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Improving the *Basic Science* Course at the Namibia University of Science and Technology

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Abstract

The Namibia University of Science and Technology (NUST) offers a *Basic Science* course required for all non-STEM majors, which sees a low pass rate, especially among the students enrolled as distance learners. We sought to research why the *Basic Science* course has a low pass rate across all modes of learning. Through interviews and surveys with students and faculty, we found disinterest and course structure were issues, information that will help NUST improve the course so all students will benefit.

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Table of Contents

Abstract ii
Acknowledgements iii
Authorship iv
Table of Figures viii
Table of Tables ix
Executive Summary x
Chapter 1: Introduction 1
Chapter 2: Background 3
2.1 Challenges with Science Education 3
2.2 Basic Science Pedagogy 4
2.2.1 Teachers and Techniques 4
2.2.2 Student-Centered Learning 5
2.3 Online Learning for Science 6
2.3.1 Benefits of Online Learning 6
2.3.2 Effective Ways to Teach Science Online 6
2.3.3 Online Course Exams 7
2.3.4 Teaching Distance Students 7
2.4 Namibia 8
2.4.1 Primary and Secondary Education 8
2.4.2 Technology 9
2.5 Namibia University of Science and Technology 9
2.5.1 NUST *Basic Science* Course 10
2.5.2 Learning Modes 11
Chapter 3: Methodology 13
3.1 13
3.1.1 Evaluating Lectures 13
3.1.2 Evaluating Faculty 13
3.1.3 Evaluating Students 14
3.2 14
3.2.1 Evaluating Vacation School 15
3.2.2 Evaluation of Distance Students 15

3.2.3 Distance Center Tutors 15
3.2.4 Visiting Distance Centers 16
3.3 16
Chapter 4: Results & Analysis 17
4.1 Objective 1 17
4.1.1 Faculty Interviews 17
4.1.2 Full-Time Student Interviews 18
4.1.2 Part-Time Student Survey 18
4.2 Objective 2 19
4.2.1 Distance Student Survey 1 19
4.2.2 Distance Student Survey 2 24
4.2.3 Windhoek Distance Student Survey 25
4.2.4 Windhoek Distance Student Focus Groups 26
4.2.5 Contacting Distance Centers 26
4.2.6 eLearning 27
4.3 Objective 3 28
Chapter 5: Conclusions & Recommendations 29
5.1 Disinterest 29
5.2 Updated Course Design 29
5.3 Discrepancies in Learning Modes 30
5.4 Distance Centers 31
5.5 Online Basic Science Course 31
References 34
Appendix A: Faculty Interviews 39
Appendix B: Student Interview Questions 41
Appendix C: Part-Time Student Survey Questions 43
Appendix D: Distance Center Tutor Survey Questions 45
Appendix E: Distance Student Survey 1 Questions 47
Appendix F: Windhoek Distance Student Survey Questions 50
Appendix G: Distance Student Focus Groups 53
Appendix H: Distance Student Survey 2 Questions 55
Appendix I: Secondary School Teacher Interviews 57

Appendix J: Part-Time Student Survey Results 59
Appendix K: Distance Student Survey 1 Results 63
Appendix L: Distance Student Survey 2 Results 68
Appendix M: Distance Center Data 72

Table of Figures

Figure 1……..……19

Figure 2……..……20

Figure 3……..……21

Figure 4……..……21

Figure 5……..……24

Figure 6……..……27

Table of Tables

Table 1……………………………………………………………………………………28

Executive Summary

The benefits of basic science education are becoming ever-more apparent. Science teaches students to organize their ideas and apply what they have discovered to everyday situations outside of class, enabling them to become better prepared and more receptive to collaboration in their future careers. Yet, many students become disinterested in the fundamentals of science because they fail to see how they apply to their career paths and will choose careers outside of Science, Technology, Engineering, and Math (STEM) as early as in secondary school.

At the university level, the bigger issue is educating students everywhere. Rural areas struggle most with these issues, and schools have tried to alleviate this with the implementation of online courses. Online courses are equipped with all the same materials that students attending class on campus have access to and do not have any specific class times, allowing the students to complete it at their own pace. Namibia, a very rural country, would benefit from online learning, specifically at the Namibia University of Science and Technology (NUST). NUST currently has a *Basic Science* course for all non-STEM majors, such as those studying management and human sciences. This course has a particularly high fail rate, especially with students taking the course on distance mode. Distance learning is when students attend lectures at off-campus distance centers, as they either live too far away from campus or have obligations which prevent them from being able to attend lectures on campus. The distance mode at NUST is supported by the Centre for Open and Lifelong Learning (COLL), which attempts to provide the same resources that the students have on campus to the distance students. However, there appears to have been inadequate support for distance students trying to take the *Basic Science* course.

