Trends in the Role of ICT in Higher Education Knowledge Management Systems

A Systematic Literature Review

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ABSTRACT

In the prevailing knowledge-driven economic society and increasingly digitizing world, knowledge as the very important resource claims a key position in the success of companies and institutions. It is even more so in the knowledge-intensive institutions like in higher education. Its proper management incorporates three main components, namely People, Technology and Process. It is the coherence between these main components that determines the success of a Knowledge Management System (KMS). Since the later years of last decade, the advancement in the features of technology hardware and their functionalities have brought more focus on the technology capabilities to serve the human resource beyond representing and processing information. Moreover, the growing digital-native generation also forms the basis for the application of advancing features of technology into the processes to efficiently utilize the knowledge resources for greater educational and research endeavors towards sustainability of higher education. This Systematic Literature review, therefore, describes the methodology developed to conduct the review and provides analysis of the findings exploring the trend in the application of information technologies in higher education KMS. It will also identify gaps where more research needed and describing lessons acquired for contextual application of KMS in developing countries' higher education.

CCS CONCEPTS

• Information systems~Collaborative and social computing systems and tools • Applied computing~Distance learning • Social and professional topics~Computer and information systems training

KEYWORDS

Information technology, knowledge management, higher education

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1 Introduction

As the core concept in this systematic literature review, Knowledge is defined as the theoretical or practical understanding of a subject that is acquired through education or practice [1]. In the case of higher education and research, therefore, knowledge refers to the theoretical or practically represented educational resources that are acquired by the community in different forms. With the advent of information technologies and the wider internet platform, the values of knowledge assets have been enhanced through sharing and collaborative research and institutions have been developing KMS to manage the process of acquiring, sharing and creation of these assets and promote organizational learning [2, 3, 4]. Knowledge management (KM) is also sought to serve higher education institutions as a tool to ensure institutional sustainability through locating, organizing and storing knowledge resources and sharing them to the community [5]. KM integrates three core components - people, processes and technologies, where technology enhances the knowledge integration and creation, process optimizes organizational design and workflow and people as the key source of knowledge and interaction in the echo system [4, 6].

The issue of knowledge representation in a way machines can understand has been a challenge for the application of information technologies in KMS. Advancements of information technology that brought expert systems, semantic web and intelligent techniques, however, enabled capturing and representing tacit knowledge from skilled employees in the form of sets of rules [4], which provide human-oriented knowledge representation that are also machine readable [3]. This advancement in the representation of knowledge further

stimulated the application of new technology features into KMS. The new techno-savvy generation also creates impetus for the adoption of new technologies in the process.

Use of appropriate technology applications in KM promotes the utilization of knowledge resources in Higher education institutions and facilitates research and teaching/learning activities [6]. Whereas KMS, with the advancing capabilities ICT offers, aims to improve quality of the higher education institutions through rich teaching-learning resources and advancing quality research outputs [9, 10]. In the context of higher education, therefore, appropriate information technologies are used to facilitate the knowledge resources organization process, while KMS aims for these institutions to efficiently achieve their mandates in Teaching-learning, research, community service and cultural preservation.

However, the uneven advancement and penetration of technologies in today's world leaves behind the higher education communities in developing countries, where the higher education systems are yet to revolutionize their ways of organizing their knowledge resources for education and research through introducing digitization. Studies in Nigerian and Sudanese universities show the challenges prevailing in the use of and awareness about technologies and technological advancements, hence deterring the appropriate development of KM systems [10, 11]. The same also applies in the higher education system in Eritrea, hence the findings serve as a context for the research agenda, which the study presented in this paper belongs to.

The main objective of this systematic literature review is to explore the changes and trends in the role of Information technology in higher education KM systems and lessons to learn for higher education in developing countries in general and in Eritrea in particular. It also aims to identify the area in the current KMS development where further research is needed. To achieve these objectives, the systematic literature review will address the following research questions:

RQ1 - What were the roles of technology in higher education KM systems over time?

RQ2 - What is the impact of KMS application in Higher Education, and the changes in the importance of ICT for KM?

This research, therefore, presents the methodology used in the SLR process, the findings from the review and discussion on the findings, in order, and the references at the end.

