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Mobile Learning in Higher Education: Insights from a Bibliometric Analysis of the Body of Knowledge

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Abstract. Mobile learning is a research domain that has gained wide prominence in contemporary Information and Communication Technology (ICT) literature. As a result, there is a need for periodic and extensive review studies to keep abreast with the latest scholarly trends. Nevertheless, review studies on mobile learning, particularly in the post-COVID-19 era, are still limited. This article presents a bibliometric overview of mobile learning in higher education literature published between 1 January 2002 and 15 November 2022. The methodology used in this research is enshrined in the core principles of scientometrics forming the basis of the bibliometric approach utilised in the study. The articles for analysis were extracted from the Web of Science (WoS) database and analysed according to defined bibliometric indicators. The VOSviewer software tool (version 1.6.18) was employed in mapping the bibliometric articles. The findings of this research reveal that mobile learning scholarship has grown consistently in the period of analysis covered in this study. It was observed in the bibliometric analysis that the most productive countries in mobile learning in higher education are the USA and China. The most influential author is M.A. Almaiah. In the recent past, universities in the Middle East have demonstrated an excellent growth projectile in mobile learning research. Education and Information Technologies produced most content on mobile learning research demonstrating its stature as a leading publication platform advancing scholarly debate on mobile learning relating to context, augmented reality, COVID-19, continuance intention and knowledge. From the foregoing, possible future research avenues are discussed.

Keywords: mobile learning; higher education; bibliometric analysis; VOSviewer; trends

1. Introduction

The exponential rise in the development of handheld technology, as well as the increasing ubiquity of mobile internet, offers society several developmental opportunities. Reflecting on the increased importance of mobile devices in modern society, there is an emergent body of research under the banner of Mobiles for Development (M4D), which studies the impact of mobile devices on various facets of contemporary society (Traxler, 2016). One of the areas that benefited greatly from mobile technology is knowledge management in the higher education sector (Liaw et al., 2010), thereby giving rise to the concept of mobile learning (m-learning). In the Knowledge Society, m-learning is an important part of knowledge management in academic contexts (Alshehri & Cumming, 2020), helping to facilitate users' knowledge management (Liaw et al., 2010), enabling knowledge building in various contexts (Basak et al., 2018) and providing a reliable learning environment where knowledge can be easily acquired and disseminated (Al-Emran et al., 2020). Consequently, m-learning has attracted huge interest from both industry and academia, considering its critical role in ensuring the continued dissemination and accessibility of academic information at the height of the COVID-19 pandemic. Studies demonstrate that scholarship on m-learning has increased in recent years (Goksu, 2021), owing to myriad purported benefits. In higher education, m-learning is a useful asset in students' knowledge acquisition endeavours (Zhonggen et al., 2019), as the majority of students use m-learning to access information (Goksu, 2021). M-learning in this context has proven to subsequently enhance students' academic performance and motivation.

Even though m-learning research cannot be categorised as a recent domain area, the COVID-19 pandemic led to an exponential rise in ICT-mediated information acquisition approaches such as m-learning. Considering the demonstrably vital role of m-learning in the Knowledge Society, with its direct impact on social well-being, the scholarly body of evidence concerning m-learning has been advancing rapidly. Arguably, the volume of m-learning literature would have increased considerably owing to the onset of the COVID-19 pandemic. Consequently, like any scientific domain, the increase in the volume of mobile literature is accompanied by an evolution in research trends. The evolution of scientific disciplines is a constant process driven by various progressive factors (Coccia, 2018), which is also true for m-learning.

We believe that the exponential rise in m-learning literature necessitates the need to collate the scattered research from various contexts and understand the latest trends of m-learning. Commenting on the attention given to COVID-19-related issues, some commentators opine that 'never before have so many researchers all over the world focused so urgently on one single topic' (Fassin, 2021, p. 5305) which subsequently led to one of the 'the biggest explosions of scientific literature ever' (Brainard, 2020). As a result, there have been suggestions that scientists are drowning in COVID-19 papers. Furthermore, m-learning is an evolving research area (Khan & Gupta, 2022). As aptly noted by Djeki, Dégila and Bondiombouy (2021), all researchers, be they novices or experienced scholars, need to be aware of the latest research trends, like the most influential journals, authors, scholars,

countries, papers, collaboration trends and the general evolution of their discipline over the years. All these can be accentuated by a comprehensive bibliometric study of a phenomenon through any of the major academic databases.

Khan and Gupta (2022) postulate that while there are several m-learning studies, very few studies adopt bibliometric mapping techniques. As highlighted earlier, bibliometric mapping helps scholars in identifying trends in a particular field through the quantification of research characteristics in that given field (Chigbu et al., 2023; Goksu, 2021). Using WoS, Elaish et al. (2019) conducted a bibliometric study that covered the period 1982 to 2015. With a focus on English M-learning, Khodabandelou et al. (2022) analysed 5 343 articles extracted from WoS. Their study was not comprehensive but rather had a specific focus on the use of m-learning in learning the English language. Goksu's (2021) bibliometric study on m-learning included both proceedings and articles published as of September 2019 and the preceding period. However, COVID-19, and the subsequent migration from contact classes to various online modes like e-learning and m-learning, took place at the end of 2019. The body of evidence is likely to have grown exponentially during the 'COVID-19 period'. To the best of our knowledge, there are very few papers exploring m-learning in higher education which have been published in the post-COVID-19 era. Therefore, this study responds to this vacuity in literature to provide an up-to-date and comprehensive inventory on m-learning research in higher education.

Furthermore, because m-learning, like the broader ICT domain, is a highly dynamic field, it would be prudent to periodically assess the latest research trends through updated bibliometric data.

The study was informed by the following research questions:

1. What is the current level of research in m-learning in Higher Education?
2. Which disciplines mostly publish m-learning literature?
3. What are the trends in m-learning research?
4. Which are the most influential countries by publication?
5. Who are the most productive and influential authors in m-learning research?
6. Which are the most prominent journal outlets in m-learning?
7. Which are the top contributing institutions to m-learning research?

2. Literature Review

The bibliometric approach has its roots in the library and information science discipline, anchored on quantitative methods (Inamdar et al., 2021). The proliferation of bibliometric studies suggests that the bibliometric approach has the approbation of scholars. Indeed, various scholars have extolled the virtues of bibliometric mapping for understanding research trends in fields like library and information science (Okeji, 2019), management, entrepreneurship, economics and accounting (Bonilla et al., 2015). According to Kuzior and Sira (2022), bibliometric analysis is a common and accurate method of analysing large volumes of scientific data to present a current view of important and emerging research trends.

