EduLink: Connecting Educators across Namibia through a Learning Management System

May 2, 2018

Submitted by:
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An Interactive Qualifying Project submitted to the Faculty of Worcester Polytechnic Institute in partial fulfillment of the requirements for the degree of Bachelors of Science

Report submitted to:

Mr. Corris Kaapehi
EduVentures Trust

Dr. Alexander Smith
Dr. Aaron Sakulich
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IQP Report

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Abstract

Our goal was to assist EduVentures in improving teacher training at environmental education centers across Namibia by implementing a learning management system (LMS). Using interviews, a decision matrix, and value analysis, we identified and implemented Google Classroom. We also led training for environmental educators and EduVentures staff, and created user guides on the LMS. Its use will enhance teacher training and environmental education center operations by connecting all of the centers through one central virtual platform.

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- **The teacher interviewees,** Ms. Tjikumise, Ms. Hilen, Mr. Kasume, Ms. Uusik, and Maurice Nkusi
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Executive Summary

A major challenge in improving education for sustainable development (ESD) in Namibia is providing sufficient training for teachers. There are numerous organizations that promote ESD and teacher training, but a central training curriculum does not exist. Poor teacher training creates a lack of uniformity in environmental education (EE), a sector of ESD, for Namibian learners. While some learners have access to EE experiences through rural expeditions, other learners do not even have access to EE related content in their schools. This has the potential to negatively impact the development of Namibia as a country because poor EE training results in the adoption of unsustainable practices by students, who are ultimately the benefactors of this training.

The phrase sustainable development (SD) merged the concepts of social and economic development with environmental conservation (World Commission on Environment and Development, 1987). The main goal of SD is to meet the world population's current needs, without jeopardizing the capabilities of future generations to meet their needs. The United Nations Educational, Scientific and Cultural Organization (UNESCO) (2014) introduced ESD to promote the SD movement. Their view is that if children are educated on environmental conservation while growing up, they are more likely to incorporate sustainability into their values and daily practices.

Recognizing its own need to develop as a country and protect the environment, Namibia has outlined a clear agenda for promoting ESD in its education system. Non-governmental organizations (NGOs) in Namibia have also aided the government by expanding ESD content to more rural, disconnected areas of the country. Despite these efforts, many obstacles stand in the way of integrating environmental content into the Namibian educational curriculum, including a lack of an effective and unified teacher training program.

Our goal was to assist EduVentures in improving EE in Namibia through the implementation of a learning management system (LMS) for web-based training. The LMS will be used to develop teacher training curriculums with environmental educators (i.e. teacher trainers) while improving the teaching skills of these educators. The system is an online platform where educators can access resources on EE and pedagogical methods, as well as collaborate in an effort to support one another. Educators can then use this information to train teachers on how to teach EE to their learners, which allows the content to reach a wider range of teachers and learners, improving EE across Namibia.

To achieve our goal, we established three objectives. We first identified the requirements of an LMS that fit the needs of EduVentures, educators, and teachers. Second, from this information, we then decided on an appropriate LMS and implemented it. Finally, after setting up the LMS, we ensured the long-term use of the system by training educators and EduVentures staff on how to use the system, and developing promotional material and user manuals.

We achieved our objectives using methods including interviews, a decision matrix, and value analysis. We first interviewed stakeholders including EduVentures staff, Namibian educators, teachers, and learners in local schools. The information that we gathered in these interviews helped us determine the user requirements of an LMS and understand how the system will be used in the future to improve EE.

Taking into consideration the feedback from interviews, we developed a decision matrix. We compared each requirement in order to prioritize the user needs for an LMS and determine the weights of every requirement. Ease of maintenance and personalized pages had the highest weights, while announcements and mobile app features had the lowest weights because of how interviewees emphasized or de-emphasized them.

We then developed a list of 32 potential LMSs through communication with the Academic Technology Center at Worcester Polytechnic Institute, literature review, and online research. We narrowed down this list by identifying five requirements that were critical to our LMS, and if a system did not meet one of the requirements, we eliminated it. This technique aided us in narrowing down the list to only seven systems.

After this, we used value analysis to determine the top LMS out of the seven remaining systems. We rated the LMSs based on their adequacy in meeting each of the user requirements then adjusted those scores based on the weights determined through the decision matrix. This ensured that systems that met high priority requirements were given a higher score than systems that met low priority requirements. We identified that the most appropriate system for EduVentures would be Google Classroom, Edmodo, or The Academy because they scored the highest in the top requirements.

Next we presented the EduVentures staff with the top ranking systems. They decided Google Classroom and Edmodo were the top two possibilities and asked to receive training on both systems. We developed a workshop for the systems, dedicated a day to walk the staff members through how to use them, and discussed the strengths and weaknesses of each system. After gaining an understanding of the

LMSs, EduVentures decided that Google Classroom would be the best LMS to implement due to its simplicity and ability to be expanded in the future.

After EduVentures made this decision, we prepared for a workshop with environmental educators from across Namibia. EduVentures invited us to travel to Waterberg Plateau Park and use their mobile classroom to teach the educators about how to use the system and what the system will be used for. At the workshop, we taught the educators how to easily navigate the virtual classroom both online and on a mobile device. We also developed a user guide with instructions and screenshots detailing how to perform tasks on the system like posting an announcement or taking a quiz. This experience helped us gather feedback on features of the LMS that the educators struggled with and features that they enjoyed. In addition, we gained insight into how they would like to use the system in the future. Following this, we created an administrative guide for EduVentures to provide them with instructions on how to be a teacher on Google Classroom, including tasks like how to review the progress of students and how to upload material.

As a final step to this project, we developed a set of recommendations for EduVentures to use as guidelines for expanding the LMS across Namibia and ensuring its prolonged use. We first recommend that EduVentures continually work to expand the system by developing additional features that further enhance the educational experience for the educators. Potential features that could improve the LMS are a Flash File Player to aid ease of use and a data analytics tool to enhance progress tracking.

Additionally, we recommend that EduVentures expands the LMS to facilitate educator-teacher training, as well as teacher-learner education. After an educator performs teacher training at an EE center, they could follow up on this training through the LMS using features such as mobile updates to continue communication. The system can also expand upon education in schools by enabling learners to take online assessments and communicate with their classmates and teachers outside of the classroom.

We also developed a set of recommendations for the A Term 2018 IQP group coming to Namibia to aid them with providing the most useful content for the system. We recommend a list of people to talk to while in Namibia since we found that these people had many ideas and opinions on the content that should be included in the LMS. We also described how the educators would like to use the system to establish a set curriculum on how to educate teachers. Additionally, we discussed what type of content would be most beneficial to the educators, including topics like various environmental issues and pedagogical approaches.

For our project we developed a comprehensive LMS for EduVentures that met the needs of the stakeholders and had appropriate documentation for easy maintenance and use. One of our most important criterion was that the LMS was able to operate well beyond the duration of our project. The use of Google Classroom will make ESD easier to integrate into the education system. This integration will instill values of SD in children and, over time, into Namibian society, which will allow for the country's sustainable growth in the future.

Authorship Page

Aatreya Chakravarti - Aatreya served as the technical expert for our project, focusing on the LMS implementation and background. In the report, he ensured that all of the details relating to the functionality of the LMS were properly explained. Additionally, he was a contributor to both the user guide and administrator manual.

Eve George - Eve served as the main interviewer for the project; she created interview questions and helped facilitate conversation with the interviewees. In the report, she wrote about the motivations and methods for conducting interviews. She was also a contributor to both the user guide and administrator manual. Additionally, she created the promotional video on the workshop at Waterberg.

Daly Place - Daly served as a primary contributor for our report and took the lead on creating presentations throughout the project. In the report, she wrote both the introduction and results sections. Additionally, she developed a plan and training material for our workshop on the LMS.

Jennifer Vandervort - Jenna served as the main editor for our report, focusing on content, as well as editing. She performed the final review before each submission. In the report, she took the lead on the executive summary and recommendations. Additionally, she was a contributor to the user guide.

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Glossary

Educators – An environmental educator who works primarily with learners, but can also lead trainings for teachers as well.

EE – Environmental Education

ESD – Education for Sustainable Development

Learners – Local vernacular for the noun “student” of children in grades K-12.

LMS – Learning Management System

NaDEET – Namib Desert Environmental Education Trust

NGO – Non-Governmental Organization

NUST – Namibia University of Science and Technology

SD – Sustainable Development

SSO – Single Sign-On

Teachers – A person who teaches in schools, in direct interaction with the learners in a classroom setting.