Basic Science at the Namibia University of Science and Technology

The goal of this project was to research why the *Basic Science* course at NUST has a low pass rate, especially among distance students, and to provide recommendations on how to increase the overall pass rate. The main objectives were to 1) determine the pedagogical and structural issues with the course on-campus, 2) determine the pedagogical and structural issues with the course on distance mode, and 3) identify ways to engage students in class. To achieve these objectives, we used interviews and surveys to gain information from the faculty and students as well as observations to assess the course structure. The methods used for these objectives were a combination of interviews, surveys, and observations. We contacted a variety of staff members, students, and teachers to gather as much information as possible about the course at NUST, student lifestyles, and science education in Namibia in general.

Results and Analysis

From our faculty interviews, we discovered that most struggle to simplify topics to a basic level. The faculty members recognize the disinterest in the classroom and attribute it to the length of time some students have gone without taking science. Student interviews highlighted issues with the setup of the course. Students claimed that having three different professors and

switching subjects weekly made it difficult to get engaged in the course. Students also do not find the course to be important because it does not directly apply to their major, so they will focus more on their other classes instead. We learned that distance mode needs the most improvement. Some contact sessions were cancelled due to poor attendance. Material is given to students during lectures that is not in the study guide that all students are provided with. If the students cannot attend contact sessions due to a time conflict and do not have access to the eLearning platform, they will not have access to the additional information. Students also stated there is too much material to be covered in such a short time, and that the course could be made better if it was not so in-depth. When contacting the secondary school teachers in Windhoek, we learned that they also have trouble relating science to students' lives. Students are more engaged in science when they participate in demonstrations. When faced with simplifying complex topics for the students, teachers rely on videos as an aid.

The department head of the Health and Applied Sciences suggested that the *Basic Science* course be completely online in the next five years. We asked students through surveys and interviews if they thought putting the course online would be beneficial and we researched what makes an online course effective so that he could begin the transition to online when we are gone. Online courses need to simulate face-to-face lectures. A way to do this is through recorded lectures, assessments to check progress, and professor availability for students to be able to ask them questions.

Conclusions & Recommendations

Based on the results from student interviews, **we recommend that NUST make the course more interactive for students** by incorporating videos and hands-on activities so that it is taught in a manner other than just verbal lectures and at-home readings. The weekly switching of subjects is difficult on the students, so **we recommend completing one subject before changing to the next**. Creating separate courses for biology, chemistry, and physics would allow students to choose the subject they are most interested in to focus their studies on. **We recommend that NUST reevaluate how distance students are getting the material necessary for them to pass.** Online recordings of the on-campus lectures would be beneficial for the students so they can get the information that is not in the study guide as well as have the freedom to complete the course at their own convenience. Because distance student support is lacking, **we recommend that NUST keep in closer contact with the distance center coordinators.** Periodic check-ins between the tutors and the course coordinator would ensure that the distance centers are able to support their students.

If an online course is to be implemented in the future, a logical flow between the subjects will ensure students have the necessary knowledge for the more complex concepts. Designing the course to have recorded lectures, interactive activities, and frequent assessments will allow students to learn the material in a way that is different from solely written material. This will contribute to the success, and the passing rate of the *Basic Science* course will increase because more students will be interested in all science has to offer.

Chapter 1: Introduction

The benefits of basic science education are becoming ever-more apparent (University of Texas Arlington, 2017). Science education provides a framework for decision making by teaching students to be inquisitive and to think critically when drawing conclusions. These skills, along with knowing how to weigh options, are essential to daily life. Science teaches students to organize their ideas and apply what they have discovered to everyday situations outside of class (Walden University, 2018). When students learn these fundamental skills, they are better prepared for collaborating with others in their future careers.

Considering the relevance of science education, it is important for all students to gain a background in science. Challenges such as disinterest and distance become more apparent when universities push for a fundamental science education. Many students are disinterested in these science courses because they fail to see how the subject applies to their career paths (Potvin, 2014). Students begin losing interest in the secondary level courses, so they choose careers outside of Science, Technology, Engineering, and Math (STEM). Another challenge universities face is access to education (Fozdar, 2015). Some students live too far away to make it to campus regularly, if at all. These students also have other work or family related commitments and struggle to gain an education because they do not have the same access to face-to-face lectures. These issues are heightened in countries with more rural areas. For example, in Namibia, at the Namibia University of Science and Technology (NUST), disinterest and distance are issues for the *Basic Science* course.

Schools have tried to solve the issue of distance through online courses. The University of Lagos in Nigeria implemented an online course for students who cannot attend classes on campus (Adewara, 2015). This online course has the same materials that students attending class on campus are given. There is a similar online program for students that live far from campus at the Addis Ababa University in Ethiopia (Chapman, 2004). This course does not have any specific class times, allowing the students enrolled to complete the course at their own pace. This allows students to direct their own learning, since the course is not strictly structured. They have the freedom to work on the material when they want, rather than being forced to at a certain time. Students are also able to learn the material in whichever way is most effective for them, which can engage them more. They can watch YouTube videos, use online simulations, and create chats with other students taking the course. This type of hands-on, self-guided learning engages students in a different way, therefore engaging them in the subject matter (Alom Shaha, 2018). When students are exposed to self-guided learning they tend to perform better than students who are not (Schmidt, 1993).

