EduLink Ocean Literacy Module

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EduLink: Ocean Literacy Online Module

An Interactive Qualifying Project Submitted to the Faculty of WORCESTER POLYTECHNIC INSTITUTE in partial fulfilment of the requirements for the Degree of Bachelor of Science

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This report represents work of WPI undergraduate students submitted to the faculty as evidence of a degree requirement. WPI routinely publishes these reports on its web site without editorial or peer review. For more information about the projects program at WPI, see http://www.wpi.edu/Academics/Projects
Abstract

Ocean literacy content is lacking in the Namibian course curricula. If people are not knowledgeable of the ocean and its importance, they will be less inclined to actively protect it through sustainable practices. EduVentures is an organization in Namibia promoting sustainable practices through Education for Sustainable Development (ESD). Our goal was to develop online modules to train teachers in the topic of ocean literacy in order for them to integrate the concepts into their lessons. To develop the ocean literacy module, we collaborated with the Ministry of Fisheries in Namibia. We utilized the course outline they provided in order to produce the content for the module. Throughout the module development process, we received and incorporated feedback on our module from the Ministry of Fisheries and the EduVentures staff. Our final module will be used in teacher training workshops run by the Ministry of Fisheries.
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Authorship

Each team member wrote one or two sections of the report. For the module, each team member created two lessons on either SMART lessons or Powerpoint, as well as created one Animaker video. We all also worked on the lesson book and content book for the module.

Madeline Chudy took the lead on editing the Animaker videos and writing up questions for the feedback survey. She developed lessons for Our Oceans and Human Impact for the module. On the report she was the main contributor to the recommendations and formatting.

Rebecca Hapgood focused on formatting digital activities for SMART lessons. She developed lessons for Education for Sustainable Development and Intertidal Ecology for the module. On the report she primarily wrote the ESD and UNESCO sections of the paper.

Alexa Itsines researched and chose educational softwares. She developed lessons for Marine Resources and Maine Food Webs for the module. On the report she was a major contributor to the conclusion and reflection.

Alice Morgan developed lessons for Blue Planet and Our Marine Environment for the module. On the report she was the main author of the executive summary as well as the introduction. She also mainly facilitated interviews and consultations for the team.
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**List of Acronyms**

DESD - Decade of Education for Sustainable Development (DESD)

ESD - Education for Sustainable Development

GAP - Global Action Programme on ESD

LMS - Learning Management System

NFQ - National Qualifications Framework

NQA - Namibian Qualification Authority

UNCED - United Nations Conference on Environment and Development

UNESCO - United Nations Educational, Scientific and Cultural Organization

SDG - Sustainable Development Goal
Executive Summary

At the rate that humanity is consuming resources, a shift to more sustainable lifestyles is necessary in order to continue living on Earth comfortably. Education for Sustainable Development (ESD) was created by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) to work towards the ideal of a more sustainable society. ESD is based on the belief that children educated about their environment and its importance will contribute to a sustainable society as they mature (UNESCO, 2014). UNESCO has been leading the push for worldwide ESD implementation since the mid 1990’s. The Namibian government has basic educational goals set in place that line up with UNESCO. However, Namibia faces many challenges with the act of integrating environmental topics, such as ocean literacy, into school curriculum. One of the biggest problems is that teachers lack the resources and training necessary to teach sustainable development to students.

Our sponsor, EduVentures, is a Namibian educational trust that has been working to implement ESD throughout the country for the past fifteen years. They share the same goals of UNESCO and the Namibian government. EduVentures works on multiple projects and programs which aim to promote environmental sustainability training in Namibian schools, such as a mobile classroom which drives to rural areas to teach lessons on sustainability. The EduLink project was created by EduVentures to connect ESD centers in Namibia through a learning management system (LMS). The ESD centers provide educational and pedagogical training to teachers who can share this knowledge with Namibian students, mediated by educators trained in ESD. Currently, one module exists on the topic of biodiversity. The EduLink project will contain a total of four modules.

The goal of our project was to create content for this LMS to be used by educators in teacher training workshops. The four modules within the EduLink project focus on topics within ESD. Our module specifically addresses the topic of ocean literacy. Ocean literacy is the understanding of the symbiotic relationship between humans and the ocean. An ocean literate society is able to make informed decisions about the ocean and its resources. In Namibia there is a lack of ocean sciences in classrooms, which creates generations unaware of the importance of the ocean. The main objective of the module is to help integrate ocean sciences into the Namibian classroom curriculum. We identified four steps to achieve this goal: assess the previous module, identify content for the ocean literacy module, construct the ocean literacy module, and receive feedback used to revise the ocean literacy module.

We began with the assessment of the first and only module that was created for the EduLink project which is on the topic of biodiversity. We conducted interviews with the EduVentures staff and administered a survey to educators that had used the biodiversity module.
This information allowed us to determine what viewers liked and disliked about the module. We then determined the content for our modules, through consultation with the Ministry of Fisheries. Through this consultation, we developed an outline of topics that should be covered in the module. We then analyzed resources, such as books and websites, given to us by the Ministry of Fisheries to find all of the content for the module. Additionally, we examined the Namibian secondary school curricula and identified areas where ESD could potentially be integrated.

After determining the content, we began constructing the module. We used SMART Notebook and PowerPoint to make the lessons in the module. SMART Notebook was chosen upon request by EduVentures; EduVentures utilizes SMART Boards in the educator training sessions because they are interactive. We also used Animaker to make videos to teach some of the content. SMART Notebook, PowerPoint, and Animaker are all compatible with Google Classroom, which is the Learning Management System used by EduVentures. Our biggest focus for the ocean literacy module was making it engaging for the teachers who would be participating in the training workshops. We also wanted to provide the educators running the workshop with plenty of options for activities to do. Because of this, we decided each subtopic would have a presentation including digital activities as well as one practical activity and one experiment or excursion.

After constructing the ocean literacy module, we presented it to both EduVentures and the Ministry of Fisheries to receive feedback. We did this by having meetings where we presented the module in its entirety and took notes on each subtopic as we went through the lessons. Overall both EduVentures and the Ministry of Fisheries enjoyed the interactivity and creativity of the module. Most of the changes that needed to be made were minor formatting and content issues. After receiving the feedback, we adjusted our module and sent the final draft including a lesson plan book, content book, questionnaire, and survey to the Ministry and EduVentures to use in the teaching training workshops.

Following the completion of the modules we proposed recommendations for future WPI students, the Ministry of Fisheries, and EduVentures. We recommend that future WPI students working with EduVentures familiarize themselves with SMART notebook technology before arriving in Namibia to work with these agencies. For the Ministry of Fisheries, we recommend including experiments and excursions in the lessons that teachers living far from the coast can perform. Lastly, for EduVentures we recommend more communication between third parties and future students on the deliverables required for a specific project so that time can be more efficiently utilized to create quality materials.
1. Introduction

Currently, around the world, countries are facing issues involving climate change, specifically related to resource scarcity. Resource scarcity is a pressing issue that is detrimental to human life on Earth (Krautkraemer, 1998). At the rate that limited resources are being consumed, humans will not be able to live comfortably on Earth much longer, unless more sustainable practices are adopted. The best way to ensure a sustainable future is to educate the youth of today about sustainable developments in order to provide them with the proper knowledge to tackle environmental issues in Namibia because they are going to be the leaders of tomorrow.

A major flaw regarding the education about sustainable development for the youth of today is the lack of ocean sciences in the classroom. The absence of ocean sciences in schools results in generations ignorant of the importance of the ocean, which in turn, has made it even more difficult to convince the adults in school systems to insert ocean concepts into future standards. Therefore, if ocean sciences are not present in science standards, efforts to include ocean sciences in curriculum, texts, and assessments will perpetually be marginalized and out of the mainstream. The Ocean Literacy Campaign was designed by scientists and educators to decide which principles and concepts everyone should understand about the ocean by the end of secondary school (Ocean literacy. 2013). An important component of the campaign is the education of primary and secondary school learners in ocean sciences.

Our project focused on integrating Education for Sustainable Development (ESD) into the Namibian curriculum. Our sponsor, EduVentures, is a Namibian environmental education trust that has been working to improve ESD throughout Namibia. A problem facing teachers in Namibia is a lack of resources and experience with incorporating ESD into their classrooms. A past group of WPI students working with EduVentures in March to May of 2018 had established a Learning Management System to provide better access to uniform materials in mobile classrooms across Namibia. This project is called the “EduLink” project. A group of students from WPI that traveled to Namibia in August to October of 2018 began working on modules on topics in Education for Sustainable Development, particularly in biodiversity. Our group was tasked with creating a similar online module for educators to use while training teachers to utilize ESD effectively. Specifically, our module focused on the topic of ocean literacy.

We also worked closely with The Ministry of Fisheries, a government organization that does marine research at the National Aquarium of Namibia. The Ministry of Fisheries developed an outreach program to allow Namibians to have better access to the information they were collecting about the oceans. The Ministry of Fisheries reached out to our sponsor EduVentures because they focus on developing lessons on sustainable development for educators, teachers, and students across Namibia.
2. Background

This section includes the background research necessary to build online modules on the topic of ocean literacy. Our sponsor, EduVentures, has been working to integrate sustainable development into the national education system. However, there is a lack of teacher training in this field. One tool that can help provide educators with important content and pedagogy is an online teacher training module. In this chapter we will begin with a discussion of education for sustainable development. Next, we define ocean literacy and then explore teaching methods for sustainable development. Lastly, Namibian education and teaching standards are explained.

2.1 Education for Sustainable Development (ESD)

Sustainable development is defined as "development that meets the needs of the present, without compromising the ability of future generations to meet their own needs" (Sustainable Development Commission, 2011). Education for sustainable development (ESD) aims to equip present and future generations with the knowledge, skills, values, and attitudes necessary to promote sustainable practices in order to address the growing environmental challenges facing the planet (Leicht A., Heiss J., Byuan W. J., 2018). ESD is the integration of climate change, poverty and sustainable consumption content into school curricula. Additionally, ESD encourages interactive, learner-centered teaching in order to develop the key competencies needed to promote sustainable development (UNESCO, 2014). Nations all over the world have begun implementing sustainable development into their education systems. In this section, we explain what ESD is, how it is implemented, and the obstacles it has faced.

2.1.1 What is Education for Sustainable Development (ESD)?

Humanity’s understanding of sustainable development will ultimately decide the fate of the planet. Riley E. Dunlap and Andrew K. Jorgenson analyze the nature and global reach of environmental problems related to sustainable development in The Wiley-Blackwell Encyclopedia of Globalization. In their paper, they evaluate three main functions that the environment performs for humans, and how misuse of these functions negatively impact the world. The first function that the environment provides us with is renewable and nonrenewable resources necessary for life, such as food, water, and clean air. Second, the environment acts as a “sink” for human waste products by either recycling them into useful or less harmful substances, or by providing a place for them to decompose. The last is to provide a living space for the human population. The need for sustainable development comes into play when humans overuse the environment’s ability to fulfill one function. For example, overuse of the first function can cause shortages in the resources humans need to live, such as depleting fossil fuels. Similarly, abusing the environment’s second function occurs when human waste products exceed the environment’s ability to absorb them, causing water and air pollution. Additionally, overusing a single living space can cause overcrowding and overpopulation. Sustainable developments are
necessary in ensuring that the planet we live on remains a habitable, safe place for humans to exist in. (Dunlap & Jorgenson, 2012)

Integrating sustainable development lessons into education can lead to a new generation of people who are conscious of the fact that their actions have direct consequences on the environment. Therefore, the best way to get to the root of the problem is to integrate sustainable development into all aspects of education. Consequently, those who grow up to become social leaders and politicians can implement the sustainable practices they learned about in their early education into their careers. This concept is best stated by 2012 UNESCO Director-General Irina Bokova: “Education is the most powerful path to sustainability. Economic and technological solutions, political regulations, or financial incentives are not enough. We need a fundamental change in the way we think and act.” (UNESCO, 2017)

2.1.2 Education for Sustainable Development (ESD) Globally

There are many organizations attempting to address the problem of sustainable development, globally. The leader of the global ESD movement is the United Nations Educational, Scientific and Cultural Organization (UNESCO). They have created a specific plan to implement sustainable practices into education systems across the globe. The goal of the plan was to encourage the transformation of education to reorient society towards sustainable development. It first began in 1992 when the United Nations Conference on Environment and Development (UNCED) recognized that education, training, and public awareness were critical tools and called for the “reorienting of education towards sustainable development” (Leicht et al., 2018). Then, in 2005, the Decade of Education for Sustainable Development (DESD) was launched, commencing 10 years of an explicit global movement towards improving and redirecting education systems towards sustainable development (Leicht et al., 2018).

