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Blended learning in the wake of ICT infrastructure deficiencies: The case of a Zimbabwean University

Research Paper

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ABSTRACT

In the wake of debates between actors in the Zimbabwean higher education sector about the effectiveness of e-learning models, it is important to investigate the effectiveness of using blended learning at a time when infrastructure challenges are disrupting ICT access. This paper aims to address this quest for a deeper understanding by investigating students' perceptions of blended learning at a selected Zimbabwean university. Twelve in-depth interviews were conducted with students from a Zimbabwean university that employs blended learning under an interpretivist paradigm. Vygotsky's Zone of Proximal Development (ZPD) was used for conceptualising students' cognitive development and Engestrom's (2003) Third-generation Activity Theory(AT) as a framework for assessing the home and the university activity systems that characterise blended learning. Findings show that blended learning can be implemented in universities with poor ICT infrastructure since asynchronous blended learning using learning management systems such as Moodle allows content to be downloaded from connected areas for offline study. The study contributes to policies on the implementation of blended learning in institutions of higher learning by showing how it enables cognitive development in the ZPD.

Keywords: e-learning, Blended learning, developing countries, Infrastructure

INTRODUCTION

Traditional face-to-face lecturing has been the norm in higher education teaching and learning, but nowadays it has been described as a passive teaching mode,(Okaz, 2015). Learners feel that face-to-face learning is quite boring and does not allow for collaborative learning which is a challenge to the learners and their lecturers (Islam, Beer and Slack, 2015).Islam, Beer and Slack, 2015). Blended learning (BL) now then comes into play as it combines classroom teaching with online learning. It also encourages both individual and group learning activities and promotes improved educational results (Garrison & Kanuka 2004).

Previous research show that there is a growing body of socio-technological literature that addresses e-learning issues relating to blended learning (Daskan & Yildiz, 2020; Root et al.,

2018; Starr-Glass, 2014, Topping et al., 2022). This work has generally focused on developed countries that have adequate infrastructure. The Covid 19 pandemic compelled developing countries to adopt e-learning and made it necessary for educationists to explore the usefulness of blended learning in developing countries that inadequate ICT infrastructure. Despite the challenges such as intermittent power outages, lack of access to ICT devices, and poor internet connectivity, the post-Covid era has seen a propensity to employ blended learning in higher education institutions(Bordoloi, 2020; Muhuro and Kang'ethe., 2020; Fauzia et al., 2020).

Blended learning, also known as hybrid learning can be defined as a combination of e-learning with traditional face-to-face instruction in a way that is carefully planned and in a pedagogically useful way. It is not a mere combination of online with face-to-face but a replacement of face-to-face time with online activity or the other way round (Niemiec & Otte 2005). Blended learning is common in the industrialised world, with about 79% of public universities in the US reported to be using BL. The situation is however different in the developing world where there is unreliable ICT infrastructure. This impedes its use in an andragogically and pedagogically viable manner.

The use of various models of blended learning has been inspired by the need emanating from negative issues such as the need to reduce the time and cost of travel to school, lack of instructional space, academic staff shortages, and recently the Covid-19 pandemic. As universities engaged in BL in the post-Covid era in countries such as Zimbabwe, the Higher Education(HE) regulatory bodies expressed concern with the effectiveness of BL compared to face-to-face-only instructional methods. The absence of empirical evidence on the effectiveness of BL caused concern among HE regulatory bodies. The regulators are worried about technological deficiencies, power outages, the availability of ICT devices, and the high cost of connectivity. Face-to-face teaching and learning are considered the gold standard that was only suspended due to the Covid 19 imposed constraints. However, HEI felt that BL is an innovative teaching and learning model that allows the development of high-level thinking skills and collaborative learning as articulated by Okaz (2015).

To investigate the usefulness of BL against this background, this study adopts the Engestrom's(2003) Third generation AT as a framework for assessing the individual and collaborative activity systems that characterise blended learning. This was found to be ideal for this study given its ability to conceptualise the technological and socio-cultural imperatives of the context under which blended learning is being deployed. Zimbabwe was selected as an appropriate unit of analysis because it is a developing country that is characterised by the ICT infrastructural deficiencies and socio-cultural issues that other previously-colonised Sub-Saharan African countries face in the deployment of BL.

The objective of this study is 'To assess the effectiveness of blended learning in the wake of ICT infrastructure deficiencies.' This objective will be understood by answering the following research question which reads:

How effective is blended learning in the wake of ICT infrastructure deficiencies?