Although systematic literature reviews have been highly useful in advancing knowledge, they do not provide as much quantitative depth as the bibliometric approach. Donthu et al. (2021) observe that while discussions on bibliometric mapping started in the 1950s, the proliferation of articles using bibliometrics is fairly new. Bibliometric techniques “are considered unbiased and free of a researcher’s subjective” judgements (Abhishek & Srivastava, 2021, p. 979), although interpretations can be both objective and subjective (Donthu et al., 2021). As scientific literature in a specific discipline becomes more voluminous, it becomes overwhelming and oftentimes challenging for scholars to have a structured and nuanced overview of the extant body of evidence. In today’s contemporary society characterised by Big Data, the voluminous increase in m-learning makes bibliometric studies a useful tool for providing an overarching view of trends in the discipline.

3. Methodology

In this study, a literature review espousing on both scientometric and bibliometric standpoints was adopted. As discussed earlier, bibliometric analyses allow researchers to analyse much larger volumes of data than systematic literature reviews. For this study, parameters were developed, which then influenced the search string and the subsequent results, that is, the data extracted. In the case of this research, we focused on all studies in m-learning in higher education published in WoS. In the following subsections, we elaborate on the data collection and analysis phases of the methodology.

3.1 Data Collection

In undertaking bibliometric studies, there are several academic databases available to scholars, like Scopus, (WoS), PubMed and Directory of Open Access Journals, with Scopus and WoS being the most extensive (Chadegani et al., 2013; Prancute, 2021). According to Chadegani et al. (2013), while Scopus coverage includes more journals, they tend to have a lower impact. On the other hand, WoS is the oldest multidisciplinary database, with stronger coverage (Chadegani et al., 2013; Singh et al., 2021) and better quality. Taking cognisance of the foregoing, this bibliometric study focused on journal articles covered by WoS. The following search string was used to locate relevant articles:

“mobile learning” OR “m-learning” AND “higher education” (topic) AND “2002-2022” (year published) AND “article” (document type).

The use of parentheses allowed the researchers to find records containing both m-learning and higher education or both m-learning and higher education. The article search was confined to the period 2002 to 2022, which according to Froberg, Göth and Schwabe (2009, p. 309), is the year (2002) when m-learning gained prominence through the very first Mobile Learning conference. Owing to our language restrictions, the search was restricted to papers published in English. Figure 1 is a screenshot highlighting the data that was captured and used to search for articles in the WoS database.

The screenshot displays a search interface with the following components:

- Topic:** A dropdown menu with a value of "Topic" and a search input field containing the string: `("mobile learning" or "m-learning") and "higher education"`. An example text "Example: oil spill* mediterranean" is visible above the input.
- And:** A dropdown menu with a value of "And" and a search input field containing the string: `2002-2022`. An example text "Example: 2001 or 1997-1999" is visible above the input.
- Document Type:** A dropdown menu with a value of "Document Type" and a search input field containing the string: `Article`.
- Publication Date:** A dropdown menu with a value of "Publication Date" and a search input field containing the string: `2002-01-01 to 2022-11-15`.
- Buttons:** A "+ Add row" button, an "Advanced Search" link, a "x Clear" button, and a "Search" button.

Figure 1: Screenshot of search string

The above search returned 567 documents, which subsequently formed the basis of this study. Donthu et al. (2021) suggest that bibliometric studies that constitute about 500 or more papers can be considered sufficient for useful bibliometric analysis.

4. Data Analysis

This study employed a two-stage data analysis approach. The first stage involved analysing WoS data that was extracted after a search using the search string mentioned above.

The second approach involved extracting data from WoS and loading it into VOSviewer (version 1.6.18.) Several software tools have been developed to facilitate bibliometric analysis of the corpus of literature because the importance of bibliometric techniques has grown. One of the most popular software tools is VOSviewer, which was employed in this phase of the study. VOSviewer enables researchers to create network maps for researchers, journals, keywords and publications based on co-citation, coupling and co-authoring relationships, and visualising the resultant output (Meng et al., 2020). Owing to the foregoing qualities of VOSviewer, it was deemed suitable for this study.

4.1 The Evolution of M-learning in Higher Education Research

Although the date for the search starts in 2002, the search results commence from the year 2005 (Figure 2). The results extracted show that m-learning in higher education research has witnessed a consistently incremental trend, both in terms of publications and citations. According to Khan and Gupta (2022), such upward trajectories suggest the relevancy and novelty of the issue or topic being analysed, in this case, m-learning.

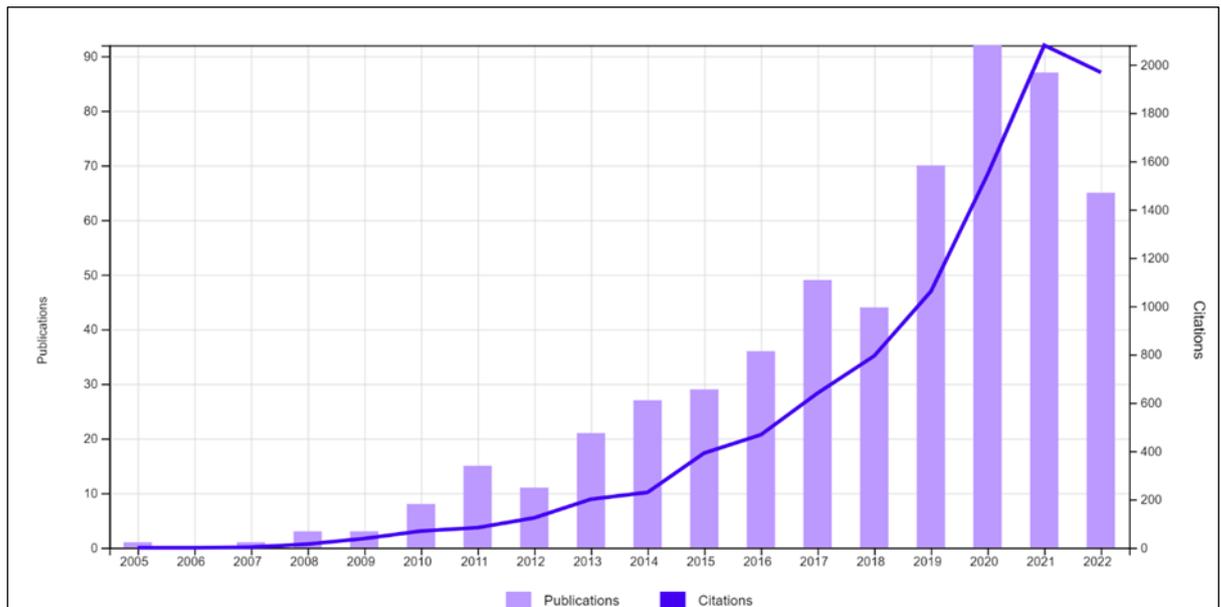


Figure 2: Evolution of m-learning research

4.2 Disciplines Publishing M-learning Articles

We sought to establish the top 10 leading disciplines in the publication of m-learning literature. The findings of this study indicate that m-learning research in higher education is conducted across diverse fields, with Education being the predominant domain. This is followed by Computer Science (Information Systems), Computer Science (Interdisciplinary applications), Information Science (Library Science), Education (Scientific Disciplines), Telecommunications, Engineering (Multidisciplinary), Engineering (Electrical/Electronic), Social Sciences (Interdisciplinary) and Green Sustainable Science Technology.