UNESCO – United Nations Educational, Scientific, and Cultural Organization

UN – United Nations

Chapter 1: Introduction

Well-educated citizens are better equipped to contribute to the development of their country (Hopkins & McKeown, 1999). Moreover, citizens with a good environmental education contribute to the sustainable development (SD) of their country. This can be accomplished through education for sustainable development (ESD), in which key SD topics are integrated into school curricula (UNESCO, 2010). The intention of ESD is for younger generations to preserve the environment as they develop their society. ESD is particularly important in developing African countries that are struggling to maintain their ecological diversity (Kyle, 2006).

There has been a variety of ESD work done throughout Africa (Malakwen, 2005). For example, in Kenya, the government has identified ESD as an important pillar in increasing the development of its citizens and has worked to integrate ESD into all learning levels. In South Africa, the government has established concrete ESD policies in its constitution in an effort to address the rapid depletion of natural resources. For this reason, South African educational standards are framed to transform society and sustainably advance standards of living (Teise & le Roux, 2016).

Namibia is a developing country in southwest Africa and has been a sovereign nation for 28 years. In 2004, the Namibian government published Vision 2030, an outline of the country's development programs and strategies (Namibia, Office of the President, 2004). In Vision 2030, the Namibian government emphasizes "education for all," demonstrating that the government understands the importance of a proper education for the development of the country. Additionally, many educators (i.e. teacher trainers) across Namibia understand the importance of environmental education (EE) as an aspect of ESD. To improve EE across Namibia, EduVentures, a Namibian environmental education trust, plans to connect a network of EE centers throughout Namibia. They then intend to train each of these centers on how to lead teacher training, the hope being that when more teachers are trained on EE, more learners across the country will be exposed to it. EduVentures has titled this project "EduLink".

To connect all of these centers around one central teacher training, EduVentures' goal was to implement a learning management system (LMS). An LMS is a web-based software that improves education for users by providing them with learning tools such as discussion boards and supplemental resources, and allowing them to learn at their own rate (Mtebe, 2015). In developing countries in particular, LMSs have become increasingly widespread as they build upon traditional classroom teaching by providing learners with supplemental education material. Because of the numerous benefits

of these systems, today they are considered to be a crucial component in many places of learning (Kim & Do 2016).

Educators across Namibia currently have no central platform to which they can go for educational resources and useful pedagogical practices on educating teachers. EduVentures Trust recognized that an LMS can be used to train and support environmental educators. Our goal was to identify and implement an LMS that fit the needs of EduVentures and Namibian EE educators. We first considered the specific requirements outlined by EduVentures that we determined through interviews with key stakeholders, then we narrowed down the available LMSs accordingly. We performed these interviews with the staff of EduVentures, educators who will be using the LMS, and teachers and learners throughout Windhoek. Using the results of the interviews, we chose an appropriate LMS, Google Classroom. After this, we held training sessions, created guides and manuals, and made a promotional video on the LMS workshop that we held for educators. Moving forward, we recommend that EduVentures use Google Classroom regularly and in the future expand the content within the system to further enhance education. Our research assisted EduVentures Trust in improving the quality of EE training and subsequently ESD content across Namibia.

Chapter 2: Background

Since its independence, Namibia's government has been working to develop the country sustainably. However, there are insufficient education for sustainable development (ESD) training tools available for teachers. One tool that can help provide teachers with important information and support is a learning management system (LMS). In this chapter, we will begin with a discussion of sustainable development (SD) and ESD. In section 2.2, we expand on ESD examples and initiatives in African nations. Additionally, we explain ESD work occurring in Namibia as well as teacher training practices. Finally, in section 2.3 we present LMSs, their uses, and features.

2.1 Sustainable Development

SD was defined in a public report by the World Commission on Environment and Development (1987) as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (p. 41). These 'needs' refer to the essential requirements of human beings including food, clothing, shelter, and jobs.

SD is comprised of three interwoven pillars: economic, social, and environmental (Sachs, 2015). While each pillar covers a distinct topic, successful SD cannot occur without the simultaneous development of each. For example, growth in the economy lifts citizens out of poverty and can result in the development of a nation in other sectors, such as social and environmental. On the other hand, ecological destruction often occurs when the economy grows without industries considering their impact on the environment (Iacod et al., 2015). Additionally, in developing areas of the world, there is a recurring problem of over-exploitation of environmental resources because they are often the main source of livelihood for citizens (Teodorescu, 2015). Developing populations need to address their immediate concerns such as poverty or hunger before they can worry about maintaining a sustainable country in the future. To ensure that citizens have a source of income that does not involve unsustainable exploitation of natural resources, alternative sources of income must be created to maintain or raise the standard of living. Effective social development, such as finding alternative sources of income, plays a role in the continuing efforts towards SD as a whole.

2.1.1 Education for Sustainable Development (ESD)

It is important to promote education in order to address the three pillars of SD (Teodorescu, 2015). This educational approach is based on the idea that a better educated population will be more conscious of the impact their actions have on the environment. Educating younger generations on the pillars of SD, as well as their impacts, will help lead to a more sustainable future (Hopkins, 2012). This idea has been defined as ESD. The United Nations (UN) definition for ESD is:

> *Education for sustainable development means including key sustainable development issues into teaching and learning; for example, climate change, disaster risk reduction, biodiversity, poverty reduction, and sustainable consumption. It also requires participatory teaching and learning methods that motivate and empower learners to change their behaviour and take action for sustainable development. Education for sustainable development consequently promotes competencies like critical thinking, imagining future scenarios and making decisions in a collaborative way (UNESCO, 2010, p. 10).*

This definition highlights the two main aspects of ESD, which are content and pedagogy (Hopkins, 2012). Content refers to a diverse range of subjects, while pedagogy refers to teacher-learner interactions that create a successful learning environment.

2.1.2 Obstacles to ESD

There are many obstacles that prevent ESD from being successful. In developing countries, it is often difficult to get students to engage in the content (Winston Soboyejo, personal communication, Jan. 25, 2018). This is largely attributed to an idea from Maslow's hierarchy of needs, which states that if basic needs, such as food and water, are not met, it is not possible for learners to even consider focusing on higher order issues like education (Maslow, 1943). Additionally, if education is not emphasized at home, the learners are often less invested in the classroom content (Shari Weaver, personal communication, Feb. 2, 2018). This problem applies to all categories of education, but is especially noticeable in the realm of ESD.

For teachers, it is often difficult to reach all learners in their classroom because attitudes towards sustainability can vary (Henley, Maloni, Maphsin & Swaim, 2014). There is a "range of opinions [among learners] regarding the legitimacy of environmental objectives" (p. 24), which is said to be

dependent on their varied upbringings and lack of previous exposure to the topic. When learners do not believe that environmental movements are legitimate, they are less likely to engage in the topic.

It is common for education to only focus on one or two SD pillars due to lack of funds and resources (Wade, 2015). For this reason, educational resources may not support all parts of SD, causing a discrepancy in what is taught through ESD curriculum. For example, it is typical to see high-consuming countries link their sustainability efforts to social development agendas, while in less developed countries sustainability education is more centered on a concern for natural resource management.

Additionally, resource limitations, such as lack of proper funds, make it difficult for developing countries to promote sustainability education policies (Kaivola & Cabral, 2004). Poorly trained teachers may teach content that is flawed or inaccurate. In addition, with weak technological infrastructure, teachers may not have the opportunity to frequently collaborate with other teachers and educators. Without this, teachers tend to be unfamiliar with successful ESD content and pedagogical techniques that could prove effective in their classroom. This leads to a lack of diversity of ideas within classrooms, which can weaken learners' understanding of how ESD can improve their country.

2.2 Improving ESD in Africa

Across Africa, there have been numerous environmental issues due to unsustainable practices. The UN has taken a leading role in addressing these problems, in part by declaring 2005 to 2014 as the 'Decade of ESD' (Kameri-Mbote, 2011; UNESCO, 2010). One of the goals of this movement was "to assist Member States and stakeholders in their efforts to re-orient existing education programs [towards ESD]" (p. ii). This global initiative has been the catalyst for the introduction of national policies throughout Africa promoting ESD (Malakwen, 2005).

The ESD movement has gathered great momentum in Africa. The Kenyan government has identified ESD as a means of increasing the development and social mobility of its citizens (Malakwen, 2005). By educating Kenyan youth on trade skills, the government enforced that SD is not just about current, but prolonged economic development. In South Africa, the government has established ESD policies in its constitution to address the rapid depletion of resources (Teise & le Roux, 2016). To enforce this, "the entire education agenda (which includes education policy and practice) is geared towards transforming society and improving lives in a sustained manner" (p. 68), which emphasizes SD in the day-to-day activities of citizens. Support for ESD has also come from sources other than

specifically ESD policy. For example, the Nile Basin Initiative, a program undertaken by Egypt and other Nile riparian states, has supported ESD by furthering the conservation and sustainability of the Nile (MESA Universities Partnership & UN Environment, 2007).