After this introduction, the rest of this paper is organised as follows: section 2 presents the literature review, Theoretical grounding of the research. Section 4 presents methods followed by analysis. A discussion and summary conclude this paper.

LITERATURE REVIEW

This section reviews the literature on blended learning intending to expose the gap that this paper aims to address. Blended learning is described as a learning method which is student centred and a combination of e-learning activities with traditional face to face classrooms (Attard and Holmes, 2020; Kerzvič et al., 2019). This interaction involving teachers and students may happen with or without the aid of technology. It may incorporate several learning strategies, such as face-to-face and online approaches, to provide novel learning methods (Wu, Tennyson & Hsia, 2010; Lim, Morris, & Kupritz, 2014) and combine the benefits of both traditional and online learning (Tselios et al. 2011). For students to achieve the best learning outcomes, effective blended learning goes above the student's degree of autonomous competence or knowledge through collaboration.

Dimensions of BL

As a way to synthesise and express the potential structure of BL, Bonk, and Graham (2006) recommends using four dimensions namely; place, time, media characteristics, and human qualities. For instance, the space whether physical or conceptual could impose restrictions on the number of classes that a school may host at a time. Similarly, the time factor could limit the ability of students of different demographic backgrounds and statuses to attend classes. Blended learning, therefore, comes in handy for such situations. Characteristics of the media, that is in our case ICT allows the storage of learning content, its communication, reuse it and analyse it in different ways. This makes both synchronous and asynchronous learning possible. In terms of human characteristics, Okaz (2015) suggests that today's student is different from the traditional one. Blended learning, therefore, allows the digital citizen to use the technologies in a way that matches their nomophobia, that is the fear of being without one's mobile phone or cellular service. Because of this, the power of BL comes in how the method of instruction is rethought to fit it into the context of use (Garrison & Kanuka, 2004).

Significance of BL in higher education

Challenges with blended learning have been made more apparent by the COVID-19 outbreak. Universities and institutions around the world were required to implement a few health standards, for example limiting class numbers. To sustain their courses for both on-campus and off-campus situations, they blended online and offline learning (Huang R, Tlili A, Wang H, et al 2021).

Burgeoning literature presents diverse arguments on the usefulness of blended learning platforms in higher education (Carr et al. 2018; Chew, Jones, and Turner, 2008; Daskan1 & Yildiz, 2020; Kanwar 2019; Topping et al., 2022;). According to research from the University of Central Florida, BL courses reduced expenses by increasing scheduling effectiveness and lowering the demand for physical facilities (Dziuban et al., 2011). To assess the efficiency of BL for participants' achievement in higher education, Vo et al. (2017) found that BL had a significant but small effect size when compared with conventional classroom instruction and concluded that BL might improve participants enhance participant performance in learning (Cortizo et al., 2010).

Distant and flexible learning is made possible by online teaching platforms, which may accommodate students with a variety of work schedules, personal circumstances, learning styles, and demands (Kanwar, 2019). Blended learning provides flexibility and promotes learner autonomy and collaboration between learners and or student-teacher which encourages the student's critical thinking capabilities. Hartel (2017) notes that the implementation of e-

learning is expected to enhance students' ICT capabilities, allowing them to function more successfully in a future of work that will be marked by more automation as a result of the Fourth Industrial Revolution (UNESCO 2020).

Blended Learning resources

Resources for teaching and learning, as well as assessments, must be made available when online teaching is extensively utilised. Internet access and the digital tools required for lecturers to create lesson plans, administer tests and guarantee knowledge transfer should be included among these resources (Hartel, 2017). Infrastructure resources such as internet access, computers or laptops, webcams, headsets, and printers are also necessary for learning and teaching online (Bates, 2015). According to Cole, Lennon, and Weber (2019), effective online learning tackles the social dimension to make up for absence and overcome distance and resource inadequacy. Students learn within their learning capabilities using the resources that are within their environment like downloaded notes, mobile phones, and e-books and this encourages experimentation and collaboration with others.

Blended Learning in the context of developing countries

The rapid advances in information and communications technologies (ICTs) have acted as a catalyst for educational transformation in recent years the world over (Nichol & Watson, 2003). Because of Covid -19, Africa has accelerated its attempt to take advantage of this technological revolution to make strides in the advancement of education. For the continent, particularly sub-Saharan Africa (SSA), these technologies offer tremendous hope towards meeting the present-day educational challenges of lack of access to quality higher education.

