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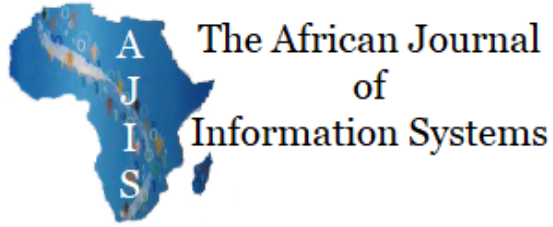
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Knowledge Sharing in the Higher Education Environment of Developing Economies – The Case of Eritrea

Research Paper

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ABSTRACT

This paper explores the prevailing higher education environment in Eritrea as a case study, with the aim of identifying factors influencing knowledge sharing and collaboration in the community both within and across the institutions. The research is based on qualitative data from semi-structured interviews with seven respondents: leaders and senior academicians representing all six higher education institutions (HEIs) in Eritrea. It investigates the environment from the socio-technical systems perspective with a holistic view of the institutional system rather than sub-systems. The results show that the HEIs have considerable levels of underutilized technology tools available in the community, and institutional guidelines to promote collaboration. However, the realities on ground show several challenges requiring coherence between the social and technical factors. This research, therefore, justifies the need to use the advanced capabilities of technologies to also augment non-technical factors for a unifying systemic solution to promote knowledge sharing at institutional level.

Keywords

Higher education, research, teaching-learning, knowledge sharing, technology infrastructure.

INTRODUCTION

Knowledge has many different definitions depending on the contexts in which the term is used. A systematic literature review in the higher education context presented a concise meaning of knowledge as “the theoretical or practical understanding of a subject that is acquired through education or practice” (Oxford Living Dictionaries, 2019, as cited in Yigzaw et al., 2019, p. 1). In the data and knowledge-based era (Yasir et al., 2017), knowledge as defined above is considered a very significant and key

resource for organizational success (Abdullah et al., 2008; Akhavan et al., 2015; Sohail & Daud, 2009). Hence the importance attributed to knowledge sharing (Haque et al., 2015).

The nature of knowledge sharing in higher education, however, is often perceived as less important as people perceive the task of research and publication as an individual's endeavor, in contrast to how industry or other organizations view knowledge sharing (Fullwood & Rowley, 2017; Kim & Ju, 2008). However, some believe (Fullwood et al., 2013) there is an implicit knowledge sharing culture in universities and that academics have a positive attitude towards knowledge sharing. In principle, knowledge sharing involves a multi-directional exchange of knowledge resources where the parties involved are both donors as well as receivers of knowledge, unlike knowledge transfer that involves a unidirectional flow of knowledge (Goh & Sandhu, 2014). Moreover, knowledge is considered as a factor of production along with land, labor, and capital in the new information era (Sohail & Daud, 2009). But, unlike these other types of resources, knowledge becomes a public good once shared and communicated (Cheng et al., 2009).

Knowledge resources in the context of higher education are those containing explicit knowledge that can be carried by a medium and shared among the higher education community over an information technology platform. It is also defined as containers that store the explicit knowledge for sharing purposes (Bo et al., 2006).

The tools and solution designed for knowledge sharing and communication in a specific geographical domain require a contextual approach that considers the prevailing realities. The extent of knowledge sharing practices needed to promote the creation and use of knowledge in higher education communities in the context of countries with developing economies are much larger when compared to countries with developed economies (Haque et al., 2015). This is supported by the fact that the people in higher education still need to be made aware of the benefits and be motivated for knowledge sharing. Moreover, a contextual approach is required in designing a knowledge sharing platform for higher education as the nature of knowledge creation and exchange is different from that in industry or other organizations (Fullwood & Rowley, 2017). The same is true for knowledge sharing platforms in countries with developing economies, as the environment and people engaged in knowledge sharing are at a different level of understanding and readiness to perceive the need and to act.

Fullwood and Rowley (2017) further mentioned that in higher education, personal beliefs and intentions are more influential on knowledge sharing than cultural influence, unlike in industry or other organizations. Ipe (2003) also emphasized that people are the core actors and sources of an organization who create, share, and leverage the use of knowledge, managing the whole process of interaction and utilization using technology tools and platforms. Therefore, it is understandable that the whole lifecycle of knowledge sharing, from creation through to re-generation of new knowledge, needs an enhancing environment to realize benefits more effectively for the institution. This core task of facilitating and enhancing the value of knowledge is carried out by an information technology-based knowledge sharing platform, which is designed to also address the non-technical factors influencing the dynamics of the process.

In general, higher education knowledge sharing and collaboration systems provide the platform for the community and promote quality research and contributions through viable interaction and teamwork. Since the last decade, the use of technology for facilitating knowledge sharing and exchange has been widely recognized. HEIs, as knowledge hubs, have been employing technology support for knowledge management (Abdullah et al., 2008; Alotaibi et al., 2014; Goh & Sandhu, 2014; Yigzaw et al., 2019).

The advancement of information technologies with expanding capabilities and features is a fundamental influence on knowledge sharing among academics and researchers in higher education.

Technology does not replace the role of the other non-technical factors, but it does augment the impacts of those influences in a way that benefits the institution and the researchers in sharing and exchanging knowledge. It further enables the possibility of explicating and codifying tacit knowledge in such a way that it can be interpreted by machines for further automation and AI applications; latest technologies are enabling us to codify and represent tacit knowledge in a machine-readable format, making digital communication between them easier and further augmenting their application using trending AI technologies (Chao & Xing, 2012; Singh, 2010; Yigzaw et al., 2019). Zhu et al. (2016) also presented in their research the advent of social media networks that are enabling tacit knowledge sharing in the last decade, providing additional tools for the inevitable need for knowledge sharing in institutions in general.

The core stakeholders in any knowledge sharing system are the knowledge workers; the people whose attitudes and intentions to adopt the enhancing technology platform determines the use of the system (Al-Busaidi & Olfman, 2017).

Research Questions

This research explores the Eritrean higher education environment for its technology availability, perceptions, and readiness to build an academic collaboration platform to meet its needs. In this context, the research attempts to address the following research question:

What factors influence knowledge sharing and collaboration in the higher education and research environments of countries with developing economies?

The above primary research question will be addressed through the following secondary questions, in the case of Eritrea:

- What is the state of technology availability and acceptance in the Eritrean HEIs?
- What is the perception of the Eritrean HEIs on technology and research with respect to teaching-learning?
- What is the status of the network and collaboration environment for research and teaching-learning among the higher education communities and the demand for it?
- What are the challenges curbing institutional will to develop their capabilities?

These secondary questions help to answer the primary research question by exploring the utilization of prevailing technologies as potential enabling factors for collaboration, the culture of technology use and research, the prevailing networking practices, and the institutional challenges respectively.

LITERATURE REVIEW

Overview of the Knowledge Sharing and Collaboration Systems

Knowledge is the core asset for the success and excellence of an organization in the era of technology and intelligence, but it requires dynamism. It requires to always be in a motion; sharing, transforming, evolving, inducing, communicating, and living in this continuous loop (Yigzaw et al., 2019). Al-Busaidi and Olfman (2017) also mentioned, “knowledge is a powerful resource that enables nations, organizations and individuals to achieve several benefits such as improved learning, innovation and decision-making” (p. 110). People engage knowledge resources in their endeavors while the dynamism

in the nature of the resources also involves many non-technical factors in addition to the technology tools that they can engage with. Cheng et al. (2009) described the importance of knowledge sharing (KS) as “once created, knowledge needs to be distributed quickly and widely because active knowledge is the ‘gem’ while idle knowledge is the ‘stone’” (p. 313). Their description justifies that sharing knowledge creates the value, and it is only through sharing that knowledge resource can have the sought impact and advantage.

Academic institutions are generally classified as knowledge-based organizations where knowledge serves as a core competence and justifies their excellence (Al-Kurdi, El-Haddadeh & Eldabi, 2018; Fullwood et al., 2013; Goh & Sandhu, 2014). They play a central role in entertaining this dynamic knowledge creation, sharing, and promoting the loop. These institutions have generic mandates that apply to almost all HEIs, as well as other contextual mandates related to their focus and geographically specific missions.

