

Contextualizing Micro-learning Deployment: An evaluation report of platforms for the higher education institutions in Tanzania

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ABSTRACT

Micro-learning is a modern learning approach hailed for improved course completion by learners and retention capability. Micro-learning relies on technologies of various types to offer improved learning experiences to learners anywhere and anytime. Micro-learning platforms of various types offer course managers and educators features for managing courses, collaborating with learners as well as monitoring their progress. Unfortunately, due to the novelty of micro-learning as an area of research, there is a scarcity of literature guiding institutions and decision-makers concerning technological choices for the right deployment. This paper proposes eleven platforms for micro-learning deployment in higher learning institutions (HEIs), particularly in Tanzania. The paper is influenced by the Design Science Research approach and the Critical Theory of Technologies. A stage-based methodology for software evaluation was used in the current study. Specifically, thirty-seven platforms from key industry trends were evaluated. The proposed eleven platforms are generically relevant for the Tanzanian context as they are affordable, customizable, and functionally able to offer quality micro-learning services. The paper adds knowledge to the micro-learning deployment domain as well as offers practical guidance to those intending to deploy micro-learning services.

Keywords: *Micro-Learning deployment, Critical Theory of Technology, Design Science Research, Tanzania Higher Education Institutions, Stage-based Methodology*

INTRODUCTION

Unquestionably, advances in Information and Communication Technologies (ICT) are revolutionizing every sector of our lives. In education, ICT plays a major role in shaping the way we organize and conduct teaching, learning, and research. Over two decades ago, discoveries of personal computers and the Internet gave birth to electronic learning (eLearning), whereby it became possible to learn from a distance. Likewise, the high proliferation of mobile technologies including smartphones and mobile Internet resulted in mobile learning (mLearning), whereby teaching and learning can happen anywhere and anytime. It is argued that the social addiction arising from use of modern applications such as social media, reduces the retention and concentration capacity of modern learners. In that regard, it is vital for educators to switch towards a more innovative technique that will maximize the concentration and retention of knowledge by the learners, and that is the core strength of microlearning. Micro-learning provides an alternative learning approach that relies on shorter instruction units and activities compatible with the new millennium learners (Zhao et al., 2010). It aims at knowledge dissemination using short and focused units, cumulatively demonstrating concepts of a larger topic, making it easier for learners to concentrate and retain (Fernandez, 2014). Currently, Micro-learning has joined the new focus of researchers on technology-mediated-learning (Kadhem, 2017). Research on micro-learning application in organizations indicate positive outcomes in various aspects including completion rate as well as retention capacity of the learners (Kadhem, 2017; Smolle & Bruck, 2017).

The Micro-learning approach is still at the infancy stage especially in higher education. While there have been a handful of successful research studies on the application of micro-learning to enhance teaching and learning experiences in the informal education sector (such as professional development, including on-job-training), there is limited literature on the application of micro-learning in the formal education sector. Moreover, the majority of research focuses on its efficacy,

acceptability, course design as well as micro-learning architecture; and little has been done in the area of deployment; as such literature on micro-learning deployment approaches is limited (Ahmad, 2017; Giurgiu, 2017). Hence, knowledge of how to deploy micro-learning services and technologies is limited as well. In addition, micro-learning awareness, research, initiatives as well as literature concerning African universities are limited.

In principle, technologies play significant roles in any ICT-based-learning including micro-learning deployment. Technologies of various types form the backbone of all transactions that happen during the delivery of a course. They include servers and network infrastructure as well as platforms that handle business transactions. Micro-learning platforms perform much like the learning management systems (LMS) in the eLearning ecosystem, as they are equipped with all necessary features for a course and content authoring as well as services administration and management (Pappas, 2018). Unfortunately, there is no single size that fits all contexts when it comes to technological deployment. The need to make the right technological choices is not new in information technology research. This is because technological deployment consumes resources, including budget and time (Asl et al., 2012). Consequently, the wrong choice of technology hinders organizations from attaining their ultimate goals (Asl et al., 2012; Jadhav & Sonar, 2009). It is from these realities that different scholars have proposed various methodologies and criteria to evaluate and select relevant technologies for the specific organization (Jadhav & Sonar, 2009). In the current paper, we apply a stage-based methodology for software evaluation to evaluate micro-learning platforms.

Hence, the objectives of the paper are to:

1. evaluate micro-learning platforms relevant for Higher Learning Institutions (HEIs) in Tanzania,
2. propose a list of platforms that are suitable for deployment in HEIs in Tanzania, and
3. recommend possible deployment options for stakeholders to apply.