UNESCO also implemented the Global Action Programme on ESD (GAP) in 2014 to scale-up ESD actions and good practices in countries around the world (Leicht A., Heiss J., Byuan W. J., 2018). Finally, in September 2015, UNESCO senior UN officials and representatives of civil society gathered as part of the 70th session of the UN General Assembly in order to adopt the Sustainable Development Goals (SDGs) (Bokova, 2017). The Sustainable Development Goals form a program of sustainable, universal and ambitious development that highlight the vital importance of human capacities, skills, and knowledge necessary to adapt and respond to the challenges and opportunities of the present and the future (Bokova, 2017). The goals also place national ownership and support at the country level as a cornerstone for their successful implementation (Bokova, 2017). This project will be focusing on SDG14, which is working towards advancing the sustainable use and conservation of the oceans (United Nations, 2018).

Overall, UNESCO’s ESD efforts focus on two main aspects: content and pedagogy. Only action-oriented, transformative pedagogy that supports self-directed learning, participation and
collaboration make the development of the key competencies needed for promoting sustainable development possible (Leicht et al., 2018). Additionally, content refers to the specific material related to sustainability, including topics like biodiversity, community-based agriculture, carbon footprints and the topic of our online module, ocean literacy. The right combination of both content and pedagogy is necessary for students to fully understand and apply what they learned in sustainable development into their everyday lives. This calls for the reframing of education systems and structures (Leicht et al., 2018). ESD concerns the core of teaching and learning and should not be considered as merely an add-on to existing curriculum or educational practices. Overall, quality education for sustainable development is about what people learn, its relevance to today’s world and global challenges, and how learners develop the skills and attitudes to respond to such challenges and use it in the future. (Leicht A., Heiss J., Byuan W. J., 2018)

2.1.3 Implementation of Education for Sustainable Development (ESD)

There are many different tactics used to implement sustainability education at student, teacher, policy-maker, and stakeholder levels. In order for ESD to be implemented into learning curriculums, countries first have to reform their policies and standards to fit ESD into the education system. In a 2013 UNESCO study, twenty-one countries highlighted that the integration of ESD into policy and/or curriculum was their country’s greatest achievement related to ESD, while another nineteen noted the development of a national ESD strategy (Leicht et al., 2018). However, mandating ESD in education systems is not a fix-all solution to the problem. ESD policies must address all aspects of ESD, including incorporating curriculum, pedagogies, and learner and teacher environment as well as content (Leicht et al., 2018). Because of the difficulty of this task, UNESCO created policy frameworks to help guide the implementation of ESD into policies. There are many countries around the world who have successfully reformed their education policies to implement ESD. For example in Japan, the UNESCO Associated Schools Programme incorporated ESD into the curriculum guidelines for elementary, middle and high schools (Leicht A., Heiss J., Byuan W. J., 2018).

ESD can also be implemented at the teacher level. In sustainable development education, the teacher serves as the facilitator by engaging the students in student-centered, cooperative learning relationships that include questioning, critical thinking, and decision-making (Leicht et al., 2018). Therefore, ESD pedagogy needs to be implemented into teacher training. In many countries, the inclusion of ESD in pre-service teacher training and at teacher education institutions has led to the advancement of holistic and interdisciplinary teaching perspectives (Leicht et al., 2018). In Indonesia, guidelines and teaching materials on ESD implementation are provided for all levels of education, and a number of training courses for teachers were completed. Furthermore, in Namibia, teacher-training programs were organized in partnership with many environmental organizations like the National Institute for Educational Development, the Wildlife and Environment Society of South Africa, and the engineering company Ramboll in Sweden (Leicht A., Heiss J., Byuan W. J., 2018).
ESD can also be implemented to create effective learning environments for students. According to UNESCO, a safe and effective learning environment for ESD both “supports the development of mutual trust and social bonds through cooperative learning relationships to enhance students’ emotional safety” and “facilitates linkages with surrounding ecosystems, and thus provides dynamic opportunities for practice and problem-solving with sustainable development” (Leicht et al., 2018). Developing whole-school and green school approaches ensures this. These types of schools design their buildings to embrace the natural surroundings to encourage connections between learners and their environment as well as manage the facilities with environmental principles to serve as a model of good, sustainable practices. Furthermore, some schools create “youth environmental investigator” programs to promote active learning in a safe, fun environment for students. (Leicht A., Heiss J., Byuan W. J., 2018)

Finally, stakeholders play a major role in implementing ESD policies into a country. Multi-stakeholder partnerships create opportunities for collaboration that lead to the development of solutions and innovations in ESD. International agencies frame and share the ESD agenda, mobilize resources, and strengthen programs while government entities at the local level create and enable the environments needed to guide and support ESD (Leicht et al., 2018). For example, in Italy, the Ministry of Environment formed a partnership with public actors and the private sector under the framework of a national campaign on education for sustainable consumption (Leicht et al., 2018). Similarly, in Uganda, the National Environment Management Authority of Uganda, the Uganda National Commission for UNESCO, Nature Uganda, Kyambogo University, and others partnered with international organizations including the German and Korean National Commissions for UNESCO and the Danish Outdoor Council to engage in advocacy, research, capacity-building and training of stakeholders on ESD principles (Leicht A., Heiss J., Byuan W. J., 2018).

2.1.4 Obstacles to Education for Sustainable Development in Namibia

Many obstacles can arise when attempting to implement an entirely new form of pedagogy and content into an education system. Laurie, Nonoyama-Tarumi, Mckeown, and Hopkins (2016) discuss the contributions ESD brings to quality education by identifying three main obstacles to ESD implementation: fully integrating ESD in curricula across all subjects, educator understanding of ESD, and the ability of school leaders to adopt new management practices and structures that complement and support ESD in the curriculum. Although these are complex, and challenging obstacles, many of these problems are solvable with the right tools.

Namibia faces some of its own specific obstacles when it comes to implementing ESD. A study done in Namibia on three secondary schools found that teachers disagreed on whether ESD should be taught in all subjects of the curriculum or be offered as an independent subject (Anyolo, 2015). Furthermore, teachers were more likely to use non-participatory teaching methods such as lecture and question and answer methods. These teaching methods leave out core parts of ESD such as the formation of key values and skills. Many teachers attributed this
lecture and question-answer teaching method to limited time, lack of ESD skills, and lack of teaching materials (Anyolo, 2015). Furthermore, a study performed in Namibian higher education facilities also collected data to explore lecturer’s views on ESD. The study asked respondents whether they taught ESD concepts in their courses. They found that 57% of respondents taught ESD concepts in their courses while 31% indicated that they did not (Kanyimba, A., Hamunyela, M., & Kasanda, C. D, 2014). Some lecturers were not sure what ESD was which was indicated by the fact that 12% of respondents were not sure whether they taught ESD (Kanyimba, et al., 2014).

The integration of ESD into curricula is a relatively new phenomenon around the globe that, like most new educational initiatives, faces significant challenges regarding implementation. However, there are many guidelines and tools available to ease the implementation process. ESD practices are slowly being implemented into Namibia’s education system, and there are many organizations attempting to aid in this process. EduVentures is an example of these organizations as they are aiming to implement ESD content and pedagogy into Namibian teacher training programs.

2.2 Ocean Literacy

Ocean literacy is an understanding of the symbiotic relationship between humanity and the ocean (Ocean literacy, 2013). The ocean has a significant influence on Earth’s ecosystems and its sustainability. A person who is considered to be ocean literate is able to understand the fundamental concepts about the functioning of the ocean, communicate about the ocean in a meaningful way, and make informed decisions regarding the ocean and its resources (Ocean literacy, 2013). The Ocean Literacy Network identified seven essential principles that every ocean literate person should know: obtaining the knowledge that the Earth has one big ocean with many features, the ocean and life in the ocean shape the features of the Earth, the ocean is a major influence on weather and climate, the ocean makes the Earth habitable, the ocean supports a great diversity of life and ecosystems, the ocean and humans are inextricably interconnected, and the ocean is largely unexplored (Ocean literacy, 2013). In November 2012, the University of Namibia hosted representatives from Namibia and South Africa to discuss the possibilities for cooperation within the southern Africa region for ocean science education (Cunningham, 2016). Meeting participants found a need to improve marine science and ocean education in the area (Cunningham, 2016). As a part of the ESD initiative, a module on ocean literacy was requested by EduVentures to be included in their Obombo mobile classroom.

2.3 Effective Pedagogy

A well developed and supported ESD implementation strategy will not be impactful for learners without effective pedagogy. Pedagogy is defined as the instructional approach used in the classroom and also includes how students and teachers relate together (UNESCO, 2018). Effective pedagogy largely influences the learning process and education of students and can
lead to “academic achievement, social and emotional development, acquisition of technical skills and a general ability to contribute to society” (UNESCO, 2018). Lessons must be engaging and informative in order to be successful in teaching students. Many factors can influence the success of a pedagogy including the age of the learners, the environment in which students are being taught, the material being communicated, and the size of the class.

2.3.1 Pedagogical Methods

Teacher-centered pedagogy places the teacher at the center of the learning process and usually involves class lectures and call and response answers (UNESCO, 2018). Teacher-centered pedagogy is criticized as it is believed that it causes students to memorize lecture material instead of gaining a strong understanding of the information being taught. It is argued that because students are not engaging in the class, it is easier for them to lose focus and harder for them to retain the lesson. Teacher-centered pedagogy can be effective when teachers engage students by requiring them to explain and elaborate on ideas throughout lessons rather than simply lecturing (UNESCO, 2018).

Learner-centered pedagogy places the student in the position to play an active role in their learning process (UNESCO, 2018). This type of pedagogy involves a teacher facilitated process for the student to use prior knowledge and new experiences to develop an understanding of a topic (UNESCO, 2018). Learner-centered pedagogy gives students the freedom to choose the way in which they learn (Ebanks, 2010). For example, multiple options for readings, assignments, and assessments may be provided for learners to pick from, which provides them more control of their education and permits them to select an option from which they will learn best. Learner centered pedagogy is supported by the idea that every student learns differently and should be given the opportunity, through teacher assistance, to understand and execute the best learning process for them (Ebanks, 2010). Learner centered pedagogy permits a more custom education for students than teacher-centered pedagogy. Learner centered pedagogy also encourages students to take responsibility for their learning and fosters the ability to self teach and to learn independently (Ebanks, 2010).

Active learning involves the combination of many different pedagogies. Teacher and learner centered pedagogy are both involved in active learning, as the background information for an active learning assignment is taught to students initially through lecture or readings. Active learning pedagogy is based on the premise of engaging learners and encouraging them to think (Arico and Lancaster, 2018). It involves hands on activities, group work, and the development of problem solving skills. Active learning simulates real-world work environments and allows students to gain a better understanding of course material. Active learning has been linked with increased motivation, engagement, and understanding of material among students (Marrone, Taylor, & Hammerle, 2018). Studies have shown that active learning increases exam performance and if implemented consistently in college classrooms would increase average grades by half a letter (Freeman et. al., 2014). Additionally, in a study comparing traditional
lecture methods and active learning, average examination scores improved by about 6% in the active learning section and students in the traditional lecturing section were 1.5 times more likely to fail than those in the active learning section (Freeman et. al., 2014). Active learning is typically more effective in smaller classrooms or in classrooms with multiple educators.

Blended learning involves the student learning both online and in the classroom. The technology and lessons used for blended learning must shift content and instruction to the control of the student, allowing them the freedom to choose where, when, and how they work (Maxwell, 2016). Blended learning can also be used to provide students with background information on curricula that will be covered in the classroom setting, allowing them to gain a better understanding of in class activities and lectures (Maxwell, 2016).

For any pedagogy to be effective in teaching ocean literacy and sustainability, local relevancy and cultural context must be taken into consideration when developing lessons (Schumacher, 1973). Learners will be more likely to adopt concepts being taught if local examples relevant in their lives are included in the curricula. Along with this and effective pedagogical methods, students will gain a better understanding of information and be more apt to apply their knowledge throughout their lifetime (Schumacher, 1973).

### 2.3.2 Qualities and Impact of Effective Educator-Learner Relationships

While the instructional approach of the educator influences the way in which a student learns, the relationship between educator and student is just as important in shaping the educational experience. A teacher-student relationship grounded in respect, care, trust and collaboration leads to a more engaged classroom and a more effective educational experience (Amushigamo and Smith, 2015). Effective teachers present information in a way that their students can best comprehend while maintaining high expectations for them. Teachers who have low expectations of their students make less of an effort to assist them in the learning process and tend to subconsciously discourage them resulting in the low academic performance of the students (UNESCO, 2018). Along with maintaining high expectations the educator must understand and support the diverse needs of their students in order to adapt their teaching style to the specific learners in their classes (UNESCO, 2018). An effective teacher executes the pedagogy that will best fit their class’ needs, but also provides resources and guidance for students to gain the important life skill of learning independently and teaching themselves.

