated (Krippendorff, 2004).

The interview transcripts of school students and teachers were analyzed through hermeneutic phenomenological methods. The method emphasizes on life world or human experience of a phenomenon as it is lived. It facilitates detailed understanding and reveals trivial aspects of experience that are usually taken for granted (Wilson & Hutchinson, 1991). The data analysis involves the multiple stages of interpretation that allow patterns to emerge (Koch, 1995). The researcher moves in the 'hermeneutic circle', between the part of the text and the whole of the text, to establish the truth by discovering phenomena and interpreting them. During the analysis, the researcher follows reflexivity and uses relevant prior experience for the interpretation of meanings. A reflection on how the researcher's questions, methods, and subject position might impact the data or the psychological knowledge produced (Langdridge, 2007). The hermeneutic circle, dialogue, and process of interpretation lead to a "fusion of horizons" (Gadamer, 2004). A hermeneutic phenomenological study has the following phases: 1) establishing the preconceptions by the researcher, 2) collecting the experiences lived, 3) reflecting on the lived experience or structural stage, and, 4) writing about reflecting on the lived experience or phenomenological text. The preconceptions of the researcher may intervene in the study. The lived meaning of the specific experience of the participants may be collected through in-depth interviews. Holistic or sententious approach (express essential meaning of the text as a whole) , and selective or marking approach (read a text a number of times)

are applied on interview transcripts to identify the thematic units. The redundancies and repetitions of each thematic unit are eliminated, and the central theme of each unit is determined by clarifying and producing its meaning. Next, the researcher reflects on central themes of each thematic unit and integrates into a central theme. Thereafter, the researcher integrates the lived experiences of the participants into a single description or phenomenological text (Guillen, 2019).

The analysis of the survey questionnaire-based quantitative inquiry was performed through structural equation modeling (SEM). SEM is a statistical methodology that takes a confirmatory approach to the analysis of a structural theory. The hypothesized model can be tested statistically in a simultaneous analysis of the entire system of variables to determine the extent to which it is consistent with the data (Byrne, 2013; Schumacker & Lomax, 2004). The analysis can be performed in SEM software programs such as AMOS, Mplus, LISREL, and SmartPLS. SEM combines factor analysis and path analysis. It has two primary components namely, measurement model and structural model. The measurement model describes the relationships between observed variables (e.g., instruments) and the construct or constructs those variables are hypothesized to measure. In contrast, the structural model describes interrelationships among constructs. The analysis involves the following six steps: a) model specification, b) model identification, c) data preparation and screening, d) model estimation, e) evaluation, and f) modification. The first step involves specifying which relationships are hypothesized to exist or not to exist among observed and latent variables. The next step requires determining whether the model is over-, under-, or just identified. The considerations of sample size, multicollinearity, outliers, normality, and missing data form part of the third step. Subsequently, the model estimation is performed to determine the value of the unknown parameters and the error associated with the estimated value. Next, model fit is evaluated through fit indices. In addition, the estimated parameters are evaluated and interpreted. The last step is controversial as it involves post hoc model modification i.e., re-specification of the model (Weston & Gore, 2006).

The two widely used methods for SEM are Partial Least Squares based Structural Equation Modeling (PLS-SEM), and Covariance based Structural Equation Modeling (CB-SEM) (Dash & Paul, 2021). PLS-SEM is a popular method among information systems researchers and has been increasingly used for theory testing and evaluating models with complex relationships (Chin et al., 2020). Therefore, this study has used PLS-SEM to examine the relationships among the research variables.

After conducting the SEM analysis, the study involved triangulation and synthesis of the findings of the several qualitative and quantitative inquiries conducted in this mixed methods research study. Triangulation enhances the trustworthiness of research findings through cross-validation (Davidov, Bush, Clear, & Coker, 2020). It enables the researcher to explore and explain complex human behavior using multiple data, investigators, theories, and methodologies (Noble & Heale, 2019). Using the triangulation method, the researcher explores different levels and perspectives of the same phenomenon to develop an in-depth understanding (Fusch, Fusch, & Ness, 2018).

5.6. Roadmap of the study

The study's roadmap is depicted in Figure 5.2. A review of the literature and context of the study guided the formulation of research questions and research objectives. The bibliometric reviews of relevant publications in the field of m-learning adoption and continuance in education, analysis of reviews and ratings of m-learning apps, and investigation of m-learning "lived experiences" of school students and teachers facilitated the identification of relevant factors influencing continuance intention to use mobile apps for school level learning. Once, the factors were identified, the existing literature was examined to propose hypotheses and a conceptual research framework. Subsequently, the proposed model was tested and validated by collecting the data from school students through a paper-based survey questionnaire and using structural equation modeling analysis. Thereafter, the results of various

research inquiries of this study were triangulated for the synthesis of the findings. Lastly, conclusions and recommendations have been provided in the study.

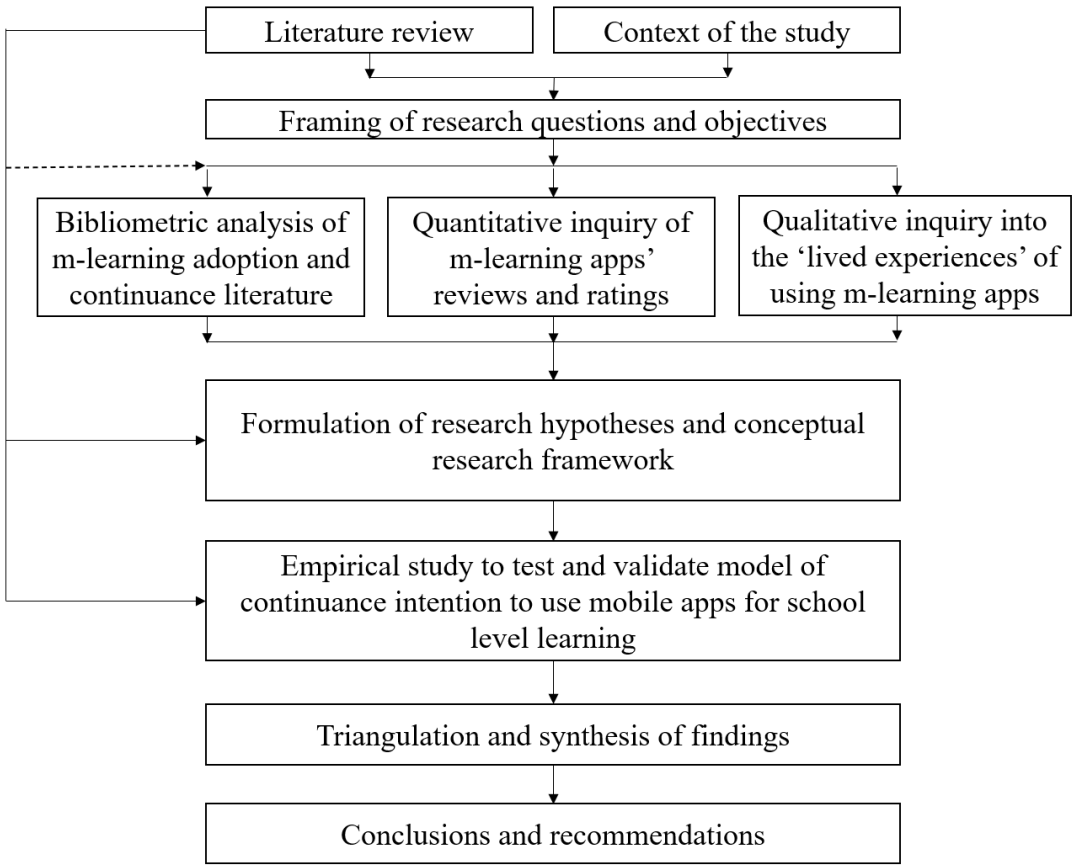

Figure 5. 2 Roadmap of the study

5.7. Concluding remarks

This chapter discussed the research design adopted in the present study. The choice of the design was guided by the research objectives of the study. A pragmatism worldview has been adopted for the mixed methods research design of the study. Further, a description of the qualitative and quantitative inquiries of the study has been provided in this chapter. In addition, the data collection and analysis methods adopted to develop an in-depth understanding of the research problem have also been

discussed. Furthermore, research hypotheses and a conceptual research framework have been proposed. Lastly, a roadmap of the research study has been presented.

The next chapter presents a structural equation modeling analysis of the survey questionnaire data collected from school students to empirically test and validate the proposed framework of continuance intention to use mobile apps for school level learning.

CHAPTER 6

EMPIRICAL TESTING AND VALIDATION OF THE RESEARCH MODEL

6.1. Introduction

The previous chapter elaborated on the mixed methods research design of the study. Based on the conceptual research framework and hypotheses of the study presented in the last chapter, a research model of continuance intention to use mobile apps for school-level learning is proposed and empirically tested in the quantitative study of this chapter. The structure of the chapter is as follows: the next section deals with the measurement items for the variables of the study. The participants of the paper-based survey questionnaire are described in section three. Next, the findings of the structural equation modeling-based analysis are presented in section four. The chapter ends with the discussion and concluding remarks in the last two sections.