It is essential to contextualize micro-learning deployment. Reflecting on the Critical Theory of Technology (CTT) lens, the design and deployment of technologies cannot be isolated from societies. The socio-political needs of the society shape the designs and how technologies are used. Failure to inscribe the needs into designs results in conflicts such as boycott (Feenberg, 2005). Likewise, Design Science Research (DSR) advocates the development of artefacts that are relevant to the context to which it is deployed (Hevner et al., 2004). Hence, this study is framed through the philosophies found in both CTT and DSR. Specifically, the African context is unique in terms of skills, budget, as well as infrastructure (Odumusu, 2017). In addition, while micro-learning, mobile learning, and eLearning are closely related, philosophically and technologically they are different; the design and development of eLearning and mLearning content and experience are tailored toward the use of computers and mobiles (smartphones, tablets) respectively, while micro-learning is standardized to utilize both media (Giurgiu, 2017). Also, unlike eLearning and MLearning, micro-learning properties standardize the design and development of content and activities (Hug, 2005). Hence, while some scholars have used eLearning platforms (LMS) to study micro-learning efficacy and acceptance (Kadhem, 2017; Smolle & Bruck, 2017), the approach requires more comparative research of its functionalities and efficacy.

Research on micro-learning deployment in both formal and informal education settings are relevant to the educational stakeholders. However, more knowledge and skills are needed to enhance the understanding and application of micro-learning in societies. In particular, the effective deployment will not only help organizations to realize their intended objectives but also increase community access to knowledge and skills. For organizations, micro-learning helps to reduce training costs as well as time to travel to the learning venues (Buchem & Hamelmann, 2010; TalentCards, 2019). Hence, research such as this paper presents, will enhance the ability of the organizations, academic institutions, as well as policymakers, to make the right choices and apply the right technological options.

LITERATURE REVIEW

Micro-learning is commonly described as an alternative learning approach that relies on short units of learning instruction known as micro-units that takes less than 20 minutes to complete. Each micro-unit addresses a single learning objective. Hence, a micro-learning course is made up of a multitude of micro-units (Bruck et al., 2012; Kadhem, 2017). Also, units of micro-learning content are simplified and shortened to be compatible with the size and capacity of mobiles (Giurgiu, 2017; TalentCards, 2019). The simplicity and specificity are essential for digestion, retention, as well as course completion (Kadhem, 2017). Practically, an ordinary e-learning or m-learning topic is chunked into several micro-units (“chunks”) to fit the micro-learning standards (Polasek & Javorcik, 2019; Smolle & Bruck, 2017).

Scholars refer to micro-learning as a natural attraction for millennium learners because it fits well with social media and web2.0 services (Zhao et al., 2010). Social media platforms, including Twitter, Facebook, Instagram, and YouTube are among the popular platforms used by most micro-learners. Also, it has been revealed that shorter instruction units are easy to absorb and interact with, hence yield the best results. Also, micro-units, also known as *microcontent* as coined by Sánchez-Alonso et al., (2006), fit well with mobiles, the main learning device used by the majority of learners in Africa to achieve learning “anywhere” and “anytime” (Smolle & Bruck, 2017). Not every short instruction unit applied to learning contexts is a micro-unit. Hug (2005) outlined seven attributes that define micro-learning units and content, including: time, content size, curriculum type, process, modularity, and learning type. Apart from being short, micro-units should be compatible with various types of media including computers and mobiles.

While micro-learning is claimed to be a new approach, the pedagogical opportunities afforded by short units of content was first introduced in the 1960s as “micro-teaching” (Hug, 2005). Research on micro-teaching claims that overloading learners with information degrade their retention capacity because the working memory of an individual is limited in terms of size as related to the forgetting-curve concept (Shail, 2019). Also, the micro-learning approach is standardized to accept learning resources available in several formats including audio, video, texts as well as images (TalentCards, 2019). Based on the nature of the content to be delivered, options are there to create a video, audio, infographics, simulations, GIFs, and more that can be either standalone or blended with other learning approaches such as e-learning, m-learning or traditional classrooms. The key to success lies in how well the course is designed to deliver the intended content and activities. Earlier research indicates that good practice is to embed a micro-learning course with immediate feedback to improve learners’ progress and productivity (Kadhem, 2017).

Micro-learning Support to Formal Education

Because micro-learning is a “form” of learning that is portable, focused, interactive, and flexible (Hug, 2005; Polasek & Javorcik, 2019), it can be used to support the delivery of formal education at all levels. It is suitable if deployed either as a dedicated learning option just like e-learning, or blended into the existing approaches (Ahmad, 2017). Possible options for deploying micro-learning services are described below:

First, micro-learning can be deployed in a blended approach to support the existing traditional face-to-face systems. That involves creating micro-learning units and activities to complement some aspects of the existing curricular. For example, they can be integrated into technical courses to add clarity, simulation, practical and collaborative experiences by leveraging from the interactive platforms. In similar ways, a micro-learning app was used to offer preparation reviews for CCNA examinations (Aigerim & Azamat, 2014). Also, at the University of Ostrava, micro-learning activities such as quizzes, feedback, and micro-units were offered through Moodle (Polasek & Javorcik, 2019). These cases demonstrate how micro-learning is used in blended forms. It is the responsibility of the lecturers and the learning institutions to decide on the ways that micro-learning is blended with the rest of the methods.

