ICT Tools for Open Educational Resources Used in an Open Distance E-learning Institution in the Fourth Industrial Revolution Era

Siphamandla Mncube
https://orcid.org/0000-0002-4863-6310
University of South Africa
ncubels@unisa.ac.za

Bongani Nkambule
https://orcid.org/0000-0001-9022-0960
University of South Africa
nkambbi@unisa.ac.za

Sindile Amina Ngubane
https://orcid.org/0000-0003-0998-7828
University of South Africa
ngubasa@unisa.ac.za

Abstract

Open educational resources (OER) are gaining popularity in higher education spaces and more attention in open distance e-learning (ODeL) institutions as they are gradually substituting printed prescribed textbooks in the teaching and learning space. The adoption and development of OER have been researched; however, the roles of knowledge management tools in storing and disseminating the resources are not well articulated. This research explores the use of knowledge management tools in an ODeL learning context. ODeL institutions use knowledge management tools and a host of other information and communication technologies (ICT) to deliver and facilitate synchronous and asynchronous learning and bridge transactional distance. Therefore, this study employed a qualitative approach to investigate ways in which lecturers use knowledge management tools to embrace and create OER. A case study approach was used at one ODeL institution. The knowledge management cycle (KMC) was chosen as the theoretical framework of the study. The key finding demonstrates that lecturers utilised a wide range of ICT tools for the storage, collection, and dissemination of OER as part of knowledge production. The study proposes the extension of the KMC from three cycles to four where "system" is added. There is a significant need for policy, impact, and the matrix to be covered under the system cycle. The study recommends that scholars who are investigating any IT artefact opt for an extended KMC where impact and user metrics will be evaluated, as this will enhance academic support.

Keywords: knowledge management; open educational resources; open distance e-learning; Fourth Industrial Revolution era; academic support

Introduction and Background

Higher education institutions (HEIs) can be considered as the primary sources of knowledge creation, preservation, and dissemination. In such occurrences, HEIs realise the significance of knowledge management (KM). KM is the process of capturing, distributing, and effectively using knowledge (Davenport 1994). Furthermore, KM promotes an integrated approach to identifying, capturing, evaluating, retrieving, and sharing all of an enterprise's information assets (Duhon 1988). With the advent of the internet and information and communication technology (ICT) tools, KM has the capability to create, store, and disseminate open educational resources (OER). This is confirmed by Lee, Lee, and Lin (2007) who argue that knowledge management is a novel method for locating and arranging specialised knowledge for efficient retrieval and reuse. Therefore, the different methods used by HEIs especially in relation to ICT innovations in promoting digital education should not ignore KM processes. KM has the potential to foster institutional learning, growth, innovation, and success (Lee, Shiue, and Chen 2016).

Before contextualisation of knowledge management in HEIs, KM is widely described in the context of knowledge creation and conversion (Nonaka and Von Krogh 2009). This is a relevant approach to manage knowledge from people and processes of an organisation to capture, codify, or render tangible and intangible knowledge (Nonaka and Takeuchi 2001). KM is informed by two types of knowledge, tacit and explicit knowledge. Tacit knowledge ("knowing") resides in people's minds and is born of experience accumulated through formal education, mutual learning, trial and error, and acting upon intuitions; whereas explicit knowledge ("knowing") is that which comes in a physical form and is readily recorded through manual and digital means such as books, websites, and any other formats (Nonaka and Takeuchi 1995). The essence of the adoption of KM is necessary for technological advances, client-increased expectations, and the need for continuous increased competition and market share (Bachnik, Misiaszek, and Day-Duro 2023). Therefore, knowledge management and its tools might have a role in the creation and distribution of knowledge such as OER. This innovative knowledge is created by scholars and managed through ICT.

OER are being increasingly introduced into higher education and other educational settings. OER are digitised resources that are freely and publicly available for academics to use in their coursework and research (Paskevicius 2023). According to Ossiannilsson (2023), the OER movement has garnered significant attention for more than 20 years, particularly in relation to the affordability and accessibility of higher education. They further allude that OER are defined as digital learning objects that are freely and openly provided to lecturers, students, and self-learners for use in teaching, learning, and research. OER can be appropriated through technology-assisted learning tools such as mobile devices, smartboards, tablets, laptops, simulations, dynamic visualisations, and

virtual laboratories (Haleem et al. 2022). This proves that OER can be appropriated through ICT and emerging web technologies that are associated with the Fourth Industrial Revolution (4IR) era.