2 Method

The following SLR metrics are applied to this research and they are strictly adhered to. These metrics form the core guidelines for the systematic literature review, mainly adapted from Kitchenham's literature review guidelines [12] with necessary modification to fit the area of focus in this research.

2.1 Keywords and Search String

The key words were selected as they represent the main pillars of the research and they were set in a search string as: (ICT* OR IT* OR "Information Technolog*" OR Technolog*) AND (KM OR *Knowledge*) AND ("Higher Education" OR Universit*)*.

2.2 Study Selection

Selection of the articles and book-chapters was done based on the occurrence of the complete search keys in the search string. Due to the multidisciplinary nature of the research topic and the extent of the research domain that spans the three main areas incorporated in the topic, the researchers justified to run the search string across various research databases including Web of Science, ACM, Science Direct, DOAJ, IEEE Xplore and Springer. They have made through search for the key terms, avoiding duplication of search instances from different sources.

2.3 Date Range

To achieve the objectives of this research, the date range for papers collection for review was set between the years 2005 – 2018. The year 2005 was selected because it represents the period when the focus on technology component of KM was gaining more attention despite the previous years, which gave more emphasis to the human component of KM and minimal focus on technology. Moreover, it is the most active period until 2010, when more KM events had been hosted in international domain and many research-works on KM were produced then after. Hence, relevant publications are also relatively widely available during this period.

2.4 Inclusion / Exclusion Criteria

Inclusion/exclusion criteria were applied in three stages as mentioned in Table 1.

Table 1. Inclusion/exclusion criteria applied in this SLR

Criteria	Inclusion Criteria	Exclusion Criteria	No. of Papers
1	Titles that include the complete keywords in the search string Titles that include 'technology' & 'knowledge management' in general settings	Titles that didn't include 'technology & 'knowledge management' along with 'higher education' or general settings.	163
2	Focusing on technology's role in higher education KM; technology's role in general KMS applicable to HE too	Where technology's role in higher education KMS is not significant by going through abstract and brief contents	35 papers 7 book chapters
3	Those with contents matching the objectives of the research after going thoroughly through the whole content	Those that are found less relevant to the focus of the current research topic after going thoroughly through the contents of the paper.	30 papers, 4 book chapters 129 excluded

The selected papers as the outputs of the inclusion/exclusion criteria were organized in a reference management system for detailed data extraction, citation and referencing needed thereof for this SLR. These papers have been collected from different research databases and journals covering a range of sources as depicted in Figure 1.

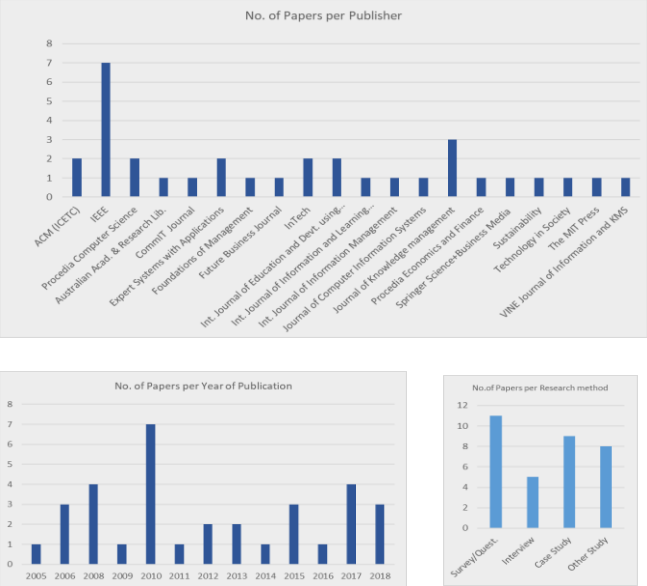

Figure 1. Representation of the papers collection

2.5 Data Extraction

Data extraction is done from each of the selected articles as per the excel sheet template prepared prior to the extraction process. The template included columns to capture the detailed description of each paper under review including: Paper title, Author/s, Publisher, date of publication, research methodology used, main area of focus of the paper, the two research questions of this SLR, and finally a general findings column. Every selected paper was thoroughly read for extracting the corresponding information to the columns and the relevant data to the research questions placed in the template columns. Five papers and three book chapters, as indicated in the inclusion/exclusion table above, were dropped in the process after thoroughly reading the papers and they were found to have no enough connection with the research questions.