NUST currently has a *Basic Science* course for all non-STEM majors. This course has a particularly low pass rate, especially with students taking the course on distance mode (H. Kwaambwa, personal communication, April 10, 2018). Distance mode at NUST is intended to provide education for students who are working, live too far away from campus, or otherwise have a time conflict with the course and cannot attend lectures at the main campus in Windhoek.

The Center for Open and Lifelong Learning (COLL) provides resources to support these students. (NUST, 2018). COLL supplies many services to students to fit their individual needs, such as variations of tutors, radio tutorials, and coordinating materials. However, there appears to have been inadequate support for distance students trying to take the *Basic Science* course, as it has continued to have a high failure rate. COLL and the Health and Applied Sciences department at NUST were not sure what needed to be done to increase the passing rate.

The goal of this project was to research why the *Basic Science* course at NUST has a low pass rate, especially among distance students, and to provide recommendations on how to increase the overall pass rate. The main objectives were to determine the issues with the course on campus as well as for distance learners and to identify ways to engage students in class. In order to achieve these objectives, we used interviews and surveys to gain information from the faculty and students, as well as observations to assess course structure. Our results showed that students lack interest in the course because they fail to see how it applies to their major. Many students had not taken a science class in many years, students struggle with finding time to commit to the course, and many lack the necessary background to be successful. We concluded that making the lectures more interactive would generate student interest in the material. Through our research of online courses, we determined the best ways to implement the course online. Improving the student learning experience in the course will result in an increased pass rate in the future.

Chapter 2: Background

This chapter covers challenges with science education globally, as well as potential solutions and specific problems at the Namibia University of Science and Technology (NUST). It describes ways the fundamentals of science are taught, along with how to successfully implement an online version of the *Basic Science* course.

2.1 Challenges with Science Education

Science education gives people a broader understanding of the world around them (Kaptan, 2012). A challenge in teaching science to students is finding ways to relate to their lives, and creating an interesting and engaging curriculum. Hands-on approaches can foster curiosity and interest; however, this is not always realistic in the large lectures that often characterize higher education. Further, many science programs cater towards teaching students who will be invested in science for the long run, rather than the primary goal of developing foundational scientific knowledge. Educators may be teaching a scientific field that is outside of their specialties. Often, just listening to a teacher deliver a lesson is not sufficient for many students to get a comprehensive understanding of a topic, as more assessments usually help reinforce the material and lead to a deeper knowledge base.

Educating rural areas is often challenging (Marksbury, 2016). Due to socioeconomic factors, such as not having properly trained teachers or the same access to technology as more-densely populated areas, students may not be as successful in science as those who have more resources. When students need access to online resources but do not have the technology to reach it, they are put at a disadvantage from their peers. Having universities nearby can help improve professional development and improve the quality of education systems. Further, many universities have started using open and distance education for various courses (Nigam, 2007). This type of study typically has courses that have been pre-planned and are meant for the students to learn on their own, with additional communication with professors and tutors. There have been numerous issues identified with creating science classes within this method of learning, especially with the implementation of the practical work that is usually involved with science courses. It is also difficult to include practical work in large, lecture-style settings.

There are many problems that arise with college students in the U.S. taking science and engineering classes at the introductory level (Wineke, 1990). These issues include professors being unaware of what other course content the students were being taught, resulting in students being bored by the repetitiveness of the subject matter. With introductory classes, basic concepts and skills have to be taught to make sure that all the students are at the same level, however this can deter the students who have already learnt these topics. This does not inspire the excitement that science should bring, it only dulls the subject matter. The student body becomes increasingly disinterested in the topics, and the professors struggle to teach the larger lectures. The faculty might also not realize that they are teaching to students who do not share the same passion that

they do, and that they are not understanding the subject matter as the faculty thinks they are teaching it.

2.2 Basic Science Pedagogy

Due to the challenges presented in basic science education, different teaching styles are necessary in order to be effective. This section discusses suggestions for how to effectively provide a science education for students. By educating students in fundamental science skills and concepts, universities can produce graduates who will use the skills to contribute positively to society, regardless of their career paths.

2.2.1 Teachers and Techniques

The abilities and attitudes of the teacher affect student learning. Students learn more from teachers with positive and confident attitudes towards science (Munck, 2007). Teacher attitudes are shaped by past experiences and confidence in their ability to be an effective educator. Positive attitudes drive teachers to develop a passion for teaching science. These teachers are more likely to develop creative ways to convey information which, will improve student learning. A good teacher also motivates students to learn and challenges their previous ideas (Shirani, 2016). In order to teach the basics of science, teachers need to have an elevated ability level compared to teachers of other subjects (Munck, 2007). Throughout science, there are topics discussed that students may find hard to relate to their lives or careers. The job of the teacher is to take the abstract concepts and explain them in a way that is understandable and relatable to all students. Teachers need to have a strong understanding of the topics and the confidence to convey that information in order to be successful.