In the evolving education context, knowledge management, OER practices, and the 4IR era should share features. The arrival of Industry 4.0 and its advanced technologies such as artificial intelligence (AI), robotics, and the Internet of Things (IoT) can make OER processes flexible (Sharma, Patel, and Shah 2023). The idea of 4IR is explained as a new extent of association and control over the product, such as the education lifecycle, which places importance on client needs that become more personalised (da Silveira et al. 2019). In such occurrences, the redistribution and transfer of knowledge continues to evolve, and knowledge management practices become relevant. The created OER as knowledge need to be managed and stored in the relevant space or devices that are in sync with 4IR and easily accessible by diverse populations. Therefore, the primary responsibility of knowledge management is knowledge sharing to enhance the performance of the organisation by achieving its mission (Santhose and Lawrence 2023). This encourages HEIs to continue to strive and provide a strong foundation for developing knowledge, skills, and increasing the ability and enthusiasm of current generations to continue learning in the evolving 4IR era (Dudhat and Ardi 2023).

Knowledge management initiatives for achieving sustainable development goal (SDG) number four, quality education, have been explored to investigate enablers and barriers to prepare higher education institutions to meet this goal (Rets et al. 2023). Also, OER initiatives have been explored in the context of higher education. Issues of OER use for the elimination of social exclusion (Dabula, Cox, and Hodgkinson-Williams 2022), OER for knowledge sharing (Wang, Han, and Yang 2022), and many more have been explored in HEIs. Yet, there are existing gaps in the literature and knowledge regarding the relationship, understanding or treatment of knowledge management, OER, and the 4IR era. Instead, a few studies propose building a partnership between humans and artificial intelligence (AI) in supporting organisational knowledge management activities (Jarrahi et al. 2023). This study sought to establish how ICT tools are used in the appropriation of OER in the 4IR era with reference to Africa's largest open distance e-learning (ODeL) institution. This was achieved using the knowledge management cycle (KMC) as the main conceptual framework of the study.

Literature Review

Higher education institutions (HEIs) continue to adopt KM tools, and research confirms that most HEIs across Africa use KM tools to support learning agency and faculty productivity (Paudel 2019). Ubon and Kimble (2002) established that the core duty of any distance learning institution is to manage knowledge to enable students and the faculties to engage in the dissemination and receipt of tacit knowledge and the documenting, restructuring, innovation, and re-use of explicit knowledge. More generally, HEIs use online learning tools such as emails, database management systems, intranets, video conferencing, and collaborative groupware. A KM system is any kind

of IT system that stores and retrieves knowledge to improve understanding, collaboration, and process alignment (Jayashri and Kalaiselvi 2023). These knowledge management systems, otherwise known as "e-learning" (Chen and Fong 2015, 431), are capacitated with the agility to administer the facilitation of synchronous and asynchronous interactions between lecturers and students. In the 4IR era, many HEIs' operations include virtual rooms, a space where mutual participation among students as well as between students and instructors not only precipitates student agency and self-efficacy, but also enables high-impact knowledge sharing and creation transactions (Alshahrani 2018; Imhanzenobe, Adejumo, and Ikpesu 2021; Nkambule, Ngubane, and Mncube 2023). Therefore, the study reviews literature based on the following themes emanating from the knowledge management cycle by McIntyre, Gauvin, and Waruszynski (2003): knowledge management and 4IR for OER, people responsible for OER, and applications used for adoption of OER.

Knowledge Management and 4IR for OER

The 4IR developments have put into perspective the rationale behind the adage that "knowledge is power." Organisations that recognise, value, generate, and advance their knowledge assets are better placed to yield positive outcomes (Mavodza and Ngulube 2012). There is a correlation between OER and knowledge management, both of which are about arranging processes and directing institutional systems to enable people's tacit knowledge to be shared between members (i.e., instructors, students, co-workers, community, etc.), and explicit knowledge to be captured, restructured, and reused in their foreseeable future (Ubon and Kimble 2002).