The second approach is to use micro-learning to deliver distance education (Polasek & Javorcik, 2019; Sun et al., 2015). This can be achieved either through blending with the existing e-learning or a dedicated approach. To improve learners' experience, micro-learning methods can be used to complement the available systems. In particular, some eLearning modules can be reformatted to fit the micro-learning characteristics and be delivered to learners (Polasek & Javorcik, 2019; Steinbacher & Hoffmann, 2015). Otherwise, micro-learning activities such as quizzes, feedback, tests, and forums can be integrated into the existing setup. These two approaches above are used with success at the University of Applied Science in Kufstein Austria to deliver higher learning courses (Polasek & Javorcik, 2019; Steinbacher & Hoffmann, 2015).

In the third approach, a full set of micro-learning courses can be delivered to distance learners. As previously explained, the distinction between micro-learning and e-learning is related to the design and delivery of content and activities. The design and style of micro-learning courses are inclined towards the reduction of transactional distances, "*a psychological and communications space to be crossed, a space of potential misunderstanding between the inputs of instructor and those of the learner to the distance learners*" (Moore, 1993, p. 22). As such, learners have demonstrated their hopes and satisfaction with the new learning approach (Aigerim & Azamat, 2014; Polasek & Javorcik, 2019). Therefore, it is up to the learning institutions to design and deliver courses that satisfy the demands of modern learners of which the choice of platforms to use is vital.

Micro-Learning Support for Informal Education

The micro-learning approach is also suitable for the delivery of informal learning to support skills development. Specifically, universities and organizations can leverage their existing eLearning platforms as well as new micro-learning platforms to build capacity for their students and employees respectively (Reinhart, 2008). Also, micro-learning is known for being pertinent to targeted and focused learning experiences (TalentCards, 2019); thus they can be used to deliver contextually and targeted learning to the employees and students to improve their awareness and skills (Buchem & Hamelmann, 2010). By using micro-learning platforms, it is possible to deliver learning experience directly to students and staff through their mobiles, provided they are relevant for the purpose.

Additionally, the micro-learning approach can be used by the HEIs to expand their horizon by targeting communities that are not privileged to enrol in the universities. Specifically, very few Tanzanians enrol in programmes at higher learning institutions (TCU, 2018). Therefore, universities can design portable micro-learning courses that help to improve knowledge and skills to the targeted communities such as farmers and entrepreneurs (Reinhart, 2008).

Micro-learning Applications

Since its inception, micro-learning has attracted the interest of different stakeholders from various fields not only to study its effect and efficacy but also to leverage from the business perspectives. It is used by organizations to reduce costs and generate revenue. Further, software developers have come up with several application software for a specific purpose that supports micro-learning deployments (Pappas, 2018). These platforms not only allow instructional designers to create and manage micro-units, but some are also the gateways for learners to access the content. They offer tools for creating and publishing content, establishing and managing collaborations, gathering and analyzing progress, and continuity of the courses, as well as offering instant feedback and integrity checks (Pappas, 2018; TalentCards, 2019). These platforms can be categorized into cloud-based applications, mobile apps, as well as stand-alone applications. While some of the platforms are mainly free and open source, many of the platforms are proprietary in such a way that the need for a license to use them is mandatory. Similarly, they can be grouped based on what they offer to the client. Some of the platforms are specific to a particular field, and some are generic and offer just tools necessary for creating a micro-learning experience, in whatever field one is interested in.

The common mobile apps include the following:

- **Duolingo**, which offers language learning possibilities. By the aid of Duolingo, it is proven that one can improve the ability to learn new languages in the shortest time (Ahmed, 2016).
- **Highbrow** offers free bite-sized email course delivery to a learner's inbox every morning for ten days to finish the course in an art or science subject.
- **Corbie** offers quick and easy to digest emails teaching on subjects like art, science, and history each morning. Each lesson is designed to boost learner's knowledge in 5 minutes or less. Further,
- **Easy-Ten** is an app to learn any language with ten words a day. Generally, it is proven that learning through apps is both progressive and challenging; there are aspects of the apps that improve learners' attention and motivation, whereas other skills and knowledge are more complex for the software to handle (Bogdan, 2016).

Apart from mobile apps, web-based as well as cloud-based services exist. They include platforms such as TalentCards, mLevel, HandyTrain, Skill-Pill, Gnowbe, Grovo, SpeechMe, and OttoLearn, just to name a few. These platforms offer various functionalities suitable for creating, monitoring, and publishing micro-learning content (Capterra, 2019; Pappas, 2018). Unfortunately, the decision-making process on which platform to use is not automatic; it requires expert knowledge as well as understanding the demography of the learners and the profile including understanding the pedagogical value as well as strategic fit in the institution. Indeed, there is limited literature on how to approach such a decision-making process. Hence, the present paper closes the gap by presenting an evaluation report of the platforms.