### 2.3.3 Online Learning

Online learning is defined as an education in which course material and instruction are delivered over the internet (Adelstein, D., & Barbour, M. K., 2017). Online learning serves as an integral part of blended learning. It is an effective and efficient tool in informing students with background knowledge before a lecture or learning activity, which allows the student to focus more on engagement with the class activity rather than struggling to understand certain portions
of the material being taught (Adelstein, D., & Barbour, M. K., 2017). Online learning is a new concept but is gradually being accepted and integrated into school systems.

2.3.4 Learning Management Systems

Learning Management System (LMS) is a system that manages the learning process in one unity, allowing access to resources and communication between users (Watson & Watson, 2007). LMS allows education to become portable through any device with access to the internet. LMSs are also known as e-learning, which is useful for its flexibility and ability to utilize various forms of media. LMS can be used to aid traditional classroom learning, known as blended learning, or, it can be used to build a virtual classroom, where learning is done online for distance learning (Al-Busaidi & Al-Shihi, 2012). LMSs allow educators to be able to upload and access learning materials from anywhere in the world (Watson & Watson, 2007). Student-teacher relations can be improved upon by using LMSs communication tools. These features include course management tools, group chat and discussion, assignment submission, and course assessment (Al-Busaidi & Al-Shihi, 2012).

Developing countries, such as Namibia, benefit greatly from LMS because many of their learning materials are not synchronized with school curriculum. Materials can also be repetitive at times. Streamlining information into one LMS allows all educators to have access to the same materials and reduces the use of inadequate information (Al-Busaidi & Al-Shihi, 2012). After assessing various LMSs, a previous group of WPI students was able to implement Google Classroom in Namibia. Google Classroom was chosen based on its qualifications related to mobile updates, personalized pages, mobile app, cost, and implementation time (Chakravarti, A., George, E. M., Place, D., & Vandervort, J. L., 2018). Specific benefits of Google Classroom are its ease of maintenance, low implementation time, and no cost for use (Chakravarti et al., 2018). A group of students that traveled to Namibia in August-October of 2018 constructed an online module for ESD using software compatible with Google Classroom, BookWidgets (Boccio, L., Gaddis, W. S.R., Manohar, A., & Smith, K.R., 2018). Bookwidgets was chosen not only for its compatibility, but also for its low cost, unique features, and ease of use (Boccio et al., 2018).

2.3.5 Teaching Tools

In order for online learning to be impactful, the online lessons utilized must be built with creative and engaging teaching tools to communicate course material effectively and maintain the interest of the learner. Online lessons are developed by educators with software compatible with many other websites and systems. SMART Notebook is a learning software used to create engaging lessons which include graphics, animations, activities, and assessments via a digitalized, interactive whiteboard (Cox, 2018). Teaching tools include videos and hands on activities such as games, excursions, and experiments. PowerPoint is a software used to create slides for presenting information with animation, images, and text. Animaker is a website that
enables users to create professional videos with the use of animated graphics, voiceover, and charts.

### 2.4 Education in Namibia

Namibian education has changed significantly throughout the country’s past and is working toward developing an improved system. Before the most recent reform, a majority of children were not gaining basic functional literacy skills, and progress toward equity in education was stagnant. In 2004, Namibia adopted *Vision 2030* as its national vision statement and long term goal as a society (Vision 2030 overview.2015). This document indicates Namibia’s goals, programs and strategies for developing into a more improved country that improves its people’s quality of life. In August 2005, the Education and Training Sector Improvement Programme (ETSIP) was published and brought with it National Professional Standards for teachers (Ministry of Education, 2006). This reform was inspired by *Vision 2030* and resulted in a revamping of Namibia’s national development strategy. *Vision 2030* states, ambitiously, that “Namibia should join the ranks of high income countries and afford all its citizens a quality of life that is comparable to that of the developed world” by the year 2030 (Ministry of Education, 2006). *Vision 2030* focuses on positively enhancing the quality of life for all. A focus on improvement of Namibian education is imperative if the country aims to join the ranks of high income countries and to follow the path stated in *Vision 2030*. According to *Vision 2030*, education needs to be focused on teaching all students basic skills, such as literacy, instead of the elite few. However, before all students can be educated correctly, the teachers need to be trained and held accountable for what they produce. Therefore, the establishment of National Professional Standards for teachers is aimed to face the country in the right direction.

#### 2.4.1 Teaching Standards

In order to ensure educators of Namibia are held to the same expectations and have students that are improving at the same speed, education systems implement learning standards that institutions are required to follow. A learning standard sets what each student should be able to achieve at a given grade level. All education systems have some form of these standards and as a result the location of a student’s school should not dictate the quality of their education. Despite slight variations in curriculum, standards ensure that the general topics covered are uniform (Ministry of Education, 2006).

In Namibia, the Namibian Qualification Authority (NQA) developed a National Qualifications Framework (NFQ) which lays out the education strategies throughout the country (Ministry of Education, 2006). This framework aims to transform Namibian education and training and also promotes competence-based approaches (Ministry of Education, 2006). NFQ establishes several end points or learning outcomes that educators will focus on attaining through their teaching (Ministry of Education, 2006). Through these goals set by the NFQ, lifelong learning is encouraged among students. A level of complexity was recognized within the
framework, regarding skills and knowledge, increasing from level 1 to level 10 (Ministry of Education, 2006). The National Professional Standards for teachers, which is addressed in the NFQ, include a focus on areas including: planning competence, teaching competence, assessment competence, management competence, professional competence, and community development (Ministry of Education, 2006).

The National Professional Standards for teachers in Namibia allows for a new approach to the training and development of educators. These standards are meant to clearly state the quality of performance that is expected from a professionally licensed educator. Universities, colleges and private providers are all required to align their programs and curricula to meet these standards (Ministry of Education, 2006). Institutions need to be accredited by the NQA before any programs or classes can be offered under these National Standards (Ministry of Education, 2006). At the end of training for up and coming teachers, these individuals will receive qualifications that allow them to enter into a managed internship in a supported environment (Ministry of Education, 2006). After two years of working as an intern, the educator will achieve a Professional Qualification (Ministry of Education, 2006). As a result, the teacher will become licensed and approved to teach. After this registration and pre-service training, the teachers will have to abide by the National Qualifications Framework and ensure they act under the standards set (Ministry of Education, 2006). Teachers are licensed for a five-year period, which has to be renewed upon expiration (Ministry of Education, 2006). In order for a teacher to renew their license, they have to demonstrate that they consistently meet National Standards and they are continuously building upon their own professional development (Ministry of Education, 2006). For teachers previously licensed, formal assessment is completed by Subject Heads and performance reviews are conducted by Principals (Ministry of Education, 2006). These individuals will then put together an evaluation to decide whether a certain teacher is competent and if they perform to the requirements of National Standards (Ministry of Education, 2006).

School management within Namibia is responsible for ensuring that teachers are performing to the National Standards. School management includes all figures of authority and power within a school system, such as principals, deputies and heads of departments. This management group is responsible for identifying mentor teachers, planning induction programs for new educators, organizing ongoing evaluation of teachers and providing professional development (Ministry of Education, 2006). In order to attain the transformation longed for in Vision 2030, school management must be dedicated to continuous educational improvement and professional development.

2.5 Conclusion

As discussed above, EduVentures has been working to integrate sustainable development into Namibia’s education system. Online teacher training modules provide educators with the capability to train Namibian teachers in the topic of sustainable development, specifically in ocean literacy. Throughout this section, ESD and ocean literacy were defined and teaching
methods were explored. It is essential to keep this information in mind when developing educator training modules which will be further discussed in the methodology.
3. Methodology

The ultimate goal of this project was to create an online module for teacher training workshops that would introduce new pedagogical tools and ocean literacy content to Namibian teachers. In order to achieve this, previous work completed on the EduLink project was evaluated. Our project sponsor, EduVentures intends to distribute these modules throughout Namibia in order to raise the level of Education for Sustainable Development (ESD). In order to achieve these objectives, we created and implemented the following research plan:

1) Assess the previous biodiversity online module
2) Identify content for the online module
3) Construct the online module
4) Receive feedback and revise module

3.1 Assess Previous Online Module

In order to assess the performance of the Interactive Qualifying Project from A-term of 2018, EduLink: Integrating ESD into Namibian Secondary School Curricula through Online Modules by Ajay Manohar, Kylie R. Smith, Laura Boccio, William Sean Ryan Gaddis, which created an online module on the topic of biodiversity, an interview and survey were administered to the EduVentures staff and Namibian educators. The feedback and suggestions received were used to improve the structure of our Ocean Literacy module.

3.1.1 Evaluation of Past Modules from EduVentures Staff

To understand the successes and failures of the past module, we interviewed the EduVentures staff. Generally, interviewing is a common way to collect qualitative data for research projects (Alshenqeeti, 2014). Specifically, informal interviews are more similar to guided conversations, as they include open-ended questions that can be adapted, added, or removed as the interview is conducted (McLeod, 2014). An informal interview allows the respondent to talk in some depth, choosing their own words, as well as allows the interviewer to ask clarifying questions to steer the direction of the interview (McLeod, 2014). This interview style helped us develop a better understanding of the EduVentures staff’s opinions of the biodiversity module.

EduVentures was the main sponsor for this project, consequently it was important to understand their needs and expectations in order to completely meet the standards for our ocean literacy module. The main purpose of the interviews was to inquire about what EduVentures would like to see in the ocean literacy module. In addition, it was also important to understand which parts of the biodiversity module worked well, and which parts of the biodiversity module EduVentures was satisfied with. Some of the questions that guided our interviews were:

1. What did you like about the module made by the past group?
2. What did not go well with the past module?
3. Are there any techniques that you currently use that work well?
4. What would you most like for us to focus on incorporating into this module?

3.1.2 Evaluation of Past Modules from Educators

In addition to the interviews that were conducted, a survey was distributed to ESD educators in order to understand their experience while using the biodiversity module as well as what changes they would like to see in our new ocean literacy module. The survey was administered via Google Classroom and uploaded as a mandatory assignment to ensure that the educators took the time to fill it out. We decided upon nine questions for the survey to encourage more insightful answers. We limited the number of questions because shorter surveys are more appealing to participants (Janes, 1999). Additionally, we aimed to write clear and unbiased questions as recommended for a successful survey (Janes, 1999). Furthermore, open response questions were chosen in order to understand the opinions and thoughts of the educators (Janes, 1999). Consultation with the EduVentures staff was utilized to choose the exact wording of the questions to verify that they were easy to understand and covered all aspects of the module. A copy of the survey can be found in Appendix 1.

3.2 Educational Content and Course Material

Identifying content followed two steps. First, we consulted with the Ministry of Fisheries to produce an outline for the ocean literacy module. Then, we gathered and analyzed information to ensure that the most relevant material was included in the module. The methods utilized during this process were consultation with the Ministry of Fisheries and content analysis.

3.2.1 Consultation with Ministry of Fisheries

Consultation is an active process in which formal and informal communication occurs between an organization and its stakeholders (Consultation and cooperation, 2012). Following the evaluation of the biodiversity module, we decided on topics for the ocean literacy course material at the National Aquarium of Namibia through consultation with the Ministry of Fisheries. The Ministry of Fisheries is a government organization that has been conducting extensive research on the marine environment and resources of Namibia and also runs the National Aquarium of Namibia (Ministry of fisheries, n.d.). The Ministry of Fisheries provided a proposed a guideline which outlined topics within ocean literacy that our module should focus on. Consultation through informal discussion between our team and the Ministry of Fisheries occurred in order to understand their specific goals for the project. Then, we adjusted the proposed outline and finalized it following the discussion with the Ministry of Fisheries. The Ministry of Fisheries also provided online resources to assist us in our research on the ocean literacy topics specified. Our determination of the finalized outline through consultation with the
Ministry of Fisheries allowed for the modules to completely cover all of the material necessary to increase ocean literacy in Namibia.

### 3.2.2 Content Analysis

Content analysis is a research technique used to narrow data collected to effectively portray messages contained within it (Prasad, 2008, pg. 174). Because the ocean literacy modules was implemented throughout the entire country of Namibia, the content covered needed to be uniform and meet national curriculum standards. Therefore, we conducted a systematic content analysis by cross referencing with the Namibian curriculum. Cross referencing is useful to help find basic information related to the subject being researched (McMurrey, n.d.). This method was utilized to integrate topics in ocean literacy into subjects already taught in Namibia. Following cross referencing, information collected was sorted by using systematic content analysis. Systematic content analysis is the inclusion or exclusion of information according to consistently applied rules (Prasad, 2008, pg. 175). In our case, the consistently applied rules was the already established Namibian curriculum. All of the course material gathered from working with the Ministry of Fisheries was narrowed down in order to most effectively teach ocean literacy according to the standards of the Namibian curriculum.