In science courses such as physics, just lecturing is not an effective teaching method (Committee on Undergraduate Science Education, 1997). Teachers have found that encouragement of group participation in classes with high enrollment allows the students to come up with their own answers to questions, which leads to a deeper understanding of the material. Students often learn the fundamental science topics through inquiry-based assignments (Munck, 2007). Allowing students to ask questions fosters inquisitive minds that will want to discover the answers. Students learn more by drawing conclusions themselves, rather than being told the answer. Projects require students to use the concepts they are learning in class and apply them to a problem (Halpern, 2003). This helps them gain a better understanding while also committing the information to memory. Students have found that demonstrations of the material are helpful. (Committee on Undergraduate Science Education, 1997). Seeing the processes happen solidifies students' understanding, especially for those who are visual learners.

At many universities, there are general education requirements for all students, regardless of a student's major. Universities often require that students take classes to fulfill a natural and physical science requirement (Texas State University, 2018). For example, The Ohio State University uses their general education requirement as a way to teach students about the relationship between science and the world they live in (S. Peltier, personal communication,

September 12, 2018). At least one of the courses needs to have an accompanying lab. The lab component reinforces the material learned in class while also allowing students to come up with their own research questions.

At Pennsylvania State University, students have the option to take a class called Science in Our World (C. Jensen, personal communication, September 12, 2018). The goal of this course is to educate students on how science affects their everyday lives. This helps students recognize the importance of science education by relating it directly to their lives, rather than forcing them to learn a science subject they do not care about. This course does not require previous scientific background. At the University of Massachusetts Amherst, students can fulfill their requirement with the typical biology, chemistry, and physics courses, but they also have the opportunity to take classes in astronomy and oceanography (UMASS Amherst, 2018). This allows students to take courses that they find most interesting, so they will be more engaged in the lectures.

At Rutgers University, the classes are based around an issue rather than memorizing facts (S. Lawrence, personal communication, September 17, 2018). One course previously offered covered three topics related to energy and climate change. It was taught by three different professors, each taking a third of the material. Students in this class did not respond well to this method of teaching. The final was comprehensive and students struggled with making connections between the three topics. Professors found that the material was too in depth for non-STEM students.

2.2.2 Student-Centered Learning

A new technique being tested in classrooms is student-centered learning (Kaput, 2018). This style of learning focuses on the interests, backgrounds, and learning styles of individual students. This allows the students to build a working relationship with their teachers, which encourages the students to put more effort into their studies. When students are able to help customize their own curriculum, they are also able to progress through the course at their own pace. In a classroom setting, the teacher may move forward depending on the progress of the class as a whole. With student centered learning, if students are ahead, they can continue moving forward or slow down to spend extra time on topics that are particularly difficult for them. This is even more relevant in the case of online courses. Students can work at a pace that is comfortable for them and on their own schedule.

Student-centered learning has had a positive impact on scientific achievement (Odom and Bell, 2015). When a teacher gives a demonstration in front of a class, it can be difficult for the students to completely grasp what concept is being conveyed. Allowing students to complete the science experiments on their own gives them the hands-on experience needed to learn. This also increases the students' interest in the subject matter and overall leads to a more enjoyable learning experience. Many science experiments can be done in groups, which encourages social interaction between students. Students start up conversations which sparks the sharing of ideas. This allows them to teach themselves and others while still doing something that they enjoy.

2.3 Online Learning for Science

Tailoring a student's education to fit each person's individual needs is seen as a way to help each student gain a firm grasp on the subject, but it is not always achievable in traditional classroom settings (Gilbert, 2015). An alternative method is needed to ensure that students can still learn science in a way that suits each one best. One way that educators are bringing individuality to education is through online courses.

2.3.1 Benefits of Online Learning

Online learning is an essential way to bring education to students from different backgrounds (Gilbert, 2015). Not all students have equal access to on-campus learning, thus an alternative education method is required. Traditional lectures are not always an option because many students have jobs, family obligations, or are simply too far away from campus for it to be a feasible option of attending. Online learning is beneficial for these students because they are able to complete the assignments when they have time to do so wherever they are, rather than being bound to a rigid, on-campus course schedule. Online learning is also conducive to the students' needs. Each student has the chance to spend as much or as little time on each topic, enabling him to be able to move at a pace that suits his needs. Being able to work at one's own pace is essential for learning science online because it allows students the freedom to revisit topics that are more difficult for them. Students taking charge of their own learning teaches skills such as time management and learning to ask for help when they need it.

2.3.2 Effective Ways to Teach Science Online

Teaching science online requires a few key resources in order to be successful; one of which is technology (Academic Partnership, 2013). Videos allow students to absorb the content while still being able to review it once the lecture has ended. Skype, an online video conference software, is another tool that brings the lecturer into a virtual classroom. It mimics having a professor around for students to ask questions and gain guidance when needed. The use of interactive labs is also helpful for students to be able to have a better grasp on science when taught online. Online lab software or at home 'LabPaqs' allow professors to assess how students complete hands-on work relating to the lecture material when not under direct supervision.