The aim of developing such a KS and collaboration system is to help HEIs achieve their goals regarding their excellence in teaching-learning and research (Goh & Sandhu, 2014; Kowch, 2013). In developed countries the sharing of knowledge and the creation of new knowledge is in the whole community of higher education and stakeholders, while the HEIs act as knowledge hubs rather than knowledge factories (Yigzaw et al. 2019). In contrast, in the developing countries the collaboration between HEIs and stakeholders in the community is not as strong as it should be. Hence, the HEIs end up being knowledge factories, producing and sharing knowledge to the wider community. Therefore, it makes good sense in the case of developing countries for the HEIs to take a good lead in developing knowledge sharing and collaboration systems that can benefit the community at large. In this regard, the HEIs are taking more prominent roles in managing knowledge sharing, and the creation, communication, and generation of new knowledge (Abdullah et al., 2008; Yigzaw et al., 2019). It is imperative that the system should promote initiatives for knowledge creation and sharing in the industry and amongst wider stakeholders in due course, and that HEIs should evolve into knowledge hubs like their counterparts in the developed world.

Knowledge Sharing and Collaboration Systems in Higher Education

During the last three decades, with the advent of the Internet and ever advancing information technologies, virtually all areas of society have been affected by the advancements in technology, including higher education (Nworie, 2006). It has become inevitable for higher education to transform their ways of teaching, doing research and communication, and for promoting further knowledge across the society. Enhancing the engagement of the higher education community, the advancement in information and communication technology (ICT) offers immense opportunities to promote the sharing of knowledge resources (KR) and communications between individual scholars and teams (Kim & Ju, 2008). The terms “information technology”, “information systems”, and “knowledge management systems” are commonly used when referring to knowledge sharing platforms or infrastructure (Al-Kurdi et al., 2018). However, as it has been shown in previous research, the use of advanced technologies alone to enhance educational or knowledge attainment does not prove efficient or it may, at times, be irrelevant. Use of enhancing technologies in education or knowledge exchange should be properly complemented with emotional, cognitive, and behavioral components to achieve optimal gains in education and knowledge sharing (Dunn & Kennedy, 2019).

Today, there are various technology enhanced systems that facilitate knowledge sharing and communication in the higher education environment, opening a new horizon for exploring and creating new knowledge. This emanates from the very nature of human beings where intelligence has no limit,

hence pushing the boundaries of existing knowledge further. This urge keeps the dynamics of knowledge creation moving and it is facilitated through sharing and communication. The platform, therefore, should be designed with due consideration of both technological and non-technical factors emanating from the very being of human nature.

Framework for Knowledge Sharing and Collaboration Platform

When knowledge resides in individual's minds and capabilities (Nonaka & Konno, 1998), possessing certain knowledge by itself does not give optimal advantage to a business organization or HEI. This acquired knowledge could have been shared or learned from others unless it emanated from a laboratory test. Besides, this knowledge in its static form does not induce results and advantages to the owner. It needs to be shared and transformed into action and manipulated with enhancing tools to add meaning and value. It needs to be shared and re-generated in the process of continuous interaction and deliberation, becoming organizational learning for the institution. In the same way, in the new role of HEIs as knowledge hubs (Yigzaw et al., 2019), the core leverage to the process of creating and carrying out knowledge is not just acquiring and storing it but sharing and communicating it widely and promoting new knowledge creation in the loop. For this reason, in HEIs knowledge sharing is not only encouraged but it is a crucial process that must be integrated into the academic culture and national responsibilities (Goh & Sandhu, 2014). Moreover, innovation as the key factor for institutional competitiveness is fostered through exploitation and exploration of ideas and findings, that are promoted through exchange of knowledge and collaboration (Long et al., 2012).

Experiences from Countries with Developing Economies

Studies show that the socioeconomic status of learners is directly correlated to their understanding of information technologies (Scherer & Siddiq, 2019), hence this poses additional challenges in the developing economies. The limited access to technology tools due to socioeconomic status of the education community requires a contextual approach to dealing with the platforms we design for knowledge sharing and collaboration among educational institutions. Due to such prevailing limitations and the fact that developing economies have huge yet untapped markets for ICT engagement in leveraging the required progress and development, researchers do not need justification for ICT enhancement in these domains (Avgerou, 2008). There is also a looming threat to knowledge sharing in that many organizations have concerns regarding the knowledge and trustworthiness of their partners in the domain (Ahmad & Daghfous, 2010; Jain et al., 2015), which emanate from issues of awareness on knowledge sharing and feelings of insecurity in opening-up their engagement. Woldegiorgis and Doevenspeck (2013) have highlighted that the role of higher education in Africa has gone through several historical experiences, which have been shaped by socio-political and economic contexts. These experiences have been common to most of the African countries, and this calls for a more contextually viable knowledge creation and sharing platform in addition to the common practices of HEIs in general.

Conceptual Framing of Factors Affecting the Knowledge Resources Sharing and Communication

Knowledge hoarding and reluctance to share knowledge have been identified as typical of human nature (Ahmad & Daghfous, 2010; Bock et al., 2005), and this needs to be addressed in the conceptual framework of developing knowledge sharing platforms. This understanding necessitates conscious design of the platforms in a way that addresses the insecurities and perceptions of the knowledge hosts (humans) and enhances security and confidence through an appropriate blend of technology and due awareness of the benefits of sharing knowledge to ensure a viable environment.

Many studies and practices have proven that technology alone does not promote knowledge resource sharing and collaboration in higher education systems. Many more factors play due roles in creating a conducive higher education environment for these ends. Referring to the range of factors that influence the sharing of knowledge and resources, researchers mention individual and institutional factors (Haque et al., 2015), culture, leadership, structure and technology (Dyson, 2004; Fullwood & Rowley, 2017), technology awareness, perception of technology tools usage and techno-culture development (McNeil, 2011; Yigzaw et al., 2019), reward systems (Dyson, 2004; Kim & Ju, 2008), and social identification and trust (Akhavan et al., 2015; Ho et al., 2011). Park and Lee (2014) also described a wider scenario with the relationship among the antecedent environmental factors mediated by dependence and trust, resulting in knowledge sharing and team performance. Research has also proven the positive relationship between knowledge sharing and whole set of factors including trust, communication, information systems, rewards, and organizational structure (Al-Alawi et al., 2007).

Moreover, Al-Salti et al. (2010) and Nurye et al. (2019) have presented the factors in categories as referred from different researchers. Their categories include knowledge-related factors (tacitness, complexity, causal ambiguity, codifiability), recipient related factors (learning intent, absorptive capacity, motivation), source related factors (capability, credibility, willingness, disseminative capacity), and relationship related factors (organizational distance, social ties). Nurye et al. (2019) further mentioned project related factors (novelty, staff turnover) and transfer mechanisms (formal & informal training). Others also refer to culture, motivation to share knowledge and the degree to which knowledge is recognized as a basis of power (Haque et al., 2015; Yasir et al., 2017).

This research explores the knowledge sharing environment of the Eritrean HEIs based on a socio-technical systems perspective derived from relevant studies (Baskerville et al., 2014; Beese et al., 2015; Lyytinen & Newman, 2008), that involves a holistic solution involving relationships and interactions between technology, data and people. Individually possessed knowledge in these knowledge institutions is organized and further enhanced through technological tools, institutional routines, practices, initiatives, and culture to effectively enrich the knowledgebase of the institutions and further build a wider knowledge community. Under this framework, the authors used the following theoretical assumptions. First, efficient knowledge sharing requires trust between the parties, clarity of inter-personal and inter-institutional roles, an enabling knowledge sharing culture, and a common language of understanding (Magnusson et al., 2014). Second, a common strategy, knowledge networks and technology tools (Baskerville & Dulipovici, 2006; Mele et al., 2010) are needed to enable efficient collaboration and sharing. Accordingly, this research presents the prevailing environment in Eritrean HEIs, identifying the factors affecting knowledge sharing and collaboration as well as the potential for systematically leveraging the existing endowments in view of the above presented background study.

RESEARCH METHOD

This research uses a qualitative methodology due to the exploratory nature of the study as perceptions and interpretations of views can better be expressed and collected through open and engaging interviews, without limiting the focus and domains of expression. Semi-structured interview questions were prepared to assess the higher education environment in Eritrea in the interest of developing a contextual knowledge resource sharing and collaboration platform. The participants of the interviews were seven institutional representatives, senior ranking academicians who are leading the institutions as deans or associate deans from all HEIs in Eritrea. Purposive sampling technique was used based on the respondents' institutional roles of examining knowledge sharing and realities from an institutional point of view. The participants' long tenure as senior lecturers and professors in the HEIs both in teaching-

learning and research was considered as an asset to get an understanding about teaching and research practices in the institutions. They all held institutional leadership positions over the previous one-to-two years during the period of the research, due to recent restructuring of all HEIs in the country. Hence, they are considered by the researchers as appropriate candidates for the theme of the research.