6.2. Measurement items for variables of the study

A survey questionnaire was prepared in English and Hindi languages and comprised two parts. The first part included characteristics of respondents (e.g., age, gender), and the second formed questions for measuring the study variables based on 5-point Likert-scale ranging from strongly disagree(1) to strongly agree(5). The items were adapted from previous studies. Modifications and rewording were done based on feedback and personal interaction with fellow researchers, school students, teachers, and principals. In addition, a pilot study involving 50 school students was conducted to ensure the validity of the research instrument. The participants indicated that the questionnaire was relatively clear and easy to understand. The content and criterion validity of the questionnaire was established. The final measurement items of all eleven constructs are in Table 6.1

Table 6. 1 Constructs and measurement items

Construct	**No. of items**	**Items**	**Adapted from**
Social influence (SI)	3	SI1. People who are important to me think that I should use mobile apps for my studies.	(Alyoussef, 2021; Venkatesh et al., 2012)
		SI2. People who influence my behavior think that I should use mobile apps for my studies.	
		SI3. People whose opinions I value prefer that I use mobile apps for my studies.	
Perceived usefulness (PU)	4	PU1. Studying from mobile apps would improve my learning performance.	(Mohammadi, 2015b; Venkatesh & Davis, 2000)
		PU2. Studying from Mobile apps would enhance my examination results.	
		PU3. Using mobile apps would improve my interest in studies.	
		PU4. Studying from mobile apps would improve my understanding of topics.	
Facilitating conditions (FC)	3	FC1. I have adequate resources to use mobile apps for my studies.	(Alyoussef, 2021; Venkatesh et al., 2012)
		FC2. I have access to quality Internet to use mobile apps for my studies.	
		FC3. I have an appropriate mobile device to use mobile apps for my studies	
Perceived value (PV)	4	PV1. Mobile apps for studies are safe and reliable.	(Wang & Teo, 2020)
		PV2. Using mobile apps gives me greater control over my studies.	
		PV3. Using mobile apps for studies is an efficient way to manage my time.	
		PV4. Overall, I believe that using mobile apps for my studies is valuable.	
Continuance intention (CI)	3	CI1. I intend to continue using mobile apps for studying on a regular basis in the future.	(Al-Azawei & Alowayr, 2020; Bhattacherjee & Lin, 2015; Venkatesh et al., 2012)
		CI2. I will frequently use mobile apps for studying in the future.	
		CI3. I expect to continue using mobile apps for studying in the future.	

Continued on page no. 99

Table 6.1 (continued)

Satisfaction (SAT)	3	SI1. Using mobile apps for studying makes me feel very satisfied.	(Al-Fraihat, Joy, Masa'deh, & Sinclair, 2020; Liao et al., 2009)
		SI2. I am satisfied with the overall experience of using mobile apps for my studies.	
		SI3. I am delighted with the overall experience of using mobile apps for my studies.	
Perceived quality (PQ)	4	PQ1. I like the quality of learning resources on mobile apps.	(Almaiah et al., 2016; Isaac et al., 2019)
		PQ2. I like the way they teach in mobile apps.	
		PQ3. I find it easy to study what I want to study when I use mobile apps.	
		PQ4. Studying using mobile apps is understandable and clear.	
Perceived compatibility (PC)	4	PC1. Using mobile apps for studying is compatible with my values.	(Isaac et al., 2019; Islam, 2016)
		PC2. Using mobile apps for studying is compatible with my lifestyle.	
		PC3. Using mobile apps for studying is compatible with my needs.	
		PC4. Using mobile apps for studying is compatible with my learning style.	
Habit (HBT)	4	HBT1. The use of mobile apps for studying has become a habit for me.	(Venkatesh et al., 2012)
		HBT2. I am addicted to using mobile apps for studying.	
		HBT3. I must use mobile apps for studying.	
		HBT4. I prefer to use mobile apps for studying.	
Attitude (ATT)	3	ATT1. Using mobile apps for studying is a good idea.	(Alyoussef, 2021; Liao et al., 2009)
		ATT2. I like the use of mobile apps for studying.	
		ATT3. Using mobile apps for studying would be pleasant.	
Perceived enjoyment (PE)	3	PE1. I find using mobile apps for studying to be enjoyable.	(Davis et al., 1992; Pereira & Tam, 2021)
		PE2. I have fun using mobile apps for studying.	
		PE3. I get positive feelings when I use mobile apps for studying.	

6.3. Participants in the survey and data collection

Data were collected from April to September 2022 using a paper-based survey questionnaire (Appendix III). The respondents were secondary (9^{th} and 10^{th} grade) and higher secondary (11^{th} and 12^{th} grade) study level students of public and private schools of the National Capital Territory (NCT) Delhi, India. The schools in Delhi were partially or entirely closed during the years 2020 and 2021 due to restrictions imposed to curb the spread of COVID-19. The students adopted m-learning to maintain continuity in education during the pandemic. In February 2022, the restrictions were removed, and physical classes were resumed in schools (DDMA, n.d.). In this study, the researchers have examined the continuance intention to use mobile learning apps after initial adoption.

The researchers used their personal contacts of students, teachers, and principals at schools to distribute the questionnaires to students. In total, 500 questionnaires were distributed, and 384 duly filled questionnaires were received. The high response rate (n = 384/500, 77%) may be due to the active involvement of facilitating personal contacts during the data collection process. Further, 18 responses were discarded as they were partially incomplete. The sample size was more than the suggested size of 200 for SEM analysis (Kline.R.B, 2005). In addition, the size was in accordance with the Inverse Square Root Method at a significance level of 5% (Kock & Hadaya, 2018). Further, the ratio of cases/observations per indicator variable (n = 366/38, 9.63) was acceptable (Bentler & Chou, 1987). Therefore, the sample size was suitable for the study.

Table 6.2 describes the sample. The respondents consisted of 188 females and 178 males in the age group of 12 to 20 years. Most (n = 280/366, 77%) of the students in the sample were from government schools. Further, 57% (n = 209/366) of the respondents were in the higher secondary grade (11^{th} and 12^{th} grade), and 43% (n = 157/366) were in secondary (9^{th} and 10^{th} grade). Nearly 69% (n = 252/366) of the students used mobile apps for studies for less than two years. Additionally, most (n = 243/366, 66%) students used mobile apps for studies for less than two hours daily.

Table 6. 2 Characteristics of the participants of survey

Characteristics	**Count**	**%**
Gender		
Male	178	48.6
Female	188	51.4
Total	366	100
Age		
12	3	.8
13	17	4.6
14	37	10.1
15	62	16.9
16	83	22.7
17	93	25.4
18	53	14.5
19	17	4.6
20	1	.3
Total	366	100.0
School type		
Government	280	76.5
Private	86	23.5
Total	366	100.0
School Grade/Class		
9^{th}	46	12.6
10^{th}	111	30.3
11^{th}	21	5.7
12^{th}	188	51.4
Total	366	100.0
For how long have you been using mobile apps for your studies?		
< 1 year	56	15.3
1 to 2 years	196	53.6
2 to 3 years	81	22.1
3 to 4 years	23	6.3
> 4 years	10	2.7
Total	366	100.0
On an average, how much time do you spend daily using mobile apps for your studies?		
Never	13	3.6
< 2 hrs	230	62.8
2 to 4 hrs	106	29.0
4 to 6 hrs	16	4.4
> 6 hrs	1	.3
Total	366	100.0
You usually score what percentage of marks in your examinations?		
Less than 40%	15	4.1
40 to 60%	64	17.5
60 to 80%	162	44.3
80 to 90%	84	23.0
90 to 100%	41	11.2
Total	366	100.0

The participants' academic performance (percentage of marks scored in examinations) was also diverse. Nearly 22% (n = 79/366) of the students usually scored less than 60% marks, and 34% (n = 125/366) scored more than 80% in examinations.

6.4. Analysis of the survey data

This study employed PLS-SEM to examine the measurement and structural models. The analysis was performed using SmartPLS 4 software. PLS-SEM is explorative research aiming to test and validate models (Efiloğlu Kurt, 2019; Hair, Sarstedt, Pieper, & Ringle, 2012). The research model (Fig. 6.1) was analyzed using a two-stage structural equation modeling (SEM) process. The first stage involved the measurement model assessment to confirm the validity and reliability. Next, structural model analysis was conducted.

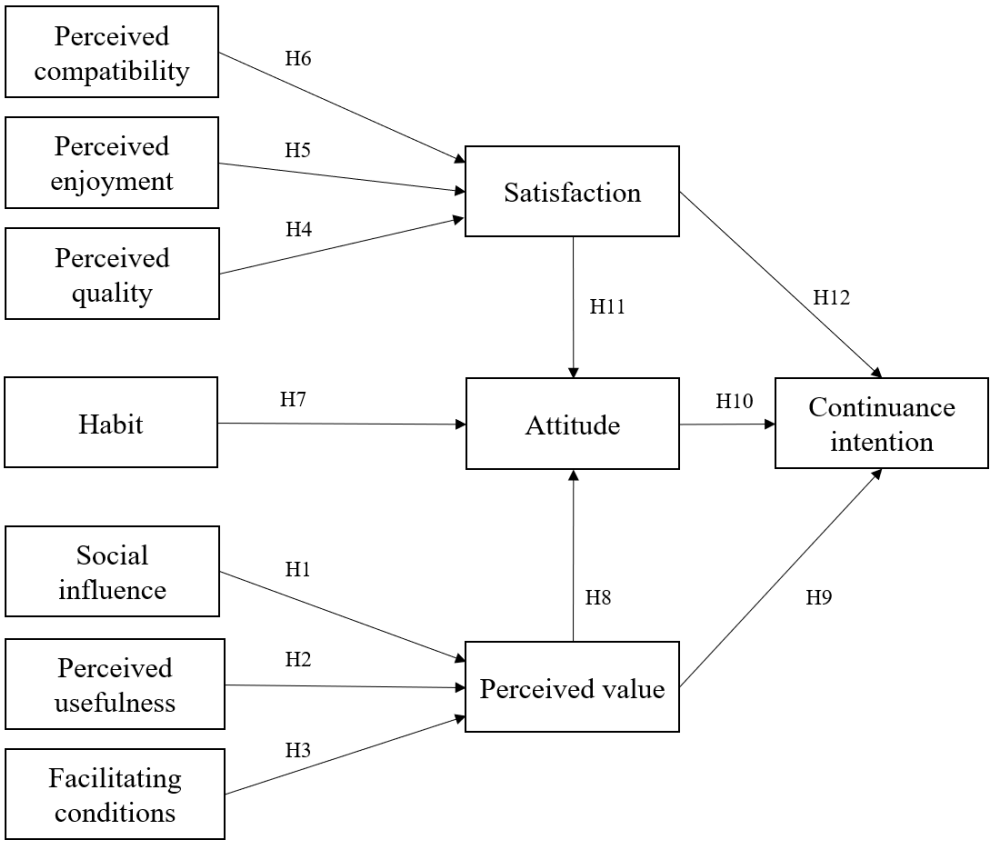

Figure 6. 1 Research Model of the study

6.4.1. Assessment of measurement model

The reliability of the measurement model was assessed by examining Cronbach's alpha and composite reliability (CR). The Cronbach's alpha values of all the variables ranged from 0.78 to 0.88 and exceeded the minimum acceptable level of 0.7 for construct reliability (Gefen & Straub, 2000). Further, the composite reliability (CR) for all the factors was above the recommended level of 0.7 suggesting good internal consistency. Moreover, the average variance extracted (AVE) of all the constructs was above the recommended lower limit of 0.5 (Fornell & Larcker, 1981b). Further, all the standardized factor loadings were significant and greater than 0.5 (Tabri & Elliott, 2012). The results indicate a good convergent validity (see Table 6.3). In addition, discriminant validity was examined with the Fornell-Larcker criterion. The factor correlation between the pair of latent variables is less than the square root of the AVE for all the factors, showing good discriminant validity (Table 6.4) (Anderson & Gerbing, 1988; Fornell & Larcker, 1981b).

