An Analysis of Heutagogical Practices through Mobile Device Usage in a Teacher Training Programme in Malawi

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Abstract: This paper analyses the mediation of heutagogical practices using mobile devices in a teacher training programme in Malawi. Existing literature suggests that the use of mobile devices facilitates the development of heutagogy, an educational approach characterised by interdependent learning, double- and triple-loop learning and participation in communities of practice. The study draws on three major heutagogical principles for its theoretical foundation. It adopts the case study method, and uses questionnaire, semi-structured interviews, focus group discussions and personal diaries for data collection. Mobile phone ownership is almost universal at the college and most of the student-teachers possess at least one Internet-enabled device. Despite laptop ownership and institutional access to computers being low, a relatively high number of student-teachers frequently use computers in their studies to complement mobile phones. Regarding heutagogical practices, few student-teachers claim to engage in interdependent learning as well as double- and triple-loop learning. Conversely, most of them tend to participate in communities of practice, particularly those involving students only. In addition, few student-teachers hold the intention to use their devices in their own teaching.

Keywords: heutagogy, teacher education, learner-centred, mobile devices.

Introduction

Background

Teacher education in Malawi is plagued by staffing challenges. According to the Malawi Education Sector Performance Report (MESPR), more than 60% of the teachers in secondary schools are unqualified (Ministry of Education Science and Technology [MoEST, 2015). The government of Malawi hires under-qualified and unqualified teachers to fill acute staffing gaps at the secondary school level (MoEST, 2015). Secondary school student-teachers are recruited either among fresh secondary school graduates or through upgrading schemes which target practising, unqualified or under-qualified teachers who want to advance their qualifications. The staffing problem is further compounded by underfunding. A higher percentage of the 2014/15 budget appears to have been allocated to higher education (30% with about 12,000 learners) and secondary education (14% with about 761,000 learners) compared to basic education (53% with about 3,688,000 learners) although the overall allocation was insufficient (Nkhokwe, Ungapembe & Furukawa, 2017). The pupil-teacher ratio (PTR) at the secondary school level, which was 41:1 in 2015, is higher than the MoEST target of 20:1 (Index Mundi, 2017, sourced from the United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics). The MoEST, through the National Education Sector Plan (NESP) for the 2008 – 2017 period, acknowledges that limited funding leads to inefficiencies that affect the quality of teacher education (MoEST, 2008). A poor learning environment in colleges

impacts negatively on the preparation of teachers and demotivates potential student-teachers to enroll (see also Msiska et al, 2013). This paper provides an analysis of heutagogical practices through the use of mobile devices among student-teachers at Domasi Teachers Training College in Malawi. This is a public institution established in 1993 to train secondary school teachers as one way of addressing an acute shortage of qualified teachers which continues to affect the education sector to date.

Review of Research Studies

There is currently a divide between policy and practice insofar as teaching is conducted at all levels of the education system in Malawi. Whilst government policies and donor-funded programmes direct educational institutions to use learner-centred approaches, the education system is characterised by attitudes and values which treat learners as empty vessels, do not take account of prior learning, and do not consider the learners' perspective (Mizrachi, Padilla & Susuwele-Banda, 2010; Chilemba & Bruce, 2015). Although the teacher training curricula promote the application of learner-centred attitudes and values, Mizrachi et al (2010) observe that the reality in training institutions is that learner-centred attitudes and values are not modelled by lecturers. They further note that most student-teachers lack the ability to transfer skills from college to the workplace after their graduation. It is assumed in the present study that the student-teachers get influenced by the attitudes to learners that they experience in college as well as lack of use of ICTs and other resources. Learner-centred attitudes and values are desired in education because they promote learner independence, increase motivation and enhance learners' control of the learning process (Blaschke, 2012).