2.2.1 ESD Initiatives in Namibia

In Namibia, the Ministry of Education has been working to correct the educational deficit inherited from the Apartheid era. They have put an emphasis on educational reform in a variety of aspects including equal opportunity regardless of race, gender, or age, as well as quality of teacher education (Ministry of Education and Culture Namibia, 1992). Under the banner of "inclusive education," the government has promised to provide education "free from discrimination and strongly secured in the values of social justice, equality and human rights" (Chinsembu et al, 2015, p. 2). These actions effectively address the economic, social, and environmental aspects of sustainability, creating a strong foundation for ESD in the years to come.

In 2004, the Namibian government expanded on its countrywide initiatives with the publication of Vision 2030 (National Planning Commission, 2004). This document specifies that the country will provide high quality education to all citizens on par with international standards, which will help Namibian learners compete in the global environment. It also highlighted Namibia's SD goals, which opened the door for ESD throughout the country.

To build on ESD in Namibia, numerous private and public organizations have been implementing supplemental education initiatives to add to learning in a traditional classroom setting. In addition to non-profit organizations, there are environmental education (EE) centers at many public parks across Namibia that are overseen by the Ministry of Environment and Tourism. These locations include Waterberg, Etosha, Swakopmund, and more. These centers invite citizens from all age groups to participate in different EE workshops. Some of these workshops already exist, while some locations are still in the process of setting up a program. The content of these workshops depends on the location or mission of the center. For example, workshops at the National Marine Aquarium of Namibia would focus on the importance of sustaining marine life, while workshops at the Namib Desert Environmental Education Trust (NaDEET) emphasize the value of learning about sustainable living using natural desert resources. This includes topics such as solar cooking and recycling old goods into useful household products.

Unlike the fixed EE centers, EduVentures travels to the learners, rather than bringing learners to their location. They do this with their Ombombo mobile classroom, which has desks for learners and an interactive SMART board for instructional use. Learners are led in an afterschool program for two weeks that supplements their schooling on ESD content. In the past, local teachers sat in on the lessons taught in the mobile classroom and eventually, teachers began to ask if they could have their own training on sustainability.

This request has led EduVentures to their EduLink project. The goal of EduLink is for more teachers to receive ESD training. To do this, EduVentures has partnered with the government-run EE centers across Namibia. At these centers, there are educators who lead environmental classes primarily for learners, but occasionally for teachers and community members. EduVentures plans to unite all of these centers by using a LMS that will contain web-based training for educators on how to teach Namibian teachers (Figure 1).

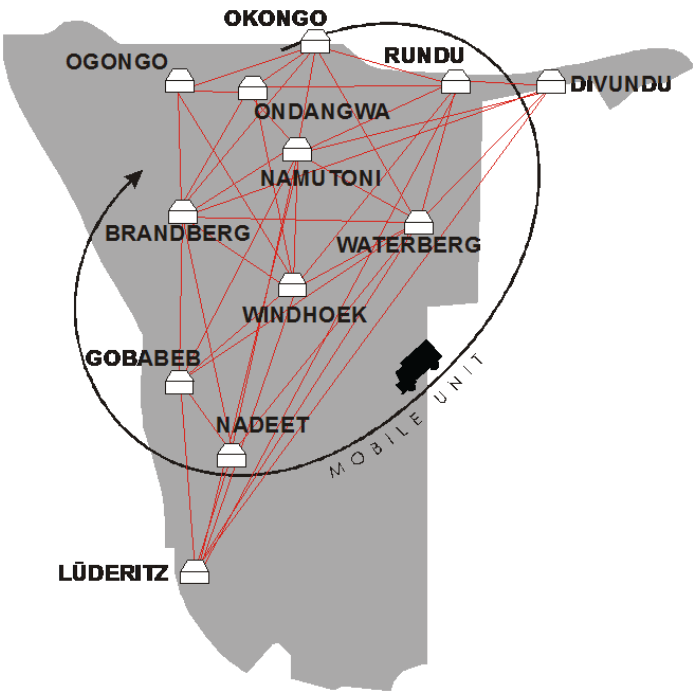

Figure 1: EduLink training center map (EduVentures, 2017a)

After the training, educators lead a pilot teacher training along with an EduVentures staff member. EduVentures hopes that once the initial educator training has occurred, each center will hold two teacher trainings a year. Additionally, the LMS will contain resources from all of the training

centers for users to easily access, which will enable them to use the material even after they leave the training.

2.3 Learning Management Systems

An LMS is an educational platform with features that allow users to access resources and communicate with other users (Kim & Do, 2016). Since an LMS is web-based, anyone with internet can have access to this content, which enhances education.

2.3.1 Uses of Learning Management Systems

LMSs are an online location for educators to upload course material and for learners to gain a more in-depth understanding of concepts (Unwin, 2010). Diverse material, including videos, lectures, announcements, and documents, can be uploaded and users can access digital resources from around the world (Kim & Do, 2016; Unwin, 2010). Additionally, LMSs facilitate interaction between learners and teachers outside of the classroom by providing learners with a simple tool to upload assignments, and allowing teachers to track and assess learner performance (Kim & Do, 2016). These features can be useful tools to supplement traditional teaching methods. This is especially important in developing countries such as Namibia, where adequate resources for primary and secondary education, and teacher training, are not uniformly available.

While an LMS can be beneficial, there are challenges that come along with its use. Internet access, among other infrastructure, is necessary for an LMS to operate at its fullest potential (Unwin, 2010). Many education centers in developing African nations, especially in rural areas, might not even have computers, rendering an LMS ineffective. Another challenge of using LMSs is the users' lack of familiarity with the systems. Many teachers are not aware of the benefits of online learning and often initially view it with skepticism because it can be difficult for teachers to adopt these new practices. However, even teachers who are more open-minded to e-learning are sometimes unaware of what it truly means. A survey conducted by Unwin (2010) in 25 African countries regarding their use of online learning found that many teachers who thought they were using e-learning techniques were not actually doing so. Instead, they were simply using the internet to find information or using email as a form of communication. In addition, a study at the National University of Science and Technology of Zimbabwe found that only 20% of learners and teachers use the LMS that has been installed at the school (Mtebe, 2015). This trend of limited usage has also been seen in educational institutions in Uganda, Kenya, and

Tanzania. This problem could be attributed to a lack of awareness about LMSs, as well as a hesitancy to adopt an unfamiliar teaching method.

Another potential drawback is that LMSs can widen the gap between the rich and poor (Unwin, 2010). Schools in wealthier communities have better infrastructure and access to resources, so they can afford to provide electricity, internet, and computers to their teaching staff and learners. Because of this, schools in richer areas would be able to pull further ahead of schools located in poorer areas. This causes the schools that are already struggling to provide quality education to fall further behind. In turn, this creates a lasting impact on society as successful education leads to better prepared learners.

2.3.2 Features

There are two types of LMSs: open-source and closed-source. Open-source systems are generally free to use, customizable, and can be altered based on user preferences at a low cost (Machado, 2007). However, open-source systems lack technical support from their parent companies, meaning that, in order to successfully implement such systems, there must be technically trained staff. This may result in a need to hire new staff or extensively train the current staff.

Server hosting infrastructure is also an important requirement. Many open-source systems require that a server be provided by the administrator separately to host the LMS (Van Gieson, 2016). In this scenario, the administrator can either rent, share, or purchase a server depending on the number of users they expect to be on the server at any given time. Open-source proprietary software might provide server hosting services for an additional cost, whereas closed-source systems often incorporate the cost of server hosting into the package fee (Totara, 2015). Depending on which server hosting route the administrator chooses, the authorized login feature may be integrated or may have to be added in independently

Additionally, the content upload feature depends on the LMS implementation. Some systems allow direct content upload onto their servers, while others use links to redirect users to an alternate website to view the content (e.g. cloud folders such as Dropbox or Google Drive) (Van Gieson, 2016). Most other features are offered through extension software, which are third-party products that can be added to the LMS to enhance the user experience. For example, there are many websites that offer online assessments on various topics for learners. This software can be integrated with the LMS to allow teachers to assess the learners online.