Among other restrictions, infrastructure issues and policy issues continue to hamper blended learning in Africa. Even though it is the ideal thing to do pedagogically, running large-scale online programs is not possible in Africa due to the lack of ICT infrastructure. The continent-wide issue with ICT infrastructure is characterised by poor service quality and restricted availability. Low Internet bandwidths, extremely constrained phone connections, and a dearth of computer ownership are all cited by Isaacs et al. (2004) as severe issues that are widespread in Africa. Uneven access is caused by the fact that the majority of ICT infrastructure is restricted to big cities and major centres and is not accessible to the vast majority of residents of remote and rural regions (Sagna, 2005).

The infrastructure needed to implement computer-assisted instruction (CAI), computer-supported collaborative learning (CSCL), blended learning, and more specifically online education is frequently lacking in nations like Zimbabwe. According to Topping et al. (2022) "computer-assisted instruction" entails the making use of computers in schools to access web-based content while being supervised by a teacher or facilitator. According to Root et al. (2018), CAI programs can be as simple as drill and practice or they can be very complex, like involving simulations. This is in contrast to online learning, which takes place away from the classroom and gives the student complete control over the time, pace, and location of their studies. Many CSCL studies have occurred inside schools instead of outside of them, according to Topping et al. (2022).

Cognitive development of the student under a blended learning environment

Neuroscientist, Small (2008) contends that everyday exposure to digital technologies like the internet and cell phones can change how the brain functions. He asserts that as people learn more, their brains continue to grow and form new connections and pathways that are continuously moulded, reshaped, and managed by expanding societal and technological

advancements. Learning is seen as a thoughtful, constructive activity involving deliberate cognitive efforts. To apply their expertise to the performance as a component of the joint learning system, cognitive tools enable learners to interact with and think about knowledge building (Kim & Reeves, 2007). The purpose of technology in instruction, according to Jonassen, Peck, and Wilson (2000), is to involve the learner actively in their process of evaluating and manipulating information, and this, in turn, accelerates the process of learning.

Technologies that support and enhance cognitive processing that leads to knowledge construction are known as cognitive calculations, storage, and information retrieval, to computers with these technological opportunities and collaborating with others, students develop knowledge rather than copy it. This is supported by Vygotsky (1978)'s sociocultural work which states, by enabling students to externalise their thoughts into forms that they can share with other people and act with, tools, in Vygotsky's view, mediate and enhance their capacity for interpersonal interaction.

Vygotsky's Zone of Proximal Development and Blended Learning

Vygotsky's Zone of Proximal Development and Blended Learning are argued as an appropriate model for theorising the pedagogical impact of blended learning (Chew, Jones, and Turner (2008). He argues that the development of a learner's cognitive development is constructed through social or cultural interaction. This means that a learner is assisted to understand their studies through a social circle that includes family educators, parents, classmates, and friends. Furthermore, the learner's relationship objects, such as books or toys, and culturally specific practices which learner encounters in the home and school activity systems as well as their community, are critical in their knowledge development process (Cortazzi, Hall, 1999, Deborah, Bodrova, 2001).

These socio-cultural factors are situated within the learner's zone of proximal development (ZPD). According to Vygotsky, learning can result in development if it occurs within the ZPD. The ZPD is defined as the distance between the actual development level as determined by independent problem-solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers. (Vygotsky, 1978, p. 86).¹ This definition encompasses the two activity systems namely independent learning or self-study and collaborative learning under the tutelage of more capable peers. This study, therefore, aims to conceptualise the home activity system and school activity systems that characterise blended learning.

Given that blended learning is a combination of traditional teaching and learning under the instruction of the superior other namely the teacher and classmates and the technological tools that the learner uses on their own (Daskan & Yildiz, 2020), mirrors the relationship between the cognitive development that takes place at the intersection of the person and the social world. This in this study is operationalised as the cognitive development that is experienced at the confluence of the individual learner and the school activity system (Lee, 1987; Manik, 1987). Doolittle (1995) posits that ZPD can be used as a theoretical base for understanding cooperative learning. This includes "positive interdependence" which is related to Vygotskyian "developmental interdependence", "social interaction" which mirrors Vygotskyian "social mediation and enculturation", and Individual accountability which is related to Vygotskyian "Individual development". Finally, group social skills related to culturally based signs and tools as well as group self-evaluation conceptualised as Vygotskyian "monitoring growth and development".