Heutagogy, the promotion of self-directed learning, is one learner-centred philosophy which the student-teachers could adopt in their teaching and learning activities. The philosophy helps to increase self-efficacy, enables learners to manage their own learning as well as reflect upon what is learned and how it is learned (Booth, Blaschke & Hase, 2016). Heutagogy also promotes collaboration among learners. Mobile devices provide an opportunity for the student-teachers to operate independently as they would be able to access online teaching and learning resources at their own convenience. The use of mobile devices could also help to enhance teaching and learning processes among the student-teachers in the face of an acute teacher shortage. MACRA (2014) reveals that 74% of tertiary students in Malawi have access to the Internet through their mobile phones. Three main heutagogical principles are considered in the present study based on the works of Blaschke (2014) and Hase (2009; 2014). The first one, interdependent learning, concerns a learner's ability to learn by themselves through practices such as exploration, discovery, research, testing hypotheses, validation and collaboration (Hase, 2014). These practices not only help in knowing how to access information but also how to conduct meaningful research and be able to validate knowledge. Interdependent learners know how to access information and verify sources by accessing appropriate journals and books or networking with experts and peers to find out if what is being read can be substantiated (Hase, 2014). This includes the ability to think rather than blindly accepting everything.

The second principle revolves around double- and triple-loop learning. Double- and triple-loop learning are both facilitated through self-reflection. As the learners engage in interdependent activities such as exploration, research and collaboration, they need to reflect upon what is learned and how it is learned (Blaschke & Hase, 2016). Double-loop involves analysing what has been learnt and how the new knowledge and the path to learning have influenced the values and belief system (Hase, 2009). Thus, the learner reflects upon the problem-solving process and how it influences the learner's own

beliefs and actions. Triple-loop learning involves double reflection in and on action as well as outside contribution by learning lessons from experience (Barbat, Boigey & Jehan, 2011). While double-loop learning promotes the application of knowledge and experiences to familiar as well as novel situations, triple-loop learning helps to develop better understanding of how to respond to the learning environment and deepening one's comprehension of why one chooses certain studying patterns. The third principle concerns participation in communities of practice (CoPs) where people with common interests and goals engage to develop knowledge and themselves both personally and professionally (Lave & Wenger, 1991). CoPs are bound by specific practices, identities, and patterns of participation. Within such communities, members share their experience and tacit knowledge in free flow, improving their abilities and skills, and fostering learning (Agrifoglio, 2015). The members explore ideas, discuss situations and needs, and help each other solve problems, although they do not meet every day. While individual members possess their own experiences, CoPs simply allow them to share such experiences with other members when they meet. Table 1 below outlines examples of heutagogical practices related to interdependent learning, double- and triple-loop learning, and participation in communities of practice.

Table 1: Examples of Heutagogical Practices

Interdependent learning	Double- and triple-loop learning	Participation in communities of practice
Exploration to learn new things	Engagement in self-reflection	Joining and participation in online and face-to-face educational communities comprising lecturers and other experts
Discovery of new knowledge	Ability to analyse what has been learnt	Joining and participation in online and face-to-face educational communities comprising fellow learners
Engagement in research activities	Ability to analyse how new knowledge and the path to learning influences one's values and belief system	Sharing knowledge and content in educational communities
Testing hypotheses	Ability to identify learning lessons from experience	Accessing knowledge and content in educational communities
Validation of knowledge	Application of knowledge and experiences to familiar as well as novel situations	Asking questions in educational communities
Collaboration with lecturers and other learners	Ability to respond to problems and issues related to the learning environment	Responding to questions and issues in educational communities

The practices among the heutagogical principles presented in Table 1 are interrelated and, most often, complement one another. The development of heutagogy can be linked to the concept of mediated learning experience since, in both situations, learners are guided to "learn how to learn" (meta-cognition) by someone who is more knowledgeable (Greenberg, 2000). The goal is to assist someone to become a more skilled and independent learner. The student-teachers at Domasi College serve two roles, as learners (at the college) and teachers (at the workplace), hence, the need for them to develop

effective analytical and self-reflection skills as well as understand the critical role of the teacher in enhancing informal learning opportunities.

Research Objectives

The aim of this research was to examine the mediation of heutagogical practices using mobile devices in teacher education. To achieve this aim, the study attempted to address the following questions:

1. How are mobile phones supporting self-determined learning?
2. To what extent do mobile phones support metacognition and collaborative learning?
3. How does a heutagogical intervention affect the student-teachers' intention to use mobile devices in their teaching?