Figure 3 shows that 337 of the 567 journal articles included in this study are from the education discipline, although it is worth noting that the chart areas are not necessarily strictly proportional to the values of each category.

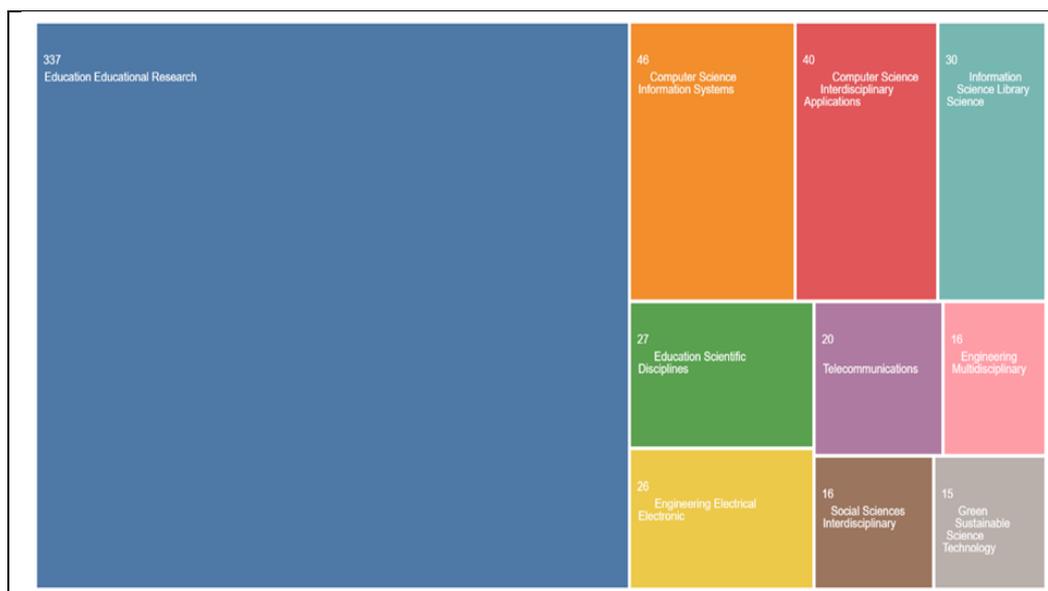


Figure 3: Leading disciplines in the publication of m-learning

4.3 Research Trends in M-learning: Keyword Analysis

To better understand the focus of m-learning research, keyword co-occurrence was used. From the corpus of 567 articles underpinning this study, 1 833 keywords were used by various scholars. To reduce the number to a more manageable size for keyword co-occurrence analysis, only keywords used a minimum of 10 times across various articles were included in the analysis. A total of 78 keywords met this threshold. Our initial findings revealed that 'mobile learning', 'm-learning', 'higher education', and 'higher-education' were the most common keywords (see Figure 4). However, since these were also the keywords used in our search in the WoS database, we decided to exclude the aforementioned keywords.

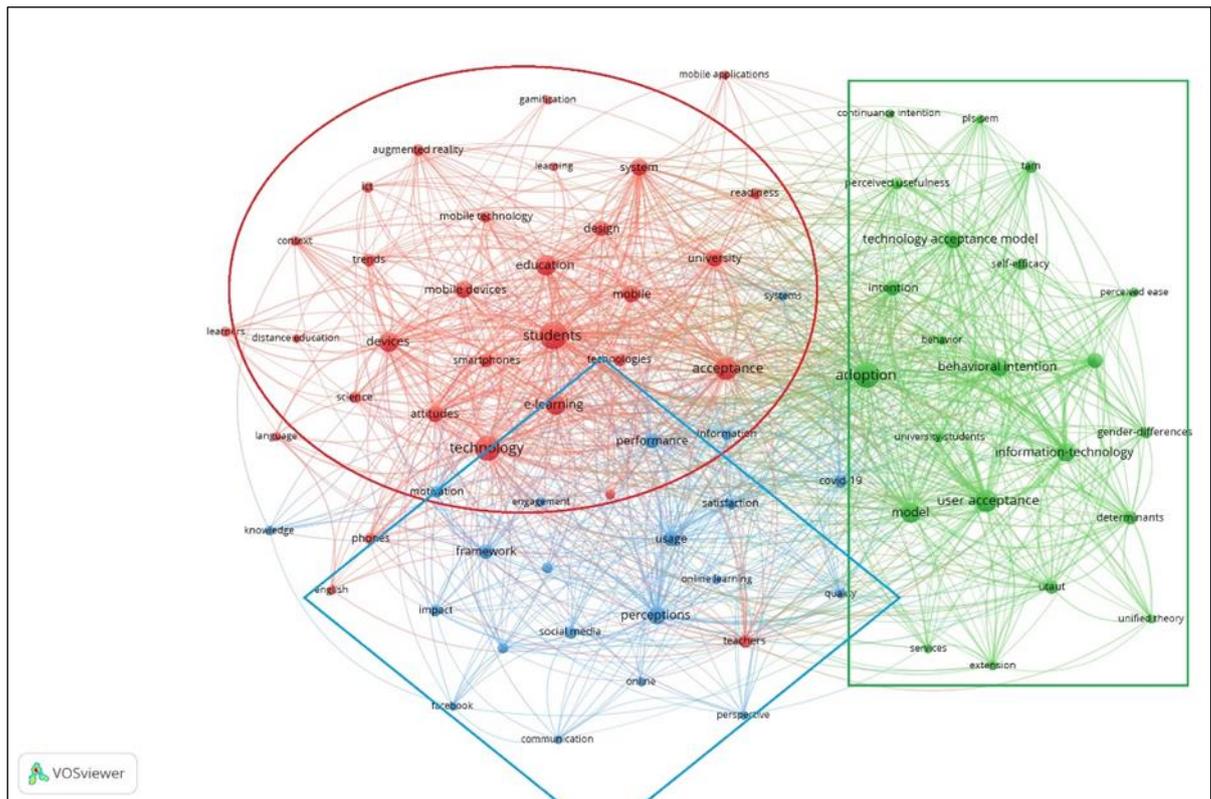


Figure 5: M-learning research trends through keyword analysis

It is observable that m-learning research remains very student-centric, with the keyword 'students' being the most prominent, with a total link strength of 417. Of these, the strongest links are between the terms 'students' and 'adoption', as well as 'adoption' and 'user acceptance'. On further analysis of the three clusters, we attempted to draw inferences from them and develop themes which could highlight research areas of interest to scholars. We interpreted them as follows;

- Red circular cluster (Student use of m-learning): this cluster seems to address the 'how' question, that is how students use mobile technologies in m-learning, as well as the technologies used. The nodes show that students use mobile technologies for languages, gamification, augmented reality, mobile applications, among others.
- Green rectangular cluster (Adoption and Behavioural Intention): the biggest node in this cluster is adoption. The rest of the keywords in this cluster seem to point to student pre-adoption perceptions, intentions and determinants, all of which influence m-learning adoption behaviour.
- Blue square cluster (Post-adoption Perceptions): the majority of the keywords in this cluster seem to capture pre-adoption perceptions. When considering the connection between the keywords in this cluster, issues like perceived impact, perceived performance, and system performance emerge.