THEORETICAL GROUNDING OF THE RESEARCH

This section presents the theories adopted for investigating blended learning in situations where infrastructure is inadequate. These are the ZPD which was adopted for interrogating blended learning as a subject and Engeström (2003) third-generation AT as a framework for assessing the two activity systems that characterise blended learning in developing countries such as Zimbabwe.

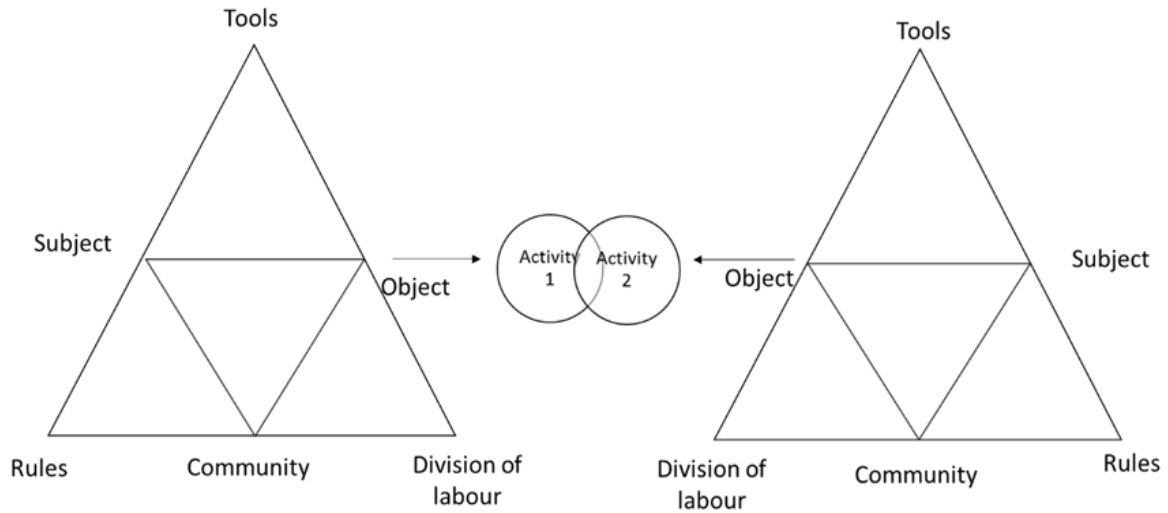


Figure 1. Third-Generation Activity Theory

Activity theory has been presented in three versions, that is, the first, second, and third generations. While the 1st generation AT consists of a subject and object which are affected by tools (Robertson, I. (2008), the 2nd generation AT depicts the activity as a collective system that includes the 'rules', 'community', and 'division of labour' that determine the undertaking of the activity (Engeström, 2001). The 3rd generation consists of a dual-activity system that depicts the interplay of two activities coming into contact with each other to produce an outcome of their effect on a phenomenon (Engeström, 2001). This study adopts the 3rd generation AT to conceptualise the two cognitive development activity systems associated with blended learning. These are the computer-supported collaborative learning system and the Computer-assisted individual system.