Methods

Research Method

This study is an action research case study within the interpretive paradigm. The interpretive paradigm is primarily concerned with generating context-based understanding of people's thoughts, beliefs, values and associated social actions. When applied to educational research, the paradigm enables researchers to build rich local understandings of the life-world experiences of teachers and students, and of the cultures of classrooms, schools and the communities they serve (Taylor & Medina, 2013). In the present study, the paradigm was used to analyse the attitudes and experiences of the student-teachers concerning the use of mobile devices to support self-determined learning.

Population and Sample

Of the total population of 696 student-teachers in second, third and fifth year at Domasi College, 394 student-teachers participated in the survey, representing 57%. The other student-teachers in the three years were either away on teaching practice or chose not to participate due to other reasons. All the 394 student-teachers at the college took part in the questionnaire survey. Semi-structured interviews were also conducted with the College Principal, Dean of Students, Dean of Education and Head of Mathematics. Another set of semi-structured interviews was held with 12 randomly selected student-teachers. In addition, three focus group discussions (FGDs) were conducted – one for each year of study – which involved a total of 18 student-teachers. Each FGD had six participants who were selected through purposeful sampling to ensure that the groups were as diverse as possible in terms of gender, and discipline. This sample size was based on Stewart and Shamdasani (1990) who postulate that an effective FDG has between six and eight participants (cited in Gill, Stewart, Treasure & Chadwick, 2008).

Instruments

The data collection exercise included multiple methods comprising a questionnaire survey, two sets of semi-structured interviews, and focus group discussion (FGDs). The questionnaire had two sections. The first section collected demographic information pertaining to the type or field of study, year of study, gender, age, teaching experience and place of work. The second section comprised questions concerning the kinds of devices in possession of the student-teachers, the extent to which mobile devices are used as learning tools and any indications of self-determined and collaborative learning among the student-teachers. The other questions explored the student-teachers' attitudes towards the use of mobile devices both in their studies and teaching activities and the influence of

device characteristics. Most of the items in this section were developed based on a five-point Likert Scale. Two interview guides were developed for each of the two sets of interviews. The first interview guide focused on background information about the college, while the second guide helped to collect data concerning the student-teachers' use of mobile devices to support their learning. Another guide was developed for the FGDs, and its themes stimulated the student-teachers to identify any other issues to do with how they use mobile devices to support their learning which were not highlighted in the questionnaire responses. The questionnaire and three guides were first piloted before their use to check their reliability and validity.

Procedure of Data Collection and Analysis

The first set of semi-structured interviews were conducted during the situational analysis phase and focused on contextual profiling of the research site to obtain background information about the college and the research participants (student-teachers). These interviews involved the College Principal, Dean of Students, Dean of Education and Head of Mathematics. The second set comprised interviews with the 12 student-teachers. During these interviews, the student-teachers provided useful and elaborate data on their experiences regarding the heutagogical use of mobile devices. They further provided valuable insights on past events regarding the general use of ICTs at the college. Three focus group discussions (FGDs) were conducted with the student-teachers. The FGDs, which took two-hours each, complemented the questionnaire survey and provided an opportunity for the participants to clarify complex issues.

Data analysis was an ongoing process in this study and was conducted in three main phases. The first phase began right in the field during the data collection exercise where emerging themes were identified and preliminary data categorisation was done. The qualitative data analysis programme, NVivo version 11 was used for data management. The second phase focused on formal analysis of the data collected through the questionnaire, semi-structured interviews and FGDs. The third phase concerned interpretation and discussion of the results based on heutagogical principles as presented in the first section.

Results

The results have been presented under two major themes: access and use of mobile devices and extent of self-determined learning.