Table 6. 3 Summary of construct reliability and validity

Construct	**Items**	**Standard loading**	**Cronbach's alpha**	**Composite reliability**	**Average variance extracted (AVE)**
Social influence (SI)	SI1	0.87	0.81	0.89	0.73
	SI2	0.83			
	SI3	0.87			
Perceived usefulness (PU)	PU1	0.82	0.86	0.91	0.71
	PU2	0.88			
	PU3	0.83			
	PU4	0.83			
Facilitating conditions (FC)	FC1	0.88	0.81	0.89	0.72
	FC2	0.83			
	FC3	0.84			
Perceived value (PV)	PV1	0.75	0.79	0.86	0.61
	PV2	0.82			
	PV3	0.77			
	PV4	0.78			
Continuance intention (CI)	CI1	0.88	0.88	0.92	0.80
	CI2	0.90			
	CI3	0.90			

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Table 6.3 (continued)

Satisfaction (SAT)	SI1	0.80	0.78	0.87	0.69
	SI2	0.86			
	SI3	0.83			
Perceived quality (PQ)	PQ1	0.78	0.83	0.89	0.66
	PQ2	0.84			
	PQ3	0.82			
	PQ4	0.81			
Perceived compatibility (PC)	PC1	0.81	0.84	0.89	0.68
	PC2	0.82			
	PC3	0.85			
	PC4	0.81			
Habit (HBT)	HBT1	0.76	0.80	0.86	0.62
	HBT2	0.72			
	HBT3	0.83			
	HBT4	0.82			
Attitude (ATT)	ATT1	0.89	0.84	0.91	0.76
	ATT2	0.86			
	ATT3	0.86			
Perceived enjoyment (PE)	PE1	0.88	0.84	0.90	0.76
	PE2	0.88			
	PE3	0.85			

Table 6. 4 Discriminant validity (Fornell-Larker criterion)

Construct	**Mean**	**S.D.**	**SI**	**PU**	**FC**	**PV**	**CI**	**SAT**	**PQ**	**PC**	**HBT**	**ATT**	**PE**
SI	3.87	0.81	**0.85**										
PU	4.08	0.77	0.48	**0.84**									
FC	4.05	0.87	0.18	0.25	**0.85**								
PV	3.90	0.75	0.52	0.63	0.38	**0.78**							
CI	3.91	0.89	0.35	0.39	0.20	0.57	**0.90**						
SAT	3.87	0.76	0.45	0.55	0.25	0.60	0.60	**0.83**					
PQ	4.06	0.73	0.37	0.54	0.27	0.60	0.56	0.72	**0.81**				
PC	3.82	0.81	0.36	0.48	0.39	0.60	0.57	0.65	0.67	**0.82**			
HBT	3.58	0.93	0.45	0.55	0.21	0.56	0.55	0.62	0.64	0.63	**0.78**		
ATT	3.83	0.88	0.39	0.55	0.32	0.60	0.59	0.70	0.70	0.67	0.75	**0.87**	
PE	3.75	0.90	0.39	0.53	0.28	0.56	0.56	0.68	0.68	0.63	0.71	0.80	**0.87**

Note: square root of the AVE (diagonals in bold), S.D. = Standard Deviation

6.4.2. Assessment of model fit

The model fit indices for PLS-SEM are still evolving (Dash & Paul, 2021). However, the approximate model fit criterion of standardized root mean squared residual (SRMR) and goodness-of-fit (GoF) were used in this study to assess the model fit (Henseler, Hubona, & Ray, 2016; Sarstedt et al., 2022). Most PLS-SEM studies use these indices to assess model fit (Chin et al., 2020; Shela, Ramayah, Aravindan, Ahmad, & Alzahrani, 2023). The SRMR values of the saturated and estimated model were 0.057, and 0.079, respectively. The SRMR values were less than the suggested threshold of 0.080 (Hu & Bentler, 1999). However, the suggested threshold of SRMR for PLS-SEM should be considered cautiously as it is preliminary (Benitez, Henseler, Castillo, & Schuberth, 2020). Further, GoF was calculated as the geometric mean of average R^2 and average AVE (Henseler & Sarstedt, 2013; Tenenhaus, Amato, & Vinzi, 2004). The value of GoF for the research model was 0.63 and was above the recommended cut-off value of 0.36 (Cohen, 1988). The results indicated acceptable model fit.

6.4.3. Assessment of structural model

The path coefficients and their significance are shown in Table 6.5. In addition, the graphical description in Fig 6.2 demonstrates variances explained for the research model's four dependent variables (ATT= 66%, CI=46%, PV=50%, and SAT 61%). The analysis indicates statistical support for all hypotheses. ATT was positively and significantly impacted HBT (β = 0.46), SAT (β = 0.34), and PV (β = 0.13). Further, the results reveal that SI (β = 0.26), PU (β = 0.45), and FC (β = 0.22) significantly influence PV. Moreover, SAT was significantly determined by PQ (β = 0.39), PE (β = 0.28), and PC (β = 0.22). In addition, CI was impacted by SAT (β = 0.27), ATT (β = 0.25), and PV (β = 0.26) (See Table 6.5).

Table 6. 5 Hypothesis testing results

Constructs' relationship	Standardized coefficients	Hypothesis-supported (Yes/No)
SI --> PV	0.26***	H1 - Yes
PU --> PV	0.45***	H2 - Yes
FC --> PV	0.22***	H3 - Yes
PQ --> SAT	0.39***	H4 - Yes
PE --> SAT	0.28***	H5 - Yes
PC --> SAT	0.22***	H6 - Yes
HBT --> ATT	0.46***	H7 - Yes
PV --> ATT	0.13**	H8 - Yes
PV --> CI	0.26***	H9 - Yes
ATT --> CI	0.25***	H10 - Yes
SAT --> ATT	0.34***	H11 - Yes
SAT --> CI	0.27***	H12 - Yes

Note: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

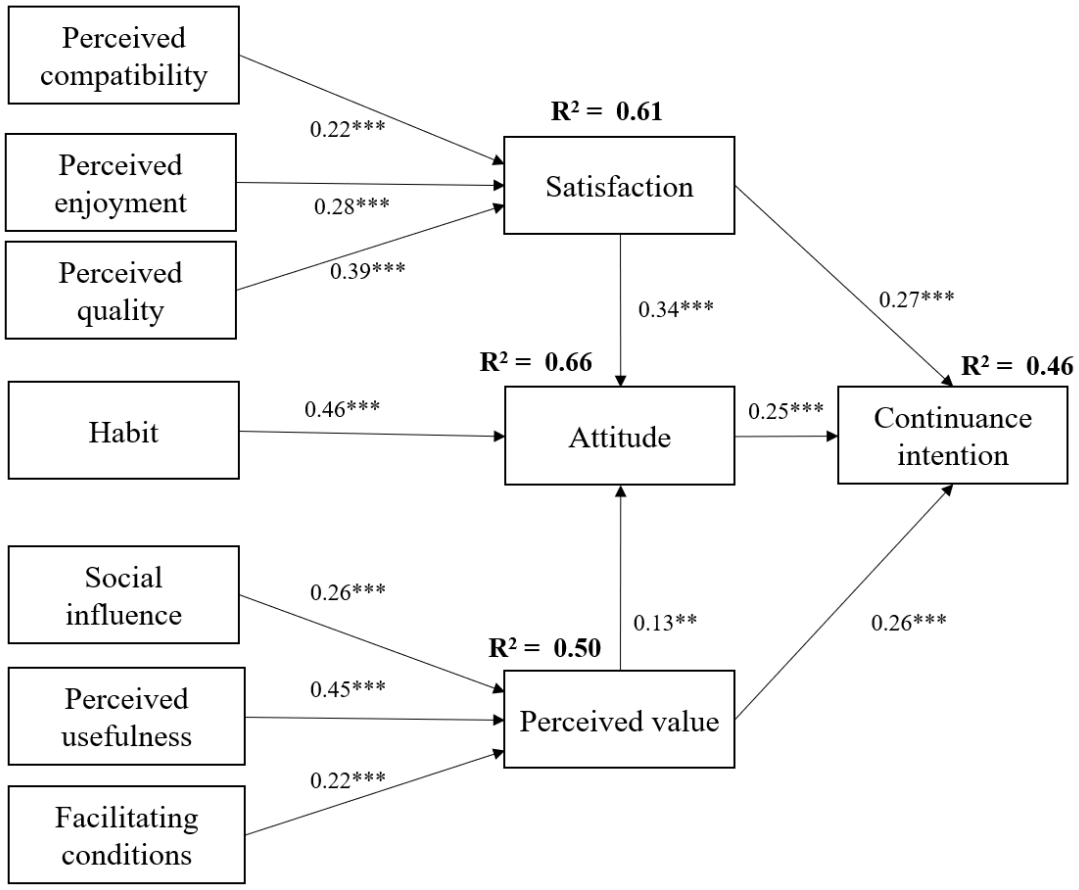

Figure 6. 2 Validated research model

6.5. Discussion

The analysis revealed that satisfaction, attitude, and perceived value directly influenced continuance intention to use m-learning apps among school students. In addition, satisfaction predicted attitude. The findings are consistent with the cognitive model of satisfaction (Oliver, 1980) and technology continuance theory (Liao et al., 2009). According to the two theories continuance intention is determined by satisfaction and attitude. The theories also suggest that satisfaction influences attitude. Further, the finding related to the positive influence of perceived value on continuance intention is in line with a study examining e-learning systems continuance intention in academic libraries (Chang, 2013). The results suggest that school students who perceive m-learning apps to be valuable, satisfactory, and a pleasant experience tend to develop an intention to continue using the mobile learning apps. Also, the students who assess the app to be satisfactory usually develop a positive attitude towards m-learning apps. In addition, the findings suggest that school students' attitude toward m-learning apps was influenced by their habits. The results enrich the existing literature, which suggests an influence of habit on continuance behavior. Indeed, a school student's attitude is also influenced by his or her habits related to m-learning apps.