A 45 to 60-minute interview was conducted with each interviewee, with prior consent for the arrangement. Six interview questions were set in three major areas of focus to explore the prevailing environment in the higher education system: (a) available technology accessories and their utilization in the community, (b) the prevailing institutional culture for sharing and collaboration, the perceptions on research alongside teaching-learning, and research initiatives in the environment, (c) the prevailing network and institutional strategy for collaboration, challenges, and institutional readiness for research. The interviews were recorded by using a standard voice recording machine provided by the Eritrean National Higher Education and Research Institute and a backup voice recording using a smart phone. The recordings were later transcribed by the researcher. Although the native language of the respondents was Tigrigna, the interviews were conducted in English because the medium of instruction in Eritrean education is English, starting from junior school (Grade 7). Hence, all official communications at the HEIs are done only in the English language.

The interview data was analyzed using Atlas.ti (Version 8.4.20) qualitative data analysis tool, which helped to organize and analyze the interview data. Thematic analysis was used to analyze the qualitative data by categorizing the data into core and representative themes and processing them. Additionally, 42 references were also consulted for the literature review on the topic, and these were also analyzed using Zotero (Version 5.0.66) reference management system. A reference was also made from the previous research of the authors on a systematic literature review in the related area.

The interview sessions were designed to gather the detailed information required by engaging the institutions' leaders who are also long tenure professors and researchers representing all available HEIs. Moreover, the interview questions were structured to address the focus of the research from institutional and systemic point of view. This information was exhaustively gathered from purposefully selected representatives of each HEI. Institutional references and guidelines were also consulted to have a more complete picture of the data gathered through the interview from the institutional point of view. Therefore, the author believes that the data was reliable enough with no further need for data triangulation, as supported by Turner and Turner (2009), who suggest that getting a fuller picture of the data is one of the aims of triangulation.

The research investigates the HEIs' perceptions and readiness for research and collaboration and the prevailing challenges deterring the vision, from a socio-technical systems perspective. The qualitative evaluation is also supported by the official guidelines for postgraduate studies and research, research funding and promotion and general higher education (HE) guidelines that are provided by the National Higher Education and Research Institute (NHERI) governing the HE system in Eritrea. It is to be noted that the mission of the NHERI is to promote higher education and facilitate the advancement of all HEIs to be centers of excellence in terms of education, research, and public services. It is entrusted with the mandate to plan, evaluate, improve, and promote higher education and research sectors in Eritrea, referred in the National Commission for Higher Education (NCHE, 2017). This research covers all the six HEIs of Eritrea,¹ all which are public HEIs. Brief information of the HEIs is presented in Table 1.

¹ These six HEIs have emanated from the University of Asmara (the only HEI Eritrea had) during the years 2003 to 2006, to expand access to higher education in Eritrea as the number of high school leavers increased. Therefore, the University of Asmara gave way to these new HEIs and ceased academic operations by the end of 2006.

Table 1*Brief Information on the Eritrean HEIs in the Academic Year 2019-2020*

Serial No.	Name of HEI	Location from the Capital	Student Population	Diploma Programs	Bachelor's Degree Programs.
1	College of Science	23 km	2265	0	6
2	College of Engineering	23 km	2120	7	8
3	Asmara College of Education	In the city	120	0	1 (PGC)
4	Asmara College of Health Sciences and Medicine	In the city	1112	6	4
5	College of Arts and Social Sciences	115 km	1860	6	5
6	Hamelmalo Agricultural College	110 km	1060	5	7

Note. HEI = higher education institution.

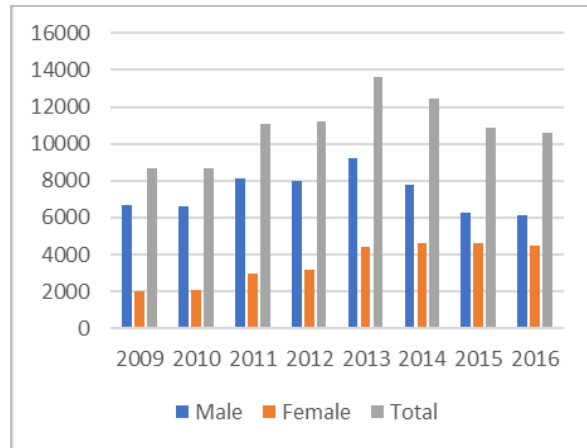
As shown in Table 1, the Eritrean HEIs are spatially located in different parts of the country, except for the two located in the capital Asmara. All entrants to those HEIs are also from all parts of the country, hence, they are provided with full accommodation and lodging free of cost as the government subsidizes the costs in full. As indicated in the national education policy document, education is free for all citizens at all levels of education. Moreover, all the HEIs offer both diploma and undergraduate degree programs, except the Asmara College of Education that offers currently only a one-year Postgraduate Certificate (PGC) in Pedagogy, as the result of the recent restructuring of the Eritrean HEIs.

Figure 1 reveals that an improving gender balance throughout the later years in all HEIs, which in a way reflects the gender equality policy of the government. The total number of students in all HEIs has been constantly above 10,500 in recent years including the current year's student population shown in Table 1, while the number of students joining bachelor's degrees and diplomas has been similar, as depicted on Figure 2. Prior to the establishment of these Eritrean HEIs in 2003, the only university in Eritrea, the University of Asmara, had a total student population of approximately 2000.

In general, the information in Figure 1 shows a considerable increase in the total student population at the higher education level with a maintained gender balance. These realities, therefore, justify the need for a knowledge resource sharing technology platform that can provide a richer resource pool and enhance the academic and research activities to meet the demands of the expanding higher education community and stakeholders. Therefore, this paper provides a new dimension to the theory considered in the research, arising from a developing economies context with the possibilities of leapfrogging new technology capabilities adoption.

Figure 1

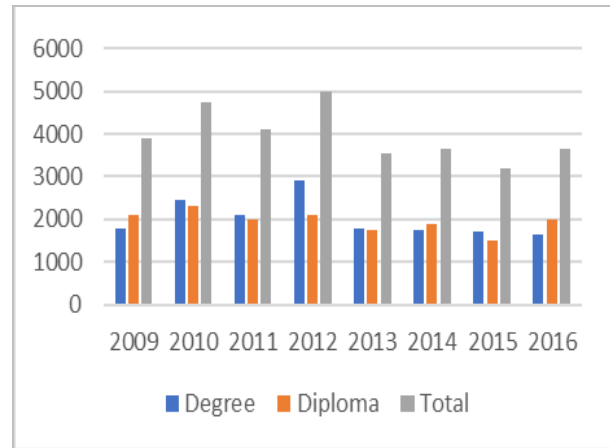
Student Population in all HEIs by Gender (2009 – 2016)



Note. HEI = higher education institution. Adapted from NCHE (2017).

Figure 2

New Degree and Diploma Entrants to all HEIs (2009 – 2016)



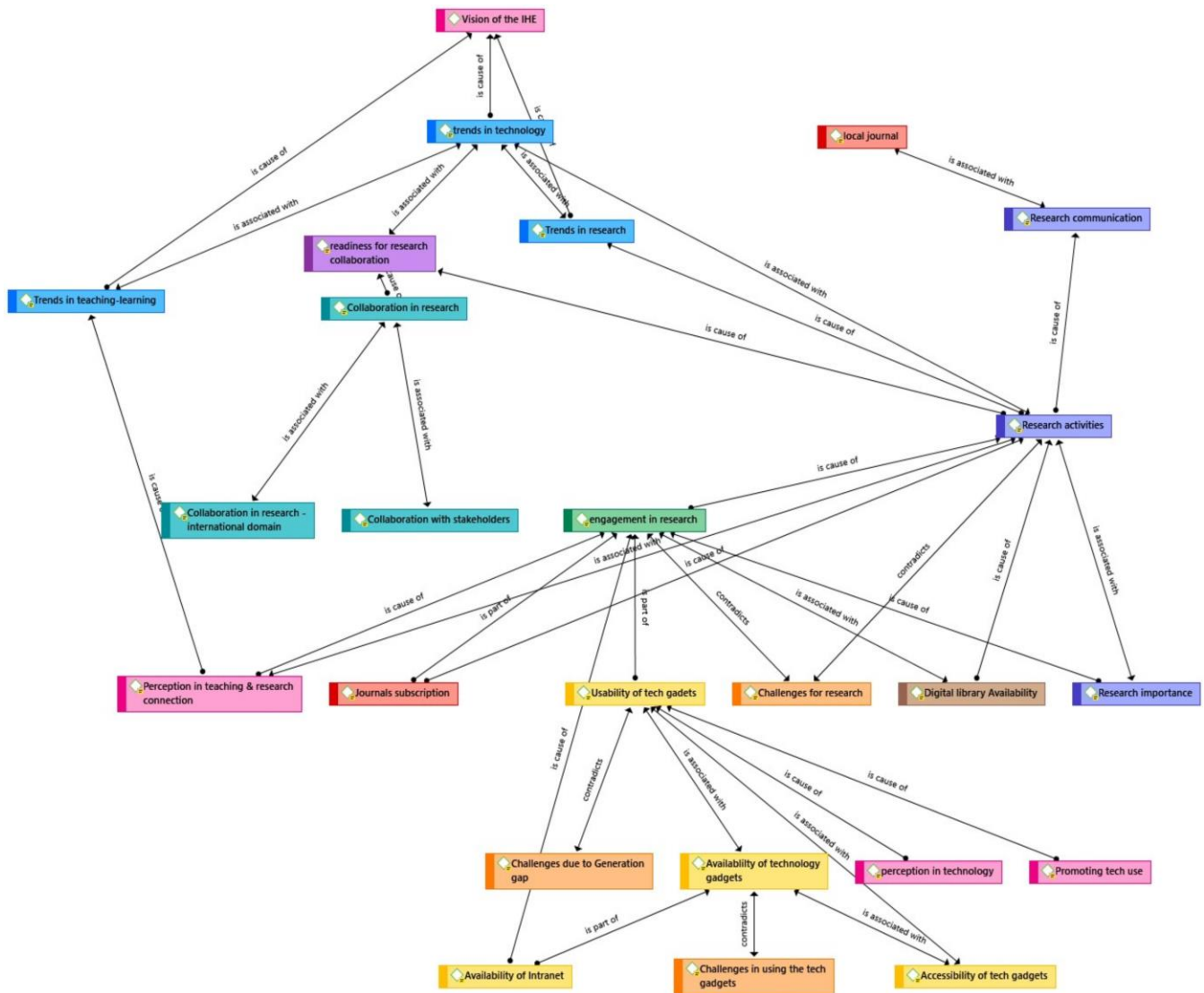
Note. HEI = higher education institution. Adapted from NCHE (2017).