Chapter 3: Methodology

Our goal was to assist EduVentures in improving environmental education (EE) in Namibia through the implementation of a learning management system (LMS). To accomplish this, we first had to identify and implement an appropriate LMS to host web based training for environmental educators across Namibia. Then we created training material for EduVentures and educators on how to use and maintain the system. The deliverable of our project was an LMS that can be used well into the future. To help achieve our goal, we focused on a series of objectives:

Objective 1: Identify the requirements of an LMS that fit the needs of EduVentures
Objective 2: Implement an appropriate LMS
Objective 3: Ensure the long-term use of the system

To achieve these objectives, we first identified the needs and requirements of EduVentures, educators, and teachers. We then determined the best system through a series of analyses, set up the system according to user needs, and made training material on how to use and maintain the system. In the following sections, we describe our methods, why we chose them, and what we accomplished with each of them.

3.1 Identify the Requirements of an LMS that fit the needs of EduVentures

To determine the requirements of the LMS, we performed a series of interviews with EduVentures staff, educators, and teachers. Additionally, as students who are not from Namibia, we used interviews with teachers and learners to gain a basic understanding of local education.

3.1.1 Learner Interviews

While learners in Namibia will not be interacting with the LMS, we interviewed them to gain a better understanding of the Namibian education system in general and learner attitudes towards ESD. We interviewed two learners at Concordia Secondary School in Rocky Crest, Windhoek and five learners at A. Shipena Secondary School in Katutura, Windhoek, and asked questions such as:

1. Do you learn about nature in school? If so, what have you learned and why? Do you like learning about nature?
2. What things do you enjoy most about your teachers?
3. What things do you wish your teacher would change?

These questions helped us understand the perspective of the learners, which was important as they are the ones who will ultimately be experiencing the benefits or drawbacks of the system.

3.1.2 Teacher Interviews

Similar to student interviews, teacher interviews allowed us to better understand the educational environment and common teaching practices. Additionally, they gave us a better understanding of computer literacy and requirements of an LMS. We interviewed four local teachers and asked them questions about their teaching practices. We visited Concordia Secondary School where we interviewed Ms. Tjikumise, a German language teacher, and Ms. Hilena, a math teacher. In addition, we visited A. Shipena Secondary School where we interviewed Mr. Kasume, a physical science and agriculture teacher, and Ms. Uusiko, a geography teacher. Our questions focused on what the average school day entails and how comfortable they were operating certain computer software. Specific examples of questions that we asked included:

1. What does a typical day look like for the students in your classroom?
2. What computer programs do you use regularly? What do you use while you are teaching?
3. How are you currently trained by teacher trainers? Do you have internal training programs for your school, and if so how often? Or, do they send you training material often, or anything of the like?

Our questions helped us understand how their teaching could be facilitated by an LMS, as well as their familiarity, if any, with LMSs. All of this information helped us determine the level of complexity of the system that we selected.

3.1.3 Educator Interviews

Meeting the needs of the educators was essential, as they are the primary users of the system. We traveled to EE centers in Swakopmund and Waterberg to conduct interviews with educators. In Swakopmund, we interviewed staff members at the Namib Desert Environmental Education Trust (NaDEET). We also visited the National Marine Aquarium of Namibia, where we talked with Gerson Katupose, the Environmental Education Officer. In Waterberg, we interviewed Martha Kambkidi, the Environmental Education Warden of the Okatjikona Environmental Education Facility. Following this, we performed an interview with Vilho Absalom, the Environmental Education Warden from Etosha National Park. These educators work on EE programs for school-aged children, community groups, or teachers. The interviews with these educators gave us a better understanding of features they would need in a system. And finally, our last educator interview was with Maurice Nkusi, the Acting Director of the Teaching and Learning Unit at the Namibia University of Science and Technology (NUST) in Windhoek. Since Mr. Nkusi implemented the LMS at NUST, his interview gave us overall technical guidance for the process. Below are some example questions from our interviews:

1. Do you currently communicate often with other teachers around Namibia, or share ideas/experiences with them about teaching? If so, how does this happen?
2. How do you currently train teachers? Do you have in person trainings, and if so how often? Or, do you send them training material often, or anything of the like?
3. How familiar are you with LMSs, and their ability to facilitate discussion amongst teachers and teacher educators?

In these interviews, we learned how the educators instruct teachers and how a virtual platform could improve this practice. We determined the educators' technical skills to better understand what type of LMS would best compliment their teaching methods. Furthermore, we acquired information regarding what content could be communicated through the LMS. This information helped guide our selection of a system by providing us with guidelines for the specific teacher training material desired in the system. It also provided us with insight into the best way to deliver and communicate the material, which helped us prioritize the user features.

3.1.4 EduVentures Staff Interviews

It was important for us to understand the expectations of the EduVentures staff, as they are the ones who will maintain the system. We interviewed Corris Kaapehi: Program Manager, Benson Muramba: Chairman of the Board, Holger Vollbrecht: Project Coordinator, Maria Johannes: Educator, and Sophie Nuuyuni: Educator. Corris Kaapehi was our main sponsor, so identifying his specific goals for the LMS was especially important for determining the needs of our project. Below are examples of our questions:

1. What do you see as the biggest problem that you would like the LMS to solve?
2. Do you have any specific features of an LMS in mind that you know you would like the LMS to have?
3. How do you plan on supporting the infrastructure of the system?

This interview helped determine the staff's expectations for the LMS such as the desired infrastructure, the required features, and the capacity in which EduVentures planned to use the system. All of this knowledge helped guide our selection of an LMS by providing information about which features would help EduVentures meet their goal of connecting ESD initiatives across Namibia.

3.2 Implement an Appropriate LMS

Since our goal was to create a solution that could be used by all educators and EduVentures staff members, it was important that the system met educator and administrator (i.e. those maintaining the system) needs. We used a decision matrix to ensure that all these needs would be met, and to determine the relative importance of features. We also used a spreadsheet filtering technique and value analysis to compare and analyze different LMSs to appropriately select a system.

3.2.1 Decision Matrix

Our first step to assess the relative importance of each user requirement was creating a decision matrix. This helped us prioritize the user needs discovered in interviews in a list by comparing each requirement to the others in a matrix format. We listed each requirement on the headings of both the rows and columns, and we compared the two at their intersection. We gave a score of one if the need in the column was of greater importance than the need in the row. If this was vice versa, we marked the

cell with a negative one. If the two requirements were of equal importance, we gave the cell a score of zero. We used the sum score of the row for each user requirement to rank the requirements overall, with the highest score being the most important. Once we calculated the sums, we made them all positive by adding 11 to each score since the lowest score was -10. Then, we divided each calculated score by the sum of all the newly calculated scores to give each requirement a weight. This ensured that the requirements with higher rankings would have more influence in the decision process.

3.2.2 Compare and Contrast

When we searched for an LMS, there were many systems that had the potential to benefit educators. Our first step was to compile a large list of 32 potential systems. We did this through communication with the Academic Technology Center at WPI to find out their list of potential systems. We then added to this list through related literature review and online research.

To choose a system, we first used a compare and contrast technique to narrow down our larger list, then performed value analysis to make the final decision. The first technique rated the list of 32 potential system based on five critical user requirements. These critical requirements were features that were absolutely necessary for a system, which we determined through our interviews. They were personalized pages, cost, implementation time, mobile updates and a mobile application version of the software. We researched each of the systems specifically regarding these criteria, and entered our findings into a spreadsheet. If an LMS was a poor performer in more than one of the first three categories and did not have either a mobile update or mobile app feature, we categorized it as “not at all possible” to implement. If a system had most, but not all of the features, we categorized it as “maybe possible.” For any system that met all of these requirements, we categorized it as “definitely possible” to implement. Through this method, we were able to eliminate 25 systems as possibilities for reasons such as high cost or extensive implementation time.

Once we had narrowed down this larger list, we performed a value analysis of the remaining seven systems. We compared all user requirements including ease of maintenance, progress tracking capabilities, and classroom discussions to rank the LMSs based on their adequacy in meeting these requirements. To perform the value analysis, we listed the user requirements in the left-hand row headings and listed each prospective system in the column headings. If the system did not have the specified requirement, we gave it a score of zero. If it had the feature and was an adequate performer in that feature, we gave it a score of 50. If the system had the feature and excelled in it, we gave it a score

of 100. This technique enabled us to quantify qualitative data by putting a numerical value on a system's performance for every feature.

Using the prioritized list of requirements that we created using the decision matrix that we outlined in section 3.2.1, we gave each requirement a weight from zero to one, where the sum of all weights added up to one. More important requirements such as personalized pages and ease of maintenance had a higher weight, and less important requirements like mobile app and announcements had a lower weight. We then found the total scores for every system by calculating its weighted sums using the scores from the value analysis and the weights from the decision analysis. We calculated this by multiplying the score for a requirement of each system by its weight. This score ensures that higher priority requirements are given higher consideration in the decision making process. We did this for every requirement for every system, and then calculated the sum of these values for each LMS. Next we compared the total scores to determine which system was best suited for the users.