Access and Use of Mobile Devices

Access to computers among the student-teachers seems to be limited at the college, with only 12 functioning computers open to all student-teachers and another 10 reserved for computer science student-teachers. Furthermore, about 47% of the student-teachers who participated in this study own a laptop. Despite limited institutional computer access and low laptop ownership, general computer use seems to be relatively high among the student-teachers. The results indicate that 65% of the student-teachers use a computer for academic purposes every day. Additionally, six percent use it at least once a week, nine percent use it once a month and 20% never use it at all. Mobile phone ownership is almost universal among the student-teachers. About 98% of the student-teachers in this study had a mobile device. Approximately 91% had one mobile phone while 13% owned two mobile phones. In addition, eight percent of the student-teachers had either a tablet only or both. It should be noted that not all phones or tablets are necessarily Internet-enabled. It is important to note that these

results only refer to ownership and do not entail actual use. In terms of Internet-enabled devices, a total of 83% of the student-teachers owned at least one such device, excluding the overlaps with laptops.

It appears that daily use of mobile devices in studies is relatively frequent among the student-teachers. About 61% of the student-teachers claimed to use their mobile devices for study purposes every day. A further 20% indicated that they do so at least once a week, 12% at least once a month, and only seven percent never at all. The results show no correlation between daily use of mobile devices and year of study, gender or subject studied. Despite the slight difference in figures for male (64%) and female (56%) student-teachers, the student-teachers' observations seem to differ based on gender. While a female student-teacher explained that she mostly uses her mobile device for chatting with friends, a male student-teacher indicated that mobile devices have made his academic life simpler. He explained that: "I do a majority of my academic work on my tablet. I even write my class notes on it." He further pointed out that the practice has enabled him to explore so much about the potential of using mobile phones as learning tools. There is a significant correlation between daily use of mobile devices and location of work (p-value = < 0.0001). About 96% of the student-teachers who work in urban areas and 40% of those in rural areas indicated that they use their mobile devices for studies every day. In addition, 77% of those who did not indicate their location of work stated that they do so every day.

During interviews, an urban-based student-teacher explained that: "I get on to the Internet every day to read about what I learn in class. It's a great idea and I learn a lot. I've even managed to influence my three friends to do the same". She added that the friends thanked her for this. This student-teacher appears to be an opinion leader who succeeded in influencing the behaviour of her friends through peer-to-peer communication channels. A rural-based student-teacher pointed out that he uses his mobile phone sparingly because there is no electricity at his school. He stated that, "I use my phone only for important communications. If I use it for teaching and learning activities, that will eat up my battery power which means that I will spend a lot of money to have it charged again". While as noted above that student-teachers are required to use computers in some of their courses, one student-teacher observed that: "The College has few computers so we rely on our phones to do internet searches. In fact, it's very convenient since we can do it everywhere."

Extent of Heutagogical Practices

The extent of heutagogy has been examined based on the student-teachers' self-reported practices. The practices relate to the extent of interdependent learning, double- and triple-loop learning and participation in communities of practice.

Interdependent learning practices

The results reveal little evidence of interdependent learning – a learner's ability to learn by oneself through exploration, discovery, research, testing hypotheses, validation and collaboration – among the student-teachers. Less than half of the student-teachers (45%) indicated that they engage in interdependent learning to a high extent. Approximately 42% stated that they do so to a low extent, while 13% indicated that they never do that at all. During interviews, a student-teacher observed that their study activities after class normally revolve around what has been determined by their lecturers, "despite the fact that we determine the study times on our own. At the end of almost every class,

we're given topics to study or assignments to work out." Another one noted that, "sometimes we do have the opportunity to study whatever we want but such occasions are rare. We have heavy workloads in each subject and our studying patterns follow what has been suggested in class."

Engagement in interdependent learning does not seem to be influenced by year of study, gender or discipline. Despite this, the student-teachers' observations seem to vary depending on year of study. A fifth-year student-teacher indicated that, "I do a lot of exploration on the Internet to get new information. Sometimes, this involves discussions with others to assist each other on difficult areas". Conversely, a second-year student-teacher observed that interdependence could result in time wastage as "there is already enough material suggested by the lecturers to work on. Every week we have about two assignments to write, and this demands a lot of time to complete". With p-value = < 0.0001, the majority of the urban student-teachers (93%) and a few of those in the rural areas (21%) claimed to engage more in interdependent learning. About 59% of those who did not indicate their place of work also stated that they do so to a high extent. One urban student-teacher explained that: "After every class, I always feel the urge to read online resources to improve my understanding of concepts. It is very useful and I learn a lot". He added that in his studying pattern priority is given to subjects in which he performs poorly.