2.6 Data Synthesis

The extracted data was synthesized as per the collection in the corresponding template columns of the research questions. The findings in each column from every paper reviewed were thoroughly analyzed and categorized in chronological order so that they provide the pattern of the research outputs signifying the specific period. Those papers with similar outcomes were categorized in a period and they are merged into set of findings exploring the specific period, regardless of how many years it spans. Accordingly, those categories of findings succeeding each other formed a pattern of understanding about the role of technology as a component of KM in higher education, the adoption of KM in higher education and revealing the latest developments in the technologies' provision. The findings of the series of periods, treated in phases in this paper, are presented in reference to the specific realities explored from the reviewed papers in connection to the research questions set. Finally, discussion on the findings by the authors of this SLR, projection of the trend in the role of technology in higher education KMS, and the future research needs are presented at the end of the paper.

3 Findings

The literatures reviewed have been systematically organized for collecting the findings across all of them over the period as per their date of publication. For ease of presenting the findings, the period is divided into chronological phases according to the similarity of events and activities revealed in the corresponding research works.

Phase-1: The years 2005 – 2006 (Paradigm shift towards more focus to IT's role in KMS)

During this period, most of the papers raised the importance of ICT in supporting KM endeavors providing justifications that previous studies referred. They referred to the indispensable role of ICT in enabling and advancing KM through its advancing features [7, 13], including the provisions for codifying and representing indigenous knowledge [14], while respecting the values of the community and the sensitive nature of this knowledge resource. Discussing about the relationship between KM and technology, Clyde [13] mentioned that "knowledge is neither equated with information, nor is a barrier built between computer-based technology (CBT) and KM. It is an inclusive perspective that views the boundary between KM and CBT as highly permeable, and that sees the value in CBT as ultimately coming from its contribution to KM efforts." The services related to eLearning and digital repositories were also presented in developing country's context as promoting the implementation of KM in higher education, despite the challenges in technology integration and awareness of the higher education community on the new technologies in these countries [11].

Research outputs of the period provided new understanding of the interconnection between KM and technology, where each of them influenced positively the advancement of the other [11, 13], and also later supported by Shoham & Perry [15]. This was presented as the advancement of ICT infrastructure and services required proper KM process to manage the technological changes and guide the changes into comprehensive impactful effects, while the development of KM

also further provoked the advancement of technologies to better represent the knowledge and facilitate the communication as per the advancing requirements of KM. Therefore, "the proposition that modern knowledge management is inseparable from a consideration of technology is compelling. We really cannot fully appreciate KM practices and possibilities without paying attention to technology, to the users of that technology, and to the impacts of that technology." [13]. Numprasertchai & Poovarawan [7] also confirmed in their research at a public university in Thailand that ICT based KM system significantly enhances the university's performance in general, in term of quality and quantity of student, innovative services, research results and innovative community services, greatly contributing towards achieving the educational mission. Amin [11], however, mentioned in his research that in addition to what technology can offer to KM, effective KM may require significant change in culture and value, organizational structures and reward systems too.

This period showed several KM and technology-related research works that recognized the importance of ICT for the KM advancement as key component along with the human values and other factors that make up KM, hence boldly justified the emergence of new period in the conception of ICT Vs. KM development in general.

Phase-2: The years 2007 – 2009 (New Technologies and features impacting on KM)

During this period until the year 2009, research works justified the uncontested importance of human values in the KM process, while this alone cannot live up-to its potential influence in the fortune of organizations and widely recognized the role of ICT to facilitate the KM process at all levels. These research works proved that continuous advancements in technology demanded human creative thinking of managing the changes and guiding them into a comprehensive solution-oriented effects through KM process, while the implementation of this KM System (KMS) in return demanded the unavoidable role of ICT into the KM process addressing the prevailing implementation gaps of KM [2, 15]. These studies mentioned that different organizations including academia have been developing their own technology solutions to help their KM process, while the importance of KM was unanimously sought and many gaps identified in those different approaches of implementing KM.