The VOSviewer 'Overlay Visualization' functionality allows for the identification of contemporary or trending research topics through keyword co-occurrence analysis, whereby the yellow-shaded topics are the more recent ones (Figure 6).

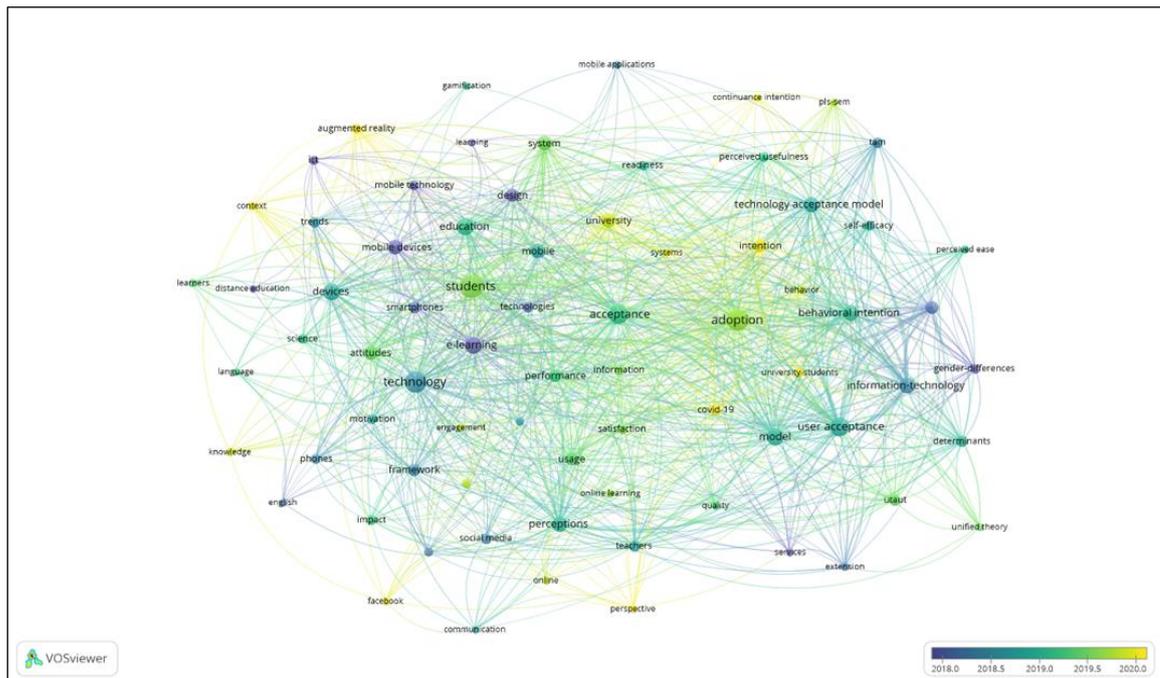


Figure 6: Keyword occurrence analysis by recency

Some of the more recent focal areas in m-learning research include issues around context, knowledge, augmented reality, intentions, COVID-19 and continuance intentions. Of the more recent areas (indicated by the yellow shading) Intentions has the strongest Total Link Strength at 194, with links to various keywords such as COVID-19, systems, TAM and perceived usefulness. Intentions shares their strongest link with user acceptance. It is worth noting that acceptance is further captured as technology acceptance and, simply, acceptance. This suggests a strong focus on m-learning acceptance.

4.4 Most Influential Countries by Publication

It is of utmost importance to understand the power and influence that different countries have on the development of a body of knowledge in any particular discipline (Valenzuela Fernandez et al., 2019). WoS regards countries as the number of publications produced by authors in a particular country. However, as aptly noted by Valenzuela Fernandez et al. (2019), countries should not be conflated with authors. Scholars may be domiciled in one country, but publish under a university located in a different country. In the process of mapping the most influential countries, the minimum document threshold was set at five.