Another way that online classes can be effective is through lecturer and student relationships. Lecturers are not always eager to move the traditional classroom online, as they often fear that students will not view the online recordings (Dona, 2017). As shown in the implementation of online aspects to lecture style courses, this is not always the case. Students tend to use the recorded lectures as a supplement for the in-class material and as a study tool for exams. Only 10% of a 210-person sample choose to skip the lectures for logistical reasons, which is insignificant compared to the 90% of students who used the lectures in a way that would benefit their learning. Students need to be engaged in an online course for it to be effective.

In order for an online course to be successful, it needs significant time dedicated to it's planning by experienced educators (Khan, 2017). There also needs to be the assurance of proper resources to support such a switch to online education. While many students may have access to a mobile device, these are often unable to support an entire course. If multiple courses are involved, there should be a consistency in the platform and structure used on the course in order to simplify the design for students. There should be a variety of assessments, and self-reflection exercises to keep them accountable. If the students are attending other face-to-face courses, they will have a higher retention rate than those only taking online courses (James, 2016). Taking one or two online courses in addition to the regular course load can be beneficial for students.

2.3.3 Online Course Exams

A problem faced with online courses is properly assessing the students' knowledge (Daffin, 2018). An exam given to psychology students who took the course online showed a 10-20% difference in scores between those taking a proctored versus non-proctored exam. The students in the non-proctored exam performed better, and also took longer to complete the exam. It is unclear if this difference is due to cheating, or the anxiety on the part of the proctored students from being watched while taking the exam. Ways to combat potential cheating involve including more open-ended questions on assessments, rather than just multiple choice. Any multiple-choice questions should have randomized answers, and overall, the exams should have shorter time frames. With questions involving numbers and math, the exams can be structured so that each student gets a slightly different question. Each question can have different numbers but require the same math to get the answer (Moore, 2017). Faculty should be wary about supposed computers crashing during an exam. While this is usually an innocent malfunction, attention should be paid to the timing of it and how many questions have been completed.

2.3.4 Teaching Distance Students

A way to keep the quality of distance learning consistent with on-campus learning is to make the online classes as similar to the on-campus lectures as possible (Ragan, 2009). The course needs to simulate a professor teaching; such as providing online chats, recorded lectures, discussion forums, and a method through which students can contact instructors directly. Assignments need to have clear time frames in which they can be completed, and lecturers must be able to monitor student progress. This can be done by posting grades and providing feedback, so that students are still getting guidance even though they have not had any face-to-face contact with their lecturer. It is critical that distance students need to have adequate technology for a proper education. Every student needs to have access to the same level of technology so that they can access everything the lecturer provides for them. Distance learning should strive to be similar to on-campus learning, so that those students are not at a disadvantage.

One example of a successful online science class is at the University of Lagos in Nigeria (Adewara, 2015). Nigerians recognize science as one of the core subjects for all levels of education, yet it was difficult for students to gain an adequate education in these fields. To

combat this issue, the Distance Learning Institute at the University of Lagos implemented an online course for students on distance learning modes by incorporating technology into its classes. This use of eLearning led to a significant improvement in the way science was taught, which enabled the classes to meet the needs of the school systems. The needs of more students can be met by implementing online learning for science courses, and the course will have a higher impact on the students.

The Addis Ababa University in Ethiopia also has successful, post-graduate distance mode programs (Chapman, 2004). These courses are designed so that minimal face-to-face contact is needed, thus allowing a greater number of students to be enrolled in the courses. Students are not bound to a specific class time and are able to maintain jobs while still enrolled in school. A major benefit is that these classes are scheduled to meet in regional centers, which are equipped with all the necessary technology so that students are able to direct their learning themselves. Students can be in full control of the time they dedicate to school, so that they are able to easily incorporate education into their lives.

2.4 Namibia

Namibia could benefit from online science education (New Era Reporter, 2015). Namibian citizens are required by the government to take seven years of primary science education and three years of secondary science education (NIED, 2009). Because many Namibian families are below the poverty line, this can restrict many children from moving on to higher education (Green, 2018). Distance is also a contributing factor to students being unable to obtain a higher education because the students live too far away from university campuses to attend classes there. Off-campus distance centers use online resources to try to combat this problem throughout Namibia.

2.4.1 Primary and Secondary Education

Education is important to Namibia, and its government invests highly in its education sector (National Planning Commission, 2015). In the 2014/2015 financial year, 23% of the total budget went towards its education sector to aid in the addition of classrooms and the procurement of textbooks. The government also reevaluated the teacher to student ratio in primary and secondary schools. Smaller teacher to student ratios led to higher passing rates. Between 2009 and 2012, the student-teacher ratio decreased from 29:1 to 27:1 in primary schools and 24:1 to 22:1 in secondary schools. Although Namibia is putting a lot of effort into improving education as a whole, science education still suffers due to the lack of qualified teachers (New Era, 2015). These teachers are proficient in other areas of study, but when it comes to science, they lack an understanding of the subject matter.