Further, the study indicated that school students' satisfaction with m-leaning apps is determined by perceived quality, perceived enjoyment, and perceived compatibility. In addition, perceived quality has the largest influence on satisfaction. The results are consistent with the propositions of the IS success model (DeLone & McLean, 2003). The IS success model propagates that user satisfaction with an information system is determined by its perceived quality. The findings suggest that the perceptions of school students regarding the content quality (e.g., learning resources, teaching methods), and system quality (e.g., ease of use) of mobile learning apps influence their satisfaction with the apps (Arain, Hussain, Rizvi, & Vighio, 2019; Liu et al., 2010). Further, the findings related to the influence of perceived enjoyment on satisfaction are consistent with a study of students in the USA (Kim, Kim, & Wachter, 2013). In addition, a recent study of online reviews of m-learning apps

suggested that perceived enjoyment is one of the main affordances for satisfaction (Gholizadeh, Akhlaghpour, Isaias, & Namvar, 2022). Moreover, (Isaac et al., 2019)'s study complements this study's findings that perceived compatibility has a significant positive effect on satisfaction.

The results indicated that social influence, perceived usefulness, and facilitating conditions predict school students' perceived value of m-learning apps. Additionally, perceived usefulness is the most influential predictor of perceived value. Perceived value involves an assessment of the benefits of m-learning apps for school students. The findings suggest that such assessment is impacted by the influence of fellow students, teachers, parents, and school administration. Previous studies tested and validated the association between social influence and perceived usefulness (Alyoussef, 2021; N. Liu & Pu, 2020). However, this study enriches the literature by empirically validating the significant effect of social influence on perceived value. In addition, the study hints that the perception of the benefits of m-learning apps is influenced by perceptions of students about their learning performance as they engage with m-learning apps. A higher perception indicates a higher perceived value. The findings are consistent with several studies of technologies such as mobile Internet and mobile governance (H. W. Kim et al., 2007; C. Wang, 2014). Further, a student's perception of possession of adequate resources such as quality Internet and mobile devices influences his or her perceived value of m-learning apps. Previous studies suggested that facilitating conditions (e.g., Internet, mobile device) significantly impact factors influencing continuance behavior such as perceived usefulness, and perceived enjoyment. This study augments the understanding of the influence of facilitating conditions by indicating that facilitating conditions significantly and positively influence the perceived value of m-learning apps among school students.

6.6. Concluding remarks

This chapter proposed and empirically tested a model of continuance intention to use mobile apps for school level learning. Structural equation modeling analysis using SmartPLS 4 software was performed on the survey data collected from

366 school students of government and private schools of NCT, Delhi. All the hypotheses of the model were supported.

The next chapter synthesizes through triangulation the findings of the qualitative and quantitative inquiries of the present study. Further, it discusses the four research objectives and lists key research findings, implications for research and practice, limitations, and future research directions.

CHAPTER 7

CONCLUSIONS, RECOMMENDATIONS AND FUTURE RESEARCH DIRECTIONS

7.1. Introduction

The study examined the factors influencing the adoption and continuance usage of mobile apps for school level learning. A mixed-methods research design was used to address the four research objectives. The factors influencing continuance intention were identified through the literature review, bibliometric analysis of the metadata of relevant publications, content analysis, sentiment analysis and statistical analysis of the m-learning apps' reviews and ratings, and hermeneutic phenomenological analysis of the m-learning 'lived experiences' of school students and teachers. Further, a research model of continuance intention of using mobile apps for school level learning was proposed. The model was empirically tested using structural equation modeling analysis. This chapter consolidates the findings of several qualitative and quantitative inquiries of this study.

The chapter has been organized as follows: the next section lists the key findings of the study. Section three synthesizes the different aspects of the study through data, method, and theory triangulation. A discussion about how the four research objectives have been addressed in the study has been presented in section four. The subsequent two sections deal with the implications of the study for practice, and research, respectively. Further, the limitations and future research directions are the subject matter of sections seven and eight. Lastly, the concluding remarks have been provided.

7.2. Key findings

The key findings of this study are as follows:

- Mostafa Al-Emran, Shakeel Iqbal, and Yi-Shun Wang are the most productive authors in m-learning adoption and continuance in education research *(refer Section 2.4.4 of chapter 2).*

- China is the top producer of articles in the research area of m-learning adoption and continuance. Further, the research production in China has doubled since 2019 *(refer Section 2.4.5 of chapter 2).*

- Technology acceptance model (TAM), Unified theory of acceptance and use of technology (UTAUT), Theory of reasoned action (TRA), and Theory of planned behavior (TPB) are the most popular theories of m-learning adoption and continuance research *(refer Section 2.4.3 of chapter 2).*

- The results indicate that m-learning adoption has been examined more than continuance. However, the research interest in continuance has gained momentum since 2020 *(refer Section 2.4.6 of chapter 2).*

- The Self-determination theory (SDT) has attracted the interest of MACE researchers since 2020. SDT focuses on how people become self-motivated based on their perceptions of the surrounding environment *(refer Section 2.4.6 of chapter 2).*

- The analysis of m-learning apps' reviews and ratings indicated that the app rating was influenced by the learner's perceptions of app quality (e.g., technical quality, customer support quality, content quality, and teaching quality), usefulness, compatibility, and social influence. In addition, sentiment analysis of the reviews revealed that the emotion of joy had the highest association with

star ratings given by the learners using the m-learning apps *(refer Section 3.4 of chapter 3)*.

- Learners tend to give higher star ratings for school-level education apps. Interestingly, a higher proportion of learners appreciate teaching quality and content quality for school education apps than higher education apps. However, teaching quality seemed to matter more for school education and content quality for higher education. The learners using higher education apps seem to make comparisons and assess compatibility more than school education apps. When it comes to school education, learners seem to show higher involvement *(refer Section 3.4 of chapter 3)*.

- The study suggested that learners express in their reviews the emotions of trust, joy, and surprise when they rate the apps highly. Further, anger, disgust, fear, and sadness were discernible in the reviews that rated 1-star *(refer Section 3.4 of chapter 3)*.

- The analysis of the interview transcripts of school students suggested that the m-learning experience is influenced by the following factors: attitude, facilitating conditions, habit, perceived compatibility, perceived content quality, perceived enjoyment, perceived teaching quality, perceived technical quality, perceived usefulness, perceived value, satisfaction, and social influence *(refer Section 4.4 of chapter 4)*.

- The findings of structural equation modeling analysis revealed that attitude, satisfaction, and perceived value are significant predictors of continuance intention to use mobile apps for school level learning. In addition, satisfaction is predicted by perceived compatibility, perceived enjoyment, and perceived quality. Further, habit, satisfaction, and perceived value predicted attitude. Moreover, social influence, perceived usefulness, and facilitating conditions predicted perceived value of m-learning apps *(refer Section 6.4.3 of chapter 6)*.

- The empirically validated model of continuance intention to use mobile apps for school level learning explained 46% of the variance in m-learning app continuance intention. In addition, the model explained 50%, 66%, and 61% of the variation in perceived value, attitude, and satisfaction *(refer Section 6.4.3 of chapter 6)*.

7.3. Triangulation

The triangulation approach of this study is presented in Figure 7.1.

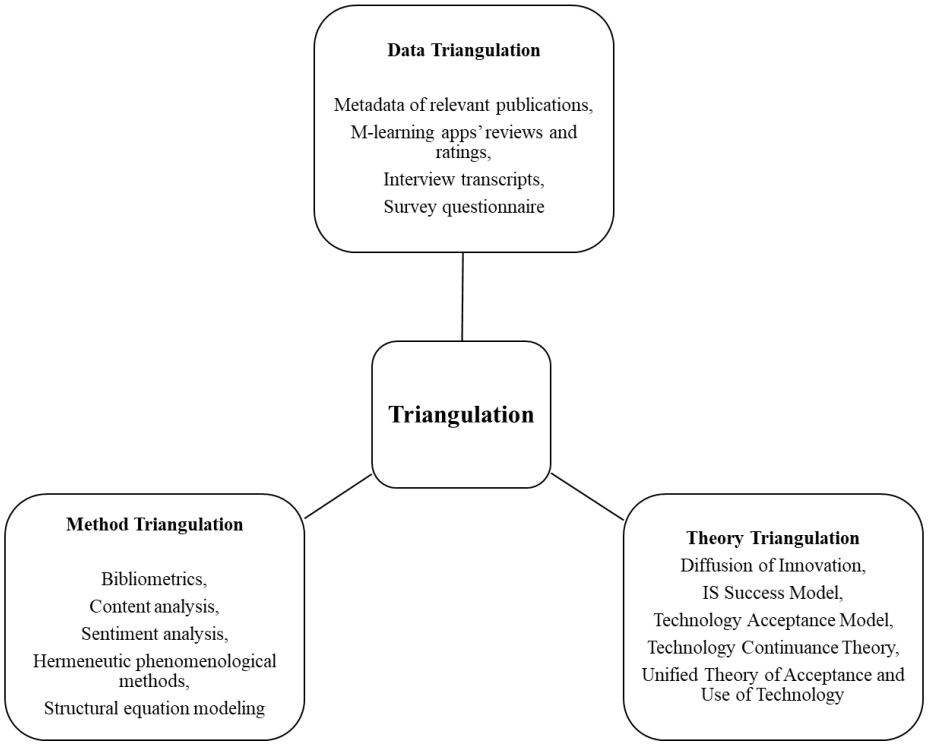

Figure 7. 1 Triangulation approach of the study

7.3.1. Data triangulation

The data for this study has been collected from multiple data sources (see Table 7.1). Firstly, the metadata of the relevant studies in the field of mobile learning

adoption and continuance in education were extracted from the Web of Science database for the period 2006-2022. Secondly, m-learning app user reviews and ratings data were collected online from the Google Play app store for the six-month duration from January to June 2020. Thirdly, semi-structured interviews of school students and teachers were recorded and transcribed verbatim during April – June 2021. Fourthly, students' perceptions of m-learning apps were captured on a 5-point Likert scale via a paper-based survey questionnaire from April to September 2022.

