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ICT-Based Knowledge Management in Education:A Systematic Review

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Abstract

Advances in technology are moving at a fast pace. Technology is inseparable from our daily lives and plays a vital role in any organization. Information and communication technologies support the education sector by enabling effective Knowledge Management mechanisms and processes. This systemic review examines the literature on the topic of information and communication technologies adaption in knowledge management. The papers included in the review went under inspection and screening based on protocols developed by the authors. The findings might provide insights for researchers in the domain of technology, education, and knowledge management.

1. INTRODUCTION

The literature review has evolved into a critical instrument for academics to map out the present condition and developments in their intellectual domain that have been documented in the literature. The systematic approaches to performing reviews may be seen as the unraveling of the undiscovered public knowledge with the goal of increasing the quality and transparency of literature reviews by eliminating omissions and biases by offering an audit of various amounts of research as well as reviewers' judgments, techniques, and findings (Tranfield, Denyer & Smart 2003).

Knowledge management is the process of managing all the information and knowledge to make use of its resources as efficiently as possible (Girard & Girard 2015). The role of knowledge management (KM) contributes to the success of any organization and especially in the education sector (Shih & Tsai 2016).

A large volume of organizational knowledge is produced in the education sector. Given that education is built on the transferring of knowledge. This escalates the importance of knowledge, and hence the vitality of KM protocols and mechanisms plays an essential role in the competence of educational institutions (Winanti et al. 2019). Information and Communication Technology, or ICT is an effective avenue for knowledge management implementation. It bridges barriers and supports the foundation of knowledge management solutions. ICT generally refers to technologies that include communicating resources such as wireless technologies, internet usage, and smart devices (Ratheeswari 2018). All these ICT resources can be implemented in schools and universities to provide access to knowledge. It is easier than ever to share knowledge between academic staff, students, and non-academic staff. The implementation of ICT supports the educators' role as facilitators of knowledge with the support of blended learning methods that came to inception due the advancements in technology (Ohemeng, Twum & Nii 2015). However, the current organizational culture plays an indispensable role in such shifts in facilitating the actualization of the smart learning mode (Moscoso-Zea et al. 2019). All departments of educational institutions must be involved in KM including upper management and administrators, human resources,

receptionists, and most importantly the IT staff. Hence, proper and well-planned KM protocols and procedures must be implemented through knowledge discovery, capturing, sharing, and application by all staff members in education with the most efficient use of technology (Al-Rahmi et al., 2019). This study aims to identify how ICT systems are useful in KM and is a modern way to improve education productivity and efficiency as compared to traditional knowledge sharing processes.

In this paper, we report on a systematic review of studies on the knowledge management based on Information and communication technology in the field of education. Our goal is to provide an overview of studies on this topic.

The targeted readership of this review are researchers and professionals in the knowledge management, education and Information technology sector who seek a better understanding of the current state of integration of these domains.

The remainder of this paper is structured as follows. Section 2 presents a literature review introducing key elements and concepts. Section 3 covers the research method that was used to compile literature of this review, as well as the methodology and selection criteria for the studies included. Section 4 shows the findings in light of the literature chosen by the framework, as well as answering research questions exhibited in **Error! Reference source not found.**. Section 5 reflects on the findings and attempts to identify the most significant research observations.

Table 1. Research Questions.

ID	Question	Purpose	PICO
RQ1	What are the geographical regions involved in the literature and when did the studies take place?	Compare and contrast in the involvement with ICT KM in education.	Comparisons
RQ2	What are the key findings of the selected studies and the research methodology used?	Summarize the findings of the selected studies.	Outcomes
RQ3	What are KMPs involved in the literature on the ICT-based KM in education?	Identify KMPs where ICT use is most prominent.	Interventions
RQ4	Who are the targets of the KMPs?	Identify the target of KMPs	Participants
RQ5	What are the enablers and barriers of ICT-based KM in education?	Identify the enablers and barriers	Interventions

2. LITERATURE REVIEW

2.1 Knowledge Management

Knowledge is one of the most valuable assets in any educational institution. An organization's personality and distinction are based on its knowledge. Hence, the management of knowledge is key to strengthen an organization's capabilities and provides it with a competitive advantage. Knowledge Management is typically defined as the strategy of delivering the right knowledge to right individuals at the right time in a way that facilitates the sharing and utilization of information by people in a manner that enhances organizational efficiency by employing existing resources (Girard & Girard 2015).

To begin to understand what knowledge management entails, we must have a deeper understanding of the concept of knowledge. Knowledge is categorized based on the following criteria: Explicitness, Codifiability, Teachability, and Knowledge Specificity (M. Altaher 2010).

Explicitness refers to the extent exists in an explicit form. Explicit knowledge refers to the knowledge that has been explicitly communicated or expressed through documentations and other avenues. In contrast, tacit knowledge refers to the knowledge that is unspoken or documented, such as intuitions and insights.

Codifiability refers to the extent to which the knowledge can be converted from tacit to explicit form.

Teachability reflects the extent to which knowledge can be taught, both tacit and explicit forms of knowledge can have varying degrees of teachability. General types of knowledge, due to their nature, are possessed by a large number of people which avails teachability of such knowledge. Specific knowledge, however, pose more challenge, as they are possessed by a limited number of individuals which makes it less straightforward to transfer.

Knowledge Specificity reflects the extents to which knowledge is specific. Specific knowledge falls under two categories: Technically specific and contextually specific. Technically specific knowledge is a deep knowledge that is relevant to a specific area. Contextually specific knowledge is relevant to a particular time, conditions, situation and place in which an action is to be taken (M. Altaher 2010).

Upon understanding the characteristics of knowledge in hands, it is key to implement the appropriate knowledge management solutions to utilize the knowledge resources residing within as effectively as possible. This has four components demonstrated in Figure 1.