In mitigating these challenges and gaps, ICT was considered to have a key role, which it further needed advancement and innovative engineering to address the gaps better. Tseng [2] said, "In the process of KM, the absorption, creation, arrangement, storage, transfer and diffusion of knowledge are all dependent on assistance provided by IT". Shoham & Perry [15] further presented that KM serves higher education in planning and managing innovation and changes triggered by knowledge sharing, relying on and using information technology capabilities.

On the other hand, Iiyoshi & Richardson [16] mentioned "Pooling intellectual resources about pedagogical practice is also becoming a necessity in a world where domains of knowledge are fluid, continuously changing, and expanding". One way or the other, this drive to represent, organize and share knowledge resources is in turn promoting the innovation of new technology solutions to address the needs. The advent of web-based technologies like Web2.0 and weblogs, also created greater opportunity to facilitate KM better by representing both tacit and implicit knowledge in academia and other organizations [16, 17], having new characteristics and new mode [18]. This has been partially contributing to the better representation of knowledge resources and systematically unifying various tasks by seamlessly organizing them. "With Web 2.0, Internet users are not only finding information on the Internet. They are also creating and uploading content" [18], also supported by Nilsook & Sriwongkol [17]. Moreover, Nilsook & Sriwongkol [17] found out in their research that weblog technology services have been well accepted by the academia in Thailand Universities when used as KM tools to facilitate knowledge sharing and collaboration among teachers, students and the community. As KM processes help in turning an organization's intellectual property into a greater productivity, new values and increased competitiveness, it requires a research on establishing an appropriate KM system with technology-task fit design of enabling technology facilities [6].

In general, the enabling capability of Information technology to KM is in allowing the expansion and universalization of the scope of knowledge and in increasing the quality and speed of transferability [2, 17] through appropriate representation [3, 4, 16]. These research works proved that the importance of KM is well justified in higher education knowledge resources sharing and collaboration and human values as vital component of the KM, while ICT ensures the existence and full potential use of the human resource without which KM would not be successful. Hence, the role of technology is bold enough in facilitating KM, while new emerging technologies need further research in exploiting the potential, they can have for KM systems, as supported by the researchers in this period.

Phase-3: The years 2010-2011 (The advent of Expert Systems into KMS & emulating human actions)

The year 2010 hosted international events on KMS, where many research works have been published in the domain of ICT and KM integration. Studies showed the advent of eLearning tools being integrated into facilitating knowledge sharing in higher education and promoting general KM processes proving the direct links between the two [19]. Others presented the implementation of ICT solutions in higher education libraries, as centers of research and teaching-learning resources, hence

facilitating the management of implicit and explicit knowledge resources through representing them to be presentable and ready for sharing [20, 21]. In these studies, KMS was considered as a tool for utilizing knowledge resources represented in electronic format and shared across digital library collection, hence justifying the important role of ICT in the process. Sitarski [22] in his case study developed a KM model based on technology provision and supported his model using a technology prototype. In this prototype, he showed how ICT new advancements can seamlessly unify user requirements and facilitate the smooth flow of the modules in the proposed KM model. Based on the theory of organizational knowledge creation by Nanoka and Takeuchi, Sitarski [22] referred that allowing constant changes of one knowledge type into another is a basis for the creation of new knowledge in the organization.

Therefore, ICT has been well proven to play a key role in the whole functionality of KM process, and this integration of ICT and KM is more impactful in the knowledge-intensive organizations like Universities [6, 22]. Highlighting the importance of ICT in every process of KM, these researchers have identified gaps in the knowledge models adopted in different settings and opened a new research agenda in further development of adaptable KM model using developments in technology that can further enrich the contents of the knowledge shared across platforms and institutions. As presented by Singh A. [4], new features of technology, the expert systems, are used to emulate the user interaction with human experts in responding to a particular challenge or solving problems; Hence, representing tacit knowledge in presentable form, while serving as a collaborative tool for both explicit and tacit knowledge resources sharing across various users with differing capabilities.