Table 7. 1 Data triangulation for the study

Data source	**Description**	**Period**
Web of Science database	Keywords related to mobile learning adoption and continuance in education were used to search the database. Metadata of 155 publications was extracted.	2006-2022
Google Play app store	The data regarding the top 2000 most relevant reviews of the four highly rated, downloaded, and reviewed m-learning apps were extracted, cleaned, and transformed for the study.	January - June, 2020
Interview transcripts	In-depth interviews of 24 students and 9 teachers of secondary and senior secondary classes of public and private sector schools of the National Capital Territory of Delhi, India were recorded and transcribed verbatim.	April - June, 2021
Paper-based survey questionnaire	The perceptions of 366 students regarding m-learning apps were captured on a 5-point Likert scale via a paper-based survey questionnaire. The participants were from secondary and higher secondary classes of public and private sector schools of the National Capital Territory of Delhi, India.	April–September, 2022

7.3.2. Theory triangulation

The metadata of relevant literature in the field of m-learning adoption and continuance revealed that the most popular theories of the research area include Technology Acceptance Model, Unified Theory of Acceptance and Use of Technology, Theory of Planned Behaviour, Expectation-Confirmation Theory, Uses and Gratifications Theory, Diffusion of Innovation Theory, Flow Theory, Self-determination Theory, and Technological Pedagogical Content Knowledge

Framework. In addition, the most researched variables include academic performance, academic relevance, anxiety, attitude, belief, gender, interactive lecture, learning environment, motivation, pedagogy, perceived convenience, perceived ease of use, perceived enjoyment, perceived learning, perceived risk, perceived trust, perceived usefulness, quality, readiness, resistance, satisfaction, self-efficacy, self-learning, social influence, and support.

The mobile learning app user reviews suggested that the following variables influence the m-learning app usage experience: attitude, content quality, customer support quality, teaching quality, technical quality, perceived compatibility, perceived enjoyment, perceived usefulness, satisfaction, and social influence. Further, transcripts of interviews of students and teachers indicated that the mobile learning experience is impacted by the following: attitude, facilitating conditions, habit, perceived compatibility, perceived content quality, perceived enjoyment, perceived mobile app quality, perceived teaching quality, perceived usefulness, perceived value, satisfaction, and social influence.

In view of the identified variables influencing mobile learning usage, the survey captured the perceptual data pertaining to the following variables influencing continuance intention: 1) attitude, 2) facilitating conditions, 3) habit, 4) perceived compatibility, 5) perceived enjoyment, 6) perceived quality, 7) perceived usefulness, , 8) perceived value, 9) satisfaction, 10) social influence. The structural equation modeling empirically tested and validated the model proposed in this study. The theoretical triangulation of this research work is described in Figure 7.2.

Theory triangulation

Data	Theory	Variable
Metadata of publications in the research area of mobile learning adoption and continuance in education	1) Diffusion of Innovation Theory 2) Expectation-Confirmation Theory 3) Flow Theory 4) Self-determination Theory 5) Technology Acceptance Model 6) Technology Continuance Theory 7) Technological Pedagogical Content Knowledge Framework 8) Theory of Planned Behavior 9) Unified Theory of Acceptance and Use of Technology 10) Uses and Gratifications Theory	a) academic performance b) academic relevance c) anxiety d) attitude e) belief f) gender g) interactive lecture h) learning environment i) motivation j) pedagogy k) perceived convenience l) perceived ease of use m) perceived enjoyment n) perceived learning o) perceived risk p) perceived trust q) perceived usefulness r) quality s) readiness t) resistance u) satisfaction v) self-efficacy w) self-learning x) social influence y) support

Data	Theory	Variable
Mobile learning app reviews and ratings	1) Diffusion of Innovation 2) IS Success Model 3) Technology Acceptance Model 4) Technology Continuance Theory 5) Unified Theory of Acceptance and Use of Technology	a) attitude b) content quality c) customer support quality d) teaching quality e) technical quality f) perceived compatibility g) perceived enjoyment h) perceived usefulness i) satisfaction j) social influence

Data	Theory	Variable
Interview transcripts	1) Diffusion of Innovation 2) IS Success Model 3) Technology Acceptance Model 4) Technology Continuance Theory 5) Unified Theory of Acceptance and Use of Technology	a) attitude b) facilitating conditions c) habit d) perceived compatibility e) perceived content quality f) perceived enjoyment g) perceived teaching quality h) perceived technical quality i) perceived usefulness j) perceived value k) satisfaction l) social influence

Data	Theory	variable
Survey question naire	1) Diffusion of Innovation 2) IS Success Model 3) Technology Acceptance Model 4) Technology Continuance Theory 5) Unified Theory of Acceptance and Use of Technology	a) attitude, b) facilitating conditions c) habit d) perceived compatibility e) perceived enjoyment f) perceived quality g) perceived usefulness h) perceived value i) satisfaction j) social influence

Figure 7. 2 Theory triangulation for the study

7.3.3. Method triangulation

In this research, a combination of qualitative and quantitative methods was adopted. The approach enabled an in-depth understanding of the phenomenon. The qualitative technique utilized data collected using semi-structured interviews of students and teachers of schools. Further, the quantitative approach employed data collected through searching relevant literature from the Web of Science database, m-learning app user reviews and ratings of the Google Play app store, and paper-based survey questionnaires. Several data analysis techniques including bibliometrics, content analysis, sentiment analysis, hermeneutic phenomenological methods, and structural equation modeling were applied to data collected through different methods. Table 7.2 outlines the methodical triangulation of this study.

Table 7. 2 Method triangulation for the study

Type of research method	**Data collection method**	**Data analysis technique**
Qualitative	Semi-structured interviews of students and teachers of schools	Hermeneutic phenomenological methods
Quantitative	Search using keywords for relevant literature from the Web of Science database.	Bibliometrics
	M-learning app user reviews and ratings of Google Play app store	Quantitative content analysis, and sentiment analysis
	Paper-based survey questionnaire	Structural equation modeling

7.4. Discussion of the research objectives

This section discusses the research objectives in view of the findings of the study.

7.4.1. Research objective one (RO1)

The first objective focussed on analyzing the existing literature on mobile learning adoption and continuance in the field of education (MACE). The metadata of 155 relevant publications was obtained from the Web of Science database through a search query. It was revealed that the MACE studies could be traced to 2006, and annual publications are rapidly increasing. Further, the contribution of MACE research to overall research in mobile technologies is scarce; even in m-learning adoption and continuance, MACE has limited contributions. The study revealed that *Computers & Education* is the most cited journal, and *Education and Information Technologies* has the most publications. The results indicated that the top two highly and widely cited articles were published in 2012 and examined higher education. Mostafa Al-Emran, Shakeel Iqbal, and Yi-Shun Wang are the most productive authors. Further, China and Turkey are the top producers of publications and have witnessed an exponential increase in MACE research since 2019. The analysis revealed that several theories

were used in the articles. However, the technology acceptance model (TAM), the unified theory of acceptance and use of technology (UTAUT), the theory of reasoned actions (TRA), and the theory of planned behavior (TPB) were the most popular. In addition, the references for the self-determination theory (SDT) have increased recently. Further, the MACE researchers frequently used the statistical technique of structural equation modeling (SEM). Next, co-citation analysis indicated that *Computers & Education*, *MIS Quarterly*, *Computers in Human Behavior,* and *British Journal of Educational Technology (BJET)* are the most influential journals. Further, the keyword analysis suggested that the researchers mainly examined the subjects of language, mathematics, and science. In addition, MACE research has several associated keywords such as augmented reality, cyberloafing, bring your own device (BYOD), game-based learning, mobile social media, learning communities, mobile-based assessment, and virtual reality. Additionally, the results indicated increased interest among the researchers in examining self-efficacy, and motivation. Further, it seems that higher publications examined adoption as compared to continuance. Moreover, the thematic map suggested further examination of themes such as addiction, engagement, satisfaction, and self-regulation. The conceptual structure map suggested that intention and continuance intention are two different constructs. Further, it indicated a close association between continuance intention and self-determination theory.

7.4.2. Research objective two (RO2)

The second objective was to examine the reviews and ratings of mobile apps for public and private sector, and higher education and school level learning. Content analysis, sentiment analysis, and statistical analysis were performed on 2000 reviews of four (two apps each in public and private sectors with one app each in school and higher education) highly rated, downloaded, and reviewed mobile learning apps on the Google Play store. The findings suggested that app usage was influenced by the learner's perceptions of app quality (e.g., technical quality, content quality, customer support quality, and teaching quality), usefulness, compatibility, and social

influence. Further, most users of the four selected apps were satisfied and had a positive attitude towards the apps. In addition, sentiment analysis revealed that the emotion of joy had the highest association with star ratings given by the learners using the m-learning apps.