*Double- and triple-loop learning practices*

Double- and triple-loop learning encompasses the analysis of what has been learnt, how the process of learning occurred and how the new knowledge and learning process influenced one's thinking (self-reflection). It further embraces the ability to choose one's best style of learning and apply the knowledge and experiences one has acquired to both familiar and unfamiliar situations. The present study reveals low levels of practice of double- and triple-loop learning among the student-teachers. About 23% of the student-teachers reported that they practice double- and triple-loop learning to a high extent, 57% to a low extent and 20% never at all.

There is a significant correlation between double- and triple-loop learning and year of study. The majority were the second-year student-teachers (31%), against fewer in the third (21%) and fifth (16%) year, who indicated that they engage in double- and triple-loop learning to a high extent, signifying p-value = 0.04694 and p-value = 0.00555 respectively. The gap between third and fifth year appears to be insignificant. A fifth-year student-teacher pointed out that she does not ever remember getting involved in self-reflection about her learning processes. She pointed out that "I usually analyse what I have learnt, but I don't scrutinise the process of learning itself". These sentiments were shared by a third-year student-teacher who noted that he does not know his best learning style. "Honestly, I can't tell what my best style of learning is. It just happens subconsciously". Double- and triple-loop learning appears to correlate significantly with discipline of study (p-value = 0.01832). Many of the science student-teachers (31%) and a few of those in the humanities (15%) indicated that they engage in double- and triple-loop learning to a high extent. One science student-teacher remarked that, "I usually reflect on how I learn and how I could improve my learning abilities…particularly when studying mathematics".

Participation in communities of practice

Student-teachers' participation in online and face-to-face communities of practice seems to be high. About 70% of the student-teachers claimed to participate in communities of practice while 30% indicated that they do not. It appears that most of the student-teachers participate in communities comprising students only. Almost 59% of the student-teachers indicated that they are currently members of communities involving students only, while only 11% participate in communities which include lecturers. One student-teacher observed that, "I feel more comfortable to participate in communities made up of students only because we're all at the same level. I don't think of joining one which includes lecturers because I may fear to participate freely".

Extensive participation in communities of practice appears to be low among the student-teachers. About 46% of the student-teachers indicated that they participate to a high extent while 24% stated that they do so to a moderate extent. Figure 1 below presents a comparative picture of the student-teachers' extensive engagement in heutagogical practices (as a percentage).
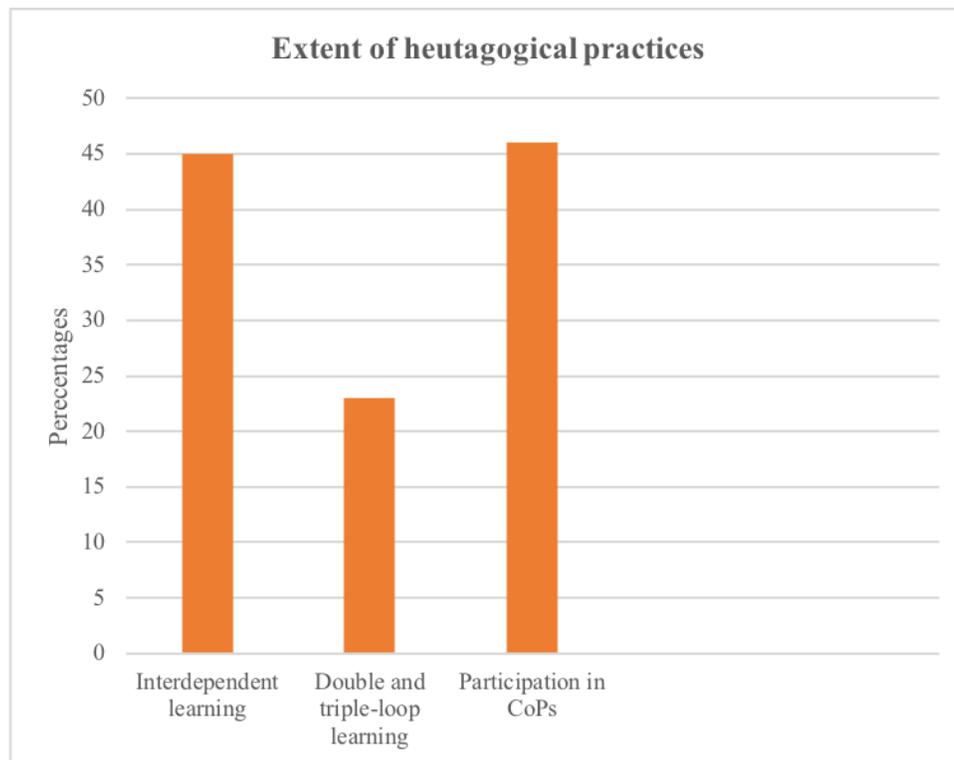
Figure 1: Extent of heutagogical practices among the student-teachers