The existence of micro-learning-based apps and platforms confirms a new trend, a shift of focus from traditional LMS to more portable and mobile-friendly learning platforms. Similarly, it suggests that learning is becoming more personalized and social that challenges the well-established tradition that learning must happen in the boundaries of schools and colleges, especially within the walls of classrooms. While it is acceptable that learning through micro-learning platforms is possible, such a claim cannot be generalized in every context. Still, the contextual factors play a significant role in shaping the outcome of the training. Therefore, it is ideal to study such phenomena in every situation independently. Primarily, it is crucial to explore micro-learning platforms and how to deploy and configure them. This study focuses on evaluating micro-learning platforms for the HEIs in Tanzania.

Micro-Learning Implementation in Tanzania

While there are scores of literature depicting e-learning and mLearning deployment in Tanzanian HEIs, as well as describing the status and how they are applied, little is done on micro-learning deployment. Specifically, because micro-learning is a new learning approach, there is limited literature concerning the status and its application in Tanzanian HEIs. However, earlier research has shown that the majority of the educational stakeholders are unaware of and inexperienced with micro-learning and micro-credential concepts and associated technologies (Ghasia, Machumu, et al., 2018). Also, there are neither micro-learning services offered, nor research focus on any of the HEIs in Tanzania. Hence, the present research contributes to the understanding of micro-learning deployment by proposing relevant platforms for the decision-makers, institutions as well as future research.

Specifically, Tanzania's situation is unique and deserves technologies that are relevant to their context and needs. In particular, the situation analysis uncovered that the HEIs in Tanzania lack skills, infrastructure, ICT literacy, as well as commitment to enforcing the available policies. It was revealed that the lack of budget forces the majority of the universities to switch to open source solutions (Ghasia, De Smet, et al., 2018; Mtebe et al., 2011; Nagunwa & Lwoga, 2012). For example, budget was said to be the reason that forced the University of Dar es Salaam (UDSM), the biggest and powerful university in the country, to switch from Blackboard to Moodle LMS (Mtebe et al., 2011). Similarly, budget was among the criteria used by Muhimbili University of Health and

Allied Sciences (MUHAS) to choose Moodle out of many other options (Nagunwa & Lwoga, 2012). Other criteria used by MUHAS are: *“availability of supporting resources, ease of training and adaptation by MUHAS community, usefulness to different university groups, Capability to be supported by the university’s limited ICT infrastructure, Capability of the technology to support pedagogy and competency-based curricular at the University”* (Nagunwa & Lwoga, 2012).

Micro-learning Technologies Acquisition Processes

There are two possible alternative ways of acquiring micro-learning in the HEIs in Tanzania. First, institutions must develop their technologies to solve their specific problems. Significantly, African institutions and individuals have been challenged by scholars such as Mavhunga (2017) and Odumosu (2017) to emerge from being dependent on foreign imported technologies, noting the need for the universities to lead the decolonizing project by producing relevant software for the needs of the societies. Second, if the internal and local creation of technologies cannot be achieved by the institutions due to various reasons including finance and skills, the alternative option is to import such technologies from elsewhere. The combination of the Design Science Research approach and the Critical Theory of Technology requires institutions to import technologies that are relevant to their needs and participate in the processes of shaping and being shaped by those technologies (Feenberg, 2005; Dresch et al., 2015). To comply with the Design Science Research Approach and the Critical Theory of Technology, imported technologies need to be relevant and customizable to fit the respective needs of an organization.

Because our purpose is not to select a specific platform for a HEI in Tanzania, we applied the generic stage-based methodology for the selection of any software package for any organization (Jadhav & Sonar, 2009). The seven stages included within the methodology together with the associated criteria are relevant, easy to comprehend and apply as detailed in the methodology (Jadhav & Sonar, 2009).

METHODOLOGICAL APPROACH

As previously mentioned, this work builds on the situation analysis conducted in four representatives HEIs in Tanzania: UDSM, University of Dodoma (UDOM), Mzumbe University (MU), and the Open University of Tanzania (OUT). Specifically, ninety-seven respondents participated in the project (Ghasia, De Smet, et al., 2018). In the process of identifying possible candidate platforms for the evaluation, we relied on ELearning Industry (2018) and Capterra, (2019) to provide a list of both prominent and emerging micro-learning platforms in the market. We also included both open source and proprietary systems as well as LMS platforms capable of delivering micro-learning services. Specifically, the Elearning Industry and Capterra are globally known for offering a handful of descriptions, analyses and comparisons of learning technologies that are trending and emerging in the market. In this study, thirty-seven (37) trending and emerging platforms were identified for evaluation. For each of the platforms, relevant data for evaluations were obtained from their respective websites as shown in Table 2. Further, customer reviews and demos were downloaded from the websites. To ground the findings within the context, literature, and policy documentary reviews were applied. Because the purpose of this study is limited to proposing (not procuring) platforms for the Tanzanian HEIs, the stage-based methodology for software evaluation selection was used. The stage-based methodology outlines seven stages followed to evaluate the software. At the heart of evaluation processes, criteria for evaluations are identified in advance. We adapted portions of the criteria for platform evaluation from Jadhav and Sonar (2009). The proposed criteria that apply to our situation is shown in Table 1 below. Functionally, a micro-learning platform must contain features for providing authoring tools, delivering and managing quality micro-learning experiences, managing learners, as well as assessing progress (TalentCards, 2019). On top of the functional features, micro-learning platforms should guarantee support and platform availability throughout.