The development of learning content and tuition is advancing and moving faster due to the existence of the 4IR (Mncube 2022). The 4IR has evolved in the provision of tuition and learning with different stages of web development: Web 1.0, Web 2.0, Web 3.0, Web 4.0, and Web 5.0 (Kasza 2019). All web developments have their role in the transformation of knowledge management of OER, starting from Web 1.0 (read-only, company focus, connected information, home page), Web 2.0 (read-write, community focus, connected people, social media, for example, blogs and wikis, etc.), Web 3.0 (read-write execute, individual focus, connects knowledge, live streams, intelligent agents, semantic webs) (Noh 2023), and followed by Web 4.0, which makes the internet more user-friendly, efficient, personalised, interactive, intelligent, and collaborative (Pliatsios, Lymperis, and Goumopoulos 2023). Lastly, the latest is Web 5.0, which aims to provide a decentralised platform to users while also incorporating human emotions using artificial intelligence (Mourtzis 2023).

KM and 4IR have the capabilities to transform the use of OER in HEIs. As both AI and knowledge management are inexorably bound up with the nature of knowledge and learning, recent advances in AI can provide new foundations for transforming KM in organisations (Sanzogni, Guzman, and Busch 2017). Furthermore, in the 4IR era, artificial intelligence and knowledge management can amalgamate for the purposes of knowledge creation, knowledge storage and retrieval, knowledge sharing, and

knowledge application (Jarrahi et al. 2023). 4IR and KM should be seriously considered in educational spaces, especially for the transformation of OER.

The Creators and Users of OER

Each HEI is characterised by people responsible for the creation and sharing of knowledge (OER). In many institutions, the administration, creation, and development of OER occur through hierarchical structures. So, social capital plays a role in the administration and creation of OER. Baker (1990, 619) describes social capital as "a resource that actors derive from specific social structures and then use to pursue their interests; it is created by changes in the relationship between actors." This is confirmed by Mncube (2022), who alludes that individuals in managerial positions can encourage the development and use of OER. Social capital plays a role in an ODeL institution, where university top management, deans, OER champions, and chairs of departments are promoting the use of OER by academics for tuition and research (Mncube 2022).

Social capital provides the mandate for the actual development of OER to researchers, academics, and administrators. Particularly in HEIs, academics create and develop OER for teaching and research, mostly using them for their modules or subjects (Mncube and Mthethwa 2022), whereas in the school context, educators are considered as prominent creators of OER (Stracke et al. 2022). HEI literature implies that academics receive more support when creating OER compared to school educators. HEI contexts are mostly given full support from academic libraries (Alenezi 2023). Academic libraries employ librarians who are professionally qualified and ideal candidates to work with faculty on the exploration, adoption, promotion, and preservation of OER (Mamafha et al. 2023; Tang and Tseng 2023). They are also in the position to assign the 5Rs: retain, reuse, revise, remix, and redistribute rights (Wiley, Bliss, McEwen 2014); they are associated with Creative Commons and other open licenses and can assist copyright holders in applying the 5Rs.

Applications Used for OER

OER rely on digital technologies for storage and management using applications software and systems. In this context, the application refers to the system or open software used by lecturers to access, search, disseminate, and use OER. Nowadays, there is technology promising to overcome the problems of applications; m-learning mobile devices provide reliable, customised, and guaranteed dynamic computing environments for users (Jurayev 2023). Applications (apps) or app technologies are viewed as "productivity tools" or prosthetic devices that allow people and social institutions to expand performance benefits while engaging in ongoing socioeconomic activities (Orlikowski and Iacono 2001). Technology has had a powerful impact on the educational system for the adoption of OER (Alam 2022). OER are online education sources, so they allow teaching and learning to be synchronous, live, and class-based, as well as asynchronous using recording and broadcasting teaching modes (Xue, Li, and Xu 2022). The increasing infusion of applications and digital technologies into

educational settings has changed the ways lecturers communicate with, choose, and structure their educational resources, and it has even changed their teaching practices (Bourbour 2023). Therefore, such resources are created, hosted, and disseminated through different applications.