### 3.3 Constructing the Online Module

The online module was constructed using various software including SMART Notebook and PowerPoint. We integrated active learning and blended learning techniques into the module with the use of games and animated videos that engage learners in the presentation of course content.

#### 3.3.1 Pedagogical Content

A main objective of EduVentures’ online modules is to incorporate teaching methods that can be applied to many learning styles and age groups. To ensure that the modules were relevant in a wide variety of classroom settings, the modules were designed to provide an abundance of pedagogical tools that were also aligned with the ocean literacy curriculum.

EduVentures requested that the modules include “engaging lessons” and “hands-on activities”. Consequently, we focused our design efforts on satisfying this request. Our background research, see section 2.3.1, indicated that both active and blended learning are the most practical pedagogy for teaching engaging, hands-on lessons. Therefore, the modules were designed to train teachers using blended and active learning techniques. The Global Partnership for Education’s flipped approach is an active learning technique used in teacher training workshops that involves providing the teachers with content and then requiring them to apply the content by conducting practice lessons (Burns, 2018). In the flipped approach, the teachers are the learners and the educators are the teachers. The purpose of the flipped approach is to help
teachers develop knowledge within a particular field rather than just memorizing content (Burns, 2018). In order to integrate this approach into the modules, we incorporated activities into the modules that allow educators to practice lessons. There are many benefits to using this approach, such as providing the educators with immediate feedback and allowing them to interact with content in applied and challenging ways (Burns, 2018). The modules also encouraged the educators’ use of active learning methods for training Namibian teachers.

3.3.2 eLearning Software

We utilized SMART Notebook software and PowerPoint to build our module. The SMART Notebook software was used to create interactive lessons and games that are compatible with the SMART boards used to present the modules during training sessions. PowerPoint was used to create slides that presented our content in an aesthetically pleasing way. The SMART Notebook software allowed for a free trial, making it the most cost effective option for designing our module. SMART Notebook is also compatible with Google Classroom, which is the learning management system that we utilized to share and present the online modules. We considered Google Classroom’s ease of use as many educators with ranging technological skills had to be able to utilize the system. EduVentures staff and educators are familiar and comfortable with Google Classroom, so time will not be wasted introducing a new learning management system and software when training sessions are conducted in the future.

3.3.3 Constructing Effective Module Components

It was important to provide educators with comprehensive course material, but it was just as essential to provide them with the teaching methods to best deliver the information to teachers. The modules were designed to build content upon each previous lesson allowing teachers to connect new information learned with material they already understand. Using this strategy ensured that important content was repeated and emphasized throughout the entirety of the module. The design also allowed the educators to understand how the information was connected and how to present their lessons in the same way.

In our discussion with the EduVentures staff, they suggested the modules be made “to be as creative and interactive as possible.” Active learning places students in a position to take control of their education by engaging them through group work and project-based curricula (University of Minnesota, 2019). As discussed in section 2.3.1, active learning methods have been proven to be most effective in presenting engaging lessons, so active learning was integrated thoroughly in the modules. Blended learning, which involves the student learning both online and in the classroom, is also an effective teaching method that calls forth creative skills from learners (Maxwell, 2016). We utilized games, hands-on activities, experiments, and animated videos created using Animaker to present the course material. Playing games in the classroom increases overall motivation, fosters positivity, boosts problem-solving skills, and creates a fun atmosphere (Victoria, 2017). By providing educators with a wide variety of
resources, they gained the ability to design and modify their lessons to accommodate the many learning styles of their students.

3.4 Receive Feedback and Revise Module

In order to ensure that the ocean literacy module met the needs of our sponsor, we consulted with EduVentures and the Ministry of Fisheries to receive feedback on our first draft of the module. To receive feedback, we presented the draft of the module on a SMART Board and went through each of the lessons in the same order and format that they will be presented in the workshop. One person stood at the SMART Board and explained the lesson in detail while three other people from our team took notes on all of the comments and feedback being given. This ensured that all of the feedback was written down and revisions could be made at a later time.

The feedback followed two rounds, one round with EduVentures and then a second round with the Ministry of Fisheries. Our feedback meeting with EduVentures mainly focused on ensuring the ocean literacy module was interactive and well-formatted. The second round of feedback was with the Ministry of Fisheries and the main goal was to clarify validity of the content. The purpose of this meeting was also to ensure we were providing all of the deliverables that the Ministry of Fisheries wanted.

Following these two meetings, we made revisions to the lessons themselves, and then created the new deliverables. Our team compiled the feedback received from the Ministry and EduVentures during both rounds and implemented them into a final version of the ocean literacy module.
4. Findings

Throughout the construction of the ocean literacy module, we received feedback that was continuously used to make improvements. Before we began construction, we received feedback about the Interactive Qualifying Project from A-term of 2018, *EduLink: Integrating ESD into Namibian Secondary School Curricula through Online Modules* by Ajay Manohar, Kylie R. Smith, Laura Boccio, William Sean Ryan Gaddis who created an online module on biodiversity. This initial feedback, through interviews and surveys, provided us with ideas on what teaching methods we wanted to incorporate into the ocean literacy module. Through consultation with the Ministry of Fisheries, we then received feedback on the educational content that should be presented in the ocean literacy module. Lastly, after constructing the module, we received feedback from EduVentures and the Ministry of Fisheries on what we created regarding content, teaching methods, and overall efficacy. We were able to implement their feedback and make improvements to finalize the module for EduVentures. While we were not able to receive feedback from educators on the ocean literacy module, it met the requirements of our sponsors and the Ministry of Fisheries by providing teachers with the tools to implement ESD into the classroom on the topic of ocean literacy.

4.1 EduVentures Interviews

Our first set of findings was from our initial interviews of the EduVentures staff during week one of our project. The purpose of these interviews was to see what the staff liked and disliked about the previous biodiversity module and what we should be focusing on in our ocean literacy module. We interviewed three staff members. The questions we asked as well as the feedback received can be seen in Table 1 below.

<table>
<thead>
<tr>
<th>Questions Asked</th>
<th>Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>What did you like about the module made by the past group?</td>
<td>Games</td>
</tr>
<tr>
<td>What did not go well with the past module?</td>
<td>Too many words</td>
</tr>
<tr>
<td>Are there any techniques that you currently use that work well?</td>
<td>Competitive games like Jeopardy</td>
</tr>
<tr>
<td>What would you most like for us to focus on incorporating into this module?</td>
<td>More diagrams/pictures, more competitive games, interactive elements</td>
</tr>
</tbody>
</table>
From these interview questions, we were able to find that the EduVentures staff would like to see more engaging and appealing lessons. They asked us to minimize the amount of text and increase the presence of diagrams or pictures throughout the module. The staff liked the use of interactive games and suggested using Jeopardy or other competitive activities in our module. Our findings from these interviews were implemented into our ocean literacy module.

4.2 Educator Survey

In order to gain feedback on the strengths and weaknesses of the biodiversity module, we sent a survey to teachers who had previously worked with the module. The feedback we received from this survey was implemented into our design of the ocean literacy module. The survey consisted of 9 questions. The first asked if the teachers enjoyed the biodiversity module and the second asked why or why not they enjoyed it. Out of the 8 responses, 87.5% enjoyed the module, 12.5% said it was okay, and 0% did not enjoy it. When asked why or why they didn’t enjoy the module, the respondents said “it had relevant information and interactive games”, was “straight to the point and understandable”, and was “informative.” Respondents had also expressed that “it was not really new information.” The third question asked if the lessons were presented in an engaging way. Of all respondents, 87.5% said yes while 12.5% said no. The feedback from these first few questions showed that overall, the teachers had a positive experience with the biodiversity module and found the lessons engaging.

The fourth question had the respondents rate 5 different aspects of the module from 1 (least helpful) to 5 (most helpful). The different aspects of the module included the introductory video, assessments, notes, pedagogy, and games. The pie charts below show the respondents’ ratings. The ratings ranged from 1 to 5, with 5 represented in green, 3 represented in yellow, and 1 represented in red. Therefore, aspects of the module with mostly green areas were the most helpful, while those with mostly yellow, orange, and red were least helpful.

Figure 1. Survey Responses Relating to Introductory Video and Assessments
The introductory video and the assessments were the only aspects of the module that had over 50% of the respondents rate it a 4 or 5 (green) on helpfulness. This feedback shows that we should incorporate an introductory lesson at the start of the workshop. It also shows that we should include assessments throughout our lessons. We incorporated this concept by including matching activities and assessments in the form of online games throughout the module.

Figure 2. Survey Responses Relating to Pedagogy and Notes

Both pedagogy and notes did not receive any 5s, however pedagogy received a higher number of 3’s than notes. Therefore, pedagogy was semi-helpful and notes were least helpful. Due to the fact that pedagogy was only slightly helpful, we did not include any information on the teaching methods that teachers should use in their classroom. Instead, we suggested ways they could incorporate ocean content into different subject areas of their classroom. Because notes were least helpful, we did not include slides with large blocks of text. Instead, for each lesson, the teachers were given a copy of an infographic with the most important information from that lesson on which they could take notes. Making the notes optional removed the inconvenience for those who did not find it helpful.

Figure 3. Survey Responses Relating to Games

Games received the least amount of green areas, however it was one of the only categories to be ranked a 5. This shows that people had mixed feelings on the games aspect of
the module. We included various games in our lessons in the form of both online assessments and digital and practical activities like Jeopardy or Pictionary. Providing a variety of games was intended to satisfy a wide range of learning styles.

The fifth, sixth, and seventh questions of the survey asked the respondents if, and why or why not they enjoyed the excursion, debate, and guest speaker. Of all respondents, 87.5% enjoyed the excursion, 87.5% enjoyed the debate, and 100% enjoyed the guest speaker. From this feedback, we concluded that the excursion, debate, and guest speaker were well-received activities and therefore they were incorporated into our module.

The eighth question asked the respondents to rank from 1 to 5 how suitable the games were at presenting the content, 5 being the most suitable and 1 being the least suitable. Four respondents ranked the games a 4, three respondents ranked the games a 3, and one respondent ranked the games a 1. Half of the respondents ranked the games a 4, suggesting that the games presented the content reasonably well. To improve upon the biodiversity module, we produced games that included only the most important content from our lessons. This helped eliminate filler activities that did not add to the most important concepts being taught.

![Figure 4. Responses Relating to Suitability of Games](image)

The final question asked the respondents what they would change or add to the module and if they had any recommendations for future modules. Some of the responses included “creating more practical activities,” “reducing wording,” “making it more interactive,” including “more Namibian examples,” incorporating “more games,” and improving “time management and set-up.” Some of the key aspects of our module were designed to make use of this feedback. Every lesson was designed with a digital activity, practical activity, and an experiment or excursion in order to increase the number of engaging activities included in the module. Throughout each lesson, a few slides of content were presented followed by a game to test the teachers’ knowledge. This was done to increase the number of overall games and to break up the
wording on the slides with interactive activities. Every lesson, practical activity, and excursion related ocean literacy content to examples specific to Namibia.

The feedback received from the survey was vital to our design of the module. Although the sample size was small, the feedback from the survey was useful and important to the design of our module. We were able to get insight on the structure and number of activities to include in each lesson, as well as what not to include from the previous module.