KM systems (KMS) refer to the tools implemented to support KM processes which includes knowledge discovery,

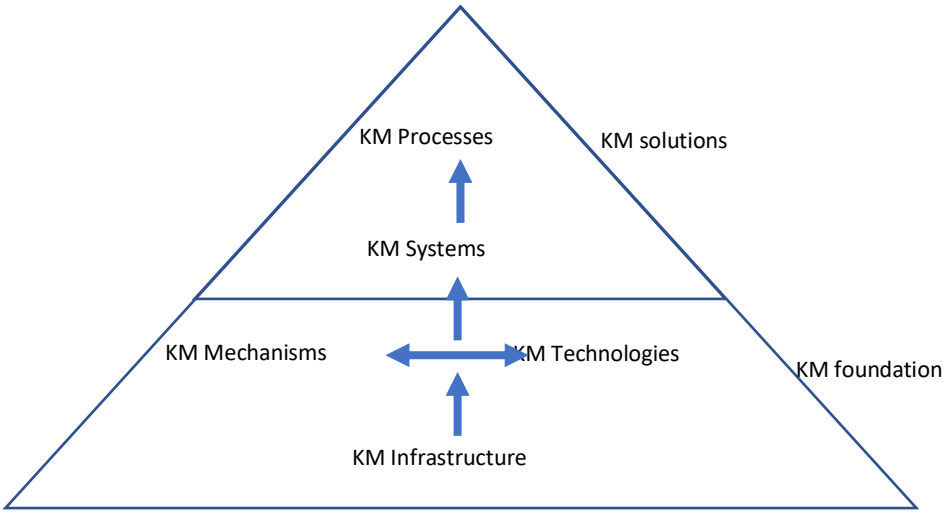

Figure 1. An overview of knowledge management solutions and foundation

knowledge capturing, knowledge sharing, and knowledge application(Irma & Rajiv 2015).

At the foundation level, KM mechanisms and technologies provide KM support for KMS, and KM infrastructure has different components that enable the establishment of such systems and processes. The Infrastructure foundation has the following enables demonstrated in **Error! Reference source not found.** (Taghizadeh & Shokri 2015).

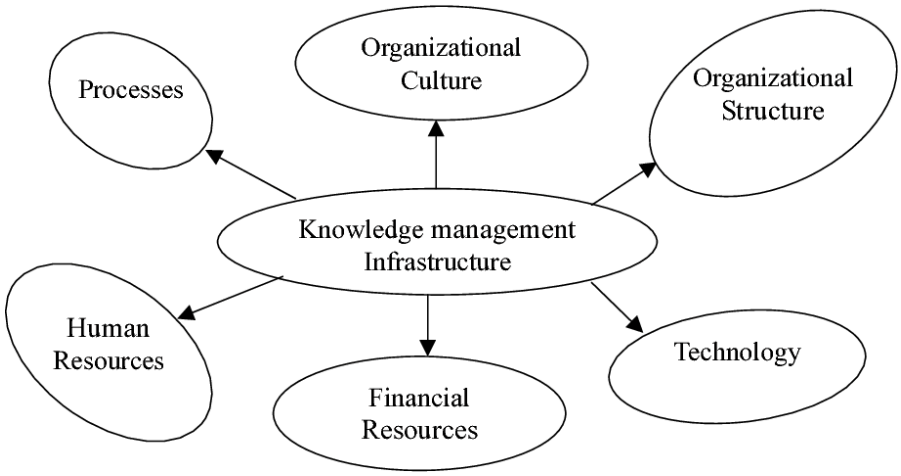

Figure 2. The general dimensions of the KM infrastructure

2.2 ICT in Education

Digitalization in education became important in Europe and gained attention to the possibility of using the proper methods to implement it to create a modernized education. (Netherlands). Hence, technology resources are essential in processing knowledge management specifically in higher education. It has been recorded by the National Center for Education Statistics that more than 70% of American establishments have used ICT resources in developing the process of distance learning (Tokareva Elena A., Smirnova 2019).

The use of ICT technologies has shown an increase in the level of education since the 1990s. Scientists see that many other advanced ICT resources, including virtual reality, will play an important role in improving education levels. It is important for education sectors to be aware of the latest trends and stay up to date with them to provide better education for the students and improve the academic's performance. ICT comes in many forms and has plenty of resources. Many educational institutions focus a lot on the use of ICT, such as implementing smartboards in classrooms, encouraging more use of iPads and electronic devices to gain access to e-books and lessons, and applying lesson practices using a variety of interactive educational programs and applications (Ratheeswari 2018).

There are certain circumstances that may lead to a shift into a complete technological environment or online learning. However, this idea alone seems horrific to certain educational academics with very low knowledge in ICT and its application in the learning process. This use of ICT shall enrich the educational communities with ICT literacy and expertise. Thus, this involves KM in ICT to be implemented (Al-Rahmi et al., 2019).

2.3 KNOWLEDGE MANAGEMENT IN EDUCATION

KM is an approach to gather, manage, analyze, share, apply, and discover knowledge within an organization to help improve performance. Many educational institutes are recognizing the importance of knowledge management and the ICT systems in improving the process of decision making. Moreover, many educational institutions believe that the use of ICT systems shall bring out new methods and techniques to develop KMPs, as well as technologies to promote efficient knowledge management systems (Sulisworo 2012).

The more the information is being shared between people, the higher the capacity of knowledge gains, hence, knowledge is often created by the interaction between people of experience with the information and resources they have.

An institution was established to focus on the creation of a better future for education, where knowledge is put into action. This institute is known as "The Institute for the Study of Knowledge Management in Education" (ISKME), which works with many educational institutes and organizations to help achieve a better understanding and application of knowledge through research that are done effectively to create an infrastructure that will work on increasing information and knowledge on many levels of the organization (Andersen 2003).

ISKME partners with schools and universities to provide assistance and guidance on using ICT-based systems in managing and sharing information and data through training centers that will transform the knowledge into efficient learning, teaching, administrative and management practices (Andersen 2003).

In December 2002, a KM in Education Summit was held in San Francisco, California. It was considered the first summit that focused on the role of KM in education in the States. It consisted of 40 professionals from schools, colleges, universities, and businesses. This summit has enriched some knowledge management practices implemented in education and enabled the discovery of how these practices can transform this knowledge into an effective decision-making process in this sector (Andersen 2003).

2.3.1 Knowledge Management Processes in Education using ICT

Knowledge management processes (KMPs) consist of discovering, capturing, sharing, and applying knowledge in education. (Figure 3) Most educational institutions focus on ways to implement KMPs using ICT systems (Ohemeng, Twum & Nii 2015). In applying knowledge management processes (KMPs), these institutes focus on enabling capabilities which involve cultures, structures, and technologies. Knowledge by itself is a capability that can increase the position of high or low educational institutes. Hence, it is important to manage knowledge using effective ways like ICT systems. In education, such knowledge can be shared and collected by academics. The graph below shows the KMPs to implement ICT systems in education (Figure 4).