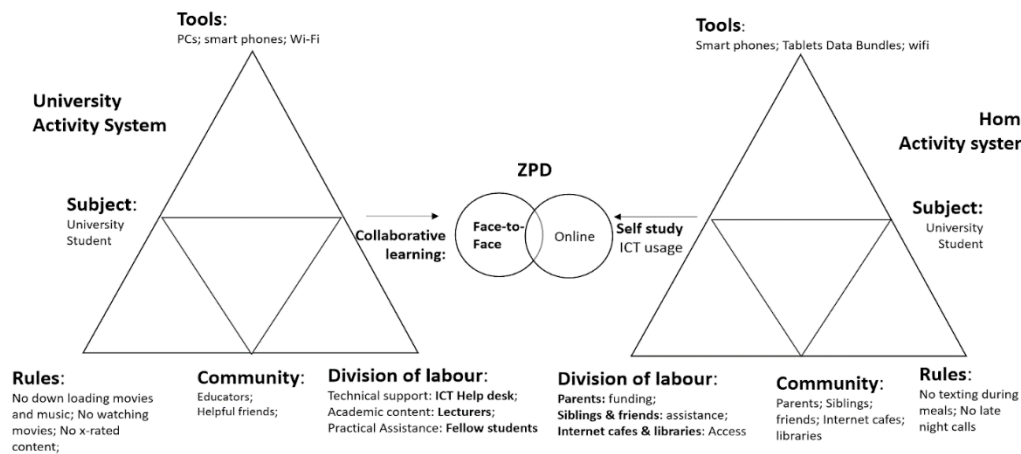


Figure 2. Blended Learning in the Home-to-Home Activity System

Applying AT to the cognitive development of students using blended learning

Mwanza and Engestrom (2003) present eight parameters that can be used for identifying and analysing the contradictions and tensions that exist in issues and problems that can arise in an activity system.

1. **Activity:** When analysing an activity system, Mwanza, and Engestrom (2003) propose that we ask what sort of activity we are interested in. In our application of AT to cognitive development using blended learning, we are interested in analysing the process that the learners undergo in traversing the ZPD. This must unpack the challenges and opportunities they experience between the individual realm and the collaborative learning system.
2. **Objective:** In answer to the Objective component of AT, Mwanza, and Engestrom (2003) admonish the researcher to ask '*Why is the activity taking place?*' The activity (cognitive development using blended learning) is taking place as discussed here because teaching and learning are now shifting into the e-world where social, business, and educational activity is increasingly taking place in cyberspace.
3. **Subjects:** The 3rd question is 'Who is involved in carrying out the activity?' refers here to the university Student because the activity is analysed from their perspective.
4. **Tools:** By what means are the subjects performing the activity? The tools in this activity are ICTs and online platforms that are used for blended learning. Tools such as mobile phones, personal computers, internet connectivity, etc are the enablers of blended learning.
5. **Rules and regulations:** Are there any cultural norms, rules or regulations governing the performance of the activity? The rules and regulations include the rules that govern access to blended learning i.e. computer-assisted instruction (CAI), computer-supported collaborative learning (CSCL) as well as face-to-face traditional mode of learning. These constitute a key aspect of contextual realities and they inevitably vary from one activity system to another.
6. **Division of labour:** Mwanza, and Engestrom (2003) also admonish us to ask 'Who is responsible for what, when carrying out an activity and how those roles are organised?' This refers to the various roles which are done and played by the superior other namely, friends, teachers, and parents who help the collaborative learning process that happens in the ZPD.

7. Community: In answer to Mwanza and Engestrom (2003)'s question, 'What is the environment in which this activity is being carried out?' we refer to the individual study system which could be the learner's home, university, and community which environment in which cognitive development is taking place.
8. Outcomes: Finally Mwanza, and Engestrom (2003) admonish the researcher to ask, 'What is the desired outcome of carrying out this activity?' The desired outcome is for the student undergoing blended learning to develop full cognitive capabilities in the ZPD.
9. Cognitive development in the ZPD: At what point does self-study needs to be complemented by assistance from the superior other?

METHODS AND APPROACH

This study adopts a bi-focal Vygotskyian conceptual lens which consists of ZPD for interrogating blended learning as a subject and Engestrom (2003) third-generation AT as a framework for assessing the two activity systems that characterise blended learning.

These are the individual study realm and collaborative realm in the university activity systems as discussed in section 3 above. Engestrom's (2003) third generation Activity theory is normally regarded as a framework for inquiry and description (Hasan, Smith, and Finnegan, 2017), its conceptual power for assessing socio-technological studies is extended here by coupling it with ZPD to interrogate blended learning in developing countries that have unstable ICT infrastructure.

We adopt an interpretivist paradigm to investigate the normative issues surrounding e-learning. Two of Klein and Myres' (1999) principles of interpretivist case studies because they complement activity theory's quest for both contradictions and contextualization and historical cultural settings. These are the principle of Dialogical Reasoning and the principle of Contextualization. The principle of Dialogical Reasoning requires 'sensitivity to possible contradictions between the theoretical preconceptions guiding the research design and actual findings.' While the principles of Contextualization call for 'critical reflection of the social and historical background of the research setting' (p. 72).

The evidence was collected using in-depth interviews with students from a selected Zimbabwean University. Twelve in-depth interviews were conducted with students that employ blended learning under an interpretivist paradigm. Qualitative research was used to extract views and perceptions from the learners and lecturers pertaining their perceptions on blended learning. This included the electronic recording of interviews using an electronic device. The evidence was then transcribed using a word processor. The analysis of the evidence during the research adopted thematic analysis. This entailed the grouping of evidence into the themes that were operationalised from activity theory and ZPD.