Table 1: Criteria for Platform Evaluation

#	Criteria	Criteria Group	Meaning
1	Included functionality	Functional	Functions to the company that software has to offer
2	Adaptability	Functional	Possible level of customization for the specific company's ever-changing needs
3	Openness	Functional	Level of openness to additional development by internal/external and to other existing applications
4	Interoperability	Functional	Capability to integrate with other tools and applications
5	Number of Concurrent Users	Functional	Number of simultaneous users that can be linked and served by the system at once
6	Compatibility	Functional	ability to be used in various Operating systems and devices
7	Source Code	Functional	ability to get hold of source code
8	Customizable	Personalizable	Ability to be customized to fit client needs
9	Ease of Use	Usability	the ease with which users can learn and operate the system
10	Platform	Portability	the capability of software to run on multiple platforms
11	Scalability	Functional	ability to handle an increased number of users and workloads
12	Availability of Support	Support	How easy it is to get support?
13	Availability of Training	Support	Ease of obtaining training
14	Popularity	Vendor	The popularity of a vendor in the market
15	Cost PER user	Cost	The license cost of the product in terms of number of users
16	Upgrading cost	Cost	The cost required to upgrade to another version

Adapted from Jadhav and Sonar (2009)

DATA ANALYSIS AND RESULTS

The following stages outline how the evaluation process was carried out.

Stage 1: Determining the Need for Purchasing the System and Conducting a Preliminary Investigation of the Availability of Packaged (Platforms)

The situation analysis described the need for micro-learning services in the HEIs in Tanzania. Particularly, it outlined the capacity of HEIs in dealing with technology-mediated learning. To systemize the evaluation process, sixteen criteria were defined, including cost, availability of support, and training, as well as the perceived usefulness¹ of the platform as shown in Table 1. Specifically, a total of thirty-seven platforms of which twenty-three are micro-learning and fourteen LMS platforms, were identified for evaluation. The list of platforms is shown in Table 2 below.

Table 2: List of Evaluated Platforms

S/N	Platform	Vendor	Country	Website
Micro-learning platforms				
1	TalentCards	Epignosis	Cal, USA	https://www.talentcards.io
2	mLevel	mLevel, Inc.	USA	http://www.mlevel.com/
3	HandyTrain	Prototyze	INDIA	https://handytrain.com/
4	Skill Pill	Skill-Pill M-Learning	UK	https://www.skillpill.com/
5	Gnowbe	Gnowbe	Singapore	https://www.gnowbe.com/
6	SmartUp	SmartUp	Ln,UK	https://www.smartup.io
7	Grovo	Grovo	NY, USA	https://www.grovo.com/
8	OttoLearn	Neovation learning solutions	Canada	https://www.ottolearn.com/
9	SwissVBS	SwissVBS	To, Canata	https://swissvbs.com/en/
10	Speachme	SpeachMe Knowledge Network	LA, USA	https://speach.me/
11	Whatfix	Whatfix	Nj, USA	https://whatfix.com/
12	uQualio	uQualio Aps	Denmark	https://www.uqualio.com/
13	iSpring Learn	iSpring Solutions	Al, USA	https://www.ispringsolutions.com
14	TalentLMS	Epignosis	Cal, USA	https://www.talentlms.com/
15	Optimty	Optimty	CA, USA	https://www.optimty.co.uk/
16	Panopto	Panopto	Sy, Australia	https://www.panopto.com
17	BizLibrary	BizLibrary	USA	https://www.bizlibrary.com
18	GoSkills	GoSkills	USA	https://www.goskills.com
19	Axonify	Axonify	Canada	https://www.axonify.com
20	Watch and Learn	Webanywhere	UK	www.webanywhere.com
21	Work Instruction	SwipeGuide	Netherlands	https://swipeguide.com/
22	NovoEd	NovoEd	USA	https://www.novoed.com/
23	ExpandShare	ExpandShare	USA	www.expandshare.com/
Learning Management Systems (LMS)				
1	Synap	Synap	Leads, UK	https://synap.ac/
2	eloomi	eloomi	Denmark	www.eloomi.com

¹ Perceived Usefulness (PU) is defined as the perception that the technology will help them to perform their work better than before (Davis, 1989).