After we completed the value analysis and identified our top systems, we presented EduVentures staff with the final options. We discussed their features, reviewed tutorials, and answered the staff's questions. Along with the staff, we were able to narrow the possibilities down to two systems. To aid EduVentures with making the final decision, we held a workshop on both systems. We created example modules, quizzes, and discussion boards to give them a chance to interact with and test each system. After reviewing the strengths and weaknesses of each system, EduVentures staff made the final decision about the most appropriate LMS.

3.3 Ensure the Long-Term Use of the System

To ensure the prolonged use of the system, we developed training and promotional material for users. This helped us to meet our project goal of aiding EduVentures in having a sustainable impact on education in Namibia. To help users understand how to maneuver the LMS and to promote it, we created a user guide, administrator manual, and promotional video.

3.3.1 Training on the System

To train educators and EduVentures staff on how to use the LMS, we had to understand the system. We researched documentation on the LMS and referred to help tutorials, if any existed. In addition, we tested the system and learned how to use it. This enabled us to not only have a solid understanding of how the system worked, but also to determine the functions of the system that could be

most difficult for users to understand. These findings helped us decide how to best educate others about the system.

Once we implemented the software, we trained educators and EduVentures staff on how to use it at a workshop held by EduVentures at the Okatjikona Environmental Education Center in Waterberg. Ten educators came to the workshop, where we demonstrated how to perform tasks on the system, such as creating an account, posting announcements, and taking online assessments. During the morning session, we taught the educators how to use features on the online application. We then created a few assignments for the educators to practice these features (Figure 2).

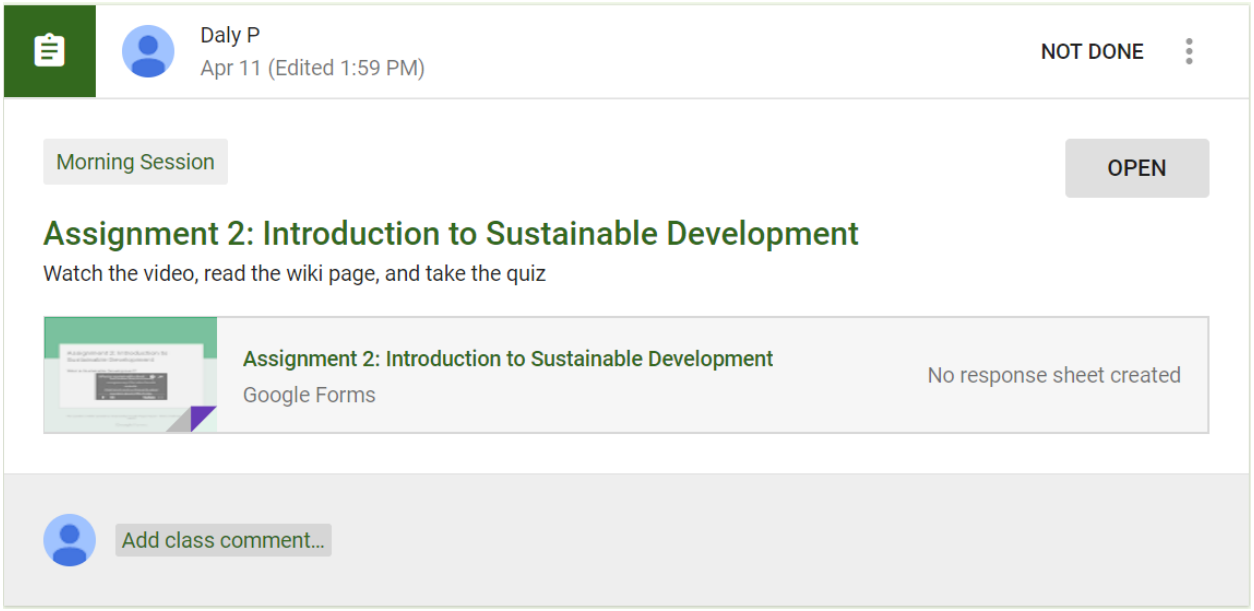

Figure 2: Example assignment from workshop

During the afternoon session, we trained the educators on the details of the mobile app, and went through all topics that we covered during the online training. We walked through topics such as how to download the app and how they could receive notifications on their phone. Similar to the morning session, we then asked the educators to practice the features of the mobile application. This test run allowed the users to try out the technology before it was officially implemented.

At the end of this workshop, we used interviews and feedback forms to collect feedback from users on the areas of the system that they found the most difficult. The interviews and surveys asked them about the features they enjoyed the most, the features they had a hard time understanding, and their thoughts on the shortcomings of the system. Below are examples of our questions:

1. How easy was the system to use? How easy was it to take a quiz?
2. What would you like additional training on?
3. What features did you like? What features did you find challenging?

This gave us insight into how we could provide the most useful material for the educators and EduVentures staff in order for them to become knowledgeable and comfortable with the software.

We analyzed the feedback forms by creating a spreadsheet to keep track of the results. We used the data to make pie charts and looked for common themes regarding which features the users struggled with and which ones they enjoyed. We were able to pinpoint a few key features that people generally found challenging, and used this information to provide as much assistance as possible to users with the training material.

3.3.2 Maximizing Utilization of the System

It was important that administrators at EduVentures could maintain the final product after we left. Lindsey Van Gieson, a staff member at the Academic Technology Center at WPI, said that if teachers do not understand how to use the system, they will not see a need to use it (personal communication, Feb. 2, 2018). They will also tell others that it is hard to comprehend, which spreads negativity about the system. To prevent this, we created a user guide and administrator manual on the use, management, and upkeep of the LMS, building on documentation that was already provided by the parent company. This documentation tended to be convoluted, so we aimed to clarify the most important directions based on difficulties that we identified from user feedback. EduVentures has to maintain the system, so the training material also included instructions for EduVentures on the management and upkeep of the system. We compiled all of this information into a comprehensive, easy-to-follow user guide and administrator manual geared towards the Namibian educators and EduVentures staff.

Training material related to the LMS was important because while we were able to show EduVentures staff and some of the educators the basic functions of the system, the LMS must be sustainable, even if EduVentures hires new staff. It would be difficult for their staff to have to spend time training future staff on how to use the system. Therefore, providing EduVentures with training material will save them time in the future and enhance the quality of our final product.

We also created a promotional video showing highlights of the workshop that we held for the educators. We created this video by capturing footage during the training, including interviews and videos of the educators using the software, and using iMovie to edit the clips into a final product. This video helped to market the LMS and ensure enthusiasm for its use long into the future.

Chapter 4: Results

In this chapter, we present our findings from stakeholder interviews, show how we chose a learning management system (LMS) for EduVentures, and explain the training material that we provided. In the first section, we summarize our key findings from the interviews and outline which features we looked for in a system. In the second section, we discuss how we analyzed and determined the weights of features discussed in the interviews to choose a system. In the final section, we explain the user guide and administrator manual that we created for EduVentures and educators on how to use and maintain the system.

4.1 Identify the Requirements of an LMS that fit the needs of EduVentures

Teachers in Namibian schools are struggling with a lack of resources. One classroom at Concordia High School, where we held an interview, had desks that were old and worn down and a few colorful posters were displayed on the walls (Figure 3). The teachers at A. Shipena High School shared that there were only five overhead projectors to share between all the teachers. They added that there were shortages of supplies such as paper and writing utensils. Additionally, internet access was only available in the main office of both schools. Despite all of this, teachers shared that they were willing to expand their knowledge of EE.

Figure 3: Desk at Concordia High School

Despite the lack of resources, learners we spoke with still aspired towards promising futures, such as careers in surgery, veterinary science, and more. These learners often make sacrifices in order to pursue their education. For example, one learner we spoke with at A. Shipena High School was from the

northern border of Namibia and was taking her first trip home in months for Easter. To accommodate learners from far away, the high schools have hostels, so some learners only return home on long school breaks. Learners are not limited to high schools by proximity, meaning they can attend any school throughout Namibia.

Namibian high schools have no specific EE courses and the closest content is in agriculture or geography classes. At Concordia High School, the two learners we spoke with both expressed a great passion for the local environment. They stated that they enjoyed learning about their surroundings and wished classes such as geography could go more in depth about the environment. EduVentures staff shared that they hope implementing the LMS will fill this gap since it will equip educators to lead training for teachers and provide them with resources. These teachers will then be able to take these resources back to their schools and provide supplemental education for learners such as after school clubs. These clubs will educate learners about the environment and enable those who live at the school to participate in additional extracurricular activities.