Extensive engagement in heutagogical practices across all the three principles is comparatively low. One student-teacher explained that communities of practice "offer us a precious opportunity to network with knowledgeable people all over the world who share important information". Another one stated that, "we have a group of over 30 students in our class in which we help one another on academic problems. Sometimes we meet face-to-face but most of the times we discuss issues through WhatsApp". Extent of participation in communities of practice correlates significantly with year of study. With p-value = 0.00176, the majority of the fifth-year student-teachers (61%), against fewer in

the second year (31%), indicated that they participate in communities of practice to a high extent. There is a minor difference between fifth and third year (43%) as well as between third and second year. One third-year student-teacher revealed that he was unable to participate extensively in CoPs due to teaching practice commitments. He stated that, "I'm very busy this semester because of teaching practice. I don't use my phone the same way I did last year … I spend a lot of time preparing for lessons". Extensive participation in communities of practice correlates significantly with location of work (p-value = < 0.0001). There is a major difference in the figures for urban (88%) and rural (25%) student-teachers. In addition, 56% of those who did not indicate their place of work claimed to participate in CoPs to a high extent. A rural-based student-teacher indicated that, "I only participate in these communities when I'm here on campus because the phone network is very poor where I work". He added that he collaborates broadly during his presence at the college. Another rural student-teacher observed that "our group has been around for some time now and the membership keeps on growing. I'm happy to be part of this group as I get much support from my friends". She added that her participation decreases during college vacation due to poor phone network in her area.

Regarding recency of participation, few student-teachers (29%) stated that they actively participated in communities of practice over the last six months. A further 21% reported that they had only done so over the last one year while for 20% it was more than one year ago. One student-teacher explained that they became very busy after the first semester as they had to prepare for teaching practice in the second semester. "In this (second) semester, we have little time to use our phones. The code of conduct does not allow us to take or use mobile phones during teaching practice hence limited opportunity to access the internet". Another student-teacher observed that they made slight use of their mobile phones in the second semester because they had to work extra hard to ensure that they improve their final grades. He explained that, "I wanted to limit my social activities, and unfortunately that meant little use of my phone". He added that every student-teacher in their class aimed at obtaining a minimum average of credit for their degree. Recency of participation does not correlate with year of study, gender and discipline. During interviews, third-year student-teachers indicated that they were encouraged by one of their lecturers to join academic communities where they could share and discuss educational issues. One of them stated that "sometimes we work in groups in class, and these groups continue to exist through WhatsApp even after the specific objectives have been completed. Students bring out academic problems and we help one another to solve them". He further revealed that the lecturer encourages them to join communities comprising students from different institutions to promote diversity. With p-value = < 0.0001, there is a major gap in the figures for urban (66%) and rural (14%) student-teachers. Moreover, 33% of those who did not indicate their location of work claimed to have actively participated in CoPs in the last six months.

Discussion

The results have been discussed in terms of access and use of mobile devices as well as the heutagogical principles of interdependent learning, double- and triple-loop learning and participation in communities of practice.