3	Docebo	Docebo	Canada	https://www.docebo.com
4	Rise Up	Rise Up	France	https://riseup.ai
5	Administrare	Administrare	UK	https://www.getadministrare.com
6	eFront	Epignosis	USA	https://www.efrontlearning.com
7	Moodle	Moodle	Australia	https://moodle.org/
8	Edmodo	Edmodo	USA	https://new.edmodo.com
9	WizIQ	WizIQ	USA	www.wiziq.com
10	Easy LMS	Quizworks	Netherlands	
11	JoomlaLMS	JoomlaLMS	Belarus	www.joomlaalms.com/
12	Chamilo	Chamilo Association	Spain	www.chamilo.org
13	eLucid	WisdmLabs	India	www.elucidlearning.co
14	e-Learning	RiskRhino	Netherlands	www.ba-pro.com

Stage 2: Short-listing of Candidate Packages (Platforms)

The purpose of this second stage is to filter the platforms identified in Table 2, to remain with the most relevant after applying the criteria shown in Table 1. In this study, all platforms that were neither educational nor did not indicate price plans on their websites were eliminated. Also, platforms that did not offer possibilities for customization of interfaces and reports were eliminated. Further, we eliminated all platforms that did not have mobiles as their delivery approach because most of the students in HEIs in Tanzania rely on mobile phones for educational purposes. Subsequently, the list was reduced to twelve platforms of which five are micro-learning and seven are LMS. The list is shown in Table 3 below.

Table 3: List of Platforms Passing Evaluation (Stage 1)

Platform	Mobile	Interactive	Assessment	Authoring	Progress Monitoring	User Management
Micro-Learning Platforms						
TalentCards	Y	y	y	y	y	y
OttoLearn	Y	y	N	y	y	y
uQualio	Y	y	y	y	y	y
iSpring Learn	Y	y	y	y	y	y
TalentLMS	Y	y	y	y	y	y
Learning Management Systems (LMS)						
Synap	Y	y	y	y	y	y
eFront	Y	y	y	y	y	y
Moodle	Y	y	y	y	y	y

JoomlaLMS	Y	y	y	y	y	y	y
Chamilo	Y	y	y	y	y	y	y
eLucid	Y	y	y	y	y	y	y
e-Learning	Y	y	y	y	y	y	y

Stage 3: Eliminate Candidate Package that does not have required features, do not work with the existing hardware, Operating Systems and Database Management Software or Network

During this stage, because the goal was not to be specific to a certain institution, the generic features of the hardware, operating systems, and database management systems' parameters were used to evaluate the remaining platforms. Micro-learning platforms must have authoring, user management, assessment, collaborative and interactive features, as well as progress monitoring and reporting tools. Hence, OttoLearn which was found to lack assessment features paramount for micro-learning to happen was eliminated. Thus, the remaining eleven platforms, of which four are micro-learning and seven are LMS, qualified for the in the depth evaluation stage.

Stage 4: Using an Evaluation Technique to evaluate remaining packages and obtain a score or overall ranking of the platforms

During this stage, an in-depth expert evaluation of the remaining platforms was conducted by using the identified criteria. The criteria are adapted from Nagunwa & Lwoga (2012), Asl et al. (2012) and Jadhav & Sonar (2009). The matrix detailing the ranking for each platform against the criteria is provided in Table 4 below. As shown in Table 4, the outcome of the evaluation of all the platforms listed in Table 3, except OttoLearn, indicated they were suitable for the HEIs in Tanzania as they possess all key functionalities and were ready for detailed evaluation in the next stage.

Table 4: Detailed Evaluation of the Platforms aligned with Criteria

Criteria	TalentCards	uQualio	iSpring Learn	TalentLMS	Synap	eFront	Moodle	JoomlaLMS	Chamilo	eLucid	e-Learning
Included key functionalities	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Adaptability	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Openness	x	x	x	x	x	x	✓	✓	✓	✓	✓
Completeness	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Interoperability	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
#Concurrent users	on Licence	on Licence	on Licence	on Licence	on Licence	on Licence	Limitless	on Licence	Limitless	on Licence	on Licence
SourceCode	x	x	x	x	x	x	✓	✓	✓	x	x
Customizable	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
EaseOfUse	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Platform	Cloud	Cloud	Cloud	Cloud	All	All	All	Cloud/server	Cloud	Cloud	All
Scalability	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AvailabilityOfsupport	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AvailabilityOftrainings	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Popularity	P	P	VP	VP	VP	VP	VP	VP	P	P	P
Price/1000 users/year	\$6,840	Contact	\$2,000	\$5,148	Contact	\$9,000	0	\$2,199	0	Contact	Contact
upgrading cost	0	0	0	0	0	0	0	0	0	0	0
Deployment method	Cloud,SaaS,Web, Android, iOS	Cloud,SaaS,Web	Cloud,SaaS,Web, Android, iOS	Cloud,SaaS,Web, Android, iOS	Cloud,SaaS,Web, Android, iOS	Cloud,SaaS,Web, Windows, Mac, Android, iOS	Cloud,SaaS,Web, Windows, Mac, Android, iOS	Cloud,SaaS,Web, Android, iOS	Cloud,SaaS,Web	Cloud,SaaS,Web, Android, iOS	Cloud,SaaS,Web, Windows, Mac, Android, iOS
usefulness	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ranking	3	4	2	2	4	3	1	1	4	4	4