Further, the findings suggest a significant difference between star ratings of public and private sector, and higher education and school level apps. The median score of star ratings for school education and private sector was more than the higher education and public sector apps, respectively. Further, the learners perceived the technical quality, content quality, teaching quality, and usefulness of private-sector apps to be better than the public-sector apps. Interestingly, although many learners perceived the teaching quality of public sector apps to be high, only a few expressed it in the reviews. On the contrary, learners like to explicitly mention their satisfaction with teaching quality in private-sector apps, especially for school education. More people tend to compare and refer to compatibility in their reviews regarding the private sector than the public sector. Only a few learners give explicit recommendations in their reviews to use the apps and even fewer for public sector apps. The learners rarely indicate the influence of others in using the app. Interestingly, such an impact was more pronounced in the case of the public sector.

With regard to differences in apps based on education levels, the findings suggested that a higher proportion of learners appreciate teaching quality and content quality for school education apps than higher education apps. However, teaching quality seemed to matter more for school education and content quality for higher education. Further, in comparison to higher education, more learners find school education apps to be useful. Additionally, learners using higher education apps seem to make comparisons and assess compatibility more than school education apps. When it comes to school education, learners seem to show higher involvement, as evidenced by a higher number of requests and suggestions. Further, more learners tend to recommend and follow recommendations regarding using the app for school education than higher education.

7.4.3. Research objective three (RO3)

The third objective was to examine the 'lived experiences' of using mobile apps for school level learning. Semi-structured interviews of 24 students and 09 teachers of schools in NCT Delhi, India were conducted over 03 months and transcribed verbatim. A hermeneutic phenomenological design was used to interpret the text and bring out the 'lived experiences' of m-learning. The following themes emerged through the 'hermeneutic circle' and 'fusion of horizons': attitude, habit, facilitating conditions, perceived compatibility, perceived content quality, perceived enjoyment, perceived technical quality, perceived teaching quality, perceived usefulness, perceived value, satisfaction, and social influence.

7.4.4. Research objective four (RO4)

The fourth objective was to conceptualize and empirically test a model for continuance intention to use mobile apps for school level learning. The comprehensive analysis of existing literature, mobile learning app reviews and ratings, and verbatim interview transcripts suggested that the following ten variables influence continuance intention to use mobile apps for school-level learning: a) attitude, b) facilitating conditions, c) habit, d) perceived compatibility, e) perceived enjoyment, f) perceived quality, g) perceived usefulness, h) perceived value, i) satisfaction, and j) social influence.

A conceptual framework of the ten identified variables influencing continuance intention was proposed based on existing studies. The data to test the model were collected using a paper-based survey questionnaire. The respondents were secondary (9th and 10th grade) and higher secondary (11th and 12th grade) study-level students of public and private schools of the National Capital Territory, Delhi, India. Structural equation modeling analysis was performed on the data collected from 366 participants. All the hypotheses were statistically supported. The findings revealed that satisfaction, attitude, and perceived value directly influenced continuance intention to

use m-learning apps among school students. In addition, habit, satisfaction, and perceived value predicted attitude. Further, the study indicated that school students' satisfaction with m-leaning apps is determined by perceived quality, perceived enjoyment, and perceived compatibility. Moreover, perceived value is predicted by facilitating conditions, social influence, and perceived usefulness.

7.5. Implications for practice

The major implications of this research study for practice are:

- A smooth and user-friendly app interface; personalized learning resources; learned and passionate teachers; well-informed and imaginative content developers; and broad compatibility of the app with mobile devices and operating systems are expected to lead to higher app star ratings and satisfaction.

- The school education apps may focus more on quality teaching with a clear explanation of concepts. Further, the customer support team of school education apps is expected to be more responsive as these apps' learners make a higher number of requests and suggestions than higher education.

- It is suggested to the developers of mobile devices to customize the technical specifications (e.g., screen size, memory, battery, user interface) to enhance the learning experience. Further, features to reduce distractions, such as blocking inappropriate advertisements, and app notifications, can be integrated into such devices.

- Google Play is a rich source of learner feedback in the form of app reviews and ratings. The mobile learning app developers can analyze these for app improvements.

- The study suggested that the students may continue using pleasant, satisfactory, and valuable m-learning apps. The developers are suggested to design safe, reliable, customized, time-saving, delightful, and likable apps. In addition, the apps are expected to have features that allow students to have greater control over their learning.

- The level of satisfaction of the students from the apps may be continuously assessed. The apps need to have features to evaluate the quality of content/learning resources and teaching. They may facilitate clear, easy, and understandable learning by students. Further, the apps are expected to be enjoyable, evoke positive feelings, and be compatible with the student's values, lifestyle, needs, and learning style.

- The students expect to improve their learning performance and examination scores and enhance their interest in studies. The apps' content may be regularly evaluated through formative assessment of learners, and content design and delivery may accordingly be modified to facilitate enhanced learning. In addition, mechanisms of formative feedback to students could be integrated into mobile learning apps to help them clarify the goals, criteria, and expectations of good performance and motivate them.

- The suggestions to use m-learning apps by influential people in students' lives tend to positively impact their perception of the app's value, and augment their decision to continue using it. Accordingly, the product managers of mobile learning apps may run awareness campaigns to promote their apps to students, parents, teachers, and school management.

- Appropriate mobile devices, quality Internet, and other relevant resources and facilitating conditions contribute to a valuable m-learning experience. Product managers may not consider their apps as isolated systems. Facilitating conditions such as quality mobile devices and the Internet are integral to the

m-learning ecosystem. Efforts can be made to adequately equip students to utilize the apps.

- The data indicating patterns of usage of the apps by students may be examined to assess a student's attitude influencing his or her continuance intention.

7.6. Implications for research

The major implications of this study for research are:

- The study described the experience of learners while using mobile apps. It is unique in its approach to analyzing the reviews posted by learners on the Google Play app store. The research has identified significant factors influencing star ratings of apps. The emotions of learners when they post reviews have also been analyzed.

- The study examined the differences between public and private sector m-learning apps. Additionally, the nuances in learning through mobile apps based on education level (school and higher) have also been presented in the study.

- This study extends previous research and provides a deeper understanding of m-learning continuance intention. The factors influencing m-learning continuance intention were identified through literature review, content analysis, sentiment analysis and statistical analysis of m-learning app reviews and ratings, and hermeneutic phenomenological analysis of m-learning 'lived experiences' of school students and teachers.

- The study has developed and validated a research model for continuance intention to use mobile apps for school level learning. Further, the measurement instruments have been adapted from previous studies for the context of mobile apps for school level learning and validated through an empirical study.

- The study extends the technology continuance theory (TCT) (Liao et al., 2009) by adding perceived value as a significant predictor of continuance intention. According to TCT, satisfaction and attitude significantly predicted continuance intention.

- According to UTAUT2 (Venkatesh et al., 2012), habit is an antecedent to behavioral intention and use behavior. However, this study suggested that habit is a significant predictor of attitude.

- IS Success model (DeLone & McLean, 2003) suggested that information, system, and service quality are significant predictors of satisfaction. This study enriched the understanding of satisfaction and suggested that it is influenced by perceived quality, perceived enjoyment, and perceived compatibility.

- The UTAUT2 model considered the monetary aspect of the "perceived value" i.e., "price value" and suggested it to be a significant predictor of behavioral intention. However, perceived value involves overall assessment based on perceptions of what is received and what is given. This study has suggested a measurement instrument for the perceived value of m-learning apps.

7.7. Limitations

The limitations of the study are as follows:

- The study is limited by reliance on one database, i.e., the Web of Science for analyzing the intellectual structure and evolution of the literature.

- The study examined reviews of four m-learning apps on the Google Play store.

- The study was conducted when the lockdown restrictions were in place due to the COVID-19 pandemic. A large number of people took to m-learning.

Although the results of this study are in the context of COVID-19, we expect them to apply to the overall m-learning process.

- The study participants for interviews and surveys were drawn from the National capital territory, Delhi, India.

7.8. Future research directions

The following research directions are suggested:

- M-learning app continuance is an emerging area of research. It is suggested to enrich this area with more studies, especially in the wake of forced adoption due to the COVID-19 pandemic.

- The researchers may be motivated to evaluate self-determination theory, and self-regulation for continuance intention.

- Emerging technologies or themes such as augmented reality, big data, cloud computing, cyberloafing, and virtual reality may be examined in detail.

- Future studies can examine the reviews of a larger pool of apps from other mobile app stores, including Apple and Microsoft.

- Future research can examine the research model of m-learning continuance for students in the context of different countries.

- The study identified factors influencing continuance intention to use m-learning apps among school students and tested and validated the research model. It would be interesting to explore various relationships among the factors, including the mediation analysis.

- The researchers can extend the model with other variables relevant to the teaching-learning process such as self-regulation. In addition, moderation effects of variables such as age, and gender may be examined.

7.8. Concluding remarks

The chapter consolidated the findings of this mixed-methods research study. The key findings of the study were presented and the qualitative and quantitative inquiries of the study were triangulated to unravel a comprehensive understanding of the continuance intention of using mobile apps for school level learning. The four research objectives of the study were addressed through a discussion about the findings of the aspects of the study. Further, the chapter delineated the implications of the study for practice and research. Lastly, the limitations and future research directions were discussed.

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APPENDIX I

SEMI-STRUCTURED INTERVIEW QUESTIONS FOR STUDENTS

Demographic data

Name
Age
Gender
Name of school
School type (public/private)
Class or Grade
Average % marks scored during the last 3 years

M-learning app experience

Which mobile device do you use? (mobile phone /tablet PC /laptop)
How many hours each day do you use a mobile device?
How many hours each day do you study using your mobile device?
How many hours each day you used a mobile device before schools were closed due to COVID-19?
How do you find learning resources on mobile devices?
What apps do you use for learning?
Which is your favorite mobile learning app? Why?
Why do you use mobile apps to study?
When do you use mobile apps to study?
What subjects/topics do you study using mobile apps?
How do you rate learning using mobile apps on a scale from 1 to 10?
What is your experience of using mobile apps for learning?
What are your perceptions about learning using mobile apps?
What factors positively and negatively influence your learning using mobile apps?
What do you do regarding these influential factors?
What suggestions do you have for mobile learning apps?