There are dual applications relevant to the appropriation of OER. Some of the applications include multimodal presentation, large display, animation, interactivity, indefinite storage, and quick retrieval of educational resources (Bourbour 2023). Apps help students understand concepts through integration that helps in constructivist learning where students interact with their peers, the teacher, sources of information, and technology (Kilag et al. 2023). It also helps to understand complex concepts through simulations, contributing to an authentic learning environment (Vidergor and Krupnik-Gottlieb 2015). The use of ICT in teaching and learning will benefit the future lives and occupations of the next generation as well as the learning environments. Software and application systems may be able to access many OERs from different sources.

Contextualising the Evolution of Distance Learning to Open Distance E-Learning

The Draught Policy for the Provision of Open Learning and Distance Education in South African Post-School Education and Training (DHET 2014) highlights the rapid demand for distance learning on South African soil. This policy attributes the DHET's high level of confidence to the significant progress distance education (DE) has made in improving access to higher education in recent years. Although the Council on Higher Education (CHE 2014, 79) is inspired by the achievements of the higher education sectors, it also rejects the practice of many HEIs using the terms "distance education" and "open learning" interchangeably or synonymously, which it claims creates a "false" impression. Their argument assumes that distance education is generally a secluded learning environment in which students are expected to make sense of and master the learning outcomes with little or no peer group interaction (CHE 2014), while

> [o]pen learning is a mode of learning underpinned by the principles of student-centeredness, lifelong learning, flexibility of learning provision, the elimination of barriers to access learning, the recognition of prior learning (RPL), the recognition of credit for prior learning experience, the provision of student support, the construction of learning programmes in anticipation of high student success rates, and the sustenance of quality assurance over the design of learning materials and support systems. (Department of Education 1995, 1)

However, in the wake of the CHE's announcement on the nature of distance education, it elaborated on it, mentioning that through the systematic application of "different media, tutorial support, peer group discussion, and practical sessions as modes of curriculum delivery," DE is just as fit to establish and sustain student agency (CHE 2014, 79). Rapanta et al. (2020, 924) argue that online learning (a term they prefer to use instead of distance education) is a miniature version of "e-learning and digital

education," both of which take a wider approach to rolling out education in terms of "a full range of digital tools and resources" beyond the employment of the "internet and a focus on digital competencies and development." Although some scholars project the sense that instructional paradigms such as "e-learning, open learning, and blended learning" all denote HEI appreciation for varying degrees of technology-mediated learning (i.e., DHET 2014), Guri-Rosenblit (2005) argues that DE and e-learning are not synonymous.

In terms of South African HEIs (particularly universities), Bozalek and Ng'ambi, (2015, 5) advise against "adopting technology for learning without basis basically because it is 'fashion' worldwide." Additionally, Ngubane-Mokiwa (2017) discusses the prospects of the imminent transition from open distance learning (ODL) to open distance e-learning (ODeL), with the latter purportedly endowed with a myriad of digitally savvy and reliable technologies. While announcing the positive enhancements that the lure of ODeL can contribute to the tapestry of distance learning, in terms of ensuring greater opportunities for networked platforms, instructor and lecturer feedback, and seamless academic administration processes, Letseka and Pitsoe (2014) were however alarmed by ambiguities around issues of quality assurance, power, and cultural hegemony. The description of the study context has been evolving. Recently, the University of South Africa (UNISA) has a new identity, that of an institution of comprehensive open distance e-learning (CODeL) (UNISA 2019). Based on the current naming of UNISA as illustrated by Mncube (2023a), we provide a summary on UNISA's identity in Table 1.

Table 1: UNISA's current identity

Year	2001-2010	2011-2020	2021-2022
Identity	ODL	ODeL	CODeL
Leadership	Prof Barney Pityana	Prof Mandla Makhanya	Prof Puleng LenkaBula

Source: Mncube (2023a, 137)