RESEARCH FINDINGS

This section presents the evidence by themes that were adopted from AT and ZPD. See Table One below for a summary of the findings. The challenge of inadequate ICT infrastructure was acknowledged by all the participants. According to Participant P3, a more systematic approach to ensuring data is available to students is necessary for addressing power challenges, 'I think it's wise for school to provide data maybe you can charge it on school fees so that they can provide data for us.'

In Participant P2's words, 'I may not be able to buy the data and I can go for a month or two without data, then I can only come here and use Wi-Fi. Once I go home, I won't have anything

due to electricity cuts. If I charge my phone here or at home at night when the electricity comes, if it just goes off, then that's it.'

Table 1. Blended learning results categorised by home and university activity systems

	UNIVERSITY	HOME
SUBJECT	<p>"Blended learning. I would like to say blended learning is good. Because it allows us students to, to, learn whilst we are at home and then we Consider a transport fee. So I think plenty of learning is good." P8</p> <p>'..but maybe because they don't know how to use a learning management system. even if they didn't know how to use it, they would've sent the materials on WhatsApp, but they didn't. P</p>	<p>".. my experience has been great. You know, as a young woman being in school at [selected uni], you have other things that you're running around with. So you have less time for, lectures. With the lecture, you cover a lot of things. Then when you go home ...you cover three-quarters, three over four. Then at home, you cover one over four...." P5</p> <p>'So adults are comfortable learning from home or learning from work most of the time because they can't keep on coming. The transport issues and time management, I think blended are learning is, uh, good.' P7</p>
RULES	<p>'The rules are in the computer lab...no eating and drinking...' P7</p> <p>'..in the lab, it's just like being in the library, that's what I, that's what I noticed. ...like, you're supposed to be silent. No eating, no, like the disciplinary, uh, rules are different from just being outside..' P1</p> <p>' We are not supposed to download or watch anything...not educational. Oh. But for educational things, you can.' P2</p> <p>'Yeah, there are rules like two hours per student.' P3</p>	<p>'There are no rules as I am old enough..' P7</p> <p>'...not supposed to watch other things that are not related to things that will build you?' P2</p> <p>'Not really. Cause, I'm the one who put regulations at my house.' P4</p> <p>"...you do not have to touch your phone since you are learning..." P5</p> <p>"For me, I was not restricted in accessing my work but sometimes my parents normally ask me to only focus on educational platforms..." P8</p>
COMMUNITY	<p>No, I don't have friends who know better than me about using the internet..... Ail ...t. Pi15</p> <p>"...Yeah, my dad. Oh, okay. Usually helps me...." P5</p> <p>'Classmates help me understand certain concepts through discussion...' P7</p> <p>"...To me, they are not just teachers,... They teach us how to live life with education. And then other students, they give us good experience in terms of understanding..." P8</p>	<p>'...yeah, from my house, I think I got a sister who's also doing a degree in psychology ..., and my mom is a teacher..., I have noticed with the, the, the introduction of the new curriculum, most of the things that I do in social work, like gender... all the social issues, uh, she has a bit of knowledge about it. So I always ask...' P1</p> <p>"To understand Usually, uh, either I use the internet, I ask other colleagues..." P5</p> <p>"Using my phone. So I can consult, my lecturer. I can consult my classmates..." P6</p> <p>"...You have access to ask anyone from anywhere in the world. So we can now share ideas internationally, we can now share ideas with students from other individuals..." P8</p>