ICT intervention with the emerging smart features was also gaining more focus along with other KM components, as the Intelligent systems were developed with capabilities to adaptive response and intelligent guidance to search, locate, acquire, share and collaborate the better represented knowledge resources [4, 23]. They further explained that the intelligent technologies introduced new features in adaptive information filtering and intelligent agent systems that leverage memory-based reasoning to select search results and suggest actions. Zamasi [24] also elaborated in his research the consideration of enabling hardware and software that facilitate the identification, communication, storage and distribution of knowledge in KM systems. These along with collaboration and intelligent systems do provide an enabling platform for KM systems development, hence optimizing the efficiency of human values' impact.

Phase-4: The years 2012-2014 (Smart systems and machine-readable representation of knowledge)

This period showed many research works in the area of intelligent technology systems offering extended role of ICT in KM systems development including: Semantic systems and web-based application, the cloud computing and web 2.0 new capabilities [3, 8, 25, 26]. In their presentations, the new introduction of semantic systems brought disruptive technologies that introduced new ways of doing things supporting decision making [25]. They also identified the barriers for processing knowledge by machines as the representation of the knowledge resources in ways that can be readable by machines.

Another research in the domain explained new semantic web technologies like Web 2.0 that could get over the challenges of representing knowledge not only as understandable by people but also readable by machines for further processing [3], hence the role of technology gaining more reasons to get more focus. Chao, et al. [3] referring to literature, further projected that the integration of semantic web with Web 2.0 technologies would lead to the evolution of 'web3.0' that caters new features to address the current limitations. Natek & Zwilling [26] also described in their research that with the development of efficient ICT tools to represent the implicit knowledge, even smaller scale desktop ICT applications like in datamining can help to extract implicit knowledge for HE decision making.

Phase-5: The years 2015-2017 (Non-technical factors influencing the ICT – KM integration)

This period was characterized by many research works focusing on non-technical factors. These factors shape the way appropriate technology is designed and developed to better utilize the knowledge embodied in the human possession and shared across collaboration platforms. Previous study by Fullwood, et al. [27] presented a minimal focus on the role of technology, institutional structure and leadership on the Knowledge sharing in a survey they implemented in 11 UK universities, despite the respondents' positive perception on the existence of knowledge culture and intentions to share. Moreover, Ololube, et al. [10] revealed in their research that ICT readiness of universities in Nigeria was rated very low as per 2015 global index report, and that this situation does not encourage the development of KMS. Their analysis, in fact, shows the inseparability of ICT from KM development in the technology and knowledge-intensive era. They further mentioned that many African countries could not efficiently utilize the technology gadgets they have due to lack of usable comprehensive wider area networks and internet, despite the considerable rate of mobile penetration, for example. This situation is a common scenario in most of the sub Saharan Africa countries, which calls further the importance of not only ICT's role, but also awareness and required investment on ICT to help them to catch-up with the tech-savvy world.

In this regard, researchers during this period emphasized on the optimistic role that technology plays; a central role in knowledge sharing among people, while the effective usability of the technology requires considering other non-technical

factors that affect the knowledge exchange. More focus was needed on the efficiency of the technology solution used in KMS by ensuring that it fits the tasks needed to impact on the efficiency of the KM processes and applicability of the technology in the relevant KM systems [28, 29, 30]. The researchers further sought list of other factors that need to be considered along with technology for a comprehensive KM solution, hence, the use of appropriate technology that fits the needs of the institution shall be accompanied by well-intended developments of the other factors that make up a more efficient KM system. Jabbouri [31] also mentioned that the engagement of ICT gained more focus in knowledge creation through promoting innovation. Moreover, the researcher proved that creating the awareness on the use of IT hardware, software and skills needed has positive impact on innovation performance.