ANALYSIS AND FINDINGS

Data collected from the semi-structured interviews has been categorized into codes as per the requirement of Atlas.ti, the qualitative data analysis tool used. These codes were then organized into code groups for ease of management and analysis of the data. The semantic linkages of the codes were then carefully designed and set on the analysis tool. Summary of related findings from the data for each code group were extracted from the tool as a report and this information was used for the analysis of the data. The semantic linkages of the codes are shown in Figure 3.

As referred on Figure 3, the qualitative data inserted into Atlas.ti was analyzed in terms of quotations of important findings, themes of these findings, categories, and conceptual domains. Each concept or quotation is coded in the system and the data codes are interconnected to each other according to their semantic linkages. Hence, the color codes show the categories under the different conceptual domains, where each color code represents themes under the same conceptual domain. At the ultimate level of the report, therefore, the overall vision of the HEIs, labelled in pink, is reflected by the trends in technology tools, research, and teaching-learning as the core focus of the research, labelled in blue. All the other conceptual domains are also color coded to reflect their affiliation with their respective code groups. The semantic linkages between the codes, therefore, help to infer the results from the findings as per the research questions, simplified and supported by the analysis tool.

Figure 3
Semantics of the Qualitative Data Codes (Atlas.ti Report)



The findings are described below in four themes related to each other and covering the relevant areas of the topic; each theme is connected to the corresponding theoretical assumption that the research is based on.

Technology Engagement and Acceptance: Tools and Networks

Almost all respondents in the interviews mentioned that their institutions have good enough provision of the basic ICT-technology tools accessible to all their academic faculties. These tools include desktops, laptops, smart phones, and LCD projectors. All of them confirmed that they do not have issues regarding the availability of technology gadgets supporting teaching-learning. While the level of utilization needs due attention, that is presented in this research as a challenge to the HEIs.

Regarding the availability of intranet infrastructure, however, most of the colleges do not have a viable network even within their campuses and across offices, despite the wide availability of standalone computing facilities in all offices and for all individual academic staff. It is also commonly mentioned by all respondents that their institutions lack usable Internet connectivity; it is so poor in many cases that it is regarded as “unusable”, hence limiting their possibilities to communicate and collaborate. In this regard a respondent mentioned “We have an Internet connectivity constraint. We don't have big-enough bandwidth. Therefore, if we like to review literature and design our research proposal, we don't get data. Lack of data and collaboration is also another issue that is coming.”

Despite the lack of enabling intranet facilities, all the HEIs have a digital library resource with offline digital materials, accessible to staff and students. In most cases they are connected to a bigger computer laboratory, or they are made accessible through Wi-Fi within a limited area of coverage, which extends accessibility of the resources on a constant basis. It was also noted that none of the HEIs have regular journal subscriptions, attributed to their unusable Internet connectivity. Expressing the severe limitation of the enabling infrastructure, one of the respondents said, “I have seven journals that I am entitled to access. Unfortunately, my full use of this is limited by the access to the Internet, which is very poor.”

As mentioned by the respondents, despite the wide availability of the technology gadgets in their institutions, they are all independent pieces of technology and only used for basic and routine processing applications for lecture preparation or organizing contents locally, hence, all are underutilized.

Perception of Knowledge Sharing in the Eritrean HEIs: Knowledge Sharing Culture, Common Understanding and Trust

Most of the respondents have mentioned that their institutions promote sharing knowledge and knowledge resources with each other and with stakeholders through inviting guest presentations or visiting and presenting at stakeholders' premises. This in all cases involves the physical presence of the guest at the host's premises and the delivery or sharing of knowledge. None of the respondents mentioned any use of a technology medium for sharing knowledge.

On the other hand, respondents indicated that despite the HEI's intent to promote sharing and collaboration in research, there is considerable evidence of reluctance to share knowledge by, mainly, researchers who do not want to expose their research activities to colleagues until they see the publications. It was mentioned by one of the respondents that “People are always repulsive. They want to work for themselves, and once published you can see on the Internet. But I think it is a problem; the habit is not there.”

This comes from feelings of insecurity, lack of trust and often misunderstanding of sharing in doing research. This might have developed due to the limited research resources and the urge for academic promotion that is connected to the number of publications one should have to get promoted, as many of the respondents share this justification. Others also attribute the issue to the lack of interconnecting technology infrastructure for utilizing resources available across institutions. In general, they tend to promote vertical collaborations with international partners to ease feelings of insecurity rather than horizontal collaborations with local HEIs.

Attitude and Perception on Research and Teaching-Learning Connection

At institutional level, it was mentioned that all HEIs intend to promote research alongside teaching-learning through different means as they perceive it is part of the institutions' endeavors. One of the

respondents said, “It is all about involving the community and making them as part of the teaching-learning. So, we mostly do community-based assessments to base our reflective teaching.”

It is also supported by another respondent as he described, “In our field in teacher education, teaching if it is not enquiry based and if you are not researching your own teaching, you might not be generating relevant evidence to support your methodology and pedagogy.”

It was unanimously supported by the respondents that the HEIs have a positive perception towards research in support of teaching-learning. This common perception was mentioned by one of the respondents as, “The professors, the lecturers and the senior staff, we feel that we should be engaged in research. So, as you know due to staff shortage, usually, priority was given to teaching in the previous years. Even from the National Commission for Higher Education, we are asked to engage in research.”

Attitude and Perception on Technology Support

All respondents mentioned that availability and efficient usability of technology facilities in their respective HEI would improve the teaching-learning and research endeavors and it would have vital impact on the overall performance of the institution. They referred to the core importance of having inter HEI connectivity and availability of usable internet connections, which can stimulate the need for sharing resources with peers, access to e-journals and publishing their research works.

As also shared by others, technology infrastructure is indispensable as it draws personal and institutional interests to promote research. In this regard, one of the respondents said:

Well, now I am appointed as associate dean for research and teaching, and I am working very hard that we overcome this problem so that we can have here in our campus the required technology infrastructure. It is imperative that we have a good Internet facility as well as intranet facilities and I believe that a lot of work has been done, at least in the intranet area, but this has been obstructed by administrative problems.

The HEIs confirmed that they are in continuous endeavors to acquire and deploy technology tools to develop the required infrastructure; better use of the technology gadgets already available and the provision of wider access to facilities like offline digital libraries and other e-resources, as access to the Internet is a bottleneck which is beyond the mandate and capacity of the individual institution to address.

In addition to the understanding by the respondents regarding the importance of technology support to research endeavors, other non-technical factors are also revealed as impeding the promotion of research engagements. One of the respondents has said it well as:

We cannot expect to be isolated the way we are isolated now. It is not only the physical infrastructure that is isolating us but also the cultural isolation, the tradition, the lack of regulation ... all sorts of things are waving on us, researchers.