Along with teachers' lack of understanding, science education is only required for ten out of the twelve years of schooling before students reach the university level in Namibia (NIED, 2009). These ten years of science education are structured so that students are learning about topics that are relatable to each grade level. Students start by learning about environmental

studies in grades one through four. This covers a broad knowledge of the environment around the students, so they learn about it at a young age and are able to appreciate it. In grades five through seven, students are taught about natural science and health education, which encompasses information about HIV and AIDS, a major health issue in Namibia (African Health Observatory, 2018). The final subjects of mandatory science education are life and physical science, which are taught in grades eight to ten. The goal of these courses is to expand their understanding of the subject matter and improve their science skills. In grades eleven and twelve, optional science courses are offered for students who wish to pursue the subject further. For students that choose to opt out of science, they will enter the university without having learnt any science for at least two years of their education. Students taking gap years or returning to school later in life will have gone even longer without any science education. Even if they had done well in secondary school, the time spent without learning science and the lack of interest in the subject could lead to students performing poorly in university level science classes.

2.4.2 Technology

Technology in Namibia has advanced tremendously since the 1990s (UNICEF, 2018). Technologies in Namibia are referred to as Information and Communication Technologies (ICTs). The use of ICTs allow education to be readily available throughout all of Namibia. Due to its size and large amount of rural areas, it is difficult for the entire population to have access to higher education, especially for families that are below the poverty line. Without the money to send their children away to school, students from these families are unable to receive a higher education. One plan the government came up with to combat this was the Cooperative Information Network (COPINE) project. This project was a collaboration with the United Nations Office of Outer Space in Vienna along with twelve other African countries to develop a computerized satellite system in schools. It would allow students living far away from the city to get the same education as those who attend lectures on campus (Kiangi, 1998). eLearning technologies are used to give students using the satellite centers the same study materials as students attending lectures on campus (Möwes, 2008). Assignments and lecture slides are uploaded to the eLearning platform where all students have access to them. This allows students living far away from campus to have access to the same education as students attending classes on campus.

2.5 Namibia University of Science and Technology

The Namibia University of Science and Technology (NUST) is one of the two public universities in Namibia (NUST, 2018). The main campus is located in the country's capital, Windhoek, and currently has an enrollment of over 11,000 students. Initially called the Polytechnic of Namibia, the university was formed by the merging of Technikon Namibia and the College for Out of School Training (COST) in 1994 shortly after Namibia gained its independence. This was a shift from vocational training to higher level degrees (Polytechnic of

Namibia, 2010). The name was changed to the Namibia University of Science and Technology in 2013, to go along with the plan to slowly eliminate the shorter-term diplomas and certificate plans (Shipanga, 2013).

2.5.1 NUST *Basic Science* Course

Having a knowledge of the fundamentals of science is one of NUST's institutional core requirements, and it is expected that all students have a level of competency in the subject (NUST, 2018). Only 32% of the students at NUST are STEM majors, despite the fact that it is a university of science and technology. The course is intended to give all these students in non-STEM programs a stronger background in science, allowing them to see the applications of basic science in their everyday lives and careers (NUST, 2018). The breakdown of the final mark is made up of tests and assignments; assignments being 40% and tests being 60%. The *Basic Science* course is split into three main topics: biology, chemistry, and physics. The expectations of what students will learn from each of these topics are as follows:

Biology:

- Life and life processes of living organisms
- Parts of plant structures and their functions
- Animal life cycles
- Importance of micro-organisms in food production, industry and medicine
- Importance of food consumed by humans

Chemistry:

- General properties of matter
- Phase changes that matter undergoes
- Terminology of elements and their compounds
- Key elements of the periodic table (focus on metals and non-metals)
- Acids, bases, buffers and pH scale
- Importance of water to humans
- Basic mathematics
- Scientific notation

Physics:

- Graph interpretation
- Energy sources
- Basic concepts and uses of electricity
- Principle examples of radioactive isotopes
- Effects of forces
- Production and transmission of sound

- Effect of noise on human hearing

Students are also expected to gain general skills from this course, such as being able to process and critically think about scientific material, work with a team, manage their time effectively, and gain communication skills.

2.5.2 Learning Modes

To pass a course at NUST, a student must receive at least a 50% grade, which consists of assignments and assessments during the semester, and a cumulative exam at the end of the semester (NUST, 2018). Additionally, students must receive at least a 40% on the final exam to pass the course.

NUST (2018) offers different learning modes to accommodate the various needs of students. The three modes offered are full-time, part-time, and distance (NUST, 2018). There are six faculties, or departments, of study at NUST; the Faculties of Computing and Informatics, Engineering, Health and Applied Sciences, Human Sciences, Management Sciences, and Natural Resources and Spatial Sciences (NUST, 2018). Only programs offered in the faculties of Human Sciences and Management Sciences are offered in distance mode, all other areas of study are only offered as full-time or part-time commitments.