<p>DIVISION OF LABOUR</p>	<p>“So I would go to my colleagues and they would help me like patiently, like explaining anything, everything that I need to know...”P6</p> <p>‘ICT department, ...help us on how to use the computer and also how to access LMS’ P2</p> <p>‘Our lecturers play the biggest role in assisting us in learning. Maybe you have questions because sometimes you don't want to waste your time writing the wrong things.’ P4</p>	<p>‘I am the parent so there is no one to assist me...’ P7</p> <p>‘My friends? They also help us do discussions. If we don't understand a certain topic, pick someone who understands it “...Yeah, I do have some friends that can help me...”P5</p>
<p>TOOLS</p>	<p>‘I use work Wi-Fi to download material so that I can study at home later ...’ P7</p> <p>“...sometimes I was forced to come to school because there's always electricity to charge my laptop...” P5</p> <p>“So the My Hope platform,...it should be accessible anytime 24/7 from anywhere you are...” P6</p> <p>“...Because electricity is always a challenge. Therefore, I normally come to school or the campus or I will visit a friend who is a fellow at the school to give me a start-up...” P8</p> <p>“...in terms of data cost, I just get support from my relatives...” P8</p> <p>“...The school could do fund raises and raise enough money or enough funds to be able to accommodate every student and be able to get whether it's a laptop or a smartphone or tab...” P9</p>	<p>“...I don't have Wi-Fi at home, so sometimes there are things you might download some things and then put them in your laptop or your phone...”P6</p> <p>‘I use my phone and laptop...data is very expensive but I find ways to buy data so that I can learn...’ P7</p> <p>“...We can now access our learning materials at anytime from anywhere and I feel that there is a great improvement because we can now go to work while learning...”P8</p> <p>‘...I have a laptop, I have a phone, I have a tablet. Yes, I use those. But I think for most students, they use their phones, which is, um, which is easier and cheaper for them to use.’ P1</p> <p>‘ I have Wi-Fi...It's unlimited’ P2</p> <p>“...Small internet cafe. You can just go there. Maybe you pay dollar ...” P6</p> <p>“...Electricity availability is a challenge...Sometimes I normally miss some of the lectures that I intend to attend when I am at home...”P8</p> <p>“...We can make sure that we have power pickups. For instance, we can have solar lighting...” P8</p>

The community has been seen as a collection of people that are physically reachable to the subject[student], our evidence shows that this has extended to include online communities. Asked if she has been helped to understand difficult content she could not understand on her own, i.e. crossing the ZPD, Participant P3 said, ‘I can, from home ...since we are using phones, I can just contact anybody from anywhere.’ She added, ‘Using my phone. So I can [even] consult my, lecturer. I can consult my classmates. I can consult anybody that I know who has the knowhow.’

The challenge of poor access to infrastructure and unaffordability of data could be addressed by the community network e.g. in the home activity system, ‘Yeah. I have some good friends who can just let me use their Wi-Fi if they have..’ said P8. It is also addressed through a process of downloading course content from a networked place for the student to use it from home while offline.

In terms of the ZPD, the students we found to be depending on each other for crossing the cognitive barriers they could not overcome individually. For instance P2 said, ‘....So in my class, you know, like, this person is, is the best. This one is more intelligent than all of us.. That's how we help each other.’ This approach is a variation from the traditional Vygotsian model where one subject acts on one object. This is a situation where the roles are swapped depending on the area of expertise. The one being taught in one discipline or topic could be the one teaching in another.

Participants noted many examples of situations when they depended on other students for them to cross the ZPD, ‘it was advanced, ..corporate finance. So I would go to my colleagues and they would help me like patiently, like explaining anything, everything that I need to know.’

Practically speaking, the addition of online lessons to face-to-face traditional classes has practical advantages of overcoming geographical distances, for instance, Participant P2 said, 'Uh, a blended lesson from the traditional lesson we used to do, we used to do more discussions. it's different from printed lessons. Cause let's say you say to others, let's come and discuss. Someone might say, not having transport, man, it's different from a traditional lesson where everyone was supposed to come to school. Mm-hmm. Or start So those are the effects of, uh, blended planning.'

The same rearrangement of the original format of activity systems is also affected by the use of ICTs. The student may conduct the self-study in self-paced a manner at the school activity system as is normally expected to happen from the home activity system.

DISCUSSION

This study is meant to investigate the effectiveness of blended learning in jurisdictions such as Zimbabwe that lack reliable connectivity and electrical infrastructure. Blended learning scholars cite electricity cuts as a major reason not to use the blended learning mode of learning (Okaz, 2015). Questioning the accuracy of this position, we conceptualised blended learning on the home and the university activity systems which are synonymous with the places where blended learning takes place. We hasten to advise that this geographical characterisation has been re-arranged by the ever-increasing use of ubiquitous communication technologies that are dominating the e-learning domain. It is, therefore, plausible to refer to them as the classroom and the individual activity systems as discussed below. In other words, the mode of learning can be referred to as the self-paced and the traditional face-to-face lectures.