4.3 Ministry of Fisheries

Our third set of findings was from our initial meeting with the Ministry of Fisheries. The Ministry provided us with a course outline indicating lesson topics and subtopics. The outline included the aim and objectives of the module. The objectives expressed that educators should be able to identify and explain many topics including defining sustainable development and how it relates to education, defining ocean literacy, explaining the importance of the oceans and marine life, and outlining the ecological and economic impacts of algae blooms. The outline also included ideas for practical activities and recommended potential sources of information. A summary of the course outline is shown below.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Sub-Topic</th>
<th>Suggested Practical Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education for Sustainable Development (ESD)</td>
<td>- Definition and history of ESD (SDG14)</td>
<td>- SDG game</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Video on SDGs from World’s Largest Lesson</td>
</tr>
<tr>
<td>Ocean Literacy</td>
<td>- Define ocean literacy and an ocean literate person</td>
<td>- Baseline questionnaire on ocean concepts</td>
</tr>
<tr>
<td></td>
<td>- Principles of ocean literacy</td>
<td></td>
</tr>
<tr>
<td>Our Oceans: An Introduction</td>
<td>- General importance of oceans</td>
<td>- Essay writing on importance of oceans</td>
</tr>
<tr>
<td></td>
<td>- Major Oceans</td>
<td>- Excursion to a business deriving benefit from ocean</td>
</tr>
</tbody>
</table>
Table 3. *Ocean Literacy Course Outline Continued*

<table>
<thead>
<tr>
<th>Topic</th>
<th>Sub-Topic</th>
<th>Suggested Practical Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Our Marine Environment</td>
<td>- Benguela current</td>
<td>- Demonstrations to show movement of dense water</td>
</tr>
<tr>
<td></td>
<td>- Upwelling</td>
<td>- Computer simulations</td>
</tr>
<tr>
<td>Marine Food Webs</td>
<td>- Primary producers</td>
<td>- Field trip to collect plankton and view them under a microscope</td>
</tr>
<tr>
<td></td>
<td>- Algae blooms and red tide</td>
<td></td>
</tr>
<tr>
<td>Fisheries and Other Resources</td>
<td>- Outline of important fish caught in Namibia</td>
<td>- Field visit to a fish factory</td>
</tr>
<tr>
<td></td>
<td>- Other living resources exploited</td>
<td>- Practical activity on fish measurement</td>
</tr>
<tr>
<td></td>
<td>- Sustainable resource use</td>
<td></td>
</tr>
<tr>
<td>Intertidal Ecology</td>
<td>- Tides</td>
<td>- Excursion to the intertidal zone</td>
</tr>
<tr>
<td></td>
<td>- Intertidal zones</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Adaptation of organisms</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Zonation</td>
<td></td>
</tr>
<tr>
<td>Human Impact and Mitigation</td>
<td>- Threats to marine environment/biodiversity</td>
<td>- Beach clean up to assess types of pollution</td>
</tr>
<tr>
<td></td>
<td>- What can I do on a personal level</td>
<td></td>
</tr>
<tr>
<td>Glossary</td>
<td>- Important terms defined</td>
<td>- No activities, just definitions</td>
</tr>
</tbody>
</table>

Each lesson applies to the objectives of the module determined by the Ministry of Fisheries. The objectives stated what the educators should be able to do after learning from the module. Table 4 displays the lessons that fulfill each objective.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Objectives Fulfilled</th>
</tr>
</thead>
</table>
| Education for Sustainable Development (ESD)         | - Define sustainable development and how it relates to education for sustainable development  
- Familiarize with the SDG’s and outline the SDG14 |
| Ocean Literacy                                      | - Define what ocean literacy entails and list its principles                                                                                          |
| Our Oceans: An Introduction                         | - Outline the importance of the oceans and identify five major oceans                                                                               |
| Our Marine Environment                              | - Identify the current flowing along the Namibia coast  
- Explain the significance of upwelling                                                          |
| Marine Food Webs                                    | - Define plankton and recognize its importance in the marine food web  
- Outline the ecological and economic impacts of algae blooms  
- Identify threats to marine biodiversity and environment                                           |
| Fisheries and Other Resources                       | - Identify major fish species caught in Namibia and argue for sustainable resource use                                                              |
| Intertidal Ecology                                  | - Recognize the significance of tides in the intertidal zone  
- Identify common intertidal biodiversity and adaptation                                           |
| Human Impact and Mitigation                         | - Identify threats to marine biodiversity and environment  
- Identify ways to protect and conserve marine environment                                         |
Through the use of outline and the meeting with the Ministry of Fisheries we received all the necessary information to build the module. We also gained an understanding of their goals for the module, allowing us to cater the module to their needs.

4.4 First Module Draft

Following the construction of the ocean literacy module, we presented the first draft to EduVentures to receive feedback on the pedagogy and formatting of the lessons. We presented each lesson on the SMART board. EduVentures was content with the general construction of the module. They were pleased with the types of pedagogy we integrated as well as the level of engagement of the activities. Specifically, they enjoyed the variety of activities provided and the flexibility to choose between a practical activity, experiment, or excursion. There were a few criticisms which applied to almost all of the lessons including formatting of the slides and adding a voice-over to the informational videos we created. A complete overview of the comments for each specific subtopic is shown in Table 5. Many of the minor comments had to do with technical problems, clarity of the information presented, and making the module more interesting. Each comment below has been placed into one of the three categories for organizational purposes. The feedback from EduVentures allowed us to improve the pedagogical tools presented in the ocean literacy module. We were also able to fix some formatting before we presented the next draft of the ocean literacy module to the Ministry of Fisheries.

Table 5. Feedback from EduVentures

<table>
<thead>
<tr>
<th>Sub-Topic</th>
<th>Comment</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean Literacy</td>
<td>● Hand out 7 principles on sheet of paper</td>
<td>● Clarity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Our oceans</td>
<td>● Fix sides of slides</td>
<td>● Technical</td>
</tr>
<tr>
<td></td>
<td>● Avoid too much text by splitting up slides or fading words in</td>
<td>● Interactivity</td>
</tr>
<tr>
<td></td>
<td>● Add in oceans meeting</td>
<td>● Interactivity</td>
</tr>
<tr>
<td></td>
<td>● Add voice over to Animaker</td>
<td>● Clarity</td>
</tr>
</tbody>
</table>
### Table 6. Feedback from EduVentures Continued

<table>
<thead>
<tr>
<th>Sub-Topic</th>
<th>Comment</th>
<th>Category</th>
</tr>
</thead>
</table>
| Our Marine Environment     | ● Fix Glitches in slide  
● Show fan in the picture for the demonstration                       | ● Technical  
● Clarity                                                   |
| Intertidal Ecology         | ● Fix music in video  
● Increase length of video  
● Add voice over to video  
● Add where a submarine and diver would be  
● Video simulation of tide  
● Fix matching activity  
● Find a way to change writing with a pen into text on SMART board | ● Technical  
● Technical  
● Clarity  
● Interactivity  
● Clarity  
● Technical  
● Technical                                                   |
| Marine Food Webs           | ● Animaker voice over  
● Figure out how to make drawings go away after the slide  
● Fix videos                                                        | ● Technical  
● Technical  
● Technical                                                   |
| Fisheries and Other Resources | ● Make infographic for information  
● Compare fish production/import/export to beef and game production/import/export  
● Put in slide about affordable fish/ health benefits of eating fish  
● Discussion about why Namibians don’t eat a lot of fish | ● Interactivity  
● Clarity  
● Clarity  
● Interactivity                                                   |
| Human Impact               | ● Describe how ocean mining works, add pictures  
● Show pictures from African penguin project  
● Add career options involving the ocean  
● Add something on threatened species                           | ● Clarity  
● Interactivity  
● Clarity  
● Clarity                                                   |

#### 4.5 Second Module Draft

Following our meeting with EduVentures we adjusted our module to present to the Ministry of Fisheries. Meeting with the Ministry of Fisheries was a week long process of continuous feedback. We presented at the beginning of the week, during which we only received minor changes. During the week we worked on the minor changes while the Ministry further analyzed our module in more detail. During a second meeting with the Ministry they supplied us with more detailed feedback about the module. This feedback addressed content that they wanted to add, content they wanted to remove, and updating content with more recent statistics. In general they liked the interactive aspects of our modules. The full list of comments is shown in...
Table 7, placed into one of three categories, clarity, technical, and interactivity. The main feedback we received was removing content that was too detailed, and adding more content. This type of feedback was categorized as clarity. Technical feedback involved problems that occurred with the presentation of the module. Interactivity involved making sure the lesson had enough activities to keep the viewer engaged.

Table 7. *Ministry of Fisheries Feedback*

<table>
<thead>
<tr>
<th>Topic</th>
<th>Comment</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainable Development</td>
<td>● Add video on SDG 14</td>
<td>● Interactivity</td>
</tr>
<tr>
<td>Ocean Literacy</td>
<td>● Focus on general importance of the oceans</td>
<td>● Clarity</td>
</tr>
<tr>
<td></td>
<td>● Start with the ocean as a whole</td>
<td>● Clarity</td>
</tr>
<tr>
<td></td>
<td>● Include importance to Namibia</td>
<td>● Clarity</td>
</tr>
<tr>
<td></td>
<td>● Change title to Blue Planet</td>
<td>● Technical</td>
</tr>
<tr>
<td></td>
<td>● Add in pictures of the Earth from space</td>
<td>● Interactivity</td>
</tr>
<tr>
<td></td>
<td>● Add more questions to the quiz</td>
<td>● Technical</td>
</tr>
<tr>
<td></td>
<td>● Add examples of climate change</td>
<td>● Clarity</td>
</tr>
<tr>
<td></td>
<td>● Take out activity with stories and principles</td>
<td>● Technical</td>
</tr>
<tr>
<td></td>
<td>● Add in mining, tourism, salt factory</td>
<td>● Clarity</td>
</tr>
<tr>
<td>Our Oceans</td>
<td>● Add Hydrogen sulfide eruptions</td>
<td>● Clarity</td>
</tr>
<tr>
<td></td>
<td>● Add formulas on CO2 combining with water</td>
<td>● Clarity</td>
</tr>
<tr>
<td></td>
<td>● Add oxygen determination</td>
<td>● Clarity</td>
</tr>
<tr>
<td></td>
<td>● Add temperature determination</td>
<td>● Clarity</td>
</tr>
<tr>
<td></td>
<td>● Include a bigger button to play sounds of animals</td>
<td>● Technical</td>
</tr>
<tr>
<td>Our Marine Environment</td>
<td>● Upwelling diagram: make text black</td>
<td>● Technical</td>
</tr>
<tr>
<td></td>
<td>● Fix video</td>
<td>● Technical</td>
</tr>
<tr>
<td></td>
<td>● Change order on phytoplankton slide</td>
<td>● Clarity</td>
</tr>
<tr>
<td></td>
<td>● Fill in the Blank Map Activity is too detailed</td>
<td>● Clarity</td>
</tr>
<tr>
<td></td>
<td>● Rephrase classroom slide</td>
<td>● Clarity</td>
</tr>
<tr>
<td></td>
<td>● Try the demonstration in Windhoek</td>
<td>● Technical</td>
</tr>
</tbody>
</table>
### Table 8. Ministry of Fisheries Feedback Continued

| Intertidal Ecology | • Change name of zones  
|                   | • Barnacle life cycle is too detailed  
|                   | • Make handout of barnacle anatomy  
|                   | • Keep barnacles, limpets, mussels, sea anemones,  
|                   | • Remove sea stars  
|                   | • Add different types of algae  
|                   | • Add pollution and littering and its effects  
| Marine Food Webs   | • Add activity on looking at plankton  
|                   | • Add herbivores and carnivores  
|                   | • More emphasis on red tides and sulphur  
|                   | • Add in tertiary consumers  
|                   | • Change primary and secondary consumers  
|                   | • Remove information on location  
|                   | • No description for each organism  
|                   | • Remove shark information  
| Fisheries and Other Resources | • Change name to Marine Resources  
|                              | • Present value of production differently  
|                              | • Kingklip picture is blurry  
|                              | • Add more fish  
|                              | • Infographics for number tables  
|                              | • Include marine tourism, diamond mining, sand mining  
| Human Impact            | • More pictures of undersea mining  
|                         | • Add in garbage patch video  

Aside from the presentation aspect of the lessons, the Ministry requested some additional deliverables. They first requested that we change the formatting of our lesson plans to a grid format. As seen in the example below. They also requested that we create a book of the lesson plans that included extra information and activities as well. The purpose of this was to provide the educator with the flexibility to include extra content and activities if time permitted. In addition to the lesson plan book, a course content book was requested to be provided to the teachers attending the course. The purpose of this book was to provide teachers with the content from the course so that they would have access to it for later reference. The book also included extra information such as case studies and interesting stories, so that they have option to learn
more on their own if they wanted. The course book also contained activities and worksheets that are ready to be distributed to their classes. This would provide them with more tools to be able to give students information to become more ocean literate. Lastly, they requested a 30 question questionnaire to test the teacher’s retention of the material presented in the module.