Access and Use of Mobile Devices

While ownership of laptop computers is high among the student-teachers, there are few desktop computers available for student use at Domasi College. In general, few student-teachers tend to use computers in their studies. Gregson and Jordaan (2009) observe that there is limited integration of technology among teachers in the developing world. Budgetary constraints hamper innovation in education delivery in Malawi as academic institutions are unable to acquire appropriate technologies to enhance teaching and learning processes (Nkhokwe, 2017). Other experts argue that several factors including age, gender, experience, discipline of study and location influence the varying degrees of technology integration in education (Benner & Pence, 2013; Osei, Larbi & Osei-Boadu, 2014; Abukhattala, 2016).

The present study shows that a slightly higher percentage of the student-teachers own a mobile device than an earlier survey report that indicated 88% as the ownership rate for students pursuing tertiary education in Malawi (MACRA, 2014). This difference could be attributed to the increase in mobile phone access in Malawi over the past few years (see Porter et al, 2016) as well as the fact that over half of the respondents (about 75%) in the present study are in-service student-teachers who earn a salary and can afford a mobile phone. The results suggest that most of the student-teachers own Internet-enabled devices, whilst only a small percentage of the "laggards" (17%) does not own one. According to Rogers (2003), laggards are near isolates in social networks and tend to be suspicious of innovations and change agents.

Slightly over half of the student-teachers frequently use mobile devices in their studies. Currently, the results suggest that student-teachers in the late majority have started using mobile devices in their studies on a daily basis at the college. According to Rogers (2003), individuals in the majority make a decision to begin using technology as a result of increasing network pressures. Factors such as year of study, gender or subject studied tend not to influence daily use of mobile devices. Although the influence of gender on daily use of mobile devices seems insignificant, the uses differ between males and females. Whilst the male student-teachers use them for academic purposes, the female ones mostly use them for social purposes. However, discipline of study correlates with daily use of mobile devices as most of the fifth-year student-teachers and those studying science appear to use computers extensively. It is interesting to note that a majority of the student-teachers in these two groups own laptops. Previous studies indicate significant differences in technology integration across disciplines, with science teachers applying it more in their teaching than their humanities counterparts (Karaseva, Pruulmann-Vengerfeldt, & Siibak, 2015; Fry, 2006). Location of work also affects daily use of mobile devices as more student-teachers who work in urban areas use their devices for studies every day than those in rural areas. Some of the urban student-teachers appear to be opinion leaders who succeed in influencing the behaviour of their friends through peer-to-peer communication channels. The rural student-teachers face a number of challenges to use of mobile devices such as lack of electricity in their areas, which makes use of electronic gadgets almost impossible. In most rural areas in Malawi, people charge their mobile phones in shops at a cost. For such students, the use of mobile devices appears to compensate for the shortage of institutional computers and low Internet access among the student-teachers.

Extent of Heutagogical Practices

The results reveal that the student-teachers engage partially in interdependent learning as their study content is mostly determined by the lecturers. However, there is some autonomy as they can determine the study times on their own. These findings appear to corroborate the tendency towards teacher-centred education in Malawi (Chilemba & Bruce, 2015). Even though engagement in interdependent learning seems not to be influenced by year of study, the observations of fifth-year student-teachers vary with those in second year. The former feel interdependent learning is crucial in their studies while the latter think otherwise. Regarding location of work, more of the urban student-teachers engage in interdependent learning than those in the rural areas. As indicated earlier, prevailing conditions to promote interdependent learning are comparatively poor in the rural areas. According to Hase (2014), interdependent learners master skills related to information access, research procedures and knowledge validation. These skills are much needed by student-teachers in Malawi where libraries are under-resourced and individuals need to go online to access valuable academic content.

The student-teachers tend to engage in double- and triple-loop learning to a low extent. It appears that only innovators, early adopters and a few in the early majority practice double- and triple-loop learning at the college. The innovators are the student-teachers who are eager to try new ideas and their "venturesomeness" is almost an obsession; the early adopters have opinion leadership and act as role models in innovation; while the early majority are those who would adopt new ideas just before the average member of the college does (see Rogers, 2003). Engagement in double- and triple-loop learning is influenced by year of study. Surprisingly, more of the second-year student-teachers engage in double- and triple-loop learning to a high extent than those in third and fifth years. The fifth-year student-teachers were expected to engage more double- and triple-loop learning given their financial capability and increased access to computers and other devices. In relation to discipline of study, most science student-teachers engage in double- and triple-loop learning to a high extent than their humanities counterparts. The experiences of the science student-teachers depict self-reflective practices where individuals analyse their study processes and determine their appropriate learning strategies as part of double- and triple-loop learning.