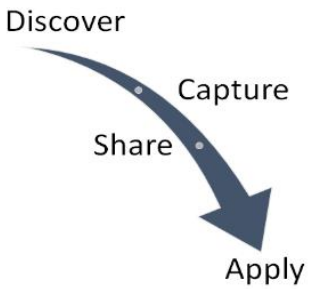

Figure 3. Knowledge Management Processes

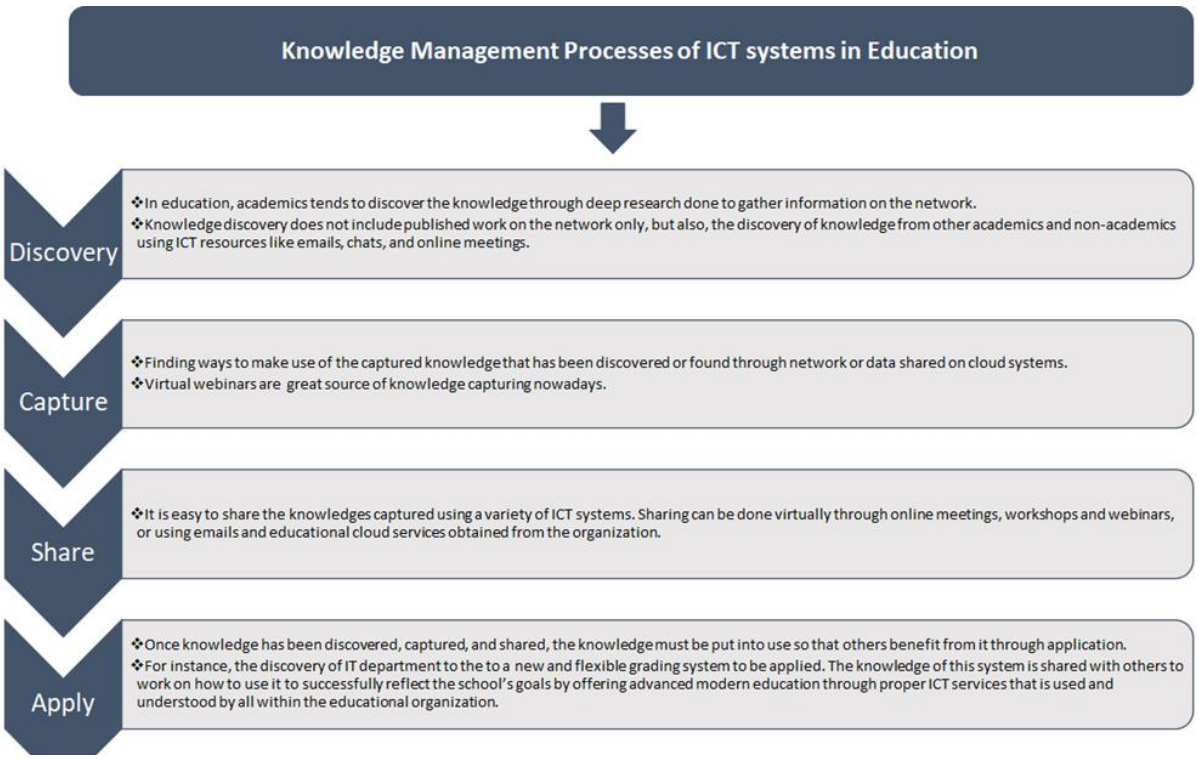

Figure 4. ICT-Based KMPs in Education

2.3.2 Forms of Education

It is known that education is improving, and we see a new form that has emerged, such as Hybrid learning. Physical, virtual, or even hybrid learning all take different forms in KMPs (Moscoso-Zea et al. 2019).

2.3.2.1 Physical Learning

Physical learning is the traditional "in-class" learning. This is the common type of learning that occurs within a classroom environment. Even though this is an in-class teaching and learning process, the use of ICT to share knowledge is essential in the modern days. Classrooms are mostly implemented with smartboards, computers, and individual's using their devices to access e-books.

2.3.2.2 Virtual Learning

Virtual learning or what is known as e-learning is a form of learning that is achieved by using ICT in teaching and learning. This type of learning has not replaced the traditional learning but is an improved version of it. There are a variety of terms used to describe this mode of learning. This includes web-based learning, online or virtual learning, and network learning. All these terms often refer to the process of learning using ICT resources to facilitate teaching and learning. Hence, knowledge can be captured, discovered, and shared through virtual learning by using information and communication technologies (Gupta & Jain 2017). In the process of virtual learning, we see teachers and instructors sharing new knowledge where students contribute to building by applying it with the knowledge they captured during these virtual classrooms (Pekarkova 2012).

2.3.2.3 Hybrid Learning

Hybrid learning involves the combination of virtual and traditional "in-class" learning to deliver the knowledge. This type of learning can be quite challenging since there is a need to maintain a balanced teaching and learning between those online and those in class. (Pekarkova 2012).

On the other hand, hybrid learning can be viewed to improve knowledge where an individual can gain knowledge traditionally in-class while still using ICT and accessing virtual sessions when needed (Ratheeswari 2018).

Research see that nothing becomes perfect without practice, so the implementation of ICT systems shall be easy if implemented properly. The implementation of ICT systems will be discussed furthermore.

2.4 Implementation of ICT-based concepts in Knowledge Management

In most educational organizations, it has been noticed that most of the knowledge is being transmitted between employees electronically, providing a paperless knowledge management system that can reach fast. It is known that ICT tools are used for communication, collaboration, sharing, and networking purposes. These tools can facilitate the KMPs within the educational organization. With the integration of the emerging technologies, many teaching methods are produced which will improve knowledge discovery, capturing, sharing, and application. Hence, it has been stated by Ghabban, Selamat and Ibrahim (2018) that the usefulness of knowledge can enhance the organization's performance (Ozdamli & Cavus 2021).

Plenty of education institutes, schools, and universities seem to be spending millions of dollars on implementing proper ICT systems, but do not consider the high effectiveness of how these technologies enhance knowledge sharing and decision-making process in planning and operating these institutes (Andersen 2003).

There are many factors that maximize the use of ICT in knowledge sharing. Nowadays, social media applications and websites contribute to the process of communication as well as knowledge sharing. Many teachers and students prefer reaching for knowledge through many online resources, hence, networking, and online researching is a way to capture and discover more new knowledge. Also, it has been found that most students prefer note-taking applications such as "Everton" and "OneNote", which is integrated within MS Teams to store the knowledge and provide an efficient e-learning environment (Ratheeswari 2018).