4.1.1 Features

We were able to determine the features in two ways, first when interviewees directly asked for them and second when interviewees indirectly revealed the need for them through their answers. EduVentures, educators, and teachers all emphasized the importance of remote access and collaboration features. Since Namibia has such a low population density, collaboration through in-person communication is generally rare. Because of this, across Namibia there are numerous WhatsApp groups in a variety of topics where teachers and educators collaborate. At NaDEET they specifically mentioned a WhatsApp group used by environmental educators to collaborate and share ideas. Additionally, all four teachers we spoke with use social media groups in their specific subjects to share ideas for lessons and resources such as tests and quizzes. Furthermore, educators use these groups to send information to a large number of teachers and other educators. These groups are popular because they allow remote access to anyone with a cell phone. When someone sends a message, notifications are immediate and always accessible. We determined that either a mobile application or a mobile updates feature, a classroom discussion feature, and an announcements feature, would all be important to consider when choosing the LMS.

Educators discussed the need for a place to post center-specific content. For example, NaDEET creates classroom activity guides for teachers to use in their schools, while at the National Marine

Aquarium of Namibia they create content on marine life. Additionally, the length and structure of training is different at every location, so follow up material must be site specific. There are also newer educators, like Martha Kambidhi, the EE warden from the Okatjikona Environmental Education Center in Waterberg, who wanted a centralized place where they could share their centers content. This would enable new staff to learn the content on their own without in-person training. Ms. Kambidhi also expressed an interest in viewing other centers' content as well. She has only been the warden for two months and believes that access to other content would assist her in developing activities for her center. Because of this, we included personalized pages on our feature list.

To train educators, EduVentures staff discussed the importance of a progress tracking feature. EduVentures plans to primarily use the system to train educators at the EE centers. These online trainings will be for a specific length, whether it be one day or one week, and educators will tab through modules that include reading material and videos. To ensure that all educators are using the system, EduVentures requested a way to track specific progress. Progress tracking features can be different from system to system, but on any system, there must be a single sign-on (SSO) feature to ensure it is possible to track one user at a time.

Furthermore, making the system easy to use was mentioned in all four environmental educator interviews. At NaDEET, we learned that this is not the first web-based system that has been created for educators and teachers in Namibia. They emphasized that the previous systems have been convoluted and difficult to use, which deterred teachers and educators from using them. Additionally, the majority of educators only had basic knowledge of computer applications, so designing the system to be as user friendly as possible was important.

In addition to features, the interview with EduVentures staff revealed a few limiting factors for the system. The constraints that affected our decision of a final LMS were cost, implementation time, and ease of maintenance. EduVentures has a grant for their EduLink project, but the grant only lasts for two and a half years. This means that eventually, their money for this project will run out, so selecting a low or no-cost system was essential. Additionally, we had seven weeks to identify, implement, and introduce a system to educators. For this reason, we needed to consider implementation time heavily. Finally, EduVentures staff noted that they needed a system that was easy to maintain because they did not want to be spending time updating and maintaining the system.

4.2 Implement an Appropriate LMS

Since three different EduVentures staff members stated that they did not have the skills to maintain the system and that they did not have the funds to pay someone to fix the system if it breaks down, ease of maintenance became an important feature. During our interview with Maurice Nkusi from the Teaching and Learning Unit at NUST, he highlighted that it was important to consider the long-term sustainability of the system. If a system worked well, but could not be maintained in the future, our work would not provide long term benefits. As a result, when we compared ease of maintenance to other features in the decision matrix, we consistently assumed that it was the most important. This led to ease of maintenance having the strongest weighted score.

Although ease of maintenance was easy to compare to the other features, the importance of other features proved more difficult to measure. For example, ease of use was a feature that we ranked of medium importance because of its ranking relative to other features. In the interview at NaDEET they emphasized that people would be hesitant to use a system unless it was intuitive. When comparing ease of use to cost, we considered ease of use more important. We decided that based on the interview with EduVentures, they would be willing to pay a little more for a system that can be easily used versus one that is free and difficult to use. Since the main purpose of the system is to train educators, our sponsor, Corris Kaapehi, emphasized the importance of tracking educator progress. This led to us ranking ease of use as less important than SSO. The main goal of our project was to implement the LMS during our time in Namibia, so ease of use was rated the same importance as implementation time. This describes only four of the eleven comparisons that we made between ease of use and the other requirements. When we made all of the comparisons, we then determined the sum of the comparisons, and this resulted in a score of 1 for ease of use. We performed this process with all eleven requirements resulting in an eleven by eleven decision matrix (Table 1).

Table 1: Decision Matrix

	Requirements											
	Mobile App	Implementation Time	Cost	Single Sign-On (SSO)	Ease of Use	Personalized Pages	Mobile Updates	Announcements	Classroom Discussions	Progress Check	Ease of Maintenance	**SUM**
Mobile App		-1	-1	-1	-1	-1	-1	1	-1	-1	-1	**-8**
Implementation Time	1		0	1	0	-1	1	1	1	0	-1	**3**
Cost	1	0		-1	-1	-1	-1	1	1	1	-1	**-1**
Single Sign-On (SSO)	1	-1	1		1	-1	-1	1	1	1	-1	**2**
Ease of Use	1	0	1	-1		-1	0	1	0	1	-1	**1**
Personalized Pages	1	1	1	1	1		0	1	1	1	-1	**7**
Mobile Updates	1	-1	1	1	0	0		1	1	1	-1	**4**
Announcements	-1	-1	-1	-1	-1	-1	-1		-1	-1	-1	**-10**
Classroom Discussions	1	-1	-1	-1	0	-1	-1	1		-1	-1	**-5**
Progress Check	1	0	-1	-1	-1	-1	-1	1	1		-1	**-3**
Ease of Maintenance	1	1	1	1	1	1	1	1	1	1		**10**

The decision matrix resulted in a low score of -10 for announcements and high score of 10 for ease of maintenance. To make all scores positive and ensure that there was no weight of zero, we added eleven to each score, altering the low and high scores to 1 and 21, respectively. We then divided the altered score by 121, which is the sum of all altered scores. For example, the sum of 1 for ease of use became 12, which then became a weighted score of .00983. We followed this process for every requirement and through the decision matrix, we determined that the most important features were ease of maintenance, personalized pages, mobile updates, and implementation time (Table 2). While there are 11 features in total, the top four take up over 50% of the weighted importance.

Table 2: Decision Matrix Results

Constraint/ Feature	**Weights**	**Cumulative Weights**
Ease of Maintenance	0.1736	0.1736
Personalized Pages	0.1488	0.3223
Mobile Updates	0.1240	0.4463
Implementation Time	0.1157	0.5620
Single Sign-On (SSN)	0.1074	0.6694
Ease of Use	0.0992	0.7686
Cost	0.0826	0.8512
Progress Check	0.0661	0.9174
Classroom Discussions	0.0496	0.9669
Mobile App	0.0248	0.9917
Announcements	0.0083	1.0000

Meanwhile, the bottom four features make up less than 15% of the weighted importance. This means that when we were choosing the system and applying value analysis, a system's performance in the top four categories weighed more heavily on the decision for the final system than the last four categories. This decision matrix technique was effective in converting qualitative data to quantitative rankings.

However, the drawback of this technique was that we subjectively determined the scores based on our inferences from stakeholder interviews.

We narrowed down our original list of 32 systems to seven systems by identifying preliminary deal breaker requirements (Table 3). These requirements were mobile updates, personalized pages, mobile app, cost, and implementation time. A system had to meet at least four of these requirements to move to our next round of evaluation. Since our project was only seven weeks long, the implementation time needed to be short, or there was no possibility for us to implement the system. The staff at each EE center we spoke with wanted to have a place where they could upload center specific content, so personalized pages was a must. The only consistent technological device in Namibia is a cell phone, so some sort of mobile app or mobile update system became crucial as well. Finally, while EduVentures has a grant for the EduLink Project, their budget is small, so we could not consider any system that was too expensive.