Figure 5: Original Lesson Plan Format

Lesson: Our Marine Environment
Time Approximation: 1 hour 30 minutes
Activities: Video, Label Reveal Map, Potential Threats to Marine Biodiversity Sorting, Fill in the Blank Map, Upwelling Demonstration
Materials: Printed out map, writing utensil, see Upwelling Demonstration at end of lesson plan for other supplies needed

Intro: Explain Benguela Current, show on map
- Benguela current
  - Important to note
    - Click on words “Skeleton Coast”, “Cape Cross”, “St. Francis Bay”, and “Penguin Islands” to make red arrows appear
    - Talk about how it’s usually foggy in Swakopmund

- Video

- Label Reveal
  - Have teachers take notes on their own printed out map, notes will be for a later activity
  - Start with Luderitz upwelling cell
    - Most intensive wind-induced upwelling cell in the current, also the world
  - Click on Benguela current, talk about how it’s globally unique being the cold-water upwelling system bordered by two warm-water current systems, click on Agulhas current and Angola current (Benguela current. n.d.)
  - Cape Agulhas is the most Southern point
  - Go through where Southern Benguela and Northern Benguela are split (at Luderitz)
- Potential Threats to Marine Biodiversity
  - Anthropogenic- Originating in Human Activity
  - Have teachers go up to board and guess whether the threat occurs naturally or as a result of human activity
    - Next slide goes through each example and briefly explains
    - Important to note these are possible threats, important to be aware of activities going on near the coast that could harm the marine environment
  - When to Incorporate into Classroom?
    - Connects back to principles that the ocean has an effect on climate and weather, the ocean makes Earth habitable, the ocean supports a great diversity of life and ecosystems

Figure 6: New Lesson Plan Format

Lesson Title: Our Marine Environment

Objective: Teachers will be able to identify the Benguela Current, understand the characteristics of the Benguela Current and its effects on Namibia’s marine environment and climate.

<table>
<thead>
<tr>
<th>Presentation Activities</th>
<th>Materials/Resources</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Upwelling Video Simulation</td>
<td>SMART presentation, SMART Board</td>
<td>40 minutes</td>
</tr>
<tr>
<td>- Label Reveal Map</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Potential Threats to Marine Biodiversity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Notes

**Introduction slide on Benguela current**
- Click on words “Skeleton Coast”, “Cape Cross”, “St. Francis Bay”, and “Penguin Islands” to make red arrows appear on map
- Talk about how it’s usually foggy in Swakopmund

**Extra Information**
- Large Marine EcoSystem (LME) is a region of the ocean in which multiple countries collaborate on strategic, long-term ocean governance of transboundary resources (The Benguela Current LME. 2013).
- The Benguela Current LME is bordered by Namibia, Angola, and South Africa (The Benguela Current LME. 2013)
- The Benguela Current LME is one of the most productive marine ecosystems on earth and an asset of global importance. It stretches from Port Elizabeth in South Africa to the province of Cabinda in northern Angola, encompassing the full extent of the cold Benguela Current. The BCLME sustains important artisanal and commercial fisheries and valuable offshore industries, including marine diamond mining and oil and gas extraction (The Benguela Current LME)
- The surface temperatures of the Benguela Current are about 8 degrees C colder than average for coastlines in these latitudes. The coldest waters of the current run right along the coast of Africa, with very little seasonal variation. Surface temperatures average about 10 to 15 degrees C near the coast and reach up to 25 degrees C on the surface, out along the continental shelf. (Benguela current. n.d.)

**Label Reveal**
- Have teachers take notes on their own printed out map, notes will be for a later activity
  - Start with Luderitz upwelling cell
    - Most intensive wind-induced upwelling cell in the current, also the world (The Benguela Current. 2013)
  - Click on Benguela current, talk about how it’s globally unique being the cold-water upwelling system bordered by two warm-water current systems, click on Agulhas current and Angola current
  - Go through where Southern Benguela and Northern Benguela are split (at Luderitz)

**Potential Threats to Marine Biodiversity**
- Anthropogenic- Originating in Human Activity
  - Have teachers go up to board and guess whether the threat occurs naturally or as a result of human activity
    - Next slide goes through each example and briefly explains
    - Important to note these are possible threats, important to be aware of activities going on near the coast that could harm the marine environment

---

After our first meeting with the Ministry of Fisheries, we implemented some of the edits for the presentation portion of the module before presenting one last time to the Ministry. During the last presentation of the module we only received minor comments to adjust our module. Following our final meeting with the Ministry we continued to work on incorporating all of the feedback received from the two meetings to produce the final draft of the module including the presentation, questionnaire, lesson plan book, and content book. We received no more feedback after sending the module to the Ministry the last time.
5. Deliverables

Through discussions with the Ministry of Fisheries and EduVentures, a list of deliverables was determined for our project. As requested by EduVentures and the Ministry of Fisheries, our group created a questionnaire that would be administered before and after the workshop with teachers to gauge retention of the information presented during that workshop. Our group then constructed the presentations for each lesson on both PowerPoint and SMART Notebook. We also created lesson plans for the educator who would be running the workshop, which included a walk through of each lesson slide by slide and descriptions of activities. Then our group compiled all of the information for each lesson as well as additional details for each topic into a content book that the teachers could take back to their classroom to create their own lessons. Lastly, the final deliverable was a post-workshop survey that will be able to give our group and future groups some feedback on what went well and what should be changed for the next modules.

5.1 Questionnaire

To test the retention of the information presented in the module by the teachers, we created a questionnaire that consisted of 24 questions. The questionnaire is to be given each time the module is presented to teachers. It should be administered once before the first lesson of the module, and a second time after the conclusion of the last lesson of the module. The questions are the same for the pre and post assessment. The questions for the questionnaire were taken directly from the content in the module. The questionnaire is composed of three questions on key concepts from each of the eight lessons. This will show if the teachers are retaining the information being taught in the module.

Figure 7. Pre/Post Educator Questionnaire

ESD

1. What organization created the sustainable development goals?
   a. United Nations
   b. International Sustainability Organization
   c. World Health Organization
   d. National Association for Education of Youth

   (United Nations.n.d.)

2. How many sustainable development goals are there?
   a. 26
   b. 20
c. 17
d. 12

(United Nations. n.d.)

3. The main focus of sustainable goal 14 is to:
   a. Prevent climate change
   b. Eliminate poverty
   c. **Conserve and protect marine life**
   d. Provide quality education for all people

(United Nations. 2018)

Ocean Importance

4. How does the ocean affects us?
   a. The ocean regulates our climate and weather patterns
   b. Many medicinal products come from the ocean
   c. The ocean produces 50% of all of the world’s oxygen
   d. **All of the above**

(US Department of Commerce, & National Oceanic and Atmospheric Administration. 2017.)

5. Which campaign was designed by scientists and educators to decide which principles and concepts everyone should understand about the ocean by the end of secondary school?
   a. Sustainability Campaign
   b. Marine Protection Campaign
   c. **Ocean Literacy Campaign**
   d. Shark Conservation Campaign

(Ocean literacy. 2013)

6. Which is not one of the seven essential principles of Ocean Literacy?
   a. The Earth has one big ocean
   b. Humans and the ocean are inextricably interconnected
   c. The ocean is largely unexplored
   d. **Humans must change their practices in order to conserve the ocean and marine life**

(Ocean literacy. 2013)

Our Oceans

7. Which of the following is not an ocean zone?
   a. Bathypelagic Zone
   b. Epipelagic Zone
c. **Nanopelagic Zone**  
d. **Abyssopelagic Zone**  
(Ocean Zones - Nature Works. n.d.)

8. **What is salinity?**  
   a. A process that results in a rotten egg smell and millions of dead fish periodically  
   b. The attenuation of sound by absorption and conversion to other energy forms  
   c. The ratio of the amount of heat energy transferred to an object to the resulting increase in its temperature  
   **d. The amount of salt dissolved in one kilogram of seawater**  
   (ScienceDirect. n.d.)

9. **What causes ocean acidification?**  
   a. The ocean’s absorption of the excessive levels of CO2 in the atmosphere, increasing the level of hydrogen ions in seawater  
   b. Anaerobic bacteria that emit hydrogen sulfide gas as a byproduct during the decaying process of plants at the bottom of the ocean  
   c. Membrane separation using pressure, electric potential, and concentration to overcome natural osmotic pressures  
   d. Garbage patches, including the North Atlantic garbage patch, secreting hazardous toxins into the ocean  
   (PMEL Carbon Program. n.d.)

**Our Marine Environment**

10. **What is the current that flows along the coast of Namibia?**  
    a. El Nino Current  
    **b. Benguela Current**  
    c. Aghulas Current  
    d. Angola Current  
    (Benguela current. n.d.)

11. **What process occurs along the Namibian coast?**  
    a. Downwelling  
    b. Sidewelling  
    c. Overwelling  
    **d. Upwelling**  
    (Benguela current. n.d.)

12. **What characterizes the Namibian marine environment?**
a. Low biodiversity, high biological productivity  
b. High biodiversity, high biological productivity  
c. Low biodiversity, low biological productivity  
d. High biodiversity, low biological productivity  
(The benguela current LME. 2013)

Intertidal Ecology

13. What causes tides?  
a. The moon and sun  
b. Weather  
c. Ocean animals  
d. Tectonic plate movement  
(Project Oceanography. 2002)

14. Which one of the following organisms would you not find in the intertidal region?  
a. Limpets  
b. Barnacles  
c. Mussels  
d. Shark  
(Project Oceanography. 2002)

15. Which intertidal zone contains the most diverse group of organisms?  
a. Splash Zone  
b. High-Tide Zone  
c. Mid-Tide Zone  
d. Low-Tide Zone  
(Project Oceanography. 2002)

Marine Food Webs

16. Which of the following is a primary producer in Namibia?  
a. Phytoplankton  
b. Seal  
c. Shark  
d. Sardine  
(NASA. n.d.)

17. What is the cause of the red tide?  
a. Pollution  
b. Ocean acidification  
c. Hydrogen sulfide eruptions  
d. Blooms of phytoplankton along the coast
18. What is a trophic level?
   a. The classification of how dangerous an animal is
   b. **The position an animal occupies in a food chain**
   c. A comparison of how big animals can get throughout their lifetime
   d. The recognition of how common an animal is in the wild

(Encyclopedia Britannica, 2019)

Fisheries and other Resources

19. Which is not a fish found in Namibia?
   a. Hake
   b. Kingklip
   c. Orange Roughy
   d. **Lionfish**

(Bianchi et al., 1999).

20. What is guano?
   a. A phenomenon that occurs when changes in Earth's climate system result in new weather patterns that last for at least a few decades
   b. A large-headed elongated fish with long jaws and strong teeth, a valuable commercial food fish
   c. **The sedimentary conglomerate of dung, carcasses, feathers, eggshells and sand accumulating in areas where seabirds congregate**
   d. A process that takes away mineral components from saline water

(Namibweb, n.d.)

21. Which of the following is not mined in Namibia?
   a. Salt
   b. **Bronze**
   c. Uranium
   d. Diamonds

(Laniado. 2015)

Human Impact

22. What is the most common pollution element found in the ocean?
   a. Glass
   b. Cardboard
   c. **Plastic**
   d. Oil
23. What are the two main threats to inshore biota, associated with mining activities?
   a. **Sediment movement and illegal kelp cutting**
   b. Overfishing and removement of nutrients
   c. Reduction of water and marine-life relocation
   d. There are no threats to inshore biota

(Currie, Grobler, & Kemper, 2008)

24. Which is not an indicator of climate change?
   a. Rising sea levels
   b. Ocean acidification
   c. Warming of the ocean
   d. **Overfishing restrictions**

(How climate change relates to oceans. n.d.)

5.2 Module

The team constructed the EduVentures teaching module on Ocean Literacy using three main softwares including SMART Notebook, PowerPoint, and Animaker. The module is comprised of seven different lessons and includes various suggestions for activities related to the content of each lesson. The lesson titles include: Education for Sustainable Development, Blue Planet, Our Oceans, Our Marine Environment, Intertidal Ecology, Marine Food Webs, Marine Resources and Human Impact. The ESD lesson includes an overview of the 17 sustainable development goals, focusing on goal 14 which is life below water. For the Blue Planet lesson, the focus was on ocean importance and general ocean literacy. Next, the Our Oceans lesson covered general ocean information, focusing on the Atlantic Ocean and Namibian-specific examples. The Our Marine Environment lesson included information about the Benguela Current and upwelling on the Namibian coast. Intertidal Ecology included content on the different intertidal zones as well as the organisms that live in these areas. Next, the Marine Food Webs lesson was aimed to teach about trophic levels and Namibian marine food webs. The Marine Resources lesson went over different resources related to the ocean, such as fishing and mining. Lastly, the Human Impact lesson covered various threats to marine biodiversity and climate change indicators. Shown below are screenshots from each lesson to show the general layout of each PowerPoint or SMART lesson.
Over three billion people depend on marine and coastal biodiversity for their livelihoods.

30 percent of the world’s fish stocks are overexploited, reaching below the level at which they can produce sustainable yields.

Oceans absorb about 30 percent of the carbon dioxide produced by humans, and we are seeing a 26 percent rise in ocean acidification since the beginning of the industrial revolution.

Marine pollution, an overwhelming majority of which comes from land-based sources, is reaching alarming levels, with an average of 13,000 pieces of plastic litter to be found on every square kilometer of ocean.