Research Activities and the Prevailing HEIs Environment

HEIs do some research in collaboration with their corresponding local partners outside of academia, which may also impact the teaching-learning experience if this is based on the findings of the research. Some of the HEIs do community-based assessments as a basis for their reflective teaching as they often have a very supportive environment offered by their stakeholders. It was mentioned by most of the respondents that research on themes in the international domain or wider scope usually require serious engagement and funding, which have been a challenge. Hence, most of the research endeavors focus on

local problems and is done collaboratively with students and/or local stakeholders. However, some of the respondents described the importance of research collaboration across international research communities as some research themes have an issue of local critical mass, with only a few professionals who can potentially collaborate. Hence, international linkage and collaboration is crucial.

There was a local funding instrument to promote research, the Eritrean Research Fund (ERF). As referred in the National Board for Higher Education (NBHE, 2013), the ERF was established in June 2013 by the Government of the State of Eritrea, in collaboration with the NBHE to encourage research and development in all fields of study. The ERF's main goal was funding research on Eritrean studies. It was sought by respondents as a good instrument to promote collaborative research with local stakeholders, although it was halted due to some institutional reasons. Besides, all respondents mentioned that their respective institutions have been running assessments and research scoping workshops to identify relevant themes and put forward their agenda for research, enforcing their readiness and positive attitude towards research work, although many other factors have been impeding the initiatives. This was well described by a respondent as:

Now the intention is there, the theme is identified for each college, what kind of research themes should be there. And usually, I think, we are working on it. We have the blueprint; we know what to do. But I think on ground there are very few research works going on.

The respondents agreed that the HEI environment is urging for development of technology infrastructure as it is indispensable and deserves attention and establishment. Some of the HEIs already have a plan to promote that. One of the respondents mentioned the urge as:

Our HEIs need to go out of the existing chalk-and-talk method of teaching and go digital, and the institutions need to be ready to embrace and go for it. Besides, the leadership of the HEI need to be aware of the importance of technology infrastructure and should be ready to use it and motivate others to do so too.

However, it is mentioned by many of the respondents that the issue of availability and provision of technology is not always the reason for lagging, as the inconvenience for the older generation teaching faculty also poses a considerable challenge. They described this as “a generation gap” where these older generation tend to use chalk-and-talk methods of teaching and show reluctance to utilize technology in teaching-learning. In contrast, the young staff and learners would easily adapt and benefit from such technology capabilities for education. One respondent also said in this regard, “We are all seniors, and you can teach them only what you know. So, there is a gap in that matter as well.

In general, the respondents agree on the core principle behind the urge for technology infrastructure development in support of research. These include exiting from the chalk-and-talk method of teaching to go digital, institutions' readiness to embrace and go for it, awareness of the leadership of the HEI of the importance of technology infrastructure and readiness to use it and motivate others to do so too.

Attitudes and Intentions to Share and Collaborate

It was a common perception by the respondents that the academy is borderless, and an academician is by default international. So, the research collaboration should not be limited to a very localized area, or it should be multi-disciplinary with national or international participation, without boundaries. It was well described by one of the respondents saying:

Myself and my faculty are ready to do research, especially in the maternal and child health issues are cross-cutting. If you see the human lives from a life cycle perspective, it is from pregnancy

through to death. This is similar worldwide, and to every human being. So, we can work better, and we are very much willing to work with interested partners.

However, they pointed out that there should be a body to coordinate the research endeavors and plans, by motivating joint proposals for research and opening linkages for such activities, with appropriate funding solutions. It was confirmed that there have been good experiences in some of the colleges having collaboration in research with international linkage partners, especially at regional level and they do need to expand the domain and they are ready to do so, should the environment be improved and become engaging, with necessary facilities and motivation. One of the respondents mentioned the prevailing situation as:

We are lacking attitude and initiative, mainly the leadership. Here the role of leadership is very important. From the teachers, heads of departments, administration, and dean of colleges; leadership is decisive here. If the leadership is committed and collaborating in the interest of learners to empower them with this mindset, and then miracles can happen in a short period of time.

This was supported by many other respondents as they need motivation and room to do research and authorization for these needs to come from the institution's administration or respective higher authorities. Therefore, the overall attitude and perceptions of the stakeholders in the higher education community to share knowledge and collaborate also determines the efficient usability of the deployment of supporting technology infrastructure to serve this end.

Status of Collaboration Among HEIs: Clarity of Inter-Personal and Inter-Institutional Roles

Regarding the prevailing status of collaboration between the HEIs, respondents have mentioned that there is lack of coordination and leadership that would clearly set the roles of each party at personal and inter-institutional levels. The existing collaboration, if at all, comes from personal knowledge of the counter parts and not through a coordinated structure. One of the respondents mentioned that:

Despite the fact that research is the corner stone in any tertiary education development, it has to be strengthened and supported and there must be intercollege collaboration and information exchange, there is no enabling structure to do that. The existing collaboration, if at all, comes from personal knowledge of the counterpart, and not through a coordinated structure.

There are, however, some practices of doing research in collaboration between faculties of different HEIs on some multi-disciplinary projects from stakeholders or consultancy works of similar breadth, as mentioned by some of the respondents.

Some of the respondents commonly agree that the HEIs are self-sufficient in the availability of teaching staff, hence there is no urge to collaborate in teaching-learning. It was supported by all respondents that such inter-institution collaborations on teaching are very minimal. Lack of awareness and attitude are also other dimensions of the unavailability of inter-institution collaborations in higher education, as supported in earlier research by Yigzaw et al. (2019).

Despite the difficulties mentioned above, some of the respondents described that they have some international linkages and interested faculties are engaged in these activities. A respondent mentioned this, saying:

There is the issue of critical mass in order to work and collaborate on some specific research areas such as seismology and trying to collaborate with the other HEIs doesn't solve the issue, hence one can go international and collaborate even at higher level to address such issues.

Besides, collaboration with stakeholders is more common than across HEIs in many cases. Most of the institutions have several activities with their local stakeholders to base their research and communicate their findings to them. Collaboration within the HEI is, however, not a usual practice.

Challenges for Doing Research

There are several challenges mentioned by the respondents that are deterring the promotion of research in the HEIs. These challenges include:

- lack of stronger guidelines in practice and supporting structure to lead research works,
- excessive teaching loads,
- funding issues as the available funding is not paying honorarium to the researcher, hence they prefer to do consultancy business than research as it pays better,
- lack of data due to the lack of usable ICT networking infrastructure and the Internet, despite the wider availability of independent technology gadgets in the higher education community,
- instability of funding, with many research works ending up on the shelf due to unaffordable publication fee requirements or means for exploring wider opportunities, hence lower motivation for further research.

Hence, the current situation in the HEIs is not promoting research on the ground as it should, despite the general guidelines set in the official documents of the board of higher education. In this regard, a respondent suggested, "So, in solving the current challenges for doing research we need to change ... we need to have legal framework, it must be okay to do a research, we don't need to criminalize the research works."

In general, to prove that the research environment progresses as envisaged, the above-mentioned challenges need to be addressed including the need for a legal framework and coordination guidelines.

DISCUSSION

In this section, the primary research question, 'What factors influence knowledge sharing and collaboration in the higher education and research environments of developing economies?' is discussed in terms of its secondary questions:

- the technological availability and acceptance in the Eritrean HEIs (tools and networks)
- the perception of the Eritrean HEIs on technology and research along teaching-learning (culture, trust, and initiatives)
- the status of the collaboration environment for research and teaching-learning among the higher education communities (coordination and roles)
- prevailing challenges from a systemic and institutional view

Technology Endowment and Acceptance: Tools and Networks

As depicted in the findings of this research, all Eritrean HEIs have a considerable distribution of underutilized technology tools as standalone working gadgets. This situation, however, provides a fertile ground for deploying unifying systems to promote efficient utilization of these resources; a systemic

approach to promote a viable collaboration environment within and among the HEIs. Enhancing the usability of those gadgets through intranet infrastructure and appropriate systems would make a difference in the enhancement of the key missions of the HEIs for quality teaching-learning and research outputs, as also supported by Goh and Sandhu (2014). Besides, lack of a functioning Internet in the HEIs also poses a challenge, and this situation further justifies the need for interconnecting the HEIs using wide area networks and promoting at least inter-institutional knowledge resource sharing, until they resolve the Internet connectivity bottleneck at national level.

In a similar study focusing on instructional technologies application and perception in EHEIs, it was revealed that more than 75% of the respondents confirmed that they have available instructional technologies in their reach, and they use those facilities (Ghosh & Tewelde, 2017). The same study also showed the importance of instructional technologies in the performance of HEIs in general. The creation of knowledge and an attitude to share in practice within the institution in consideration were also rated above 4.25 in a 5-point scale. These findings indicate that the HEIs have considerable availability of technology tools for teaching-learning and the positive attitude of the faculties towards the acceptance of these tools, despite the absence of further enabling intranet infrastructure in most of the HEIs.