Table 3: Deal breaker requirement spreadsheet analysis

Legend	
Y	Yes
N	No
$	< $ USD1000 Per Year
$$	> $ USD 1000 Per Year
?	Information not Found
> 1m	Greater than one month to implement
1w	One week to implement
	Not Possible
	Maybe Possible
	Possible

Systems/ Requirements	Google Class	Moodle	Blackboard L.	I.Canvas	Sakai	D2L BS	BNED LC	Blackboard	Pearson OC	eFront	Schoology	Edmodo	Skillsoft	NetDimensions	Adobe Captivate	Docebo	The Academy	GNsis Connect	WebStudy	Eliademy	OpenSIS	Chamilo	Litmos	ATutor	CLIX	Digital Chalk	EduBrite	ILIAS	itsLearning	LonCapa	OLAT	iCohere
Mobile Updates	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y
Personalized Pages	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y
Mobile App	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y
Cost	F	F	$$	$$	F	$$	$$	F	$$	$$	$	F	??	??	$$	$$	$	$$	$	F	$	F	$	F	$	$$	$$	F	$$	$	$	$$
Implementation Time	1w	> 1m	> 1m	> 1m	> 1m	> 1m	1w	> 1m	> 1m	1w	> 1m	1w	?	?	> 1m	> 1m	1w	> 1m	?	?	> 1m	> 1m	1w	> 1m	> 1m	> 1m	> 1m	> 1m	> 1m	?	?	?

This table demonstrates that Google Classroom would be an appropriate system for EduVentures since it meets all the critical requirements, while Moodle and Blackboard Learn would not be appropriate since they are either too expensive or require an extensive implementation process.

After narrowing down our options to only seven systems, we used value analysis to determine the final system (Table 4). We rated each system on how well it performed in specific requirement categories. For example, Google Classroom's parent company, Google, handles all server and site maintenance and therefore this LMS ranked 100 in the category of ease of maintenance. Once we chose all of the ratings, we then multiplied by the weights determined through the decision matrix. This ensured that we gave the systems that met the most important requirements a greater score, thereby weeding out systems that may have scored higher on less important categories and lower on more important categories.

Table 4: Value Analysis

Legend	
No Feature	*0*
Has Feature	*50*
Excels	*100*

Systems/ Requirements	**Weights**	Google Classroom		Edmodo		eFront		The Academy		Eliademy		Chamilo		WebStudy	
Ease of Maintenance	**0.1736**	100	17.36	100	17.36	100	17.36	100	17.36	100	17.36	0	0.00	100	17.36
Personalized Pages	**0.1488**	100	14.88	50	7.44	50	7.44	50	7.44	100	14.88	100	14.88	50	7.44
Mobile Updates	**0.1240**	100	12.40	100	12.40	50	6.20	100	12.40	50	6.20	100	12.40	50	6.20
Implementation Time	**0.1157**	100	11.57	100	11.57	100	11.57	100	11.57	100	11.57	0	0.00	50	5.79
Single Sign-On (SSO)	**0.1074**	100	10.74	100	10.74	100	10.74	100	10.74	100	10.74	100	10.74	100	10.74
Ease of Use	**0.0992**	100	9.92	50	4.96	50	4.96	50	4.96	50	4.96	100	9.92	100	9.92
Cost	**0.0826**	100	8.26	100	8.26	0	0.00	0	0.00	0	0.00	100	8.26	0	0.00
Progress Check	**0.0661**	50	3.31	50	3.31	100	6.61	100	6.61	100	6.61	100	6.61	100	6.61
Classroom Discussions	**0.0496**	100	4.96	100	4.96	50	2.48	100	4.96	0	0.00	100	4.96	100	4.96
Mobile App	**0.0248**	50	1.24	100	2.48	50	1.24	50	1.24	0	0.00	50	1.24	100	2.48
Announcements	**0.0083**	100	0.83	100	0.83	50	0.41	100	0.83	50	0.41	100	0.83	100	0.83
SUM			**95.45**		**84.30**		**69.01**		**78.10**		**72.73**		**69.83**		**72.31**

Google Classroom and Edmodo were top performers in the majority of the requirements and scored the highest after we calculated the weighted scores, while eFront and Chamilo scored the lowest (Table 5).

Table 5: Value Analysis Result

System	Score (Out of 110)
Google Classroom	95.45
Edmodo	84.3
The Academy	78.1
Eliademy	72.73
WebStudy	72.31
Chamilo	69.83
eFront	69.01

EduVentures asked us to conduct a workshop on Edmodo and Google classroom to help them make the final choice between these two systems. After we developed and carried out a small practice workshop on both systems to enable the staff members to test out the software as administrators, they decided they liked Google Classroom best based on usability and potential to expand.

4.3 Ensure the Long-Term Use of the System

Once we created the system, we led a training and created manuals to ensure that all users knew how to use the system. In addition, we created a promotional video using iMovie showing highlights of the training to help spread enthusiasm about the implementation of Google Classroom for the EE centers. EduVentures held the training on April 17th at the Okatjikona Environmental Education Center in Waterberg (Figure 4).

Figure 4: Aatreya working with Martha Kambidhi

Ten environmental educators attended from eight different centers across Namibia. Overall, the educators liked the interface of both the online classroom and the mobile application. In the morning, we walked these educators through the computer interface of the system. We then gave them a feedback survey so that we could gain an understanding of how intuitive the system was for them to use. Out of the five options we presented, eight of the nine respondents said that they found the system somewhat easy to use or very easy to use (Figure 5). None of the respondents believed the system was very difficult to use or somewhat difficult to use.

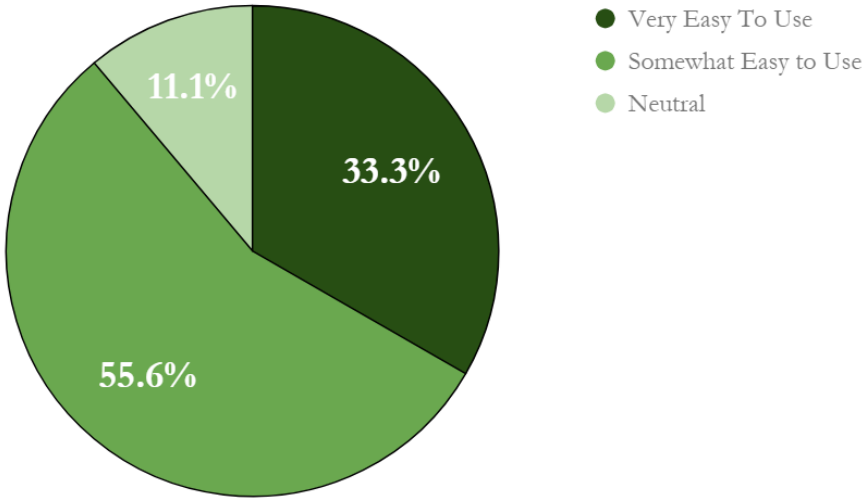

Figure 5: Responses to ease of system

During the afternoon, we trained the educators on the mobile application of Google Classroom. We taught them how to download the Google Classroom application to their phone, and how to perform all of the functions that we taught them online on their mobile device. We gave them a feedback form again and provided them with the same five response options. Of the eight survey respondents, five found the application somewhat easy to use and three found it very easy to use.

Some features that the educators enjoyed were the mobile application and ability to communicate with each other. Four of the eight stated explicitly that the LMS was easier on the phone and another two mentioned that they enjoyed the notifications feature on the phone. Following the training, we had a discussion about the system and its features. Vilho Absalom from Etosha stated that sometimes learners ask questions he is not prepared for and he believes the system can help solve that problem by allowing easy access to content. When he gets a question he does not know the answer to, he is planning on posting it on the LMS with the hope that other educators might have the answer. This will be particularly easy because of the Google Classroom mobile application since all educators now have it downloaded on their phone and can receive notifications anywhere that they have cellphone service.

To assist them moving forward, we created a user guide and distributed physical copies to all the educators in attendance. For educators who did not attend, we uploaded a copy into the EduVentures EduLink Google Classroom page. While the educators did like the features of the system and learned how to effectively maneuver it, many mentioned that they would like more practice with the system. During the discussion, Vilho and Martha emphasized that some features were hard, but suggested that

the more practice they have, the easier it will get. This user guide will assist them in the future as they practice with the system from their EE centers. For example, if EduVentures ever creates another class for different training, educators will need to join it, so one of the tutorials we developed was on how to join a class (Figure 6).