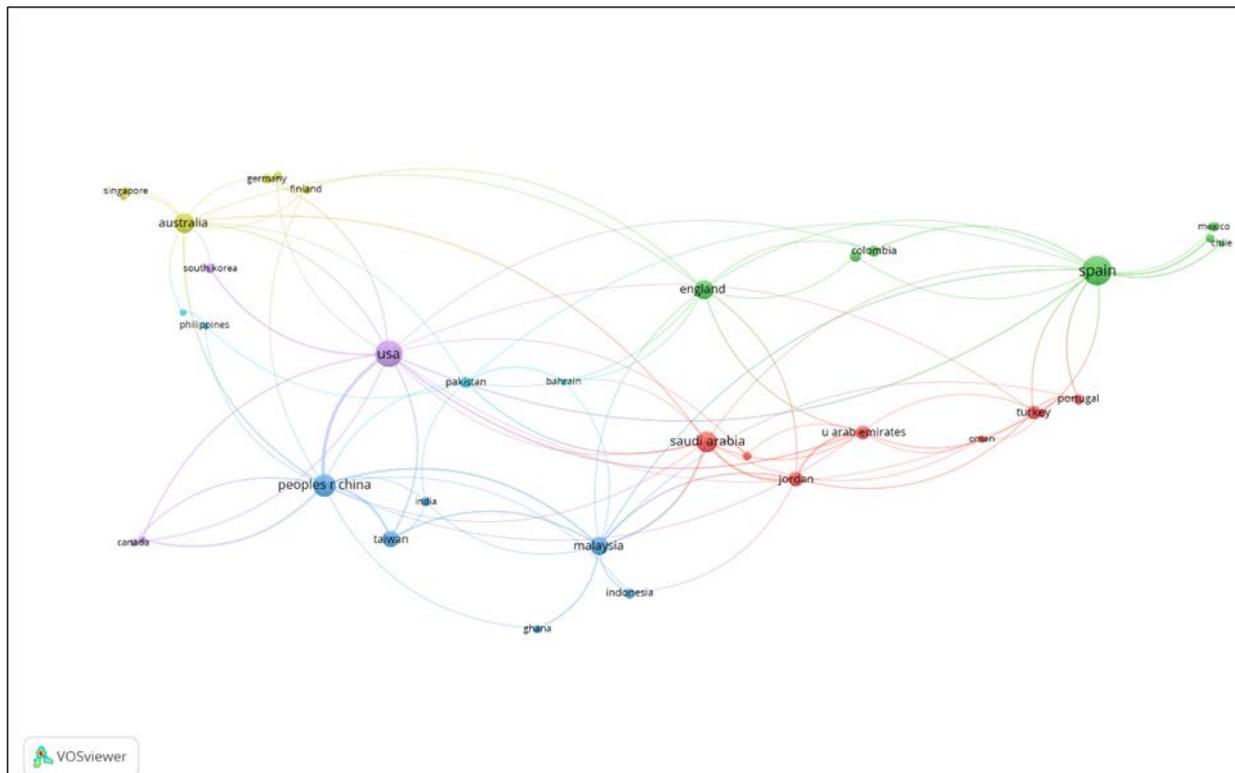


Figure 7: Most influential countries in m-learning research

As highlighted in Figure 7, the USA is the most productive country in the world in the domain area of m-learning in higher education, followed by the People's Republic of China and Spain. This is indicated by the size of the circle or node: the larger it is, the more documents there are originating from that country. Furthermore, the thickest link is between the People's Republic of China and the USA (link strength of 14), thereby indicating a strong co-authorship relationship between the two countries. The network overlay feature of VOSviewer indicates that in the recent past, Saudi Arabia has been the most active source of m-learning research.

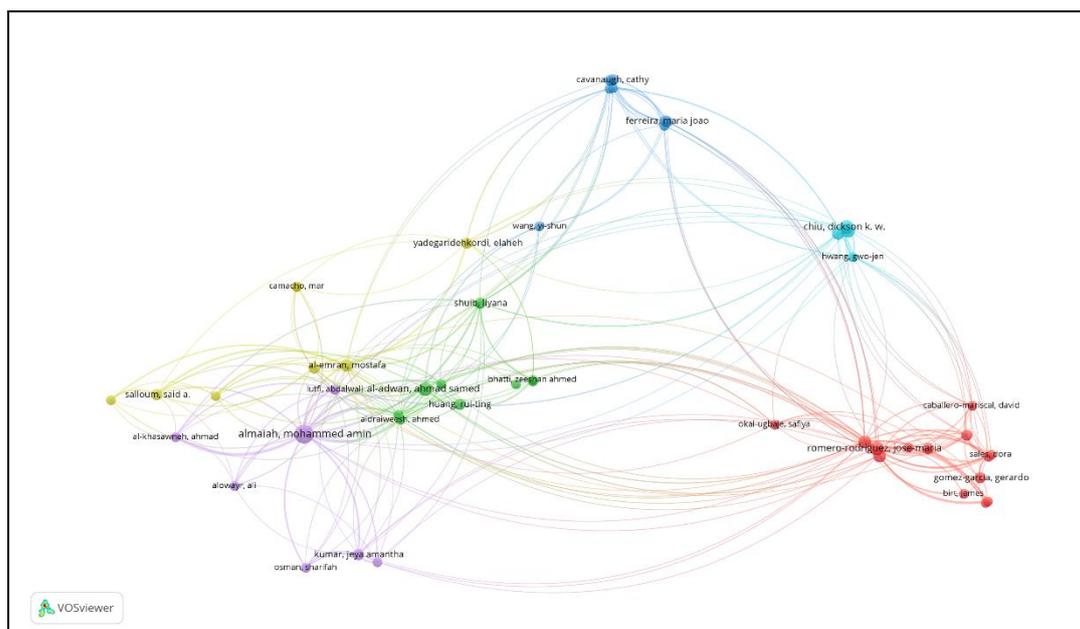
4.5 Most Productive and Influential Authors

Citations are increasingly being used as performance indicators to gauge an article's or author's relevance, impact and influence in academic settings (Aksnes et al., 2019; Ellegaard & Wallin, 2015), where higher citations denote more influence and opinion leadership (Sharara et al., 2011), although this has also led to some perfunctory citations. Some scholars argue that the number of citations attained by a scholar is more important since it reflects the influence of a researcher (Bonilla et al., 2015). Similarly, citations have been preferred over the number of publications as a measure of influence since they suggest that the researcher is publishing interesting and effective research (Goksu, 2021). Therefore, using citation analysis, we also sought to establish the most published/cited authors in the m-learning domain. Initially, we only considered authors with five or more articles, which resulted in nine authors meeting the threshold (Table 1).

Table 1: Most influential authors by citations and productivity

Author	Documents	Citations	Total link strength
Almaiah, Mohammed Amin	11	384	20
Chiu, Dickson K. W.	6	121	19
Lo, Patrick	6	121	19
Ho, Kevin K. W.	5	93	17
Al-Adwan, Ahmad Samed	6	160	15
Al-Emran, Mostafa	5	345	11
Aznar-Diaz, Inmaculada	5	58	3
Hinojo-Lucena, Francisco-Javier	5	56	3
Romero-Rodriguez, Jose-Maria	6	61	3

As reflected in Table 1, M.A. Almaiah is the most influential author by citations, as well as the number of articles that made up our analysis. We then proceeded to lower the threshold to a minimum of three articles, which increased the number of authors to 53. This was done to ensure a greater representation of authors in our analysis. Of the 53 authors, 50 were connected in a network, which we subsequently used for further analysis. This resulted in six clusters, as indicated by the six different colours in Figure 8.

**Figure 8: Author clusters**

Additionally, we conducted a citation analysis to establish the most influential articles in m-learning research. We set the threshold of citations at a minimum of 100, which subsequently reduced the articles to 14. Nevertheless, we restricted our search to the top 10 most influential papers by citations.