In general, the existing status of the HEIs in terms of technology tools endowment and potential for ensuring quality technology infrastructure can be considered as promoting knowledge sharing platforms and culture.

Perception on Technology Use, Research, and Knowledge Sharing: Culture, Communication, and Trust

The results show that the HEIs have guidelines that promote sharing and collaborative research endeavors, whereas individuals still have reluctance to openly share knowledge resources, especially in terms of publicizing their research activities. There is a need to promote awareness at the individual level and enhance sharing of knowledge at all levels. As also justified by the perspective from the socio-technical systems theory adapted in this research, the technical and social characteristics of the institutions are always interrelated in a healthy information system development, hence the interactions amongst each other need to be harmonized to enhance institutional capabilities.

Attitudes and Perceptions on Technology and Research

As shown in the findings, there is a common understanding at institutional level that teaching and research go hand in hand, and that teaching-learning needs to be based on evidence. Some of the HEIs base their teaching-learning on the community-based research and developed their curriculum accordingly. Whereas, other HEIs have limitations in adopting research as a support to teaching-learning for various reasons including dichotomy of the terms “research” and “teaching”, lack of good leadership to enforce research as part of the endeavors, excessive-engagement of faculties in teaching and lack of supporting instruments like funding and motivation.

With the inevitable connection between research and teaching, all HEIs have a common understanding that the availability and usability of technologies would enhance their overall performance and promote research along with teaching-learning. The desire for a functional intranet to facilitate the endeavors of the HEIs and wide-area technology infrastructure between them is drawn from the strong belief in sharing resources and promoting research to base their teaching-learning activities on. Hence the role of technology in enhancing the engagements at institutional and personal levels for quality teaching-learning and research outcomes is supported by all the respondents in different ways and expressions. In the prevailing context of the HEIs, where connectivity to the Internet and thus with international partners

and resources is severely crippled, developing intranet infrastructure and facilities with offline accessible resources is sought as an immediate and emergency option, while interconnection among HEIs at national level is equally in demand.

As revealed in a related study by Ghosh and Yigzaw (2020) on Eritrean HEIs, the attitudinal readiness of teachers for technology integration into higher education pedagogy was found to all be positive, closer to the higher rate in the scale provided, with very low deviation from the average. Those ratings included the teachers' perception on effectiveness, relevance, enjoyability, advantages and acceptance (excitedness) of the introduction of technology in teaching-learning and research. This shows the readiness of the higher education community for accepting technology as a support for the core mission of the HEIs, that is, teaching-learning and research.

In addition to the meager unifying technological systems support available in the HEIs, other non-technical factors are also impeding the endeavors to promote research and communicate results in the local higher education communities. These non-technical factors affecting the utilization of technology and promotion of research include culture, tradition, absence of guidelines and regulation on-the-ground for doing research also need appropriate attention and timely remedy to enhance the overall efficiency of the institutions. This can also be justified in connection to what Dunn and Kennedy (2019) mentioned as the use of technologies to achieve optimal gains in higher education knowledge sharing should be accompanied by emotional, cognitive, and behavioral components. It was also revealed that several research activities have been triggered by the local funding instrument, the Eritrean Research Fund, and they were only conducted because of this short-lived motivating instrument. In general, research activities have been directly associated to the availability of funding and for reasons of academic ranking promotion, as also indicated by Yigzaw et al. (2019).

Looking forward into the endeavors of the HEIs and considering people as the core actors in the process (Ipe, 2003), they all foresee the need for technological infrastructure support as the main enabling factor to promote research and communication among interested scholars. The absence of technology infrastructure in the local context is not a very common challenge in the international domain and the HEIs are now opting not to remain isolated from their counterparts in other countries. This perception and attitude towards research and technology support creates an imperative to introduce technology infrastructure within and across the HEIs, in the local domain to start with. The other reason behind the desire for technology infrastructure is the strong need to go out of the traditional chalk-and-talk method of education despite the looming generation gap between the mostly technophobic teachers and the tech-savvy student communities.

Attitudes and Intentions to Share and Collaborate

These initiatives of the HEIs, running extensive research scoping workshops and reaching out to local stakeholders illustrate the positive attitude and intentions of the HEIs towards working together with counterparts and stakeholders and sharing research results. It is also mentioned by Goh and Sandhu (2014) that knowledge sharing is at the core of the responsibility of higher education in the process of living up-to its expected role in the community and producing quality research and teaching-learning outcomes.

As also stressed by many of the respondents, leadership of the HEIs has a determining role to play. Unless the leadership of the institutions engages the young academics into the key endeavors and revolutionize the way the institutions perform in this age of technology and a boundaryless education environment, the transition to modern teaching-learning and research may be delayed even further. This

may leave the desire for change under threat despite the institutional positive intentions, attitudes, and perceptions. Therefore, the leadership is expected to play its role in the foreseen transition, thereby promoting collaboration and knowledge sharing within and among the HEIs.

Status of Collaboration Among HEIs: Inter-Personal and Inter-Institutional Roles

Collaboration among HEIs is usually coordinated by a responsible body that can guide and facilitate the interconnection. However, this has been a challenge in the case of Eritrean HEIs. The absence of an adequately supportive and coordinating institution and interconnecting technology infrastructure has left the HEIs unable to promote collaboration as they should.

It was also mentioned that reluctance to share knowledge has been considered as typical human nature (Ahmad & Daghfous, 2010; Bock et al, 2005). The rare initiatives seen have mostly been established through personal knowledge of the partners from other institutions and not organized formally through their institutions. This creates an interesting problem for this research to find ways to urge the leadership to become agents for change, paving the way for organized means of collaboration and sharing, as also supported by Dyson (2004) and Fullwood and Rowley (2017). Organizing awareness campaigns and exposure visits for the leadership, while promoting younger scholars to the higher HEI positions would ease the challenge for the need for collaboration among the HEIs. Therefore, it is imperative to reinforce the internal linkages between the institutions as well as external linkages in order to promote collaboration and enhance the quality of the HEIs.

Challenges for Doing Research and Collaboration: From the Systemic and Institutional View

As referred in the NBHE (2010), the NHERI has established a research guideline document in October 2010 for all the HEIs in Eritrea that promotes research activities by all faculty members of the HEIs. It provides clear responsibilities of HEIs in support of motivating their respective faculty members to run research activities alongside teaching-learning by providing them with necessary resources. These research guidelines clearly state the importance of research in the higher education community and has provided the list of responsibilities that HEIs should follow. They urge every HEI to recognize and motivate every research endeavor by its faculty members. However, the reality on the ground shows several challenges that are local to the institutions and external to them.

Despite the clearly set guidelines, the HEIs have mentioned various challenges in promoting and conducting research. This indicates that the issue is not due to lack of guidelines, but rather due to the prevailing environment that lacks the required resources and a lack of empowerment in the guidelines to support the HEIs in practice.

Among the many challenges shown in the findings of this research, excessive teaching loads of faculties and instability or lack of funding are the highest deterrents for promoting research in the HEIs, which need to be addressed at institutional levels. Absence of a legal framework for doing research is also another challenge that the scholars face, as doing research has often been “not okay” as described by respondents when it may be regarded as a threat for excessive information security needs. Having a clear and legal research guideline would provide relief for scholars and provide a basis for their research work. The other challenge is the absence of an intranet within the HEIs or an interconnecting technology infrastructure between them. It is unanimously understood, therefore, that the need to introduce and extend intranet infrastructure and services as well as interconnecting technologies across HEIs are of utmost importance. The deployment needs to take place in a planned, step-by-step, and contextual

approach to build a technology culture in the community as also mentioned by Dyson (2004); Fullwood and Rowley (2017); McNeil (2011) and Yigzaw et al. (2019).

Findings from this research reveal that young scholars who have been exposed to advanced technology-supported education systems in the universities where they have been sent for their postgraduate studies in developed countries are core assets to treasure. They can be leaders in embracing and leading the new technology engagement of these HEIs and help the successful deployment and utilization of the new development. It is referred in the Higher Education in Eritrea, Annual bulletin (2017) that a total of 503 scholars from the HEIs have been sent to universities abroad for their Masters' degree (445) and PhD degree (58) studies, as there are no postgraduate programs provided by the local HEIs, except in a few selected areas but these did not survive.

The core engine for technology development in the Eritrean HEIs is the clear urge that they need to base their communication and collaboration on technology infrastructure, both internal to the institutions and across the institutions at national level. The readiness for technology supported development and the promotion of research alongside teaching-learning is clearly confirmed at the institutional levels. However, the prevailing culture and traditional ways of teaching-learning do pose challenges that deserve attention and an appropriate approach to address and transform them.