(United Nations. 2018)

Figure 8 shows the part of the ESD lesson that focused on sustainable development goal 14, life below water, which was the goal that was most applicable to our overall ocean literacy topic.
Once you click on the images, the words underneath appear providing more information on how the ocean affects various aspects of our lives.
Figure 10. Second Screenshot from Blue Planet Lesson

(Why is the ocean important?. 2013)
(US Department of Commerce, & National Oceanic and Atmospheric Administration. 2017.)
Clicking on the yellow boxes with question marks will reveal the six most abundant ions in seawater. Also, clicking the grey box will bring up information about other major dissolved substances in seawater.
Figure 12. Second Screenshot from Our Oceans Lesson

(Byrne, Mackenzie, & Duxbury, 2018)
Our Marine Environment:

Figure 13. Screenshot from Our Marine Environment Lesson

This shows a SMART activity used in the Our Marine Environment lesson. The boxes can be dragged to either the ‘Natural’ or ‘Anthropogenic’ labeled circles based on which type of threat to marine biodiversity they are. If the square is dragged to the correct location, it will disappear. If it is dragged to the correct location, it will bounce back.
Intertidal Ecology:

Figure 14. *Screenshot from Intertidal Ecology Lesson*

For this activity, the teachers would have to drag the correct zone, characteristics and organisms to their respective zones.

(Project Oceanography. 2002)
Marine Food Web:

Figure 16. *Screenshot from Marine Food Web Lesson*

(WISE Marine. n.d.)
This slide in the Marine Food Webs lesson summarizes the different trophic levels.

(NASA. 2008)

This slide in the Marine Food Webs lesson summarizes the factors that affect the growth of phytoplankton in Namibian oceans.
Marine Resources:

Figure 18. Screenshot from Marine Resources Lesson

The fishing sector remains one of the biggest contributors to the local economy.

#2

The fishing industry is the second most important foreign exchange earner for Namibia after mining.

$10 billion

In 2016, the fishing industry provided around N$10 billion in foreign exchange.

(Barnard. 2005)

Figure 19. Second Screenshot from Marine Resources Lesson

Guano is the sedimentary conglomerate of dung, carcasses, feathers, eggshells and sand accumulating in areas where seabirds congregate.

The Benguela provides nutrient-rich waters, allowing for huge shoals of fish which caters for a variety of seabirds on the coast.

The dry climate resulting from the cold ocean current further favours the build-up of guano and the retention of its nutrients.

(Namibweb, n.d.)
These slides show examples of the information within the Marine Resources lesson as well as how it was displayed.

Human Impact:

Figure 20. Screenshot from Human Impact Lesson

(How climate change relates to oceans. n.d.)

Figure 20 shows how the Human Impact lesson portrayed climate change.

5.3 Lesson Plan Book

Another deliverable that was asked for by the Ministry of Fisheries and EduVentures was a book containing lesson plans for each subtopic within the module. These lesson plans will be used by the educator who will run the training workshop. Each lesson plan will walk the educator through how to operate the SMART lesson slide by slide and will list important points that should be emphasized. The plans also list the activities that will accompany each lesson. For each subtopic, our group included three different types of activities: digital, practical and excursion/experiment. The digital activities are those that use the SMART board, such as Jeopardy or Pictionary. The practical activities are those that require minimal materials but are still engaging and informative, such as debates or writing an essay. Lastly, the excursions/experiments require the most materials and planning and include taking a trip to a remote location such as a fish factory or conducting experiments using laboratory equipment. Our group provided these options for each lesson in order to allow the educator running the workshop to make decisions on what would be best, taking into consideration the time and
materials available. For example, if the workshop did not have the materials present to conduct an ocean sample pH and oxygen level test, then the group would play Jeopardy or Pictionary instead. The structure of the lesson plans that we used divide the information into presentation, practice, and production sections. The presentation section contains all of the small activities included in the lessons themselves as well as the notes for the educator about how to interact with the board and what important points to say for each slide. The practice section includes the digital and practical activities that could accompany each lesson. A description and set of directions for each practical and digital activity can also be found in this section. Lastly, the production section of the lesson plan includes the respective excursions and experiments for each lesson. A description, set of directions and a list of materials required for each experiment can be found in this section as well. An example of a completed lesson plan is shown below; this plan is for the human impact lesson within the ocean literacy module.

**Figure 21. Human Impact Lesson Plan**

Lesson Title: Human Impact

<table>
<thead>
<tr>
<th>Objective: Teachers will be able to…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain knowledge about which activities are harmful to marine ecosystems,</td>
</tr>
<tr>
<td>which oceanographic conditions are associated with patterns of climate change,</td>
</tr>
<tr>
<td>and learn about how to live more sustainably to preserve marine life.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Presentation Activities</th>
<th>Materials/Resources</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Main threats to marine biodiversity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Brainstorming ways to support SDG 14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- SMART Board</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 45 minutes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes
Second Slide: Threats to Marine Environment/Biodiversity

Important Points:
- The main threats to the marine environment are mining activities, overfishing, natural threats, oil spills and pollution, and unsustainable harvesting practices.
- There are several other threats to the marine environment, however these are the most prevalent examples in Namibia
(Currie, Grobler, & Kemper, 2008)

Third Slide: Mining Activities

Important Points:
- Two boxes will appear when you touch the space they are located in. One is between the two pictures and the other is on the left side of the arrow
- As a result of mining activities, sediment movement and illegal kelp cutting activities have hurt marine biodiversity
- Inshore reef areas and kelp beds provide a crucial role as a food source and shelter for several organisms, therefore the kelp cutting is detrimental to the surrounding ecosystem
- Removing and relocating sediment as a result of mining can result in the formation of land bridges, changing the geography of coasts or islands and negatively impacting the ecosystems around it
- Reveal the fact under the green oval by clicking on the shape with the SMART marker
(Currie, Grobler, & Kemper, 2008)

Fourth Slide: Overfishing

Important Points:
- Three boxes will appear when you touch the space they are located in. They are on the left side of the pictures.
- Overfishing can have very harmful impacts on the ecosystems around the fishing location and the organisms that depend on these fish to survive
- A Namibian example is when the sardine stock declined significantly in the 1960s due to overfishing. Then, anchovies became more popular to fill this fish gap until the same overfishing depleted the availability.
- Seabird populations that depended on these fish to survive decreased dramatically, dying from starvation
(Currie, Grobler, & Kemper, 2008)

Fifth Slide: Unsustainable Harvesting Practices

Important Points:
- Two boxes will appear when you touch the space they are located in. One is above the picture and one is below.
- Similar to overfishing, overharvesting can also have significant impacts on the ecosystems around the harvesting location and the organisms that depend on them to survive.
- A Namibian example includes the overharvesting of guano, which is required for the African penguin to burrow in.
- Nesting in other locations, because of the lack of guano, results in the penguin’s eggs being predated by Kelp gulls and chicks being susceptible to heat exhaustion.
- Therefore, overharvesting hurts the organisms that depend on the item being overharvested and can set the ecosystem off-balance.

(Currie, Grobler, & Kemper, 2008)

Sixth Slide: Oil Spills and Pollution

Important Points:
- The persistent chronic oiling from ships discharging waste oil and sunken boats leaking oil could possibly lead to a major oil crisis in Namibia.
- Certain organisms, such as African penguins who are flightless, are especially vulnerable when it comes to oil spills.
- A medium-sized oil spill between Mercury and Ichaboe islands would threaten 80% of the Namibian penguin population.

(Currie, Grobler, & Kemper, 2008)

Seventh Slide: Oil Spills and Pollution

Important Points:
- Four boxes will appear when you touch the space they are located in. One is above the picture, one is to the left, one is below and one is to the right.
The biggest source of pollution is directly from land based sources, dumping thousands of tons of waste and trash into the ocean on a daily basis.

- Plastic is the most common element found in the ocean.
- Plastic debris absorbs toxic chemicals from ocean pollution and therefore poisons the organisms that consume it.
- Plastic does not degrade, but breaks down progressively into smaller and smaller pieces and never disappears.
- Small animals can absorb chemicals from pollution as they eat. The larger animals who consume them will increase the concentration of toxins consumed through their food. Therefore animals at the top of the food chain will have exponentially more contamination from the food they eat, which could be lethal to the organism.

(Currie, Grobler, & Kemper, 2008)

Eighth Slide: Oil Spills and Pollution

Important Points:
- The North Atlantic garbage patch is continuously growing and will only stop if we reduce our waste and pollution.
- Great Pacific Garbage Patch is the largest garbage patch in the world.

(Yoneda, 2010)

Ninth Slide: Oil Spills and Pollution

Important Points:
- Go through the diagram showing the movement of water in each gyre.
- Mention that there is a garbage patch accompanying each one of these gyres.

(Yoneda, 2010)

Tenth Slide: Natural Threats

Important Points:
- Although most threats to marine diversity are human related, there are some threats that are completely natural.
- Namibian example: Lions moving to the coast to eat seals.
  - Click on the lavender rectangle to reveal the words beneath it.
Since the rain in the desert has been minimal, there is a lack of food for the lions to eat. Therefore, they have begun to move towards the coast to catch seals for their meals. The pictures on the left and right show the lions catching seals. This is not a result of human impact, it is a response to a change in the environment.

(Rust, 2019)

Eleventh Slide: Threats to Marine Environment/Biodiversity

Activity:
- Have the educators fill in the ovals with the threats that were discussed in the previous slides
- Try to limit one educator to one oval to encourage more volunteers
- The answer key can be seen on slide 2
- Ask the educators what some other threats to the marine environment are, if they can think of any
  - Have them brainstorm in small groups

Twelfth Slide: Climate Change

Important Points:
- Click above or below each picture to reveal the information for each topic
- Carbon Emissions
  - Energy and heat from the atmosphere that results from increasing carbon emissions build up in the ocean
- Ocean Acidification
  - Absorption of CO2 increases acidity of the ocean, therefore the increased carbon emissions cause the ocean’s pH to decrease
  - When combined to ocean warming, organisms including coral reefs are dying off and cannot provide a healthy ocean habitat for the organisms that rely on them for food and protection
- Rising Sea Levels
  - As oceans warm, the seawater expands and takes up more space. Also, the melting of the ice caps add water to the oceans.
- Both processes cause a rising sea level, putting coastal cities in danger for the future
- The image shows an example of sea level rising, however the image was not based on a location in Namibia
- Fossil Fuel Usage
  - Reducing fossil fuel usage will reduce the amount of CO2 and other GHGs produced, benefiting the ocean

(How climate change relates to oceans. n.d.)

Thirteenth Slide: What can I do on a personal level?

Activity: Things we can do to help
- Have the educators brainstorm ways that they can help mitigate climate change and write their ideas on the board
- The grey boxes hide examples of possible mitigation efforts, so click on the boxes if you would like to show the educators some examples

<table>
<thead>
<tr>
<th>Practice Activities</th>
<th>Materials/Resources</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Human Impact Pictionary</td>
<td>- SMART Board</td>
<td>- Human Impact Pictionary</td>
</tr>
<tr>
<td>- Debate on Phosphate Mining</td>
<td></td>
<td>- 30 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Debate on Phosphate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mining</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 30 minutes</td>
</tr>
</tbody>
</table>
Notes:

Digital Activity: Human Impact Pictionary

Materials Required: SMART Board

Time: Approximately 30 minutes

Directions:

Divide the teachers into two teams.

Select one person from each team to be your picturist for the first word. The picturist is the person who attempts to illustrate the word using the pencil and paper.

Everyone else on the team will try to guess the word that the picturist draws.

Players on the team will take turns acting as the picturist.

The team that guesses their picturist’s word first gets a point, and the team with the most points after all of the words have been used wins.

Human Impact Pictionary:

The words used for this game are all examples of negative human impacts that affect the ocean.

Here is the list of words that you will have the picturist draw:
Ocean Mining
Overfishing
Oil spills
Pollution
Natural Threats (lions eating seals)
Climate change
Rising sea levels
Fossil fuels
Ocean acidification
Carbon emission

----------------------------------------------------------------------------------
Practical Activity: Debate on Phosphate Mining

Materials Required: None

Time: Approximately 30 minutes

Directions:

Show the Animaker on phosphate mining to give the educators a background of what it is and the benefits/drawbacks

Split the educators into six groups

Each group will take the perspective of one of the following stakeholders of phosphate mining:
- Farmers
- Fishers
- Unemployed citizen with the potential to work as a miner
- Phosphate mining company representative
- Ministry of Fisheries/Aquarium representative
- General citizen

Have the groups discuss their thoughts on phosphate mining from their assigned perspective

<table>
<thead>
<tr>
<th>Production Activities</th>
<th>Materials/Resources</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Beach clean up</td>
<td>- Travel to beach</td>
<td>- 1 hour</td>
</tr>
</tbody>
</table>

Notes
Excursion: Beach Clean Up

Time: 1 hour

Description: During this beach clean up, the educators will take an hour to travel to the beach in Swakopmund and collect trash.