Table 2: Most influential articles by citation

Authors and Year	Title of Article	Journal	Citations
Gikas & Grant (2013)	Mobile computing devices in higher education: Student perspectives on learning with cell phones, smartphones and social media	The Internet and Higher Education	570
Cheon, Lee, Crooks & Song (2012)	An investigation of mobile learning readiness in higher education based on the Theory of Planned Behavior	Computers & Education	463
Motiwalla (2007)	Mobile learning: A framework and evaluation	Computers & Education	416
Evans (2008)	The effectiveness of mobile learning in the form of podcast revision lectures in higher education	Computers & Education	388
Al-Emran, Elsherif & Shaalan (2016)	Investigating attitudes towards the use of mobile learning in higher education	Computers in Human Behavior	220
El-Hussein & Cronje (2010)	Defining mobile learning in the higher education landscape	Educational Technology & Society	219
Abu-Al-Aish & Love (2013)	Factors influencing students' acceptance of m-learning: an investigation in higher education	International Review of Research in Open and Distributed Learning	155
McKinney, Dyck & Lubber (2009)	iTunes University and the classroom: Can podcasts replace Professors?	Computers & Education	142
Hamidi & Chavoshi (2018)	Analysis of the essential factors for the adoption of mobile learning in higher education: a case of students of the University of Technology	Telematics and Informatics	131
Sobaih et al. (2016)	To use or not to use? Social media in higher education in developing countries	Computers in Human Behavior	123

Although the African continent is under-represented in m-learning research, it is worth noting that among the topmost cited papers is one co-authored by a scholar based in South Africa, that is, Johannes Cronje. Of the top cited articles in Table 2, we observed that the majority, that is, four out of ten articles, were published in Computers and Education journal. Naturally, this triggered a question; could Computers and Education be the most influential journal publishing in m-learning in Higher Education? To answer this question, we proceeded to assess the topmost contributing journals in the field of m-learning.

4.6 Most Prominent Journals Publishing on M-learning in Higher Education

A further citation analysis was undertaken to establish the most prominent journal outlets where mobile researchers commonly publish. The identification of top journals in any field has several advantages. Therefore, the ability to publish in top journals is an important consideration among social scientists, as it predicts long-term impact and career success (Hou et al., 2022). For this exercise, we undertook a citation analysis of sources to identify the most influential journals. Only journals that had five or more documents qualified for inclusion in this analysis, which led to 30 journals being included in the analysis.

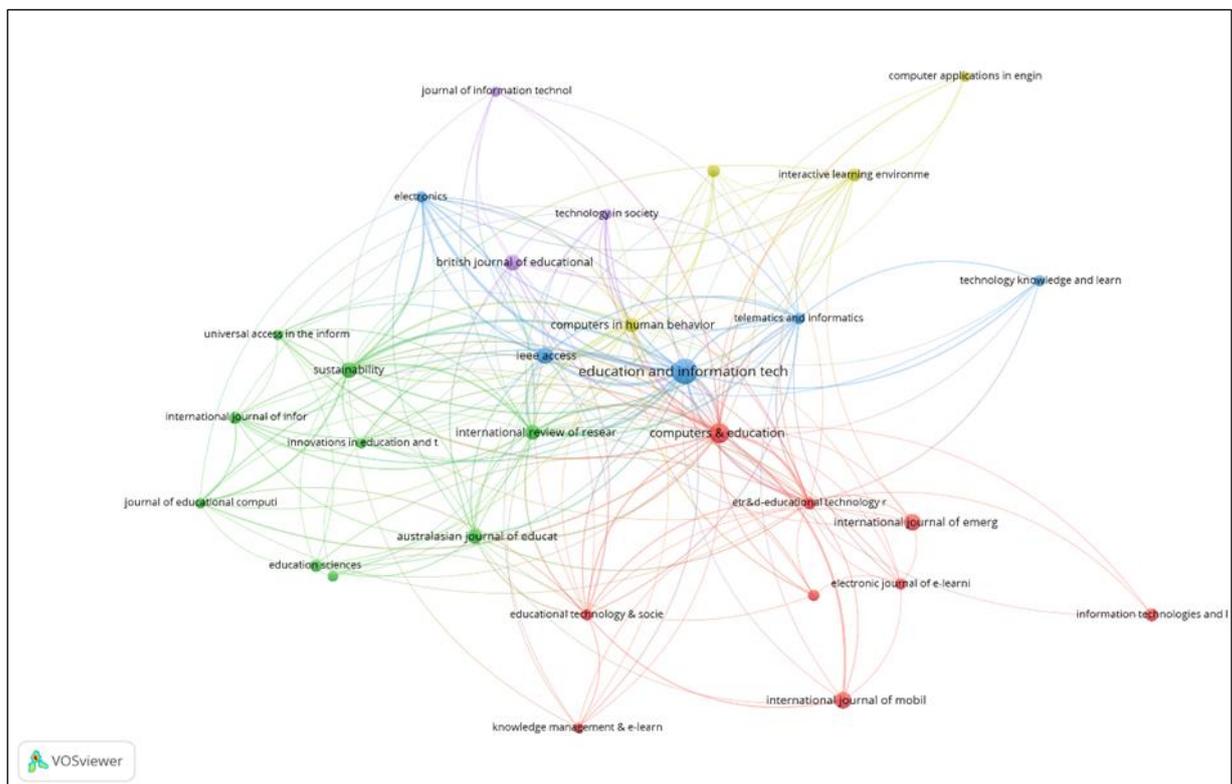


Figure 9: Most active journals in m-learning research

As depicted in Figure 9, 'Education and Information Technologies' is the most active journal, followed by 'Computers and Education'. The 'Overlay Visualisation' feature shows that while Computers and Education was the most active journal around the year 2016, Education and Information Technologies, Sustainability, IEEE Access, Technology in Society and Electronics have recently been more active, as indicated by the yellow shading in Figure 10.