In general, from the institutional viewpoint, the HEIs have identified the challenges in two categories; those that are local to the HEI's internal affairs and those that are beyond the local domain of the HEI to address. It is also noted that addressing all those challenges and coordinating solutions should entail a unifying systemic approach, augmenting individual and institutional collaboration and sharing the goal of enriching the knowledge base of the higher education community.

CONCLUSION

The higher education system in Eritrea forms a good example of such systems in developing countries, mainly in sub-Saharan Africa, where the teaching-learning tradition in most countries is yet to be revamped and transformed to modern methods. Their state of readiness and the urge for technology enhanced transformation may vary, but the challenges are mostly similar. The core means for transformation is the readiness for transformation at institutional level and the perceptions of the HEIs community. The case of Eritrea shows that the HEIs are ready for transformation and demonstrate a desire for intervention mostly at institutional and national levels to facilitate the need for transformation. Technology enhanced transformation will provide immense opportunities for collaboration and knowledge sharing through viable systems within and among institutions as the techno-culture also grows.

The institutions possess the imperative attitude and perception regarding the need for technology support for research and its connection to teaching-learning. The extensive research scoping workshops and initiatives the HEIs showed to identify research themes for each HEI have been positive indications of the desire for promoting research and the need for technology infrastructure and services support. Having the main challenges identified in the strategy to address the urge, it is the researchers' recommendation that the prevailing facts and situation need a contextual approach to plan and develop the required technology-based solution to enhance the HEIs' performance in teaching-learning and research. Contextualizing the challenges and devising solutions accordingly would also provide a good lesson to counterparts in the developing world. It was also mentioned by Woldegiorgis and Doevenspeck (2013) that historical experiences, mainly shaped by socio political and economic

situations due to a long colonial past, are the reason for considering a contextual approach to prevailing contextual challenges in the case of African higher education systems.

The increasing number of young scholars in the Eritrean HEIs who have been exposed to advanced technology-based education systems in the developed world during their postgraduate studies, can be good leverage for transformation of the higher education system in Eritrea. These scholars can be the agents and leaders of transformation in teaching-learning and research, as well as in promoting a receptive higher education environment for new technologies and knowledge sharing systems. Hence, this research reveals a good deal of information to support authorities of higher education and urge them to aim at holistic solutions based on the prevailing context and act accordingly in support of the HEIs' initiatives in their overall quality enhancement endeavors.

In general, this research opens a timely dimension for the HEIs in developing economies to act, in solving the contextual challenges with contextual and holistic solutions converging towards viable institutional sharing and collaboration environments. Off-the-shelf technology solutions do not usually satisfy higher education and research environments in developing countries. Therefore, this research recommends overhauling the prevailing contextual challenges with an appropriate orientation towards building a coherent system that strengthens institutional capabilities with seamless interconnectivity with the wider community of higher education and research. The lesson to share is the focus on a unifying socio-technical systems solution for the community, based on advancing the capabilities of technologies to augment non-technical factors, rather than trying to address issues independently at the sub-system level. Most importantly, getting the resources saved from technology augmentation into future utilization in a new dimension for the community through enhancing their capabilities with knowledge sharing and collaboration systems, rather than laying them off because of automation and digitization. This also opens a new dimension in the socio-technical systems perspective in the context of developing economies, where the lay-off of resources could be a potential concern. Human resources require due attention along with technology enhancement in further strengthening institutional capabilities; hence, further research is needed here.

IMPLICATIONS FOR RESEARCH

This research shows the prevailing status of the Eritrean HEIs, regarding their technology gadgets endowment and inter-networking, the perceptions, trust, and culture of the institutions towards technology, interpersonal connections, and research activities from the organizational point of view. Therefore, the outputs of this research have implications for further research in developing a contextually fit technology supported solution to enhance the needs of the institutions to collaborate and share the available knowledge resources. It further invites research to address the challenges identified in this research in the coherence between technological, cultural and policy fronts towards institutional capabilities development.

The findings of this research also suggest that there is a room for leapfrogging technology enhanced infrastructure support for collaboration. Therefore, it opens wider opportunities for further research to carefully design technology support solutions, seamlessly integrate these in the community with appropriate interventions for the prevailing non-technical factors. This creates further opportunities for research on how to efficiently re-utilize the released human intelligence and other resources due to automation and artificial intelligence trends in technology development, especially in the case of developing economies where leapfrogging is a possibility in technology adoption.

IMPLICATIONS FOR PRACTICE

This research contains various lessons that could also be useful for other developing economies for initiating their own contextual exploration and development of solutions. The culture of competition within colleagues of the same institution or even across the local institutions has been an overwhelming experience as the study revealed, while the research and education community is all about borderless collaboration. The results show that sharing resources and knowledge benefits all parties, by providing a wider pool of tools and resources, rather than the other way around as is often perceived.

The same resource can serve different parties for different requirements, having a multiplier effect on its use. In this regard, this research encourages the promotion of collaboration and sharing of knowledge resources across institutions of higher education, relevant stakeholders, and the public. The limitations of ICT support infrastructure and a lack of its awareness could be the reason for an attitude of insecurity and internal competition, which could be similar in many developing countries. Therefore, the findings in this research could provide a reference point for developing contextual studies in their respective higher education and research environments.

This research identifies key non-technical factors that have a considerable effect in enhancing the higher education environment with the necessary technology enhanced collaboration and knowledge sharing support. These factors are, of course, not the only factors that could manifest in other developing economies. Therefore, lessons learned from similar studies in different countries would benefit all parties in building more contextually feasible technology-enhanced solutions, that consider easing and eventually addressing the non-technical factors as well and drive higher education and research communities towards state-of-the-art solutions.

REFERENCES

- Abdullah, R., Selamat, M. H., Jaafar, A., Abdullah, S., & Sura, S. (2008). An empirical study of knowledge management system implementation in public higher learning institution. *International Journal of Computer Science and Network Security*, 8(1), 281–290.
- Ahmad, N., & Daghfous, A. (2010). Knowledge sharing through inter-organizational knowledge networks: Challenges and opportunities in the United Arab Emirates. *European Business Review*, 22(2), 153–174. <https://doi.org/10.1108/09555341011023506>
- Akhavan, P., Hosseini, S. M., Abbasi, M., & Manteghi, M. (2015). Knowledge-sharing determinants, behaviors, and innovative work behaviors: An integrated theoretical view and empirical examination. *Aslib Journal of Information Management*, 67(5), 562–591. <https://doi.org/10.1108/AJIM-02-2015-0018>
- Al-Alawi, A. I., Al-Marzooqi, N. Y., & Mohammed, Y. F. (2007). Organizational culture and knowledge sharing: Critical success factors. *Journal of Knowledge Management*, 11(2), 22–42. <https://doi.org/10.1108/13673270710738898>
- Al-Busaidi, K. A., & Olfman, L. (2017). Knowledge sharing through inter-organizational knowledge sharing systems. *VINE Journal of Information and Knowledge Management Systems*, 47(1), 110–136. <https://doi.org/10.1108/VJIKMS-05-2016-0019>
- Al-Kurdi, O., El-Haddadeh, R., & Eldabi, T. (2018). Knowledge sharing in higher education institutions: A systematic review. *Journal of Enterprise Information Management*, 31(2), 226–246. <https://doi.org/10.1108/JEIM-09-2017-0129>
- Alotaibi, H., Crowder, R., & Wills, G. (2014). Investigating factors for e-knowledge sharing amongst academic staffs. In C. Granja, & D. Malzahn, (Eds). *Proceedings of the 6th international conference on information, process, and knowledge management* (pp. 58–61).
- Al-Salti, Z., Hackney, R., & Özkan, S. (2010). Factors impacting knowledge transfer success in information systems outsourcing. In *Proceedings of the European, Mediterranean and Middle Eastern conference on information systems*. <https://squ.pure.elsevier.com/en/publications/factors-impacting-knowledge-transfer-success-in-information-systems>