Conceptual Framework

The knowledge management cycle was chosen as the conceptual foundation for this investigation. KMC is a collection of technology tools that enable stakeholders' "knowledge and experiences" to be examined, innovated, synthesised, transmitted, and shared (Salem 2014). KMC is a software infrastructure with an ICT focus that ensures that knowledge movement is identified, documented, saved, shared, examined, and productively used (Nonaka 1994). Processes determined by the calibre of human capital entrusted with carrying out these tasks set off KM systems. This study chose a generic KMC architecture for its KMC conceptualisation, as indicated in Figure 1.
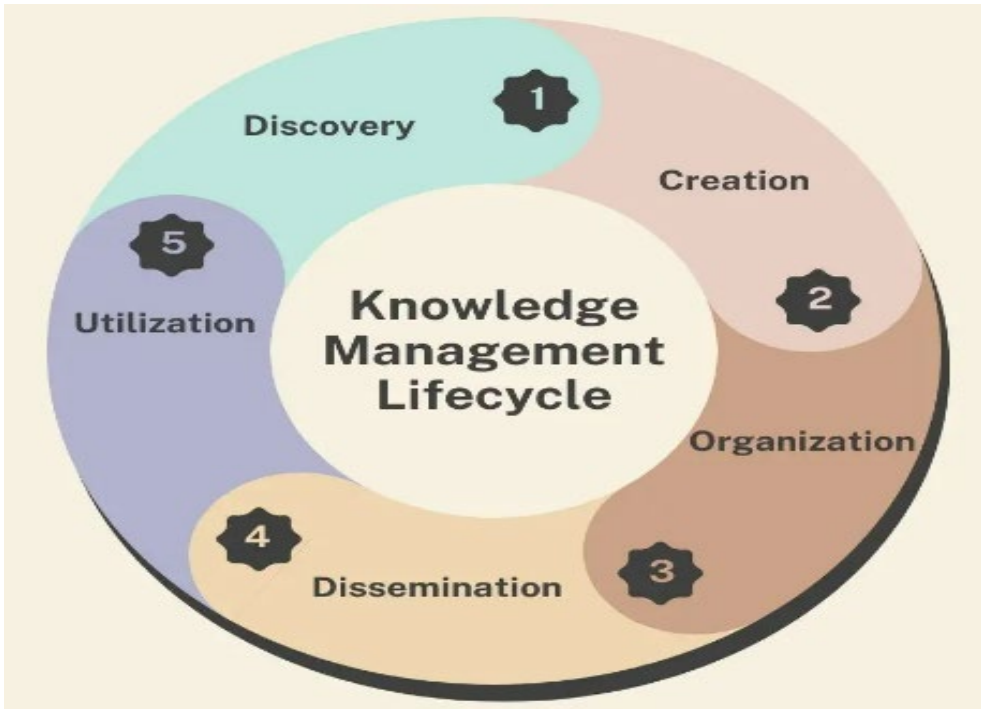
Figure 1: Knowledge management cycle (McIntyre, Gauvin, and Waruszynski 2003)

The adoption of the KMC consists of six steps, as illustrated in Figure 1. However, this study describes the KMC according to its relevance to the study in the introduction of OER. This study considers the management circle as the first stage. This stage entails the process of capturing and organising knowledge (McIntyre, Gauvin, and Waruszynski 2023). This stage helped to uncover and understand how lecturers store and organise OER for tuition in their university.

Secondly, the application becomes relevant because it is responsible for access, search, dissemination, and use. Organised knowledge is stored in such a way that it can be accessed, searched, and disseminated by users working in the organisation (Patriotta 2004). This is relevant to academia when OER are appropriated. The appropriation of OER involves all characteristics of the application circle such as access, search, dissemination, and use.

Lastly, the people's circle becomes the final process in the circle. Once knowledge is created, it can be shared amongst people working in an organisation (Patriotta 2004). Better sharing leads to better ideas, thereby creating a valuable knowledge repository. In this context, the people circle allows the study to gain insight into how lecturers share the OER created in their institution. Then, once the knowledge is shared, it allows the knowledge acquired to solve problems in real time (Davidson and Voss 2022).

Methodology

The ODeL institution was chosen as the case study and a qualitative approach and constructivist research technique were used. Snowball sampling was utilised since the initial participants were recruited from a heterogeneous academic department of the university (eight colleges, 18 schools, and 70 departments). Initially, the researchers wrote to the chairs of departments to ask for the relevant participants who are adopting or creating OER in their departments. Those who responded gave out names for the relevant people who were approached. The first round of individual interviews consisted of 19 participants. During the first round of interviews, the selected participants suggested other colleagues who are fully involved in the processing of OER. The second set of interviews consisted of 23 more participants. The semi-structured interviews involved a total of 42 lecturers, including junior lecturers, lecturers, researchers, senior lecturers, associate professors, and full professors. Semi-structured interviews were deemed the most appropriate strategy for qualitative research because of their adaptability (Gillham 2005). From 25 to 60 minutes were allotted for the interviews. Because professors are responsible for teaching and rely on OER, this was a factor in the selection process.