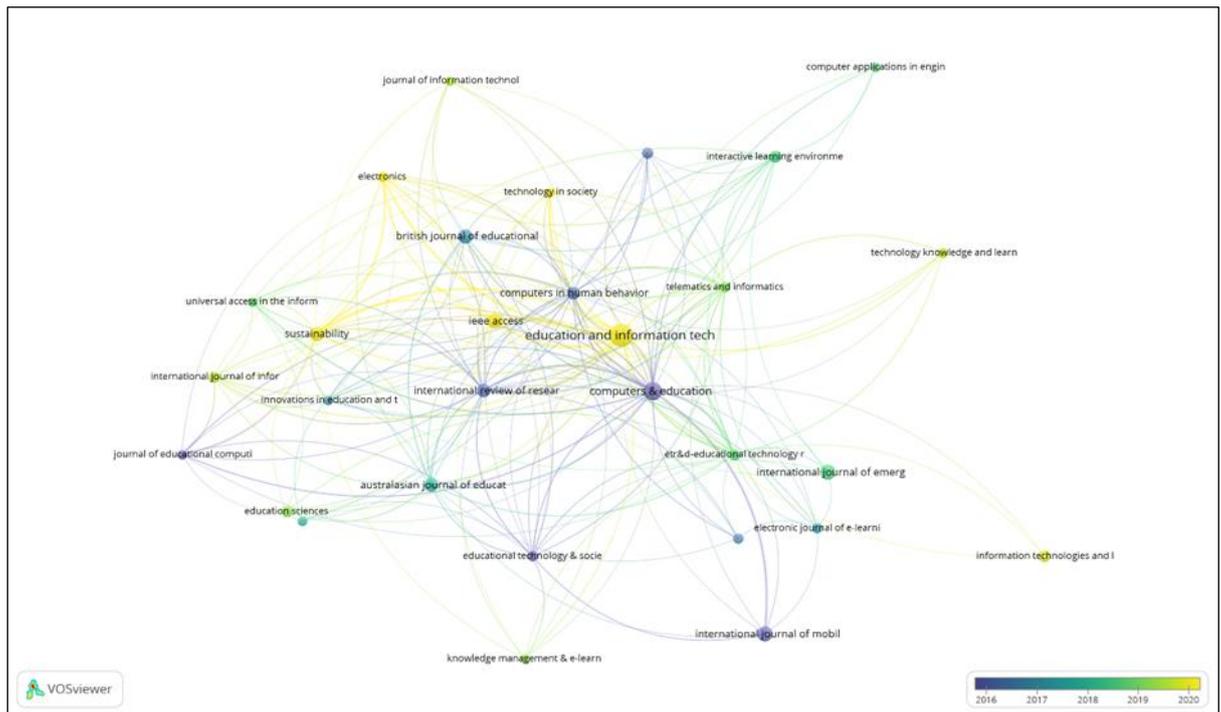


Figure 10: The most active journals in the recent past

We decided to browse through the ‘Aims and Scope’ sections of the most active journals to get a better understanding of the foci. Sustainability, IEEE Access, Electronics and Technology in Society are multidisciplinary in nature, while IEEE Access, Electronics and Technology in Society restrict themselves to papers where the main foundation of the paper is the role of technology in any facet of society. On the other hand, Education and Information Technologies restricts itself to research on the role of various computing devices on both formal and informal learning.

4.7 Most Productive Institutions

We employed citation analysis to identify the top contributing organisations or institutions to m-learning research. We observed that 716 institutions were covered in the data set we used. Of the 716 institutions, 15 had five or more documents in the data set.

We noticed that the majority of the universities on the list were from the Middle East (Table 3). All but two of the universities on the list were from three regions, namely, the Middle East, Asia and Australasia. The most productive institutions are domiciled in the Kingdom of Saudi Arabia. Likely, the Kingdom’s National e-Learning Centre which was established in 2017 to support educational institutions and eLearning has been influential in promoting scholarship on m-learning in recent years. Furthermore, the Kingdom’s Ministry of Education implemented a national learning management system named Madrasati, and prioritised research and development efforts to promote all forms of online learning (UNESCO, 2022), which could also have benefited m-learning research.

Table 3: The most productive institutions in m-learning research

Organisation/Institution	No. of Articles	Citations	Country
King Faisal University	12	295	Saudi Arabia
Universiti Teknologi Malaysia	8	169	Malaysia
King Saud University	6	131	Saudi Arabia
Al-Ahliyya Amman University	5	124	Jordan
Universiti Sains Malaysia	8	138	Malaysia
University of Granada	14	115	Granada
University of Hong Kong	9	181	People's Rep. of China
National Chung Hsing University	5	28	Taiwan
University of Guam	5	93	USA
King Abdulaziz University	6	58	Saudi Arabia
University of Murcia	5	88	Spain
University of Sharjah	5	89	UAE
Zayed University	5	18	UAE
Bond University	5	199	Australia
University of Salamanca	5	37	Spain

5. Discussion

Our findings indicate that m-learning is a highly dynamic field, which continues to attract the attention of researchers. The COVID-19 pandemic brought all forms of online learning under the spotlight, which further led to a proliferation of literature from various countries. Our findings align with those of Goksu (2021) and Khan and Gupta (2022), whose earlier bibliometric studies found m-learning to be on an upward trajectory. Thus, Traxler (2016) argues that the growth of m-learning research suggests that there is still a need for more research to underpin investments, and inform issues such as policy, capacity building as well as raising awareness.

We observed that m-learning research cuts across various disciplines, although education remains the primary discipline publishing m-learning literature. Our observations are consistent with Khan and Gupta's (2022) findings, as well as Imtinan, Chang and Issa (2012, p. 190), who reasoned that the adoption of theories from disciplines such as Information Systems, Education, Human-Computer Interaction and Telecommunication Engineering had 'made m-learning a multidisciplinary research field, indeed'. The multidisciplinary nature of m-learning research means that the field benefits from diverse perspectives, thus ameliorating the various challenges that it faces. According to the European Commission (2022), the synergistic collaboration of different disciplines can lead to invaluable insight beyond current intellectual boundaries, thereby developing novel and useful solutions to complex problems. Similarly, Coccia (2018) notes that the combination of different perspectives from diverse disciplines can help to solve more complex problems, as well as generate new ideas. Furthermore, new technology, along with socio-economic factors, is one of the key factors that leads to the evolution of scientific disciplines. Consequently, with ICT being at the core

of m-learning, it is fathomable that the evolution of ICT will continue stimulating more research questions.

Although there is substantial interest in the opportunities for m-learning appropriation in the developing world (Traxler, 2016), relatively well-off countries remain the most influential countries. Recently, Springer Nature analysed their largest paper contributors. They found the USA to be the most prolific publishing nation, followed closely by the People's Republic of China which was 'closing the gap with astonishing rapidity' (Springer Nature, 2019). Furthermore, in 2018 the Chinese were also the Americans' biggest collaborative partners. By contrast, Khan and Gupta (2022) identified Taiwan as the most influential country in m-learning research. However, it is worth noting that our study focused exclusively on m-learning in higher education, while Khan and Gupta's (2022) study was more inclusive. Additionally, our findings corroborate those of Djeki, Dégila and Bondiombouy (2021), in that African developing countries lag their developed peers in terms of research in educational technologies such as m-learning. The under-representation of poor or developing countries is not limited to m-learning research but includes other areas such as public health (Plancikova et al., 2021). In fact, in a study that also assessed the representation of various countries in three large academic databases, namely, WoS, Scopus and Dimensions, no African country was found among the top 20 in any of the databases (Singh et al., 2021). Of the most productive countries in m-learning research, only Ghana appeared on the list. It is worth mentioning that Ghana appears on the periphery, with very weak links to other countries. The poor representation of African countries was also noted in other bibliometric studies on m-learning (e.g. Khan and Gupta, 2022).

We observed that authors from the developing world, particularly Africa, are under-represented in literature. However, Plancikova, Duric and O'May (2021) argue that it is well documented that variables where a scholar grows up or lives may play a role in influencing their opportunity to publish in high-impact journals. Scholars from resource-constrained countries often have to contend with problems like the lack of interest from elite journals, editorial prejudice, weak peer networks and a lack of research funding. As aptly noted by Traxler (2016), while the publication of journal articles is sometimes rewarded in the Global South, often it is not, thus negatively impacting the productivity of researchers. However, when discussing the influence of authors based on WoS citations, caution must be taken. Some scholars (see Singh et al., 2021) argue that WoS should not be used in isolation as it tends to exclude citations outside the WoS coverage. Nevertheless, the same argument could be made against any other database.