- Avgerou, C. (2008). Information systems in developing countries: A critical research review. *Journal of Information Technology*, 23, 133–146. <https://doi.org/10.1057/palgrave.jit.2000136>
- Baskerville R., Davison R., Kaul M., & Wong L. (2014). Designing artifacts for systems of information. In B. Doolin, E. Lamprou, N. Mitev & L. McLeod (Eds), *Information systems and global assemblages. (Re)configuring actors, artefacts, organizations*, (pp. 446). Springer. https://doi.org/10.1007/978-3-662-45708-5_15
- Baskerville, R., & Dulipovici, A. (2006). The theoretical foundation of knowledge management. *Knowledge Management Research and Practice*, 4, 83–105. <https://doi.org/10.1057/palgrave.kmrp.8500090>
- Beese, J., Haki, K., & Aier, S. (2015). On the conceptualization of information systems as socio-technical phenomena in simulation-based research. *ICIS 2015 Proceedings*. Association for Information Systems.
- Bo, G. M., Luccini, A., & Dicerto, M. (2006). Knowledge resources management and sharing in the TENCompetence project. *Proceedings of International Workshop in Learning Networks for Lifelong Competence Development, TENCompetence Conference*, Sofia, Bulgaria.
- Bock, G. W., Zmud, R. W., Kim, Y. G., & Lee, J. N. (2005). Behavioral intention formation in knowledge sharing: Examining the roles of extrinsic motivators, social-psychological forces, and organizational climate. *MIS Quarterly*, 29(1), 87–111. <https://doi.org/10.2307/25148669>
- Chao, L. Zhang, Y., & Xing, C. (2012). The semantic web-based collaborative knowledge management. In Huei-Tse, H. (Ed), *New research on knowledge management technology*, (pp. 87–99). InTech.
- Cheng, M. Y., Ho, J. S. Y., & Lau, P. M. (2009). Knowledge sharing in academic institutions: A study of Multimedia University Malaysia. *Electronic Journal of Knowledge Management*, 7(3), 313–324.
- Dunn, T. J., & Kennedy, M. (2019). Technology enhanced learning in higher education: Motivations, engagement and academic achievement. *Computers & Education*, 137, 104–113. <https://doi.org/10.1016/j.compedu.2019.04.004>
- Dyson, L. (2004). Barriers to sharing and creating knowledge in higher education. In *Innovations through information technology* (Vol.1 & 2, pp. 33–36). Idea Group Publishing.
- Fullwood, R., Rowley, J., & Delbridge, R. (2013). Knowledge sharing amongst academics in UK universities, *Journal of Knowledge Management*, 17(1), 123–136. <https://doi.org/10.1108/13673271311300831>
- Fullwood, R., & Rowley, J. (2017). An investigation of factors affecting knowledge sharing amongst UK academics, *Journal of Knowledge Management*, 21(5), 1254–1271. <https://doi.org/10.1108/JKM-07-2016-0274>
- Ghosh, S., & Tewelde, S. (2017). Application of instructional technology in promoting KAP in a new learning paradigm in Eritrean higher education. https://www.researchgate.net/publication/328496359_Application_of_Instructional_Technology_in_promoting_KAP_in_a_new_learning_paradigm_in_Eritrean_Higher_Education
- Ghosh, S., & Yigzaw, S. (2020). Teachers' readiness for TPC integration in higher education: A case study in Eritrea. *i-Manager's Journal of Educational Technology (JET)*, 16(4), 1–8. <https://doi.org/10.26634/jet.16.4.16674>
- Goh, S. K., & Sandhu, M. S. (2014). The influence of trust on knowledge donating and collecting: An examination of Malaysian universities. *International Education Studies*, 7(2), 125–136. <http://dx.doi.org/10.5539/ies.v7n2p125>
- Haque, M. M., Ahlan, A. R., & Razi, M. J. M. (2015). Factors affecting knowledge sharing on innovation in the higher education institutions (HEIs). *ARNP Journal of Engineering and Applied Sciences*, 10(23), 18200–18210.
- Ho, L., Kuo, T., & Lin, B. (2012). How social identification and trust influence organizational online knowledge sharing. *Internet Research*, 22(1), 4–28. <https://doi.org/10.1108/10662241211199942>
- Ipe, M. (2003). Knowledge sharing in organizations: A conceptual framework. *Human Resource Development Review*, 2(4), 337–359. <https://doi.org/10.1177/1534484303257985>
- Jain, K. K., Sandhu, M. S., & Goh, S. K. (2015). Organizational climate, trust and knowledge sharing: Insights from Malaysia. *Journal of Asia Business Studies*, 9(1), 54–77. <https://doi.org/10.1108/JABS-07-2013-0040>
- Kim, S., & Ju, B. (2008). An analysis of faculty perceptions: Attitudes toward knowledge sharing and collaboration in an academic institution. *Library & Information Science Research*, 30(4), 282–290.
- Kowch, E. (2013). Towards leading diverse, adaptable and “smarter” organizations that learn. In J. Lewis, A. Green & D. Surry (Eds.), *Technology as a tool for diversity leadership: Implementation and future implications* (pp. 1–34). IGI Global.

- Long, C. S., Ghazali, N. I., Rasli, A., & Heng, L. H. (2012). The relationship between knowledge sharing culture and innovation capability: A proposed model. *Journal of Basic and Applied Scientific Research*, 2(9), 9558–9562.
- Lyytinen, K., & Newman, M. (2008). Explaining information systems change: A punctuated socio-technical change model. *European Journal of Information Systems* 17(6), 589–613.
- Magnusson, J., Nilsson, A., & Valentin, K. (2014). Knowledge management theory in interorganizational settings. In *The fifth European conference on organizational Knowledge, Learning and Capabilities* (Article 103). https://warwick.ac.uk/fac/soc/wbs/conf/olkc/archive/oklc5/papers/f-3_valentin.pdf.
- McNeil, R. (2011). Application of knowledge management for sustainable development in institutions of higher education. *Dalhousie Journal of Interdisciplinary Management*, 7, 1–13. <http://hdl.handle.net/10222/13825>
- Mele C., Pels J., & Polese F. (2010). A brief review of systems theories and their managerial applications. *Service Science* 2(1–2), 126–135.
- National Board for Higher Education (2013). *Eritrean research fund operational manual* [Manual].
- National Board for Higher Education (2010). *Research guideline for IHE in Eritrea* [Report].
- National Commission for Higher Education (2017). *Higher education in Eritrea: NCHE building the future* [Annual bulletin].
- Nonaka, I., & Konno, N. (1998). The concept of ‘Ba.’ Building a foundation for knowledge creation. *California Management Review*, 40(3), 40–54. <https://doi.org/10.2307/41165942>
- Nurye, S. A., Molla, A., & Desta, T. A. (2019). Factors influencing knowledge transfer in onshore information systems outsourcing in Ethiopia. *The African Journal of Information Systems*, 11(4), 279–298.
- Nworie, J. (2006). Academic technology in higher education: Organizing for better results, *Journal of Educational Technology Systems*, 35(1), 105–128. <https://doi.org/10.2190/D573-8274-660N-4032>
- Park, J. G., & Lee, J. (2014). Knowledge sharing in information systems development projects: Explicating the role of dependence and trust. *International Journal of Project Management*, 32(1), 153–165.
- Scherer, R., & Siddiq, F. (2019). The relation between students’ socioeconomic status and ICT literacy: Findings from a meta-analysis. *Computers & Education*, 138, 13–32.
- Singh, A. (2010). Knowledge based expert systems in organization of higher learning. In *ICWET '10: Proceedings of the international conference and workshop on emerging trends in technology* (pp. 571–574). Association for Computing Machinery. <https://doi.org/10.1145/1741906.1742037>
- Sohail, S. M., & Daud, S. (2009). Knowledge sharing in higher education institutions: Perspectives from Malaysia. *VINE*, 39(2), 125–142. <https://doi.org/10.1108/03055720910988841>
- Turner, P., & Turner, S. (2009). Triangulation in practice. *Virtual Reality* 13, 171–181. <https://doi.org/10.1007/s10055-009-0117-2>
- Woldegiorgis, E. T., & Doevenspeck, M. (2013). The changing role of higher education in Africa: A historical reflection. *Higher Education Studies*, 3(6), 35–45. <http://doi.org/10.5539/hes.v3n6p35>
- Yasir, M., Majid, A., & Yasir, M. (2017). Nexus of knowledge-management enablers, trust and knowledge-sharing in research universities. *Journal of Applied Research in Higher Education*, 9(3), 424–438. <https://doi.org/10.1108/JARHE-10-2016-0068>
- Yigzaw, S. T., Jormanainen, I., & Tukiainen, M. (2019). Trends in the role of ICT in higher education knowledge management systems: A systematic literature review. In M. A. C. González, F. J. R. Sedano, C. F. Llamas, & F. J. García-Peñalvo (Eds.), *TEEM'19: Proceedings of the seventh international conference on technological ecosystems for enhancing multiculturalism* (pp. 473–480). Association for Computing Machinery. <https://doi.org/10.1145/3362789.3362805>
- Zhu, H.-M., Zhang, S. T., & Jin, Z. (2016). The effects of online social networks on tacit knowledge transmission. *Physica A: Statistical Mechanics and its Applications*, 441, 192–198. <https://doi.org/10.1016/j.physa.2015.08.044>