APPENDIX II

SEMI-STRUCTURED INTERVIEW QUESTIONS FOR TEACHERS

Demographic data

Name
Age
Gender
Teaching experience
School type (public/private)
Subject(s) taught
Class(es) or grade(s) taught

M-learning app experience

Which mobile device do you use? (mobile phone /tablet PC /laptop)
How many hours each day do you use a mobile device?
How many hours each day do you use your mobile device for teaching and related activities?
How many hours each day did you use a mobile device before schools were closed due to COVID-19?
What teaching and related activities do you do using m-learning apps?
How do you find teaching resources on mobile devices?
Which m-learning apps do you use for teaching and preparing your lectures?
Which one is your favorite mobile app?
How do you rate mobile learning apps on a scale from 1 to 10?
What is the experience of using mobile apps for learning?
What are your perceptions about learning using mobile apps?
What factors positively and negatively influence your teaching and learning using mobile apps?
What do you do regarding these influential factors?
How has mobile learning changed your approach to teaching?
What suggestions do you have for mobile learning apps?

APPENDIX III

SURVEY QUESTIONNAIRE

This questionnaire contains two parts. **Part I** is about the demographic profile and **Part II** is about the questions for measuring this study's variables based on 5-point Likert-scales ranging from strongly disagree (1) to strongly agree (5).

Part I – Characteristics of the participants

Name of student	छात्र का नाम						
Age of student	छात्र की उम्र						
Name of school	विद्यालय का नाम						
Gender of student	छात्र का लिंग	☐ Male	☐ Female	☐ Prefer not to say			
School type	स्कूल का प्रकार	☐ private (प्राइविट)	☐ government (सरकारी)	☐ other (अन्य)	☐ don't know (पता नहीं)		
Class	कक्षा	☐ 9th class (नौवीं कक्षा)	☐ 10th class (दसवीं कक्षा)	☐ 11th class (ग्यारहवीं कक्षा)	☐ 12th class (बारहवीं कक्षा)		
For how long you have been using mobile apps for your studies?	आप अपनी पढ़ाई के लिए कितने समय से मोबाइल ऐप्स का उपयोग कर रहे हैं?	☐ less than 1 year	☐ 1 to 2 year	☐ 2 to 3 years	☐ 3 to 4 years	☐ more than 4 years	
On average, how much time do you spend daily using the mobile apps for studies?	औसतन, आप पढ़ाई के लिए मोबाइल ऐप्स का उपयोग करके प्रतिदिन कितना समय व्यतीत करते हैं?	☐ Never	☐ less than 2 hrs	☐ 2 to 4 hrs	☐ 4 to 6 hrs	☐ 6 to 8 hrs	☐ more than 8 hrs
You usually score what percentage in your examinations?	आप आमतौर पर अपनी परीक्षाओं में कितने प्रतिशत अंक प्राप्त करते हैं?	☐ less than 40%	☐ 40-60%	☐ 60-80%	☐ 80-90%	☐ 90-100%	

Part II - questions for measuring this study's variables

Please tell us your level of agreement with these statements (कृपया हमें इन कथनों के साथ अपनी सहमति का स्तर बताएं)		strongly agree (पूरी तरह से सहमत)	agree (थोड़ा सहमत)	neutral (तटस्थ राय)	disagree (थोड़ा असहमत)	strongly disagree (पूरी तरह से असहमत)
People who are important to me think that I should use mobile apps for my studies.	जो लोग मेरे लिए महत्वपूर्ण हैं, वे सोचते हैं कि मुझे अपनी पढ़ाई के लिए मोबाइल ऐप्स का उपयोग करना चाहिए।	☐	☐	☐	☐	☐
People who influence my behaviour think that I should use mobile apps for my studies.	मेरे व्यवहार को प्रभावित करने वाले लोग सोचते हैं कि मुझे अपनी पढ़ाई के लिए मोबाइल ऐप्स का उपयोग करना चाहिए।	☐	☐	☐	☐	☐
People whose opinions I value prefer that I use mobile apps for my studies.	जिन लोगों की राय को मैं महत्व देता हूं, वे पसंद करते हैं कि मैं अपनी पढ़ाई के लिए मोबाइल ऐप्स का उपयोग करूं।	☐	☐	☐	☐	☐
Studying from Mobile apps would improve my learning performance.	मोबाइल ऐप्स से पढ़ाई करने से मेरे सीखने के प्रदर्शन में सुधार होगा।	☐	☐	☐	☐	☐
Studying from Mobile apps would enhance my examination results.	मोबाइल ऐप्स से पढ़ाई करने से मेरा परीक्षा परिणाम बेहतर होगा।	☐	☐	☐	☐	☐
Using mobile apps would improve my interest in studies.	मोबाइल ऐप्स के इस्तेमाल से मेरी पढ़ाई में रुचि बढ़ेगी।	☐	☐	☐	☐	☐
Studying from mobile apps would improve my understanding of topics.	मोबाइल ऐप्स से पढ़ाई करने से विषयों की मेरी समझ में सुधार होगा।	☐	☐	☐	☐	☐
I have adequate resources to use mobile apps for my studies.	मेरे पास अपनी पढ़ाई के लिए मोबाइल ऐप्स का उपयोग करने के लिए पर्याप्त संसाधन हैं।	☐	☐	☐	☐	☐
I have access to quality internet to use mobile apps for my studies.	मेरे पास अपनी पढ़ाई के लिए मोबाइल ऐप्स का उपयोग करने के लिए गुणवत्तापूर्ण इंटरनेट उपलब्ध है।	☐	☐	☐	☐	☐

I have an appropriate mobile device to use mobile apps for my studies	मेरे पास अपनी पढ़ाई के लिए मोबाइल ऐप्स का उपयोग करने के लिए उपयुक्त मोबाइल डिवाइस है।	☐	☐	☐	☐	☐
Mobile apps for studies are safe and reliable.	पढ़ाई के लिए मोबाइल ऐप्स सुरक्षित और भरोसेमंद हैं।	☐	☐	☐	☐	☐
Using mobile apps gives me greater control over my studies.	मोबाइल ऐप्स का उपयोग करने से मुझे अपनी पढ़ाई पर अधिक नियंत्रण मिलता है।	☐	☐	☐	☐	☐
Using mobile apps for studies is an efficient way to manage my time.	पढ़ाई के लिए मोबाइल ऐप्स का उपयोग करना मेरे समय का प्रबंधन करने का एक कारगर तरीका है।	☐	☐	☐	☐	☐
Overall, I believe that using mobile apps for my studies is valuable.	कुल मिलाकर मेरा मानना है कि पढ़ाई के लिए मोबाइल ऐप्स का इस्तेमाल करना मेरे लिए मूल्यवान है।	☐	☐	☐	☐	☐
I intend to continue using mobile apps for studying on a regular basis in future.	मेरा इरादा भविष्य में नियमित रूप से पढ़ाई के लिए मोबाइल ऐप्स का इस्तेमाल जारी रखने का है।	☐	☐	☐	☐	☐
I will frequently use mobile apps for studying in the future.	मैं भविष्य में पढ़ाई के लिए अक्सर मोबाइल ऐप्स का इस्तेमाल करूंगा।	☐	☐	☐	☐	☐
I expect to continue using mobile apps for studying in the future.	मैं भविष्य में पढ़ाई के लिए मोबाइल ऐप्स का उपयोग जारी रखने की उम्मीद करता हूं।	☐	☐	☐	☐	☐
Using mobile apps for studying makes me feel very satisfied.	पढ़ाई के लिए मोबाइल ऐप्स का इस्तेमाल करने से मुझे बहुत संतुष्टि मिलती है।	☐	☐	☐	☐	☐
I am satisfied with the overall experience of using mobile apps for my studies.	मैं अपनी पढ़ाई के लिए मोबाइल ऐप्स का उपयोग करने के समग्र अनुभव से संतुष्ट हूं।	☐	☐	☐	☐	☐
I am delighted with the overall experience of using mobiles apps for my studies.	मैं अपनी पढ़ाई के लिए मोबाइल ऐप्स का उपयोग करने के समग्र अनुभव से प्रसन्न हूं।	☐	☐	☐	☐	☐
I like the quality of learning resources on mobile apps.	मुझे मोबाइल ऐप्स पर सीखने के संसाधनों की गुणवत्ता पसंद है।	☐	☐	☐	☐	☐
I like the way they teach in mobile apps.	जिस तरह से वे मोबाइल ऐप्स में पढ़ाते हैं, मुझे वह पसंद है।	☐	☐	☐	☐	☐