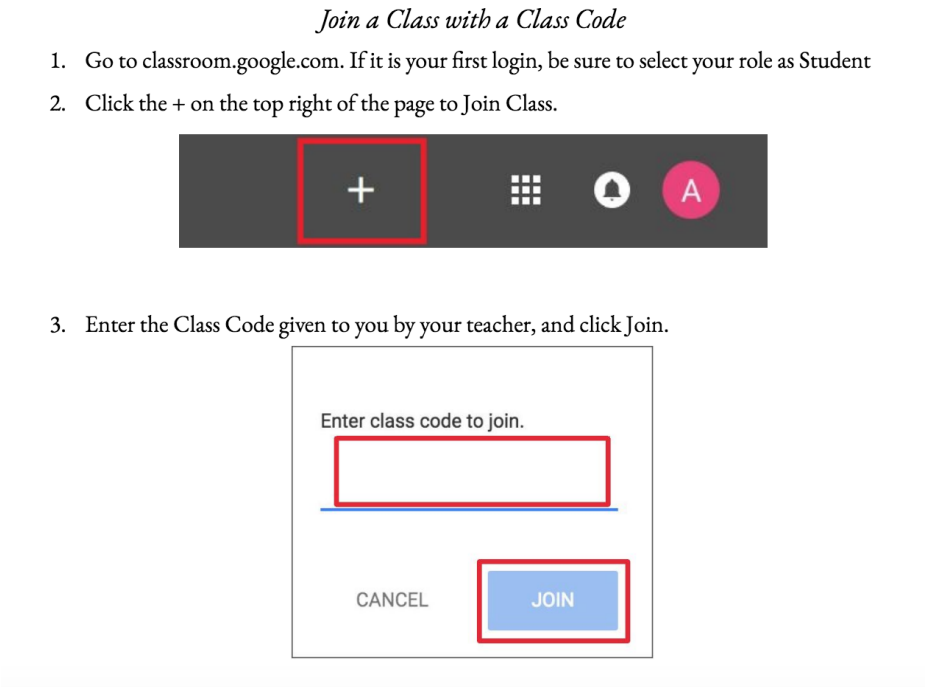

Figure 6: Example user guide page

EduVentures will be the administrators of the system moving forward, so to assist them we created an administrator manual. We held an additional training with them in Windhoek on April 30th, where we taught the staff how to manage their classroom in detail. During this workshop, we discussed topics such as how to create a class from scratch, change administrator and student access rights, grade assignments, and add new students. Based on the training session, we found that the EduVentures staff was getting more comfortable with the system after more use.

Chapter 5: Recommendations and Conclusion

We identified Google Classroom as the most appropriate learning management system (LMS) and implemented it for use by EduVentures and educators across Namibia. We also developed a series of recommendations for EduVentures regarding future use of the system. These recommendations serve as guidelines to the organization for expanding the LMS across Namibia and ensuring its prolonged use.

5.1 Expanding the System

We recommend that EduVentures works to expand the system by developing additional features that further enhance the educational experience of the educators. One feature that could be integrated into Google Classroom is a Flash File Player. Flash files are interactive files that are similar to PowerPoint, but allow the user to directly interact with the system using their devices. They are often used to create educational games to make content more engaging. Multiple EduVentures staff members mentioned flash files as a content option during the staff interview because they introduce an alternative pedagogical teaching approach for educator training. Currently, these flash files are embedded in a separate website that is created using Google Sites, and the link is posted in Google Classroom. A better system would be if they could be opened directly in Google Classroom, which would require embedding flash files directly into the LMS. We recommend that EduVentures looks into this feature of embedded flash files to improve the system experience.

It would also be useful to integrate a data analytics feature within Google Classroom. Currently, the progress tracking feature only enables EduVentures to see performance scores on online assessments. Data analytics would allow EduVentures to access additional educator data, including when they log in, log out, and how much of an assignment they have completed. EduVentures would be able to track educator progress which would allow them to ensure that the staff is using the system appropriately and going through the training in the intended order. User data can be accessed through the purchase of a Google G Suite membership.

We aim for the LMS to have a long lasting impact on Namibia and to be used for many years to come. To help achieve this, we recommend that EduVentures regularly uses the system by uploading new content and staying in communication with the educators on a regular basis. Even if EduVentures is not holding training sessions with educators often, it is important that they still use the discussion and mobile updates features of the LMS to ensure prolonged use. Additionally, Google is always releasing

new features for Google Classroom. We recommend that EduVentures stay up-to-date on the latest system improvements since there may be new features released that could be beneficial to the organization and educators.

To ensure educators continue using the LMS after the Waterberg workshop, it would be helpful for EduVentures to post frequent assignments. At the workshops, the educators discussed that it is not always easy to create activities for learners who visit their centers, so they would like for the system to have many potential environmental education activities that they could do with kids or teachers in the future. EduVentures could post an assignment requiring every educator to upload possible activities, and once the educators have each submitted their response, the activities could all be posted for discussion. This would enable the educators to stay familiar with the technology so that when content is uploaded to the LMS in A Term 2018, they will not have forgotten how to maneuver the system.

5.2 Educator-Teacher Training

Currently, the LMS is used by EduVentures to teach environmental educators. However, we recommend that the system be expanded to facilitate teacher training as well. After an educator performs teacher training at an EE center, they could follow up on this training through the LMS. This may include uploading material and using discussion boards to provide more training for teachers and to stay in communication with them even after the training has ended.

Some features that would enhance teacher training are quizzes and mobile updates. After the training at an EE center, educators could use online quizzes to gauge retention of the material. Educators could also upload new modules with additional information and use quizzes to ensure that the teachers cover this material. Educators could then use progress tracking to see which information the teachers have a thorough understanding of, as well as the content they struggle with. These features would allow for continuous online teacher training after the in-person training at the EE centers.

Additionally, educators could use Google Classroom to stay in contact with teachers. If teachers have questions regarding content or pedagogical practices, they could use the discussion board feature to ask the educator or other teachers. Educators could also use mobile updates to notify teachers about new online resources or other potential teacher training workshops. These features enable constant communication between teachers and educators, increasing the sharing of ideas related to education across Namibia.

Similar to educator-teacher training, we recommend that EduVentures could use Google Classroom to improve teacher-learner education. LMSs have become widely used in schools around the world since they enhance the learner experience and have features not provided in the traditional classroom setting. Learners can take online assessments and communicate with their classmates and teachers through the system. If internet accessibility allows, meaning that there is a strong enough internet connection and sufficient computer availability in schools, it would be beneficial to the Namibian education system to expand Google Classroom to schools.

5.3 A Term 2018 IQP

A group of students from WPI will be traveling to Namibia in August 2018 to continue our work. These students will be uploading teacher-training content to the LMS. We suggest that they create content on both EE and pedagogical practices for the system to help prepare educators for teacher trainings. Adobe Captivate is an appropriate software to use for creating the content since it allows for easy development of interactive flash files, which is the type of content that EduVentures is looking for.

For our project, there were many people who we reached out to in order to gain more insight into education and to identify the most appropriate LMS for implementation. We recommend that the A Term group communicate with the following people as well since we found that they had many ideas and opinions on the content that should be on the LMS:

1. Viktoria Keding: NaDEET cofounder & environmental educator
2. Martha Kambkidi: Environmental Education Warden at the Okatjikona Environmental Education Center in Waterberg
3. Maurice Nkusi: Director of the Teaching and Learning Unit at NUST
4. EduVentures staff
5. Various teachers and learners at secondary schools in Namibia

At our educator training workshop in Waterberg, we received feedback on what content educators wanted in the system. The educators have no uniform plan for teacher training, so it would be valuable to develop training that would provide them with a set curriculum for educating teachers. Additional content that would be helpful is information on various environmental issues and pedagogical approaches. Specifically, it would be valuable to have content on how teachers can integrate

education for sustainable development (ESD) into many different subjects, from math class to English class.

Although we did not have enough time to observe the learners' experiences after the implementation of the LMS, assessing their knowledge before and after the teachers are trained through the LMS would be an effective way to determine the success of the system. We suggest that the group uses additional interviews, feedback forms, and pre and post testing with learners, teachers, and educators using the system to assess learning and observe whether the LMS has contributed to the learners' EE experiences.

5.4 Conclusion

We identified and implemented an LMS to be used by EduVentures and educators to improve teacher training in Namibia and provided them with both a user guide and administrator manual on how to use and maintain the system. Environmental educators are spread throughout the country, so Google Classroom has the potential to improve the quality of training by connecting all educators through a remote virtual platform. Educators in the North can now communicate and share ideas easily with educators in the South. Additionally, the web-based training will encourage educators to develop their activities and programs, in turn improving their centers. This will lead to an advancement in EE across the country.

Once educators are trained on how to lead teacher workshops, they can train teachers on how to teach learners in their classrooms. When teachers are trained, they will learn how to integrate EE in their classroom. A math teacher can use real world math problems about the amount of garbage produced by a country, for example, and German teachers will be empowered to include EE vocabulary in their lessons. This will lead to a group of learners who are better equipped to tackle environmental issues in Namibia using all aspects of their education, which will allow for the country's sustainable growth. The future success of the EduLink project and its ability to cascade from educators to teachers to learners is a model that can be followed by other developing countries.

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