5.4 Content Book

After completing the lessons and lesson plans, our team created a content book that the teachers will take home with them to use in their classrooms. This book contains all of the content presented in the SMART and PowerPoint lessons, as well as additional information not covered in the slides. This additional information includes more detailed explanations of the content, case studies of some of the experiments and processes touched upon in the lessons, and full length stories about Namibian oceans and marine life in general. The book will also include a list of activities and games that the teachers can use to teach the ocean content to their students. Some of these activities are crosswords, word searches, Pictionary, charades, vocabulary matching games, fill-in-the-blanks, and worksheets. Finally, the book will provide a list of websites and reliable sources for teachers who want to research more information about the content.

The following image is a screenshot of the content book’s Table of Contents. The order of the content presented in the content book follows the order that the lessons will be presented in the teacher workshop.
Each topic contains content from the lessons as well as additional content not covered in the lessons. For example, in the Intertidal Ecology section, everything covered in the lesson about intertidal organisms is incorporated in the content book, as well as additional information like labeled diagrams and detailed information on organism life cycles.

Intertidal Organisms

The barnacle is a crustacean, relative to the shrimp. Like other crustaceans, it has a tough, protective covering made of chitin. During their juvenile, or larval stages, barnacles swim freely about in the water column searching for a place to live. Once they find a place to settle, they produce a glue. This glue oozes from their head. They use this glue to attach themselves to the substrate. This keeps them from being tossed about by incoming waves. Once anchored in place, they begin to build a home of calcium carbonate plates. Four plates make a door that can be opened and closed. This door protects them from predators or keeps them from drying out. Once their home is complete, they use their feathery legs to filter food from the water. These legs, called cirri, have sensory organs that can locate plankton in the water. As the barnacle grows, it must shed its chitin shell and enlarge its home. When it is time to reproduce, the hermaphroditic barnacles extend sperm filled tubes to neighboring barnacles. Fertilization takes place and the cycle begins again.
Each of the sections in the content book also contains a few activities that teachers can use in their classrooms. The following images show a crossword and fill in the blank activity that can be printed out and used in a classroom.
Figure 24. *Crossword Example*

**Intertidal Organism Vocabulary**

Created using the Crossword Maker on TheTeachersCorner.net

<table>
<thead>
<tr>
<th>Across</th>
<th>Down</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Strong, silky fibers that are made from proteins that are used by bivalves to attach to the substrate.</td>
<td>1. A type of reproduction where offspring arise from a single organism, and inherit the genes of that parent only.</td>
</tr>
<tr>
<td>4. The surface or material on or from which an organism lives, grows, or obtains its nourishment.</td>
<td>2. A perforated plate by which the entry of seawater into the vascular system of an echinoderm is controlled.</td>
</tr>
<tr>
<td>5. A specialized cell within tentacles that contain a barbed or venomous coiled thread that can be projected in self-defense or</td>
<td>5. When a living organism grows new tissue after loss or damage.</td>
</tr>
<tr>
<td>8. An animal that is hunted and killed by another for food.</td>
<td>7. An organism produced asexually from one ancestor, to which they are genetically identical.</td>
</tr>
<tr>
<td>9. A fibrous substance consisting of polysaccharides, which is the major constituent in the exoskeleton of arthropods.</td>
<td>10. The active immature form of an animal, especially one that differs greatly from the adult.</td>
</tr>
<tr>
<td>14. Two shells or valves that are hinged on one side.</td>
<td>11. An invertebrate of a large phylum which includes snails, slugs, mussels, and oysters.</td>
</tr>
<tr>
<td>15. A marine invertebrate of the phylum Echinodermata that has a spiny outer layer.</td>
<td>12. A tough outer protective layer.</td>
</tr>
<tr>
<td>16. A large, diverse arthropod taxon which includes familiar animals such as crabs, lobsters, crayfish, shrimp, and barnacles.</td>
<td>13. An animal that hunts, kills, and eats other animals.</td>
</tr>
</tbody>
</table>

(Please note the crossword puzzle is included.)
At the end of the content book there is a section called references with additional information available for the teachers to research if they are interested. Since the content book will be printed out and given to the teachers rather than sent to them online, the references are given as a list of websites rather than actual links to the source. The following picture is a screenshot of the list of additional resources for the Blue Planet lesson.
5.5 Post-Workshop Survey

In order for future improvements to be made to the module and ocean literacy content, surveys should be administered at the end of the educator workshop and completed by the attendees of the workshop. We provided surveys for the end of each lesson and one survey for the end of the entire workshop. These should be administered by the educator who will be running the workshop. The surveys analyze the likeability of the module, the effectiveness of the digital activities, practical activities, and excursions, and the usefulness of the content presented. The surveys are presented below.
Ocean Literacy Module Feedback

This survey is for educators and teachers who have attended the training session that used the EduLink Ocean Literacy Module and is intended to gain feedback for the improvement of future modules. All responses will be anonymous and kept confidential.

* Required

1. Did you enjoy the Ocean Literacy module? *
   
   Mark only one oval.
   
   ○ Yes
   ○ No

2. Why or why not did you enjoy the Ocean Literacy module? *
   
   ______________________________________
   ______________________________________
   ______________________________________
   ______________________________________

3. Were the lessons presented to you in an engaging way? *
   
   Mark only one oval.
   
   ○ Yes
   ○ No

4. Please rate each aspect of the Ocean Literacy module. *
   
   Mark only one oval per row.

<table>
<thead>
<tr>
<th>1 (Least Helpful)</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5 (Most Helpful)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lessons</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Games/Activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Content Book</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. **Please rate each subtopic within the Ocean Literacy module.** *

*Mark only one oval per row.*

<table>
<thead>
<tr>
<th>Subtopic</th>
<th>1 (Least Useful)</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5 (Most Useful)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education for Sustainable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Development</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Blue Planet</td>
<td></td>
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</tr>
<tr>
<td>Our Oceans</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Our Marine Environment</td>
<td></td>
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<tr>
<td>Intertidal Ecology</td>
<td></td>
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<tr>
<td>Marine Food Webs</td>
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<tr>
<td>Marine Resources</td>
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<td></td>
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<tr>
<td>Human Impact</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. **Did you enjoy the excursions during the workshop? Why or why not?** *

   
   
   
   
   
   

7. **Did you enjoy the guest speakers? Why or why not?** *

   
   
   
   
   

8. **Did you enjoy the debate? Why or why not?** *

   
   
   
   
   

9. What was your favorite part of the workshop? *


10. What would you change or add to the module? Do you have any recommendations for future modules? *


Figure 28. *Post-Lesson Feedback Survey*

**Post Lesson Feedback**

This survey is for educators and teachers who have attended the training session that used the EduLink Ocean Literacy Module and is intended to gain feedback for the improvement of future modules. This survey will be administered after each lesson and is aimed to get feedback on only the lesson that the survey follows. All responses will be anonymous and kept confidential.

* Required

1. **Did you enjoy this lesson?** *
   
   *Mark only one oval.*

   [ ] Yes

   [ ] No

2. **Why or why not did you enjoy the lesson?** *

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

3. **Did you find this lesson engaging?** *
   
   *Mark only one oval.*

   [ ] Yes

   [ ] No

4. **What did you like/dislike about the lesson?** *

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

5. **What do you suggest for improvement in future lessons?** *

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
6. Conclusion and Recommendations

Throughout our work on the ocean literacy module and communication with EduVentures and the Ministry of Fisheries, our group has formulated recommendations. These recommendations fall under three categories: assisting the Ministry of Fisheries in expanding ocean literacy throughout Namibia, improving EduVentures communication, and assisting future WPI students who will be working on the EduLink project through software tutorials.

6.1 Ministry of Fisheries

EduVentures’ goal as an organization is to improve Education for Sustainable Development (ESD) across Namibia. The aim of our module follows this overarching goal, however, as per request of the Ministry of Fisheries, we focused more on advancing ocean literacy content instead of general ESD knowledge. In order to work towards making Namibia ocean literate, all parts of the country must be able to understand basic functions of the ocean, communicate about oceans in an effective way, and make decisions regarding the oceans and ocean resources. Within the module, some activities can only be applied to workshops near the Namibian coast. Our module was created under the assumption that those who would be directing workshops using our lessons would be on the coast. Therefore, if workshops were to be held inland some of the activities would need to be changed to accommodate these environments. If the Ministry of Fisheries would like to maximize the amount of ocean literate individuals, different versions of lessons must be available for various locations including those not near the ocean at all. Another way the Ministry of Fisheries can introduce and familiarize inland areas with ocean literacy concepts is to sponsor trips to the coast so these teachers and students can actually visualize what is being taught to them. Also, hosting workshops in these locations with different physical examples of Namibian marine life could spark interest and allow connections between lecture and real experiences.

6.2 EduVentures

Overall, working with EduVentures was a positive experience for our group. The staff was very friendly and provided guidance for us whenever it was asked for. One recommendation that we have for when other student groups come to work on the EduLink project in the future is to improve communication with the third party that has interest in the module’s creation, which for us was the Ministry of Fisheries. Our group received additional deliverables that would have been beneficial to have more information on beforehand. Better communication would allow for a more efficient process and would save groups time when constructing the module and setting deadlines throughout the term. This would also ensure satisfaction of all parties with minimal iterations of the project deliverables.
6.3 Future WPI Students

EduVentures’ EduLink project has room to grow in the future, therefore new WPI IQP groups will be working with the organization to create modules on different topics within ESD. One recommendation that we have for future groups is to familiarize themselves with SMART Notebook and PowerPoint. This software was used to create all of our lessons within the module and allowed more interactive activities as requested by EduVentures and the Ministry of Fisheries. However, some of our time was spent watching tutorials and figuring out the controls within SMART Notebook when this time could have been used on more important work. Therefore, it would be beneficial if future groups came to Namibia ready to create their lessons without needing to teach themselves how to use the software in addition.

6.4 Conclusion

Our project focused on integrating Education for Sustainable Development into Namibia’s education system through online teacher training modules. We researched ocean literacy and the Namibian education system to provide insight into the course material as well as insight into the most effective methods to train teachers. The process of designing the online module involved the collection of content from the Ministry of Fisheries, the compilation of feedback from both the Ministry and EduVentures, the utilization of blended and active learning pedagogy, and the construction of the module with the use of SMART Notebook software, PowerPoint, and Animaker. Following the completion of the module, an ESD educator training workshop will be conducted. At the end of each day of the workshop, surveys will be administered to gain feedback on the module. The responses will then be used to make recommendations for the improvement of the ocean literacy content and the future modules in the EduLink project. Overall, our module aims to provide Namibian educators with the tools to properly implement ocean literacy content into the current curriculum. The module will be utilized in educator workshops, where feedback on the content and design will be acquired. In the future, the edited content will be utilized to assist in the development of the ocean literacy course curriculum for schools in Namibia. The module will lead to a group of learners who are better equipped to tackle environmental issues specific to oceans in Namibia using all aspects of their education, which will allow for the country’s sustainable growth. The future success of the module and its ability to flow from educators to teachers to learners is a model that can be followed by other developing countries.
7. Reflection

Throughout our time in Namibia, we have met so many kind and welcoming people, learned countless things about ourselves and the world around us, and explored all of the beautiful sights the country has to offer. We had the pleasure of working with EduVentures and the Ministry of Fisheries to produce a teacher training module on the topic of ocean literacy which will help advance the United Nations’ Sustainable Development Goal Fourteen, Life Below Water. The module will leave a lasting impact, as it will be used by the Ministry of Fisheries and EduVentures to spread knowledge of ocean literacy and to promote sustainable practices throughout Namibia. The module will lead to group of learners who are more knowledgeable of the ocean and better equipped to promote sustainable practices in Namibia.

The process of planning and developing the module has given us the experience of carrying out a project from start to finish, including the experience of troubleshooting and revising. The skills we have learned throughout living in Namibia and working on our project can be applied to our professional careers after we leave WPI. We are so grateful for our experience in Namibia and greatly enjoyed our time completing the project.
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Appendix

Appendix 1: Educator Survey

The questions that were asked are as follows:

1. Did you enjoy the Biodiversity Module?
   a. Yes or No

2. Why or why not did you enjoy the biodiversity module?

3. Were the lessons presented to you in an engaging way?
   a. Yes or No

4. Please rate each section of the Biodiversity module.

5. Did you enjoy the outdoor excursion to look at different plants and animals? Why or why not?

6. Did you enjoy the guest speaker during the workshop? Why or why not?

7. Did you enjoy the debate? Why or why not?

8. How suitable were the games used to present content?

9. What would you change or add to the module? Do you have any recommendations for future modules?