The research shows that most of the participants viewed blended learning as a helpful model for their studies. This is because they felt that this introduces a combination of self-study flexibility and in-class interactivity in their learning process. As participant P1 ‘...for me, it's [BL]good because when I come for face-to-face lessons, ... you get ... the explanation when you see somebody's face, ... you can ask questions, like here and there, and then you'll be interacting. But then also there's the online platform. ... it's flexible. You can do it wherever you are. You can just learn.'

While university education has always required a great deal of self-study, blended learning's requirement for a significant part of student work to be conducted outside the classroom improves their independent learning skills. Participant P3, said, ‘The advantage of combining is, you have time to discuss with, other colleagues and, there will be more time for you to research on your own, for some topics that you do not get.’

Even while blended learning was widely applauded as a good innovative approach to learning, some students preferred the face-to-face approach. This was mainly due to the difficulty of understanding the modules that required calculations. As P5 put it in her words, 'I think, blended learning is good when you're doing like, those modules that don't need workings... we can just say it's 50-50, but we would prefer the face-to-face lessons. 'On the contrary, participant P9 suggested that the flipped classroom should be a 3 phase process starting with a face-to-face introduction followed by self-study and finally returning to the face-to-face lectures for clearing any challenges that the student will have met during their self-study. Our snapshot study could not reveal whether these opponents of the self-study were at different stages of technology adoption as stipulated by Rogers' (2005) diffusion of innovation where the laggards and the early adopters viewed innovations differently.

The study was conducted at a Zimbabwean university that uses Moodle as an asynchronous learning management system. The devices used, that is, the Vygotskian AT construct 'tools' were mainly mobile, tablets, and laptops which were pre-chargeable and can be used offline and off-electric grid. This made both the learning management system, Moodle, and the devices usable in areas of poor infrastructure. Many participants reported that they could download lecture notes from networked areas to read them offline. For instance, participant P8 said, '..I use the Wi-Fi here at school to download some stuff so that when I get home I can read..'

When asked how they cope with power outages, participant P8 added, '...you are supposed to at least come to school, there's a generator so you can work.' in the event of having missed a synchronous lesson, she added, '...normally on, on my home, they don't delete the messages after a lecture. So if you are a good student, you just follow up if you had problems with electricity.' This shows that blended learning can be conducted despite the infrastructure challenges that affect the developing world.

There was a notable reliance on the community for addressing infrastructure challenges and traversing the Zone of proximal development. For addressing the main problem of that is, incessant power outages, that bedevil blended learning. Some students reported that they could charge laptops at neighbours that had solar power or other electrified places such as the University and public places. The community also provided Wi-Fi access either as device-to-device tethering or connecting to a friend's network.

On the development of cognitive skills, it was found that students almost always relied on assistance from classmates, seniors, siblings, or teachers. The roles were found to be interchangeable sometimes. Especially among students, that is, the one assisting in one module or topic will be assisted by others in another one. While Vygotsky's ZPD does not freeze these roles, the superior other who helps is not fully defined. What is clear is that the community in which the learner is embedded is a complex combination of dynamic roles.

LIMITATIONS

Out of several universities in Zimbabwe, the study was limited to one university. To gather adequate information the researchers would require travelling to other universities but due to lack of financial resources, this was not possible.

CONCLUSION

Based on the findings of the study, the following was concluded:

1. ICT devices have a profound effect on the cognitive development of the BL using student.

2. Universities and educational institutions must make sure that they take responsibility and improve on the infrastructure challenges such as lack of ICT and electrical infrastructure and lack of reliable connectivity if they want to ensure that blended learning is implemented.
3. Training and orientation programs are offered regularly to the learners and their lecturers to improve in their knowledge and understanding of blended learning.

Even in situations of poor infrastructure. The subject, who is the student, will employ the tool i.e. the ubiquitous ICTs which act on the object to produce the outcome of cognitive development. This activity system is mirrored in both the home and university activity systems as articulated by Engestrom's (2008) third-generation AT. This combination of the two activity systems depicts the way blended learning shapes the cognitive development of the university student who manages to navigate the infrastructure challenges in developing countries.

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Given the above findings, it must be acknowledged that blended learning may help the cognitive development of students in developing countries which have poor infrastructure. Policymakers must, therefore, endeavour to equip public places where students from deprived places may charge their devices and download course content for use off the grid and offline. Both the university and the home activity systems must promote the use of chargeable devices such as laptops because desktops and cloud-based applications will fail to work off-grid and offline

Future research must assess must guide the development of low bandwidth applications and low electricity devices for off-grid and off-line use.

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