Most of the schools in UAE have been using an interactive Microsoft Cloud system for knowledge sharing between the upper management and the staff members. (Hossain Masud & Huang 2012) Using cloud computing in sharing data through Microsoft's OneDrive system, most of the staff members are aware of updates and important files from feedback and grading reports to workshops, webinars, and meeting links. Also, knowledge sharing can be done using e-mails, chat groups, and during the professional development workshops in a brainstorming session (Ozdamli & Cavus 2021).

2.4.1 Knowledge Management ICT Approach

Implementing the ICT approach for managing knowledge across a variety of educational institutes has facilitated the knowledge passing between employees. The ICT approach in teaching, learning, and knowledge sharing is a strong approach as compared to other traditional approaches. Knowledge in the earlier days relied on face-to-face interaction and paper-based learning to pass knowledge. The traditional pedagogy has been defined as a pre-technology context of education, where the teacher is considered the main source of knowledge sending information that is received by students where the teaching process is fixed (Mbodila & Muhandji 2012).

As for ICT-based pedagogy, learning can be based on critical thinking and problem solving with technical practices. With the use of ICT, teachers create and develop different strategies that promote deep learning; hence, ICT systems provide a variety of models and creative tools for the teaching-learning process using web-learning, e-learning, virtual and digital training and learning (Mbodila & Muhandji 2012). Thus, this shift into an ICT-based approach has enabled teachers to transform these traditional teaching methods into modern innovative teaching practices (Mbodila & Muhandji 2012).

2.4.1.1 Comparison between the traditional-based and ICT-based KM approaches in education

A comparison between the traditional-based and ICT-based KM approaches in education has been done (Ratheeswari 2018). In a traditional pedagogy, there seems to be a weak link between theory and practical as compared to the ICT-based pedagogy. The traditional pedagogy relies on a direct face-to-face interaction, while ICT-based KM depends on an integrated virtual interaction. Furthermore, traditional pedagogy provides access to knowledge only to those within the classroom or inside institutional community. On the other hand, knowledge is accessible by all including the abroad community from different countries through the ICT-based approach. Moreover, the ICT-based KM pedagogy allows sharing and editing data using the cloud services, unlike the traditional approach which relies on printable paper-based information. Hence, the ICT-based KM approach allows fast sharing and capturing of processes as compared to the traditional approach (Ratheeswari 2018).

2.5 Role of ICT in Knowledge Management for Education

A study has been conducted in Moscow that was based on some survey findings to indicate the students' view on using ICT in education. The result was that most of the students (94%) preferred that this modern education be based on the use of technology more often. Moreover, when asked about the reason for their choice, students noted that the role of ICT not only helped in developing knowledge easier, but also it increased their possibility of improving technical literacy, which is the basis of the twenty-first century in building broader knowledge and learning opportunities. (Tokareva Elena A. , Smirnova 2019) About (92%) of the students believe that they are proficient in using technology and can use a vast number of programs through their learning process. Many students (85%) confirmed that teachers are open to the idea of students using their devices during classes, to facilitate sharing resources and obtaining a flexible learning process between students and teachers (Tokareva Elena A. , Smirnova 2019).

Another study has been conducted on the role of ICT use and its effect on job performance in education and specifically at the University of Jordan (UOJ). The purpose of this study was to identify strategies to utilize KM to improve job performance (JP) at the university. Several lecturers at the University of Jordan believe that when knowledge is shared with other colleagues from several departments, it can maximize collaboration, knowledge, improves productivity, and their problem-solving skills. Hence, it is believed that knowledge sharing using ICT systems must be supported and encouraged, since it can be done at a faster pace. The study also mentions that KMPs are not fully supported and organized at the University of Jordan, which lead to more work being done, since not much effort of knowledge sharing is facilitated at the university due to limitations of ICT usage to perform this sharing of resources (Masa'deh et al. 2017).

2.5.1 Conceptual KM Model

With the implementation of knowledge management in education, it is believed that many institutes will maximize their ability to manage and utilize knowledge to achieve effective performances using ICT systems. Thus, these institutes must measure their performance to identify the effectiveness of KM efforts. Based on the studies collected and theories mentioned earlier, a conceptual model has been designed to describe the process of KM in the educational sector (Sulisworo 2012).

Figure 5. Conceptual KM Model

To summarize, the model (Figure 5) indicates how KM performance is to be measured. The process shall begin with the activities performed at the institutes by using ICT systems to implement these activities. Later, these activities are to be measured and matched with the KMPs in order to find out the effectiveness of KM and its performance in these institutions (Sulisworo 2012).

2.5.1.1 Educational Institutes Process activities

Educational institutes activities shall include teaching and learning activities, assessments, and examinations, as well as product development. Product development includes those programs, courses, and lessons that are designed and developed to be measured for its effectiveness in delivering knowledge to students. Teaching and learning activities include all the processes to deliver knowledge to students from resources, libraries, simulations, labs and computers to facilitate the learning process. Finally, assessments and examinations needed to be carried out to ensure proper procedures followed to analyze statistical examination results obtained (Ohemeng, Twum & Nii 2015).

2.5.1.2 ICT System Usage

For modern education to be achieved to apply knowledge sharing, the activities mentioned above are all to be implemented by using ICT systems and tools. Technology has facilitated the way these activities are to be processed to improve KMPs. Also, enabling ICT systems in KM can include managing database systems, help desk services, learning management systems (LMS), and academic content management and exchange (Omona n.d.).

2.5.1.3 KM Performance

KM performance can be measured based on matching all these above factors to identify if knowledge is transferred and managed properly using ICT-based systems. If targeted goals are achieved, this can build the educational organization's performance. Hence, ICT systems can play a major role in improving decision making process, knowledge sharing at a faster pace, facilitating accessibility to information, and improving the quality of education which can satisfy customers and increase profit. (Ohemeng, Twum & Nii 2015). There are some other key features that contribute to the role of ICT in KM and these include: (Ozdamli & Cavus 2021).

- **Communication and collaboration**

Collaboration is a must in any organization. A rich communication needs to be established to acquire collaboration between staff members and students. Communication is easily done through emails, chat groups on different platforms, or even video conferencing through MS Teams or Zoom meetings.