Authors mostly cited by m-learning scholars include Venkatesh et al. (2003) and Davis (1989). It is worth noting that Venkatesh and his colleagues developed the Unified Theory of Acceptance and Use of Technology (UTAUT) model, while Davis developed the Technology Acceptance Model (TAM model). As noted by several scholars (Chao, 2019; Chibisa & Mutambara, 2022; Kaisara & Bwalya, 2022), these models are the two most commonly used theoretical frameworks in

m-learning research. While the two frameworks have demonstrated their utility in several m-learning studies, this could suggest that the discipline is missing out on some insights that could come through the adoption of different frameworks. According to Park (2011), the lack of a solid theoretical framework to guide m-learning interventions remains the most serious challenge faced by m-learning. While Park made this observation over a decade ago, a cursory glance at the extant literature suggests that this concern remains valid.

Surprisingly, the most active university is not based in any of the traditional research heavyweights, that is, China, the USA or Taiwan but in Saudi Arabia. This could suggest that there could be only a handful of Saudi universities that produce significant research on m-learning, while it could be more spread out among many universities in China and the USA, which then cumulatively leads to a high country output. The Overlay Visualisation feature of VOSviewer indicates that in the recent past, the Middle East has witnessed a noticeable growth in m-learning literature output.

Education and Information Technologies was the most prominent journal outlet publishing m-learning literature, followed by Computers and Education. Computers and Education has been identified in various m-learning studies as a prominent outlet favoured by many researchers (Goksu, 2021; Khan & Gupta, 2022; Krull & Duarte, 2017). Based on the results of these studies, insight is provided to authors who wish to identify and consult the most influential journals for their purposes, be it to publish or seek new m-learning resources, such as new articles.

Of the fifteen most productive universities in m-learning in higher education research, the majority come from Asia. Of these, ten are in the Middle East, also known as West Asia. The dominance of Asian institutions mirrors the findings of Khodabandelou et al. (2022), whose study found that eight of the ten most productive institutions in m-learning research are located in Asia. Asian universities were also prominent in study. In the present study, most of the leading institutions are based in Saudi Arabia, while in Khodabandelou et al.'s (2022) study, most of the top institutions are based in Taiwan. A key difference between this study and that of Khodabandelou et al., (2022) is that their study focused on using m-learning to learn the English language, while our study was focused on broader m-learning in higher education.

6. Future Research Agenda

The bibliometric analysis has highlighted several issues that could inform future research endeavours. Scholars from the Global South need to have their voices heard. As noted by Plancikova, Duric and O'May (2021), it is important that editors and editorial boards of leading international journals provide more opportunities for researchers domiciled in the Global South. Similar sentiments are echoed by Moosavi (2020, p. 342), who argues that "it is our duty to locate and amplify these voices, even if this is challenging". From the keyword analysis, it is apparent that issues around contextualising m-learning research are gaining importance. Through the keyword co-occurrence network visualisation feature of

VOSviewer, we can identify some potential future research avenues through the linking of different keywords.

Our results revealed a link between 'Context' and 'Knowledge'. This potentially suggests that contemporary research is focusing more on 'contextual knowledge'. Currently, there is very little research emanating from the Global South, which is necessary if developing countries are to be equal partners in the increasingly competitive global knowledge society. Therefore, rather than seeking to develop generalisations, more research is needed to accentuate contextual factors. We also observed a link between 'framework' and 'context'. The keyword 'framework' is linked to only two contemporary (yellow-shaded) keywords, namely; 'context' and 'online'. This possibly suggests that there is increasing interest in developing frameworks that are contextually bound, as well as useable in an online setting. The interest in context, while perhaps under-reported in m-learning literature, is well documented in the broader knowledge management literature. The importance of context in knowledge management is well discussed by Thompson and Walsham (2004), who lament the insufficient attention paid to the context where meaningful activity takes place. In m-learning, some scholars (see Hamidi and Chavoshi, 2018) have extended the popular TAM model to include 'context' as an independent variable. By being sensitive to context, researchers collect data that is unique to a location, time and environment (Basak et al., 2018).

'Students' are the stakeholder that is the primary focus of most of the extant literature. The keyword co-occurrence analysis did not reveal any other stakeholders (except teachers), which suggests a gap in the body of knowledge. There is a clear overemphasis on students (Total Link Strength of 432) in m-learning literature. The focus on students is evident both in contemporary studies and those conducted in the immediate past. Therefore, it is important that other stakeholders are included in m-learning foci. Other stakeholders may include government, telecommunications corporations, university ICT administrators and management.

More research is also needed in new but under-researched areas such as the role of social media, including Facebook and WhatsApp in m-learning. The influence of COVID-19 on m-learning research is inarguable. Furthermore, the adoption of m-learning during the COVID-19 pandemic was mostly non-volitional. Therefore, it would be useful to undertake further studies on continuance intentions to use m-learning in the post-COVID-19 era.

Moreover, as mentioned earlier, it seems there is an overemphasis on adoption-related research (Total Link Strength of 524). Adoption shares its strongest link with acceptance (link strength of 27). More research is needed on pre-adoption factors, such as m-learning implementation critical success factors and potential challenges that implementers may face.

Finally, there is a need to increase m-learning research from other non-education disciplines. The dominance of education may lead to the drowning out of critical contributions from smaller but important disciplines such as information science,

knowledge management and telecommunications. Our findings show symptoms of a dynamic field that is evolving and yet to reach maturity, which is likely to continue to be driven by technological developments and contributions from various research contexts.

7. Limitations of the Study

The study is not without its limitations. Firstly, the results of a bibliometric study are to a great extent influenced by the keywords used. Therefore, using other keywords may have yielded different results. Secondly, this study used data extracted from one database, namely, WoS. This review was limited only to papers written in English. Therefore, important knowledge presented in languages other than English may have been missed. Other studies may also use other databases such as Scopus and Dimensions to expand the body of knowledge.

8. Conclusion and Recommendations

This study was designed to explore and highlight the make-up and status of m-learning in higher education research. Metadata was extracted from WoS database and quantitatively analysed using VOSviewer software. The study demonstrates that learning in the higher education field is on an upward growth trajectory, with noticeable growth in the Middle East. The developing world, particularly Africa and South America, is still under-represented. We believe that the study provides invaluable insights regarding the contribution, or lack thereof, of various actors in the m-learning discipline. Although the study is not without its limitations, it provides a glimpse into the m-learning research trends in the extant body of knowledge and elucidates gaps which could be considered for further research by other scholars. With the continued attention paid to m-learning in higher education, regular bibliometric studies may be needed to keep appraisal of developments in the m-learning domain

9. References

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