Most of the student-teachers at Domasi College participate in communities of practice. These include online as well as face-to-face forums which deliberate on academic issues. However, the student-teachers' participation tends to be high for communities comprising students only. While being part of networks which include lecturers seems to be restricted to innovators and early adopters, participation in communities comprising students only appears to be common practice as student-teachers in the early majority and a few in the late majority seem to have joined the trend.

Comparatively, there is generally high engagement with only one heutagogical principle (participation in CoPs) unlike with the other two (interdependent learning and double- and triple-loop learning). This revelation points to the need for deliberate interventions by the college to create a conducive environment that promotes the use of mobile devices to facilitate interdependent learning as well as double- and triple-loop learning. Most universities prohibit the use of mobile phones in learning settings (Fernandez, 2018) and the level of infrastructure development does not support the application of mobile technologies (Ali, Shaame & Kombo, 2013). Additionally, the Internet bandwidth in academic institutions is significantly low and this inhibits access to online resources.

Since student-teachers at Domasi College and other similar institutions serve two complementary roles, the modelling of practices which support independent learning is important in colleges of education. In line with Blaschke and Hase (2016), through self-reflection, the student-teachers would become more aware of their preferred learning style and easily adapt to new learning situations, thus, enabling them to become more capable and self-reliant learners.

More of the older student-teachers in fifth year as well as those in urban areas participate in communities of practice to a high extent than those in second year and rural areas, respectively. The student-teachers presented situations where they were able to portray self-reflexivity and analyse their learning environment through identification of barriers and determination of appropriate decisions on how to improve their learning processes. Furthermore, some of the student-teachers' experiences relate to the mediated learning experience (Greenberg, 2000) as they ably engaged in analytical processes of their learning and determined novel ways of how to deal with barriers impeding heutagogical use of mobile devices.

Although the results show high participation of the student-teachers in communities of practice involving themselves, it appears that the participation slowed down significantly within the last six months before this study. Several factors influenced this decline such as the occurrence of teaching practice for those in third year, where use of mobile phones was not allowed, and commencement of the second semester in which they had to prepare for final-year examinations. It is intriguing that there were no variations based on year of study because most of the fifth-year student-teachers owned laptops and claimed to use computers extensively, unlike those in the lower levels. The third-year student-teachers revealed that their lecturers encourage them to join CoPs. Consistent with the extent of participation, recency of participation corresponds with daily use of mobile devices in terms of location of work with those based in urban areas registering a high rate. In Malawi, student-teachers working in urban areas have a greater chance to use their devices for academic purposes than their colleagues in rural areas due to the availability of a relatively good mobile network.

Conclusion

The study suggests that mobile devices, particularly mobile phones, present a unique opportunity for the integration of technology in teacher training programmes within the developing world. This is so as ownership of mobile phones seems almost universal among the student-teachers and most of them possess at least one Internet-enabled device. Additionally, there are generally positive perceptions towards the use of mobile devices as learning tools as well as high intention to use the devices in one's own teaching. To foster the development of interdependence and double- and triple-loop learning among student-teachers, training institutions need to create a conducive environment where learners are provided the freedom to define their own learning paths and determine individual learning styles. Such an environment requires the establishment of reliable Internet connectivity and formulation of favourable policies. Furthermore, there is a need to encourage student-teachers to join and actively participate in communities of practice where they would be able to enrich their academic potential through access to educational resources and interaction with experts in their field. The success of technology adoption in education also hinges on student-teachers being independent and reflective on their learning processes since they function both as learners (during their studies) and teachers (after graduation). There is further need for them to be creative and resourceful in accessing educational

content, and be able to determine their own learning plans and behaviours as well as identify ways to improve them.

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