Further research on technology application for KM indicated the use of mobile devices and services [32], and collaborative technologies, social networks and web 2.0 [33, 34]. The use of these technologies for sharing knowledge were driven by perceptions of usefulness, peer usage, personal innovativeness and task-technology fitness. They identified organizational culture including attitudinal difference between academics, admin staff and the community towards knowledge sharing were also sought as challenges that deserve appropriate attention while considering the new technology developments facilitating KM. Almujally & Joy [35] further found out from a case study in Saudi universities that technology solutions used in KM have addressed the challenges posed due to barriers and boundaries. These existing barriers in Saudi universities were due to culture and technology awareness and could be addressed through advancing web-based KM technology applications and appropriate implementation. Individual, technological and organizational barriers are also identified, and same web-based knowledge sharing technologies are considered supporting the model developed for KM in universities. Almujally & Joy [35] justified this model as "developed by combining the behavioral, technological, and organizational determinants from two well-established theories, namely the task-technology fit (TTF) model, and the unified theory of acceptance and use of technology (UTAUT)". It aims to blur the boundaries using the KM system across the university communities.

Phase-6: The year 2018 (Consolidating technological and non-technological factors on ICT – KM relationships)

Recent studies in the domain presented that developing ICT capabilities greatly promotes the development of KM in an organization, leading to sustainable competitive advantage [9, 36, 37]. These researches also justified that computer mediated tools and new technology features are found to be essential means to boost knowledge capacity and sharing in the academia, hence the role of technology in KM is considered as mandatory to ensure greater level of quality achievement in the higher education. Akram, et al [37] identified in their research certain IT capabilities that greatly enhance KM including IT infrastructure, IT applications, IT competence, and IT skills, while Ghabbana, et al [9] mentioned several other factors that influence the effectiveness of knowledge sharing and need appropriate attention in addition to the key role IT plays. These factors include, the nature of knowledge, staff attitude, motivation to share, opportunities to share and working culture.

In general, the findings presented in the six phases can be summarized as in Table 2, where the key events and corresponding impacts on KM are shown signifying the respective phase. The findings in each phase characterize the specific period with the changes and developments in ICT and corresponding impact and developments in KMS. Hence, the advances in technologies over the periods mentioned and the advancements of KM as supported by technologies is plotted in Figure 2, showing the relative advancement of both ICT and KMS over the period from 2005 – 2018.

Table 2. Chronological summary of key events and impact of ICT on KM

Phases	Key events and developments	Impact
Phase-1 (2005 – 2006)	Codifying tools, Indigenous knowledge sharing, inseparable (ICT-KM), new era in ICT & KM relationship	Technology gaining focus in KM
Phase-2 (2007 – 2009)	emergence of Web2.0, weblog, advancing tech change mgt., advancing KM needs new technology features	New technologies and features recognized for impacting on KM
Phase-3 (2010 – 2011)	Expert systems, adaptive filtering, memory-based selection, Tacit K representation in digital libraries using new tech	Advent of smart systems into KM & Tacit Representation, emulating human actions
Phase-4 (2012 – 2014)	Advent and use of Cloud computing, Web2.0, Semantics, disruptive technologies, Machine readable K representation, smart technologies	Intelligent & semantic systems, machines understand the K representation better
Phase-5 (2015 – 2017)	survey in 11 UK univ. -> neutral perception on Tech/ positive on Knowledge culture and need for sharing. Challenges in technology readiness in developing countries posing barrier for KM	Impeding factors identified as technology awareness, Sharing culture, role of leadership & structure, finances
	perceptions on usefulness, peer usage, TTF, personal innovativeness, technology awareness, cultural barrier, role of hardware/software	Focus on non-technical factors to support technology use; optimize the technology impact on KM
Phase-6 (2018)	CBT & new techno- features support the non-technical factors as well; boosting KM, organizational performance and competitiveness, KM became One of ICT's key applications	ICT - KM relationship well established; new KM, calling for further research

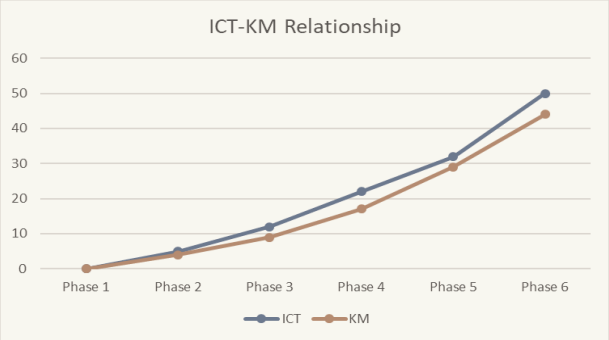

Figure 2. ICT – KM relationship trend from the SLR findings

Figure 2 shows the six phases spanning from the year 2005 – 2018 on the horizontal axis, while a relative scale on the vertical axis representing the advancement of technology and the corresponding advancement in KMS as revealed during the phases.