❖ Reusability

One advantage of using an ICT-based system is the ability of being able to reuse information and data that is shared whenever needed.

❖ Personalization

Usually, when data and folders are shared, teachers and required staff members are free to attach personalized files created to reflect the courses and subjects being taught, which in return gains the approval from the heads and leadership team. Information can most likely be changed, modified, removed, or extended based on demands.

❖ Accessibility

To manage knowledge being shared, staff members are given access only to required information and files. Often, gaining access to files can help staff members understand the structure of work and be able to complete tasks with the same template of work given. (Pekarkova 2012).

2.6 Challenges faced by implementing ICT in Education.

Integrating ICT in education has brought plenty of opportunities and led to the arise of more challenges; therefore, schools and other institutes must make sure that enough training has been provided, good planning, clear policy, proper technology tools that reflect the teaching strategy, and an appropriate level of investment is set to reach maximum goals and benefits of education. In education, many obstacles may arise based on environmental, cultural, and educational abilities. (Mbodila[1], Jones[2] & Muhandji 2013)

2.6.1 Environmental Challenges

It is expected that most countries can learn, study, and work, but certain environmental challenges seem to prevent the process of learning. When the environment is not helpful, there can be limited IT infrastructure to fully implement ICT in education. Upon the implementation of ICT, planners and policymakers must put the following into consideration:

- There must be proper educational buildings available to manage technology. Several countries have old buildings which are not suitable for implementing electrical wires, heating, and cooling systems, as well as safety security systems. Hence, knowledge cannot be gained or proceed faster if the environment does not help in the process of KM.
- Weak and slow network connections. In certain countries, where poor signals and network connection exists, can disrupt the process of knowledge transfer in education. (Khakpour 2015).

2.6.2 Cultural Challenges

Diverse cultures exist in different parts of the world. Thus, challenges arise with a diversity of cultures using ICT in education. Most internet content is in English. An estimation of 80% indicates that most online content is in English. (Mbodila[1], Jones[2] & Muhandji[3] 2013) Hence, challenges may arise indicating that most educational software are in English. This could be challenging for some countries where English is not the mother language. With this challenge, many educational academics may not be aware of rich knowledge on the internet that can be in languages other than English. For teachers, there may be plenty of teaching resources that are useful but not in English, which leads to a limit of knowledge resources based on language. (Mbodila, Jones & Muhandji 2013).

Among these challenges also, the lack of overlapping cultural knowledge. Certain countries may have different beliefs on certain published research done on the internet, which may lead to extensive knowledge searching conducted by students and teachers to gather information and data (Khakpour 2015).

2.6.3 Educational Challenges

Aside from the challenges mentioned earlier, challenges of KM in education do exist based on departments and subsystems that will be summarized below based on findings.

2.6.3.1 Departmental Educational Challenges

The challenges will reflect based on the departments and subsystems:

1. **Research Subsystems:** The challenge involves the lack of trusted work published on the internet by academics and researchers.
2. **Technical Subsystems:** The lack of ICT to support KM. Hence, it can be challenging to manage and transfer tacit knowledge using technology.

3. **Human Resources Subsystems:** Some believe that rewards and benefits are to be calculated and added to those gaining and sharing the most knowledge with others. Thus, a reward system or a sense of appreciation shall be given in exchange for knowledge (Khakpour 2015).
4. **Administrative Subsystems:** Lack of knowledge in the education field and experience in managing tacit knowledge across the educational organization.
5. **Students' activities:** This subsystem involves the misuse of knowledge gained, obtained, and the possibilities of plagiarism performed by students.

Educational institutions must put into consideration the following challenges to successfully acquire tacit and explicit knowledge among students, teachers, instructors, and administrators using various ICT resources. (Khakpour 2015).

3. METHOD

Conducting a review of relevant literature is a pivotal step in any research; it evaluates the nature of knowledge brought about a given field of interest, highlights its gaps and as a result, paves the way to future research and establishes the groundwork to uncover new territories of knowledge (Pahlevan Sharif, Mura & Wijesinghe 2019). A literature review that is adherent to a set of protocols to eliminate bias is defined as a systematic review (Popay et al. 2006). A systematic review attempts to identify relevant studies in order to answer predetermined set of research questions and evaluate their quality based on a particular criterion. This review was conducted in the following phases: the identification of inclusion and exclusion criteria, data sources and search strategies, data coding and analysis, and quality assessment. The details of each phase are provided in the following subsections.

3.1 Inclusion/exclusion criteria

The researchers have established the inclusion and exclusion criteria to guarantee the relevancy and quality of the papers included in this paper. The studies included in this review must adhere to the criteria listed in **Error! Reference source not found.**.

Table 2. Inclusion and exclusion criteria.

Inclusion	Exclusion
Articles, journal. Includes KMPs. Includes Education Includes ICT-based KM systems. Article in English Articles from Q1 or Q2 journals based on SJR ratings. Accessible	Books, chapters, thesis, magazine, Proceedings White papers Abstract, less than 4 pages prior to 2015 zero citations unless published in 2021

3.2 Data sources and search strategies

The studies included in this paper were extracted in April 2021 through a broad search done in the Scopus and IEEE libraries.

The search queries included the following in addition to constraints determined by the inclusion and exclusion criteria (except for proceedings):

- Includes "ICT" and "Education" and "knowledge management". (Scopus N=254, IEEE N=190)
- includes "technology" in content, "knowledge management" in keywords and includes "Education" in title. (Scopus N=374, IEEE N=55).
- Includes "ICT" and "Schools" in content and includes "knowledge management" in keywords. (Scopus N=64, IEEE N=20).

The search yielded 957 results. The refinement of the search results was conducted in accordance with The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) (Page et al. 2021) shown in Figure 3. 150 duplicate records were removed prior to screening, leaving 807 records to be analyzed based on the exclusion and inclusion criteria. 512 papers were excluded for the following reasons: papers were excluded based on the citation requirements (N=244), records with less than 4 pages (N=157), proceedings (N=42), records published prior to 2015(N=40) and articles published in low-quality journals (N=29). The remaining 295 studies were then assessed for eligibility based on the title and abstract which resulted in 9 papers, one paper was excluded upon reading the full text as it concerning the health sector. Thereby, only eight articles have been included in the review.