I find it easy to study what I want to study when i use mobile apps.	जब मैं मोबाइल ऐप्स का उपयोग करता हूं तो मुझे पढ़ना आसान लगता है।	☐	☐	☐	☐	☐
Studying on mobile apps is understandable and clear.	मोबाइल ऐप्स पर पढ़ाई करना समझ में आता है और स्पष्ट है।	☐	☐	☐	☐	☐
Using mobile apps for studying is compatible with my values.	पढ़ाई के लिए मोबाइल ऐप्स का इस्तेमाल करना मेरे मूल्यों के अनुकूल है।	☐	☐	☐	☐	☐
Using mobile apps for studying is compatible with my lifestyle.	पढ़ाई के लिए मोबाइल ऐप्स का इस्तेमाल करना मेरी जीवनशैली के अनुकूल है	☐	☐	☐	☐	☐
Using mobile apps for studying is compatible with my needs.	पढ़ाई के लिए मोबाइल ऐप्स का इस्तेमाल करना मेरी जरूरतों के अनुकूल है।	☐	☐	☐	☐	☐
Using mobile apps for studying is compatible with my learning style.	पढ़ाई के लिए मोबाइल ऐप्स का इस्तेमाल करना मेरी सीखने की शैली के अनुकूल है।	☐	☐	☐	☐	☐
The use of mobile apps for studying has become a habit for me.	पढ़ाई के लिए मोबाइल ऐप्स का इस्तेमाल करना मेरी आदत बन गई है।	☐	☐	☐	☐	☐
I am addicted to using mobile apps for studying.	मुझे पढ़ाई के लिए मोबाइल ऐप्स इस्तेमाल करने की लत है।	☐	☐	☐	☐	☐
I must use mobile apps for studying.	मुझे पढ़ाई के लिए मोबाइल ऐप्स का इस्तेमाल करना चाहिए।	☐	☐	☐	☐	☐
I prefer to use mobile apps for studying.	मैं पढ़ाई के लिए मोबाइल ऐप्स का इस्तेमाल करना पसंद करता हूं।	☐	☐	☐	☐	☐
Using mobile apps for studying is a good idea.	पढ़ाई के लिए मोबाइल ऐप्स का इस्तेमाल करना एक अच्छा विचार है।	☐	☐	☐	☐	☐
I like the use of mobile apps for studying.	मुझे पढ़ाई के लिए मोबाइल ऐप्स का इस्तेमाल करना अच्छा लगता है।	☐	☐	☐	☐	☐
Using mobile apps for studying would be pleasant.	पढ़ाई के लिए मोबाइल ऐप्स का इस्तेमाल करना सुखद रहेगा।	☐	☐	☐	☐	☐
I find using mobile apps for studying to be enjoyable.	मुझे पढ़ाई के लिए मोबाइल ऐप्स का उपयोग करना आनंदनीय लगता है।	☐	☐	☐	☐	☐

I have fun using mobile apps for studying.	मुझे पढ़ाई के लिए मोबाइल ऐप्स का इस्तेमाल करने में मजा आता है।	☐	☐	☐	☐	☐
I get positive feelings when I use mobile apps for studying.	जब मैं पढ़ाई के लिए मोबाइल ऐप्स का उपयोग करता हूं तो मुझे सकारात्मक भावनाएं आती हैं।	☐	☐	☐	☐	☐

LIST OF PUBLICATIONS AND THEIR PROOFS

1) Singh, Y., & Suri, P. K. (2022). An empirical analysis of mobile learning app usage experience. *Technology in Society*, *68*, 101929. https://doi.org/10.1016/j.techsoc.2022.101929

2) Singh, Y. and Suri, P.K. (2024). Insights into mobile learning continuance intention among school students and teachers via a hermeneutic phenomenological study during COVID-19, *Kybernetes*, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/K-05-2023-0904

3) Singh, Y., & Suri, P. K. (2023). A Bibliometric Analysis of the Literature on Mobile Learning Adoption and Continuance in the Field of Education. *International Journal of Interactive Mobile Technologies (iJIM)*, *17*(17), pp. 38–58. https://doi.org/10.3991/ijim.v17i17.40965

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Technology in Society
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An empirical analysis of mobile learning app usage experience ☆

Yashdeep Singh, Pradeep Kumar Suri

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Abstract

The study analyzed the reviews and ratings of mobile learning apps. Word frequency analysis, sentiment analysis, and content analysis were performed on 2000 reviews of four highly rated, downloaded, and reviewed mobile learning apps on the Google Play store. The results revealed that the most frequently mentioned topics included mobile applications, courses, and teaching. The majority of the reviews had a positive sentiment. Trust, anticipation, and joy were found to be the prominent emotions. Further, the text was coded to three themes (app quality, app suitability, and influence to use) and ten sub-themes. We found that seven identified sub-themes (technical quality, customer support quality, content quality, teaching quality, usefulness, compatibility, and learner influencing others), learners' sentiment, and length of review influence star ratings of apps. The star ratings and emotions of joy, trust, disgust, and sadness were moderately associated. The association was strong between the emotions trust and joy, sadness and fear. Further, there was a significant difference between star ratings based on the apps' sector (public or private) and based on the apps' education level (school or higher). The article concludes with a discussion on the learners' experience using mobile learning apps, implications for practice, limitations, and future research directions.

Introduction

Mobile applications (apps) are an integral part of our daily lives. Availability of the Internet on mobile devices (e.g., smartphones, tablets, and notebook PCs) has augmented these apps' usage. Recent data shows that 97% of the world's population is connected by mobile cellular signals, and 53.6% use the Internet [1]. The apps utilize mobile device features (e.g., GPS, camera, QR code scanner) to deliver a unique and personalized experience to users [2]. The leading app stores, including Google Play, Apple App Store, Windows Store, and Amazon Appstore, have close to 6 million apps, with Google Play having the largest share [3]. Google Play has significantly large downloads (84.3 billion in 2019) due to its availability on a broader range of mobile devices [4].

Insights into mobile learning continuance intention among school students and teachers via a hermeneutic phenomenological study during COVID-19

Yashdeep Singh, P.K. Suri

Kybernetes
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Article publication date: 11 January 2024

Abstract

Purpose

This study aims to describe the m-learning experience of school students and teachers during the COVID-19 pandemic and explores the factors influencing the continuance intention of m-learning.

Design/methodology/approach

Semistructured interviews of 24 students and 09 teachers of schools in national capital territory (NCT) Delhi, India were conducted over 03 months and transcribed verbatim. A hermeneutic phenomenological design was used to interpret the text and bring out the "lived experiences" of m-learning.

Findings

The following 15 themes or factors influencing continuance intention emerged through the hermeneutic circle: (1) actual usage, (2) attitude, (3) context, (4) extrinsic motivation, (5) facilitating conditions, (6) intrinsic motivation, (7) perceived compatibility, (8) perceived content quality, (9) perceived mobile app quality, (10) perceived teaching quality, (11) perceived usefulness, (12) satisfaction, (13) self-efficacy, (14) self-management of learning and (15) social influence.

Research limitations/implications

The study offers insightful recommendations for school administrators, mobile device developers and app designers. In addition, suggestions for effectively using m-learning during disasters such as COVID-19 have been provided. Several future research directions, including a nuanced understanding of m-assessment and online discussions, are suggested to enhance the literature on m-learning continuance.

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A Bibliometric Analysis of the Literature on Mobile Learning Adoption and Continuance in the Field of Education

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DOI: https://doi.org/10.3991/ijim.v17i17.40965

Keywords: bibliometric analysis, continuance intention, education, mobile learning, technology acceptance, technology adoption

ABSTRACT

This study examines mobile learning adoption and continuance in education literature through bibliometric methods. The metadata of 155 relevant publications was extracted from the Web of Science database and imported into "biblioshiny" for analysis. It was found that Education and Information Technologies has the highest publications, and Computers & Education is the most cited journal. Author analysis revealed that Shakeel Iqbal has the most articles fractionalized. Further, the most cited articles were published in the year 2012. The study revealed an exponential increase in research in the top producers, China and Turkey, since 2019. TAM was found to be the most popular theory among researchers. In addition, interest in self-determination theory has been growing recently. The studies examined limited subjects (language, mathematics, and science). The findings indicated several associated keywords, such as augmented reality, cyberloafing, and virtual reality. The thematic map revealed emerging (e.g., self-regulation), niche (e.g., literacy), motor (e.g., attitude), and basic (e.g., addiction) themes. Further, the conceptual structure map suggested the nuances of difference between the constructs of "intention" and "continuance intention."

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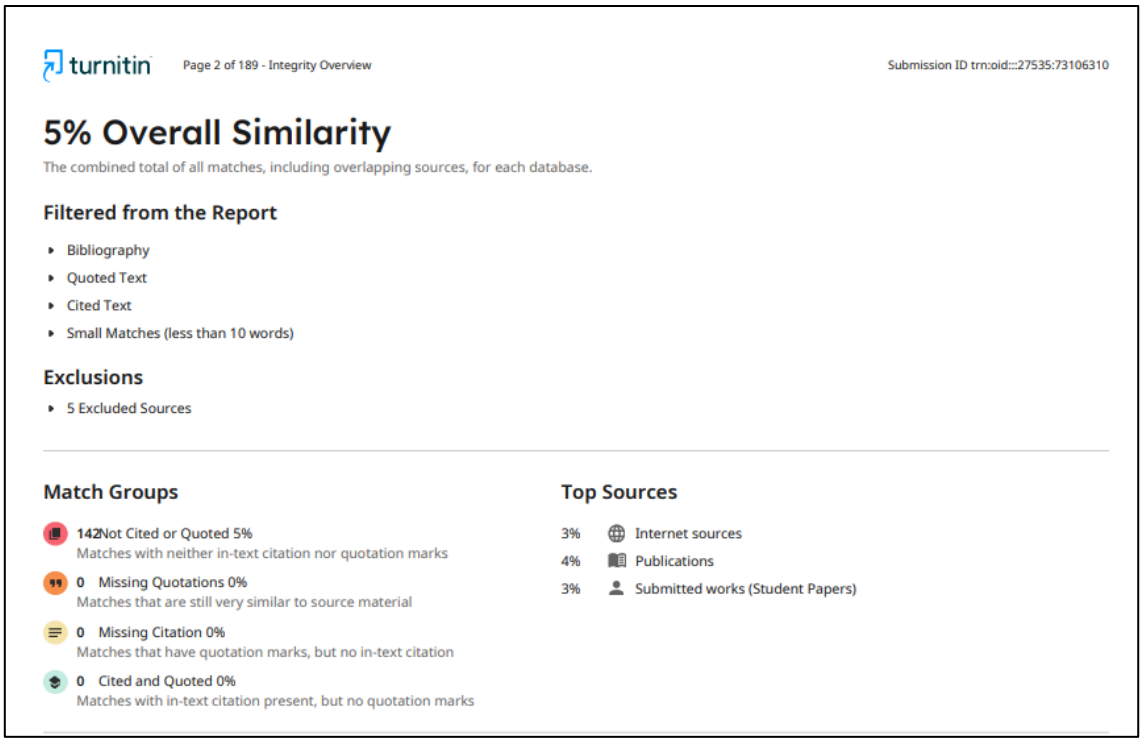

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