Full-time students are expected to attend at least 80% of classes, practical assignments, and excursions (NUST, 2018). Absences from classes for a job are not excused; these absences can be factored into the student's grade. Only full-time students who do not live in Windhoek are allowed housing on campus, as it is limited. Part-time status is intended for students who are employed, however they are still expected to attend all relevant lectures, and complete assignments and exams.

Distance mode is intended for students who cannot attend classes at the main campus in Windhoek, due to economic obstacles or living far from campus (NUST, 2018). There are many satellite centers spread out across the country where students can work with instructors and tutors. Distance students are expected to obtain the reading material for the course, as well as follow along with eLearning materials that are supplied to them. The students are given a study guide and are expected to turn in assignments to the tutors at the satellite centers.

While these programs offer the possibility of higher education to students who would otherwise be unable to obtain it, there are challenges with these programs. For example, nursing students studying on distance mode at the University of Namibia (UNAM) expressed that it was challenging to balance school and a job, especially students in the Northern Campus (Du Plessis, 2016). They often found that studying was not considered a priority by their employers. There were many problems with video conferencing, which was better in theory than practice due to technical difficulties. Overall, the Northern Campus students struggled more than others; the distance students expressed more needs to improve the course and stated that the skills workshops were not offered at the Northern Campus, making it difficult for the students to

attend. More academic guidance from lecturers, as well as better communication and a quicker distribution of course materials were suggested as methods to improve the program.

The Centre for Open and Lifelong Learning (COLL) at NUST supports students in distance mode and provides them with a number of resources to help them succeed (NUST, 2018). Marker-tutoring has tutors add additional comments to assignments when grading to give additional guidance in the subject. These tutors are also available for telephone and email tutoring. Tutorials about the subject matter are given once a week. Optional vacation schools are offered on campus during breaks for certain programs, and distance students are encouraged to attend. Radio tutorials are broadcast on the national radio, and there is online tutoring, called teleteaching. eLearning is another mode offered by the university and provides a Virtual Learning Environment (VLE). Through this mode, students can have access to course material and assignments online, interact with a tutor, submit assignments online, and have a more interactive experience.

The distance centers vary in size, ranging from over four hundred students to less than ten (H. Kwaambwa, personal communication, April 10, 2018). Some of these centers get no contact hours with tutors, due to there being a lack of tutors or a lack of students. Typically, the distance students meet once a week. The students at these centers often have jobs and have to work during the week and therefore cannot dedicate all of their time to school. The distance students have a particularly low pass rate for the *Basic Science* course, with only 10-20% passing (as compared to a pass rate of 50-60% for part-time students and 70% for full-time students).

Students should not be limited in their ability to learn fundamental scientific concepts and skills by their distance from campus, and the implementation of online learning at distance centers can help combat this problem at NUST. Our next chapter will describe our goal and the methods we used to gather data towards it.

Chapter 3: Methodology

The goal of this project was to research why the *Basic Science* course at NUST has a low pass rate, especially among distance students, and to provide recommendations on how to increase the overall pass rate. We will do so by achieving the following objectives:

1. Determine pedagogical and structural issues with the *Basic Science* course on campus.
2. Determine pedagogical and structural issues with the *Basic Science* course on distance mode.
3. Identify ways to engage students in the course.

Using an interview-based methodology, we collected data on the students' and faculty's thoughts and opinions on the *Basic Science* course. We analyzed this data to provide recommendations to NUST on how to improve the overall pass rate of the *Basic Science* course, and how to provide more support for the students taking the course on distance mode.

3.1

Determine pedagogical and structural issues with the Basic Science course on campus.

We collected information from faculty and student interviews to determine what areas of the curriculum are more difficult for students to learn, and why the students struggle in general. This allowed us to identify what areas of the course the faculty think are most in need of improvement and whether this aligns with what the students have to say.

3.1.1 Evaluating Lectures

We sat in on three on-campus lectures in order to gain general information on how the *Basic Science* course was run. Since there were multiple professors teaching the course, we sat in on a lecture by each professor to see the differences in teaching styles. Observing is effective because it allows researchers to see how the participants act naturally in a situation. (Kawulich, 2005). We informed the professors of our objectives in order to gain permission to attend their lectures, but there was minimal interaction with the students during the lectures. We sat in the back of the lecture hall in order to be able to have as many students as possible in our sightline.

3.1.2 Evaluating Faculty

During the spring mid-semester break at NUST, we met with the head of the Health and Applied Sciences department and decided which faculty members were best to talk to on campus. We interviewed the current faculty and those who had taught the course in the past. We used semi-structured interviews to learn more about the structure of the *Basic Science* course and their pedagogical approach (Appendix A: Faculty Interview Questions). The goal of these

interviews was to see if there were specific subjects that students struggle with most and to gain insight on why the professors believed students struggled with these subjects. We also asked the professors for ideas on how they thought the course could be improved in order to benefit the most students, as well as ways to make the course easier to teach.