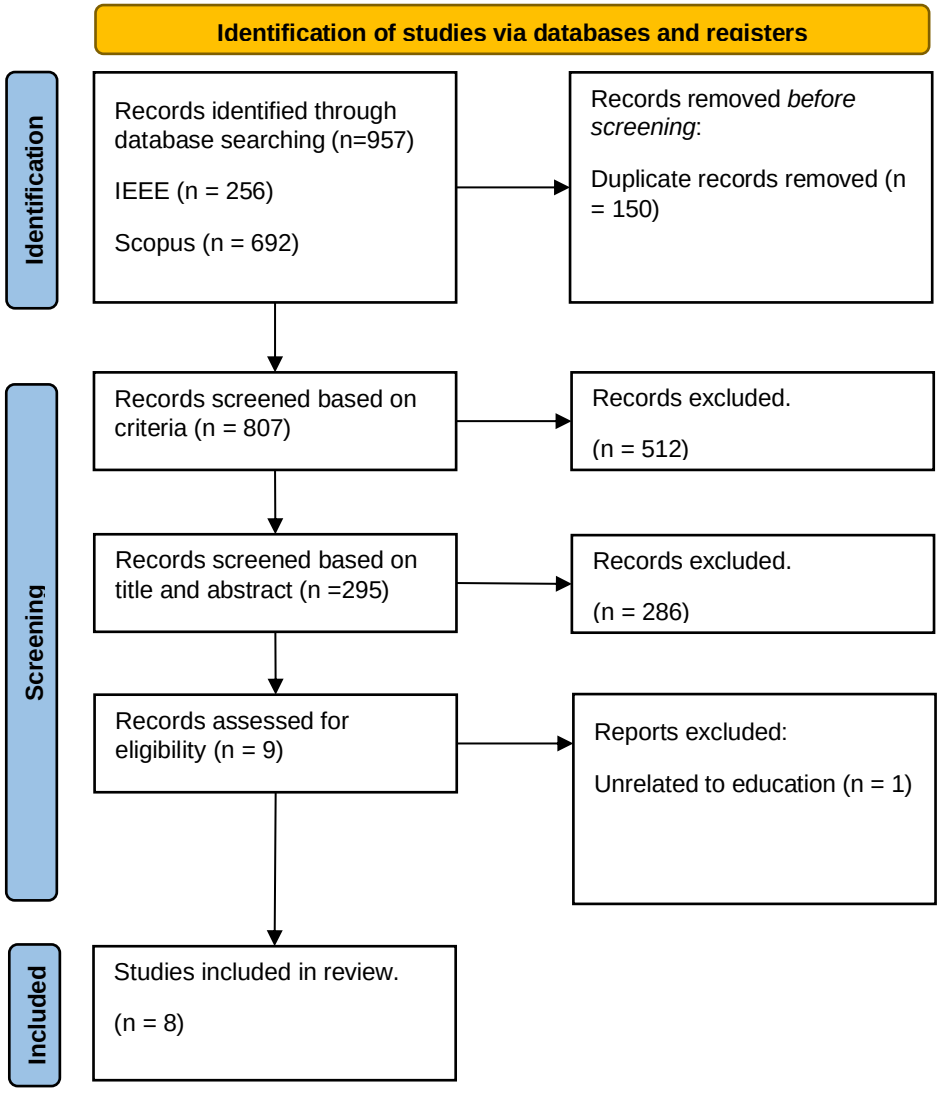

Figure 6. The PRISMA flowchart

3.3 Data coding and analysis

The attributes corresponded to the research methodology quality were coded including (a) the primary KMPs, (b) research strategies (e.g., queries and surveys, interviews, theoretical analysis and so forth), (c) research results (e.g., positive, impartial, and negative), (d) participants and stakeholders, (e) database, and (f) country. All through the data analysis stage, the articles which did not unmistakably depict the KM measures influence on education have been avoided from the synthesis. The examination of the gathered papers was completed by the writers of this review by breaking down each article manually.

3.4 Quality assessment

This stage identifies several questions to evaluate the quality of the selected articles. The checklist shown in Table 3. A percentage score on how relevant the study to the questions listed will be assigned to each article, if the article scored below 50%, it is then to be excluded, as Table 4 highlights the results of the analysis, it has been concluded that all the selected studies fulfil the quality assessment requirements. Where a three-point score system is assigned to each question depending on the answer, where if the answer is "Yes" the corresponding score is 1, "No" corresponds to "0", and "Partially" corresponds to 0.5.

Table 3. The quality assessment checklist.

#	Question
1	Are the research objectives clear?
2	Does the research clearly specify the KMPs?
3	Are the research methods in a sufficient level of detail?
4	Does the research clearly specify the role of ICT in KM?
5	Does the study add to the systematic review?
6	Does the research specify the technology used in KM?
7	Does the research provide the consequences of any problems?
8	Does the study add to your knowledge or understanding?

Table 4. The quality assessment results.

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Total	Percentage
S1	1	1	1	1	1	1	1	1	8	100%
S2	1	1	1	1	1	1	1	1	8	100%
S3	1	1	1	0.5	1	1	1	1	7.5	93.75%
S4	1	0.5	1	1	1	1	1	1	7.5	93.75%
S5	1	1	1	1	1	1	1	1	8	100%
S6	1	1	1	1	1	1	1	1	8	100%
S7	1	1	1	0.5	1	0	1	1	6.5	81.25%
S8	1	1	1	1	1	1	1	1	8	100%

4. RESULTS

Based on the criteria elaborated in chapter 3 of this paper, eight studies on ICT-based knowledge management in education were selected to be examined and analyzed. We report the results reached based on the following predetermined research questions.

4.1 What are the geographical regions involved in the literature and when did the studies take place?

Error! Reference source not found. is a pie chart that illustrates the percentages of the selected studies on ICT-based KM in education by different regions of the world. For the purposes of this data set, the world is divided into seven regions.

What stands out is that the regions of Asia and Europe lead the way in terms of the applying ICT-based KM in education, with 51% and 37% respectively. By contrast, few studies have emerged from Africa.

Turning to the Asia, South Asian countries boast half of the studies emerging from the continent, the MENA region and namely Jordan and India from South Asia produce the reaming studies in equal measures.

Finally, moving on to **Error! Reference source not found.** demonstrating a bar chart illustrating number of studies concerning the ICT-based KM in education by year.

It is clear from the chart that the years 2017 and 2019 have the highest frequency, while only one per year have been included from the years 2017 and 2021.