The data collected was managed and stored using NVivo. The transcripts were anonymous before being coded in NVivo and analysed. NVivo memos on various subjects were produced by going back to the individual interviews and further analysing the data after reading the interviews and the codes again. The researchers then started to search for themes. After discovering or combining concepts, the researchers completed the analysis reviewing all the coding, themes, and connections between the key themes. The researchers then started to redefine and rename the final themes. Consent to conduct research at one ODeL university and a letter of ethics clearance were acquired. It is crucial to abide by ethical rules, such as those pertaining to informed consent, confidentiality regarding participants, sponsors, and co-workers, the priority of the study's benefits over its risks, and participant requests that go above and beyond what is considered socially acceptable (Lipson 1994). Due to this, all participants are referred to as Lecturers 1–42 in the presentation and discussion of the findings, keeping participants' names secret.

Findings

Management Platforms for OER

Lecturers use virtual platforms and social media for the management and capture of OER. There are many virtual online options available for lecturers to use in the adoption and development of OER. Due to their usability, ease, features, and freedom to post and keep OER, social networks were considered appropriate for the process. The most popular digital media platforms were Facebook, LinkedIn, WhatsApp, YouTube, blogs, and ResearchGate. One lecturer shared the following:

> I used YouTube at times, some blogs, and your research sites like your subject content related. I am used to ResearchGate and research scholar and these other sites for online resources. (Lecturer 9)

Social networks are popular because they are more cost-effective and more accessible than any other types of software. Social media is considered favourably by lecturers and students with smartphones as they can quickly access and use such platforms. Social media's straightforward, recognisable user interfaces and minimal effort when posting and downloading OER content make them crucial for the use, diffusion, and promotion of OER.

In addition to digital media platforms, some lecturers commended cloud storage devices as suitable platforms for storing and sharing OER in an ODeL institution. This includes different online storage platforms such as OneDrive, Google Drive, and iCloud. These were selected as the best online storage platforms to help lecturers share all educational resources according to subject or content. They are also considered drives because they can provide encrypted and secure access to your files. In drives, files are shared amongst students and lecturers and can be proactively scanned and removed when malware, spam, ransomware, or phishing is detected. Lecturers opt for online drives because they are spaces that are replacing the physical storage devices of computers. Other lecturers recommended drives because they are native to the cloud, eliminating the need for local files and minimising risk to devices.

Applications Used by Lecturers for Knowledge Management of OER

The majority of the lecturers used three applications: YouTube, Google Scholar, and OERu. The lecturers relied on YouTube to access and post OER. One of the reasons for appropriating YouTube was that students like to access OER from YouTube because of its usability and user-friendliness. YouTube is commended as a relevant platform for OER because it plays a significant role in open access and does not require any registration or subscription processes. A minority of participants use OERu (OER Universitas) to store their OER. OERu is coordinated by the OER Foundation, an independent non-profit organisation. The OERu network of institutions offers free online courses for students around the world (McGreal, Mackintosh, and Lane 2023). Lectures mentioned that the purpose of OERu is to increase access to and reduce the cost of higher education for students around the world—particularly for students who are academically excluded (who do not qualify) from enrolling in higher education institutions.

Lecturers share files and documents as OER that are Creative Commons licenced with students, regardless of geographic location and time. Microsoft Teams and Zoom were also used by the majority of lecturers as interactive instant chat-based platforms that enable the sharing of documents and conducting online meetings. Participants indicated that Microsoft Teams and Zoom are capable of supporting OER content development

that can be reconstituted at a later stage and that is sharable among students, lecturers, and the general public. One lecturer stated:

> I think that Microsoft Teams could be used in terms of having online actual face-to-face interactions with students like discussions, etc. and I think Google Classrooms also provide quite—what do you call it—an effective space. (Lecturer 14)

Furthermore, using Teams and Zoom, lecturers were expected by the university to convert their content to video and audio formats that are easily accessible on virtual platforms. Lecturers convert their teaching content into slides to make it virtually available to their students, while others rely on virtual e-learning platforms, because these enable them to teach students and a wide community of stakeholders.