The abovementioned findings address the research questions as follows.

RQ1: What were the roles of technology in higher education KM systems over time?

As summarized in Table 2, the research finidngs in the different phases have justified the advancing roles of technology in different forms and addressing the timely demands of manageing the knowledge resources in KMS. The application of technology on KMS is, in fact, considered as one of the key areas of technology deployment among other end uses.

RQ2: What is the impact of KMS application in higher education, and the changes in the importance of ICT for KM?

the research findings revealed that the advancement in higher education KMS through time and the role of ICT in KMS along the same timeline have been growing, while the rate of growth increased recently due to the advances in technology features to represent knowledge in all forms and facilitate the KM process more smartly compared to the initial phases, shown in Figure 2. It was depicted in the findings that both technology and KM have been positively influencing each other and continued to develop along similar rates of growth, while technology is currently progressing higher because of its wider application domains in addition to its role in KMS.

4 Discussions

The results of the systematic literature review show that KMS is in a continuous change and progress towards achieving institutional efficieny in terms of achievements of the higher education mandates. The trend in the importance of KM systems in higher education also shows that it is increasing over time as it gets to address the challenges in knowledge resources creation, accessibility and sharing in the community. Simillarly the role of ICT in enabling the KM system to more efficiently perform has also been gaining more focus and serving the end as the technologies continuously advance over time, hence addressing the research questions (RQ1 and RQ2) as also presented in Table 2 and Figure 2 respectively.

Besides, in the case of developing countries where several challenges are depicted in the findings of this research, the researchers suggest that adopting KMS shall be a process, preparing the higher education community for the inevitable need for technology revolution that fits the tasks needed, by appropriately addressing the non-technical factors to go along. These factors include cultural readiness and techno-culture development, technology awareness and appropriate use of technology gadgets in the higher education community, and building positive perceptions on technology support. Therefore, higher education institutions in developing countries have a lesson to learn from the findings that the way to advancing their higher education systems shall not be all about investing huge budget on revolutionizing the technology endowment.

On the otherhand, the fact that the new advancement in ICT including mobile technologies have become ubiquitious, the new digital-natives in developing countries seem to have skipped a generation of technologies and directly embracing the state-of-the-art provisions. Similarly, those countries who do not have even basic KMS infrastructure will have to directly jump into adapting latest technology enhanced KMS that the world offers. Therefore, this situation deserves a special contextual approach to design and develop appropraite technologies and required process to prepare the communities to become efficient users and benefitiaries of the resources.

In the case of Eritrean higher education system, where even a national technology infrastructure that spans all institutions doesn't exist, the development of state-of-the-art technologies and KMS do need a careful and contexually designed process. This process shall address both technical and non-technical factors, with the aim of achieving the intended acceptance and appropriate use by the higher education community, as learned from the findings of this research.

With this understanding from the SLR findings and the latest adavncements of cloud computing, cloud native applications, internet of things (IoT) and the advent of blockchain technologies, the authors foresee a new eara of doing things intelligently, supported by smart agents. Technologies are emulating the interaction between users and and knowledge resources, mostly humans, and the representing knowledge in a format understandable by machines. These enable further the application of technologies to provide wider range of decision support capabilities, while human intervention is always behind the key actions. This new technology support provision

will be capable of not only representing but also processing of kowledge and make it ready for desired decission making by the user or user communities. This new advancement and integration of technolgies may lead to a new working order and ways of doing things as Chao, et al. [3] mentioned, the 'web3.0'.

Therefore, as per the findings of the systematic literature review and the trends revealed thereof, the authors believe that higher education institutions need to have new models of KMS that utilize the advancing features of technology as the main enabler that also enhances the integration of non-technical factors into the whole end. This projection, therefore, calls for more research on appropriate KMS in the dynamic environment that is geared by the ever-advancing technologies and consideration of the non-technical factors that bridge between technologies and user communities.

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