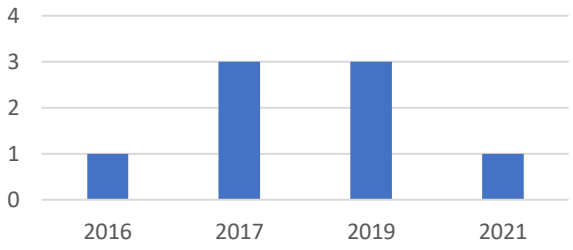

Figure 7. selected articles based on the publication

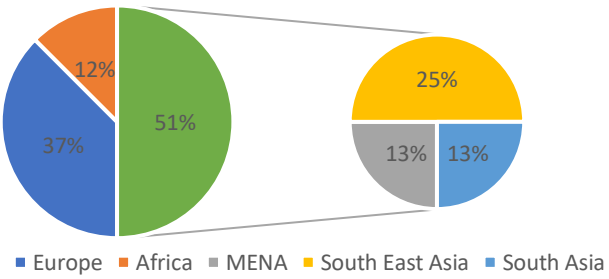

Figure 8. Geographical regions of the selected studies

4.2 What are the key findings of the selected studies and the research methodology used?

Figure 9 is a pie chart the illustrates an overview percentage of the research methodologies included in the selected studies on ICT-based KM in education. Most selected studies followed qualitative methods (surveys), with 62% of all records. A study from Taiwan have gathered data from 439 individuals (students and staff) from thirteen public and private higher education institution on the relationship of the KM and KM enablers on school effectiveness. The study concluded that structure, culture and IT support all play a comparable role in availing the KM enablers capabilities and that such capabilities have resulted in 74% of variance in school effectiveness (Shih & Tsai 2016).

A case study from the University of Jordan surveyed responses from 207 lecturers on the relationship between knowledge management processes and job performance. The study confirmed that in the Jordanian context, KM processes have a direct impact on the KM performance and as direct result a net positive effect on the job performance. The main KM processes that integrated IT in this paper were Knowledge storage (Masa'deh et al. 2017). An empirical study from the Moscow State Universities have examined records from 704 4-year students on the effectiveness of the use of ICT in higher education. The study found that the IT infrastructure is lacking in their universities. The research attributes the lacking of ICT-based knowledge management to the organizational culture and the lack of funding (Tokareva, Smirnova & Orchakova 2019).

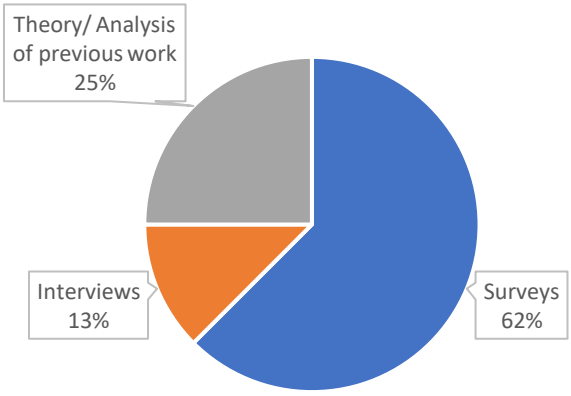

Figure 9. Overview of the research methodologies of the selected studies

Near East University surveyed responds from sixty-nine students from the Computer Information Systems department on the knowledge sharing technologies. The research concluded that students are more likely to share information and communicate on social media over emails, learning environments and other means. However, learning management systems are the preferred tool for lecture notes and course resources.(Ozdamli & Cavus 2021)

Quantitative data collection and analysis methods by surveying 214 university students was adopted to study the big data adoption in knowledge sharing. The results showed that the main factors in facilitating big data adoption are the usefulness, perceived ease of use, perceived risk, and behavioral intention to use big data. Age, and culture and motivators were a key determinants of KM sharing. Big data adoption in knowledge sharing will have a significant impact on education sustainability (Al-Rahmi et al. 2019).

Thirteen percent of studies have conducted interviews. A study by the Mauritius Research Council conducted interviews with key informants in seven of the higher education institutions in Mauritius on the enablers and barriers to knowledge creation, sharing and transfer. The research concluded that despite having the IT infrastructure and experienced staff, none of the universities had KM procedures and policies. This was largely due to organization culture and structure (Veer Ramjeawon & Rowley 2017). Twenty-five percent of the studies relied on theoretical analysis or review of previous literature. (Hu et al. 2016) is a review of literature that analyzes the use of massive open online courses (MOOCs) in smart education. MOOC are being offered in even developing nations. The MOOCs are best used in a blended learning model. An effective KM model must take into consideration the organizational cultural implications to the adopting an ICT-approach towards learning. (Moscoso-Zea et al. 2019) proposed a hybrid information and knowledge infrastructure that allows the digitization of knowledge to improve decision making in HEIs. The infrastructure is based on the integration of big data and specifically Business Intelligence & Analytics. The author suggests that the automation will facilitate the implementation of ICT-based KM and the capturing of knowledge.

4.3 What are KMPs involved in the literature on the ICT-based KM in education?

Table 5. ICT-based KMPs in literature

Study	Knowledge discovery	Knowledge capturing	Knowledge sharing	Knowledge application
S1 (Hu et al. 2016)			✓	✓
S2(Shih & Tsai 2016)	✓	✓	✓	✓
S3(Abdel et al. 2019)	✓			
S4(Tokareva, Smirnova & Orchakova 2019)			✓	
S5(Ozdamli & Cavus 2021)			✓	
S6(Al-Rahmi et al. 2019)			✓	
S7(Veer Ramjeawon & Rowley 2017)	✓	✓	✓	✓
S8(Moscoso-Zea et al. 2019)		✓	✓	

Table 5 highlights the KMPs involved in the selected studies. ICT was utilized in knowledge discovery in three studies. Technologies of KM discovery systems includes e-learning systems, e-mails, websites ,online storage facilities, databases, and repositories (Shih & Tsai 2016; Veer Ramjeawon & Rowley 2017; Abdel et al. 2019). Knowledge capturing systems as mentioned included big data mining and AI-based automated systems (Shih & Tsai 2016; Veer Ramjeawon & Rowley 2017; Moscoso-Zea et al. 2019). Knowledge sharing includes MOOCs, e-learning systems, social media, emails, online conferencing and data visualization and analytics system (Hu et al. 2016; Shih & Tsai 2016; Veer Ramjeawon & Rowley 2017; Al-Rahmi et al. 2019; Moscoso-Zea et al. 2019; Tokareva, Smirnova & Orchakova 2019; Ozdamli & Cavus 2021).