MyUnisa for Creating and Sharing OER

The lecturers used the institutional learning management system MyUnisa to create and share OER. They decided to continue using the current institutional system because both the myUnisa and library systems could manage OER and there was no reason to switch to another one. It was determined by the majority of lectures that MyUnisa was sufficient to meet the OER requirements for coursework and research. They all admitted that they liked myUnisa due to its straightforward graphic user interface, which allowed quick engagement and participation. They also praised myUnisa for its adaptability and familiarity, as it allows for student participation and can incorporate a variety of media modalities that are important for both teaching and learning. A lecturer explained:

> I usually post those OER in the institutional system and again after that, I've got to market those OER to students so that they can be able to utilise them. (Junior Lecturer 1)

Besides the usefulness, familiarity, and usability of myUnisa, other lecturers expressed the opinion that they adhere to the current system since it is required and permitted by institutional policy. One lecturer said:

> No, I think MyUnisa is key to any academic right and our students have been aligned to MyUnisa so directly, so there are no other systems that I'm using besides MyUnisa. (Senior Lecturer 6)

Discussion

OER are well appropriated through virtual platforms, social media, application software, and institutional learning management systems. The study found that there is a relationship between KM and OER in the 4IR era. Ubon and Kimble (2002) postulate that KM allows institutional systems to share tacit knowledge and for explicit knowledge to be captured, restructured, and reused. The relationship with OER within the institution can be related to tacit and explicit knowledge. The literature concurs that social capital has an influence on lecturers concerning the creation, adoption, and

utilisation of OER (Mncube 2023b). This further confirms that institutional social capital aligns with the processing of "tacit" knowledge assets. Once lecturers are informed to create, adopt, store, and disseminate knowledge, "OER" refers to the "explicit" process.

KM tools were found to be useful in the management of OER. Applications and platforms are relevant in the appropriation of OER in the 4IR era. Jarrahi et al. (2023) confirm that in the 4IR, using artificial intelligence and knowledge management, standards regarding knowledge creation, storage, retrieval, and sharing need to be enhanced. KM and 4IR realities might not be separated in the evolving technology in an education context. The consideration of KM allows users to capture the essence of "management," "people" and "application" in OER. People are referred to as "lecturers" who are key actors in the creation, sharing, use, search, access, capture, and organisation of OER. Lecturers are the primary stakeholders in HEIs responsible for the creation and adoption of OER (Mncube and Mthethwa 2022). The current phases of the KMC, as shown in Figure 1, have great potential to manage OER as "knowledge."

However, the KMC described by McIntyre, Gauvin, and Waruszynski (2003) lacks a significant phase such as "systems," which covers the impact and usability factors including metrics in the creation and adoption of OER. A system refers to the principles, methods, and tools of information storage, search, classification, and processing (Murodullaevich and Sharifjanovna 2023). On the other hand, systems are a "double reality" (Giddens 1984). In this context, the system can be referred to as the institutional policies and practices that govern the OER. Therefore, studying "systems" as an IT artefact can provide researchers more opportunities to understand many of their critical implications, both "intended and unintended: for individuals, groups, organisations, and society" (Orlikowski and Iacono 2001, 40). Therefore, the study proposes an additional phase called "system." This concept will consider the duality of the system where issues of policy, impact, and user metrics will be considered when users are appropriating OER.

Conclusion and Recommendations

In establishing knowledge management tools to serve the creation, sharing, and use of OER in the 4IR, a KMC was used as the conceptual underpinning. The findings indicate that the knowledge management tool has great potential to manage OER in HEIs, especially in the 4IR. The study was able to identify ICT tools used for OER in an OdeL institution. The study proposes the extension of the KMC from three cycles to four where "system" is added. There is a significant need for the system cycle to cover policy, impact, and the matrix. In the 4IR era, it is crucial to consider issues such as the matrix, impact, and users' perceptions because they give an overview of the usability of a system in any organisation. A future study will investigate the usability of systems for appropriating OER focusing only on students in an ODeL context. The study recommends that scholars who are investigating any IT artefact opt for an extended KMC where impact and user matrix factors will be evaluated.

Acknowledgments

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