Stage 5: Doing Further Scrutiny by Obtaining Trial Copy of Top Software Packages (Platforms) and Conducting an Empirical Evaluation

Because the last two stages are concerned with negotiating contracts and purchasing the chosen platform(s), this project ended at stage five. This stage is concerned with practically experiencing the chosen platforms. Therefore, the researchers experimented with the provided demo and trial version of each platform, as well as their associated mobile apps to experience both the educator's as well as the learner's side of the application. It was realized that all the listed platforms are functionally suitable for micro-learning deployment in any environment including the HEIs in Tanzania. Thus, it is for the recipient institutions to make their decision based on their respective contexts. Specifically, the decisions should be guided by their respective financial, technical ability as well as policy environments.

DISCUSSION

The result of the evaluation process is the eleven platforms that are suitable and proposed for the HEIs in Tanzania. Because the situation in the institutions indicates a lack of key technical skills and limited budgets and infrastructure, the proposed platforms can be determined as best fit for the purpose as they possess the following attributes:

1. **They are functionally suitable:** As shown in Tables 1 and 3, the eleven platforms possess key features for micro-learning offering and management as described. They are inter-operable and useful for the purpose. Moreover, they allow a high number of concurrent users.
2. **They are financially affordable:** The list is comprised of two LMS-based platforms that are freely available. Likewise, the price for the rest of the platforms ranges from USD 2000 to USD 9000 per 1,000 users. The price range provides options for institutions to choose the product(s) that they can afford if they are interested in micro-learning-based platforms.
3. **They are technically customizable:** The ability to customize the platform is vital for institutions to adjust the appearance, reports, and functionalities of the systems to reflect their needs. The result reveals that it is possible to customize interfaces and key reports of the platforms to fit to the institutional demand depending on the contracts. Also, the source-code of some of the platforms such as Moodle is available for free. Hence, institutions can add relevant functionalities to the products.
4. **They are technically scalable:** With the number of students within universities increasing, it is possible to expand the capacity and functionalities of the platforms as per the contracts. Hence, institutions will not be forced to replace the existing platform to satisfy growing demands.
5. **They are technically supported:** To ensure the smooth running of the platforms, vendors are committed to offering support and training to their clients. The support ranges from online-based communities to e-mail support, as well as site visits. This is ideal for environments that lack key technical abilities.
6. **They are deployable and can be hosted on various platforms:** The results indicate that there are many ways that platforms can be hosted including cloud and software as a service (SaaS). Likewise, the services can be deployed using different methods including on web-based services, native, and web mobile apps. The HEIs have room to choose the right platforms for their respective educators and learners.

RECOMMENDED DEPLOYMENT OPTIONS

The deployment options offered by the platform vendors must allow for the institutions and stakeholders to make an informed decision. Hence, to leverage from the proposed platforms, depends on whether an institution can make the right choices on the following strategic deployment options:

a) In-house Development versus Outsourcing:

While it is logically viable to use applications developed in-house as they are supposedly developed to reflect the actual situation in the organization, the reality is that a majority of the HEIs in Tanzania rely on outsourced learning platforms such as Moodle (Mtebe & Kandoro, 2016; Nagunwa & Lwoga, 2012). The institutions lack the financial and technical capacity to manage in-house development. Therefore, while we call for long-term strategies on in-house production of solutions, for the time being, we recommend the outsourcing of micro-learning platforms until the institutional environment permits internal development.

b) Open Source versus Proprietary Platforms:

First, one of the key differences among the choices between open-source software (OSS) and proprietary software lies in the ability to own or access the source-code of the applications. Most of the proprietary platforms are closed; customers are not allowed to access source-codes. When one is in control of the source code, they can customize and extend the functionality of the application at will, provided there is a need and capacity to do so (Glynn et al., 2005; Hauge et al., 2010). Second, most of the proprietary software are not free, and the institutions need to purchase them before they can be deployed. Third, deployment of some of the proprietary software is not free, organizations pay for installation and training of such systems (Hauge et al., 2010). The fourth aspect of using proprietary software is the guarantee of a committed team to support the system, unlike free and open-source software that rely on the voluntary commitment of the supporters (Glynn et al., 2005). In this respect, institutions must conduct their detailed situation analysis concerning the capacity of the vendor to meet their commitment as far as support and training are concerned. The vendors of the proposed platforms are committed as indicated on their websites as supported by the testimonials of their supposed customers. Moodle is one example of open source software that has a strong online community for support, and almost everything you need to know about the platform is available and accessible online (Al-Ajlan & Zedan, 2008; Nagunwa & Lwoga, 2012).