4.4 Who are the targets of the KMPs?

Error! Reference source not found. is a column chart illustrating the frequency of the type of participants/ targets of the ICT-based KM in education based on the selected studies.

Five studies involved student learning and content delivery and four studies tackled the KM needs of the HEI staff.

None of the studies have involved K-12 educations or school education.

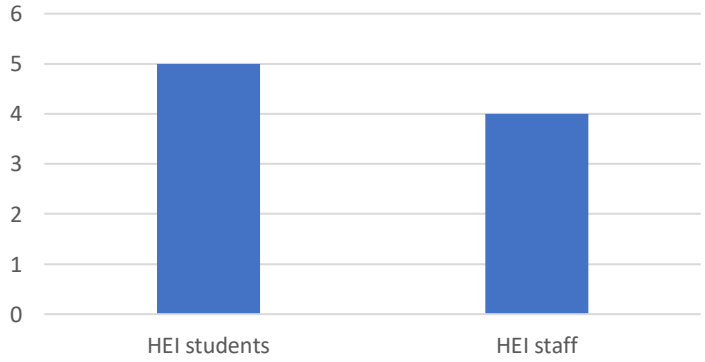

Figure 10. The targets of KMPs

4.5 What are the enablers and barriers of ICT-based KM in education?

Most studies have named the organizational culture as the main influencer on the adaptation of ICT-based education. See more details in the table below.

Table 6. Enablers and barriers

Enablers and barriers	
Organizational Culture	Building a knowledge-sharing culture is instrumental, the majority ICT-based approaches rely on KM sharing. (Ramjeawon & Rowley 2017)
IT Infrastructure	Frustrations ensue in developing countries due technical issues they may face due the poor bandwidth and lack of infrastructure. A good infrastructure enables the implementation of more powerful and efficient solutions.(Gupta & Jain 2017)
Accessibility of the Technology	Students in one study preferred communication via social media over the emails or e-learning systems. (Ozdamli & Cavus 2021)
Incentives	Incentives enrich the knowledge-sharing culture.
Management	Helps in creating the foundation to implement KM protocols that fosters ICT
Academic and Real-world relation	A Disconnect between academia and real-world application and the current trends is one of the challenges facing the KM, an efficient system will aide in bridging such gaps.
Funding	Lack of funding will affect the ICT-adoption negatively and it has been the case for several studies included in the review.
Organizational Structure	The organizational structure directly affects the level of socialization and collaborations and the creation on knowledge.
Knowledge Databases	Institutions with developed knowledge repositories, such as online courses, set up collaborative tools, emails-forum-chat-video, knowledge mapping, coaching/mentoring and best practices, with a view to facilitating knowledge sharing.(Veer Ramjeawon & Rowley 2017)

5. CONCLUSION AND DISCUSSION

A variety of research articles examine the concept of KMPs in education and their role in processing, capturing, sharing, exchanging, and applying this knowledge using ICT-based systems. Based on the studies conducted, it has been examined that the use of ICT-based systems within the educational process improves education levels among students and teaching staff, as well as the non-academic staff. On the other hand, some obstacles needed to be considered with this integration of ICT-system. Moreover, the goals behind this study were to highlight some of the effective uses of ICT-systems in managing knowledge in education, to compare the traditional knowledge approach with the ICT-based approach, and to identify the challenges faced of using ICT tools to manage knowledge in educational organizations whether in schools or higher education institutes. Hence, many of these challenges need to be put into consideration to ensure that these ICT-based systems are integrated properly with the knowledge management plans created within the educational organization. With the use of ICT-based systems in education, KM can be achieved properly and effectively in a coordinated and organized manner in a way that leads the organization to achieve its main goals. On the other hand, these studies have also shown that the role of technology tools has improved the job satisfaction among teaching staff by maximizing collaboration and productivity through knowledge being shared among members (Masa'deh et al., 2017).

So far, the management, funding, ICT literacy and organizational culture are among the top barriers and enablers to the implementation if ICT-based KM. Hence, the selection of technology must consider these elements. The human factor barriers can be minimized using big data and AI systems. Such systems can automate some data discovery and capturing procedures and produce analytical reports aided with visualizations to stakeholders. An effective use of ICT must not disturb the work culture and negatively affect any pre-existing protocols and mechanisms, accessibility and teachability of ICT will extend the effectiveness of KM. This has been shown by the favorability of social media over dedicated e-learning platform in communication technology (Ozdamli & Cavus 2021).

HEIs in developing nations recognize the importance of tacit or explicit KMPs, but there can be a number of challenges to the successful implementation of effective policies. HEIs in both developed and developing countries can lead to a more comprehensive and informative knowledge base in this field by conducting studies on knowledge management systems and policies.

The most prevalent use of ICT in literature is on knowledge sharing, innovative knowledge discovery models are lacking, this may also contribute to the disconnect between academia and real-world knowledge (Ramjeawon & Rowley 2017). It is suggested that as future work, to research more mechanisms to acquire the tacit knowledge, big data, data mining and AI technologies can possibly contribute the actualization of smarter KM (Moscoso-Zea et al. 2019).

There has been a debate over the contribution of IT support versus the organizational structure and mainly management, where some studies have concluded the importance of ones over the other, but what is clear is that the importance of the IT foundation is of an increasing priority when implementing KM protocols and procedures.(Shih & Tsai 2016)

In this systematic review, all the data collected was related to managing knowledge in an ICT-based system in education. Also, the study has included an extensive focus on using technology to manage knowledge in education and to highlight its impact among students, staff members, and the educational environment. A variety of learning types was mentioned such as: physical, virtual, and hybrid learning. Moreover, a connection to KMPs has been made to support this study.

The research has answered the five research questions with results to support each question. However, the focus was on the KMPs: discover, capture, share, and apply, as well as their effect on the ICT-based approach in education. These four KMPs have been evaluated within literatures focusing on the ICT-based KM. The study has targeted those within the education sector and five studies have already captured those targets to be HEI staff and students. Thus, there is a lack of research on KM in K-12 education considering that K-12 schools vastly outnumber the number of universities and can provide a great insight into KM in education. Furthermore, a reflection on the enablers and the barriers of the ICT-based KM approach has been performed after observing data from various papers.

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