Likewise, the decision to deploy open source should reflect the policies of the institutions, as well as those of the nation. For example, at MU it is strictly declared that “*When two types of software solutions exist (proprietary and open-source), choice of open-source software shall prevail; provided that the open source is proven stable, reliable and can internally be supported*”. Therefore, we recommend both Open Source and proprietary solutions appropriate for HEIs provided there are business cases for the choice made.

c) Native versus Web apps

Mobile applications fall into three categories: Native, hybrid, and web apps. The debate concerning native and web-apps is ongoing (Perera, 2019). Both types of application have pros and cons that need to be evaluated based on the situations at the specific institutions (Han Rebekah Wong, 2012; Joorabchi et al., 2013). We recommend conducting a situation analysis to understand the demography of the intended users. If an extreme majority (more than 90 %) of users are on one specific mobile operating system, and the institution's financial capacity is not able to support both types of the app, then we recommend a native solution of the dominant operating system. Otherwise, the web version can be deployed to serve users of different platforms. Another factor that needs to be considered is the availability of in-house skills to develop both native mobile apps and web-apps (Joorabchi et al., 2013).

d) In-premise versus Cloud services

The questions regarding where the deployment is done are equally important (Armbrust et al., 2010). The decision to deploy services using the organization's servers is influenced by the control over the platform and content, the availability of required infrastructure, skills, and budget (Mero & Mwangoka, 2014; Mtebe, 2013). When a deployment is done to the cloud, institutions are not concerned with the up-keep of the infrastructure (Mero & Mwangoka, 2014). Unfortunately, very few researchers including Mero & Mwangoka (2014), and, Mtebe (2013) have explored the use of cloud-based services in HEIs in Tanzania. Other criteria to be consulted are the national and institutional policies concerning cloud-based services. At this juncture, based on the state of the cloud-based services and the complications associated with on-premise deployment, we only recommend in-premise deployment over cloud in the institutions that have the necessary capacity including skills, budget and infrastructure. Our recommendations are consistent with the work done by Mero & Mwangoka (2014) and Mtebe & Raisamo (2014).

e) Micro-learning Platforms versus LMS

Earlier in the paper, the distinction between micro-learning and e-learning was made. Specifically, LMSs are developed for e-learning delivery (Machado & Tao, 2007). Therefore, both the philosophy and design of the features are tailored towards learning that uses macro-content either in blended or full e-learning forms (Machado & Tao, 2007). While we acknowledge the adjustments made to address micro-learning needs, more remains to be done. On the other hand, micro-learning platforms are specifically designed to deliver bite-sized, focused, and interactive content (Giurgiu, 2017). Unfortunately, the costs of LMS are comparably lower than of micro-learning platforms.

Therefore, if the situation at a particular institution permits, we recommend the procurement of micro-learning platforms over the LMS to leverage from the novelty of the platforms as compared to LMS. However, for the institutions that lack required resources including sufficient funds, the best option is to deploy LMS services such as Moodle because they are capable and customizable to fulfil the need of any institution. By integrating multimedia tools such as Articulate Storyline in the LMSs, it is possible to enhance LMS-based experiences.

CONCLUSION AND FUTURE WORK

This paper is being published at a time when HEIs are contemplating deploying micro-learning services. To date, no HEI in Tanzania has formally deployed micro-learning services or established research in micro-learning. In this paper, discussions concerning suitable platforms and deployment options for the HEIs in Tanzania are presented. The need for HEIs to make the right choices that reflect their context as stressed by the Critical Theory of Technology and the Design Science Research is recommended (Feenberg, 2005; Hevner et al., 2004). The findings and recommendations are relevant for educational stakeholders, who are responsible for decision making, and are affected by technologies to be deployed. We have recommended outsourcing micro-learning technologies until institutions possess the necessary resources and infrastructure. Similarly, the choice of open-source, as well as outsourcing services, should reflect national and institutional policies.

This paper contributes knowledge to the micro-learning deployment domain. Specifically, it provides a practical guide on how to evaluate platforms for specific purposes. Moreover, the compiled analysis of literature concerning the status of micro-learning research as well as the proposed list of micro-learning platforms and deployment options will help future researchers and practitioners intending to deploy micro-learning services.

Because this is the first work of its kind in micro-learning deployment in Tanzania, there are several issues that the researchers were not able to explore. Likewise, there are several limitations that the researchers were unable to mitigate. For example, this work relied on the account of people who have little experience with micro-learning usage and deployment. Also, the situation analysis was carried out in just four universities, which challenges the ability to generalize the findings. Therefore, other researchers should expand the scope of this work to include all other universities in Tanzania, Africa, and beyond. Moreover, there should be research tailored towards the impact, relevancy, and application of micro-learning in various sectors. We believe that the knowledge acquired from this work will inspire more work of the same kind to improve knowledge, possibilities, and opportunities associated with micro-learning services, concepts, and technologies.

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