3.1.3 Evaluating Students

We used semi-structured interviews to obtain more in-depth student opinions on the *Basic Science* course (Bagdon, 2004). Using open-ended questions, we asked which topics they found most difficult in the course, how the course could be made more interesting, and if putting the course online would be beneficial (Appendix B: Student Interview Questions). We asked all the students the same questions. Benefits of face-to-face interviews include the ability of the researcher to push for more detail and to explain any questions that the interviewee finds unclear (Opdenakker, 2006). Conducting a face-to-face interview allows the researcher to develop a friendlier relationship with the interviewee, making them feel more comfortable sharing information. We messaged randomly selected full-time and part-time students on eLearning. If they responded and were willing to be interviewed, we set up a time with them to meet. We set up six interviews, and none of the students showed up. Instead, we waited outside of the lecture halls after the *Basic Science* lecture and pulled students to interview. This would ensure that the students we approached were enrolled in the *Basic Science* course. During each interview, two of our team members were present; one asked questions while the other recorded the interview by taking notes. In order to interview more students, we approached random students on campus and inquired if they had ever taken the *Basic Science* course at NUST. If they had, we interviewed them. We approached students on Upper Campus, as that part of campus is predominantly non-STEM students. Approaching students that were sitting on campus was more effective because the students typically had time to do an interview.

We attempted to interview part-time students on their way out of lecture, however all the students we asked did not have time to interview with us. In order to collect data from these students, we sent a survey on eLearning to the 261 registered part-time students (Appendix C: Part-Time Student Survey Questions). Since part-time lectures meet in the evenings twice a week, we determined this was a more effective method than formal interviews. We sent out a reminder message to fill out the survey after a couple of days, to ensure that we received as many responses as possible.

3.2

Determine pedagogical and structural issues with the Basic Science course on distance mode.

We visited two distance centers to observe how the contact hours were taught. We contacted the tutors from all the centers to gain information on the students registered for the

center and sent out surveys to all the distance students. The goal of this was to gain more information on the learning experience for students on distance mode.

3.2.1 Evaluating Vacation School

Vacation school is a time for students on distance mode to travel to the NUST campus and attend face-to-face lectures during breaks (NUST, 2018). We attended the four-hour *Basic Science* vacation school lecture to observe how it was taught. We had a few minutes after lecture to speak with some students to discuss their experience with the course on distance mode, as many did not have enough time on campus to complete a formal interview.

3.2.2 Evaluation of Distance Students

Because we could not visit all of the distance centers due to time restraints, we sent out a survey to all 500 distance students enrolled on the eLearning site (Appendix E: Distance Student Survey 1 Questions). We used Google Forms to analyze the data. The responses were individually exported into an spreadsheet, and we created graphs of the data to be able to visualize the correlation between the questions. The survey consisted primarily of multiple-choice questions, with an open-ended question at the end for general feedback.

Based on our initial findings, we sent out a second survey through Google Forms to gather more specific data (Appendix H: Distance Student Survey 2 Questions). It was sent to the same 500 distance students asking questions about why they do or do not attend contact sessions, and why other students do not attend contact sessions.

3.2.3 Distance Center Tutors

Each satellite center is supposed to have a tutor for the *Basic Science* course. We first emailed all of the regional heads at each distance center to get the contact information for the *Basic Science* tutors. We received four responses back either providing us with contact information for the tutor or informing us that there was no *Basic Science* tutor. We emailed the tutors whose emails we were given a survey on Google Forms to fill out. However, we only received one response to this (Appendix D: Distance Center Tutor Survey Questions). We called the tutors and verbally asked them the survey questions and entered their answers into the survey ourselves. We called the regional heads who did not email us back for the rest of the tutors' information. If there was no tutor, we asked the regional heads the reasoning. Some of the tutors did not answer our phone calls, so we asked them questions through texts. To help us gain insight on the population of absent students, we asked why the tutors thought students were not attending lectures, how many students typically attended, and a few other questions about attendance.

3.2.4 Visiting Distance Centers

We visited the distance center in Walvis Bay because it had the most registered students besides Windhoek. We observed a contact session to gain a better understanding of how distance students were learning. We distributed surveys to the students who attended, to ensure we reached as many students as possible with our survey that we previously sent out electronically (Appendix E: Distance Student Survey 1 Questions). We informed the students not to fill it out if they had already done so online.

We attended a contact session in Windhoek and handed out a survey to the students present at the contact session (Appendix F: Windhoek Distance Student Survey Questions). We also conducted focus groups with the students who were willing to stay a few minutes after class (Appendix G: Distance Student Focus Group). There were two focus groups; one with two students and the other with three students.

3.3

Identify ways to engage students in the Basic Science course.

All courses at NUST are ranked at certain levels, and the *Basic Science* course is a level four. Any courses below level five are considered secondary level courses. We determined that discussing how secondary school teachers keep students engaged in science was important for evaluating how to engage students in this course. Since students are given the chance to opt out of science education in secondary school, we wanted to talk to teachers who keep students engaged in science. We identified secondary schools in the Windhoek area by connecting with a staff member in the admissions office at NUST. We asked her to direct us to secondary schools in the area that send the most students to NUST so we could reach out to them.

We contacted four of the secondary schools provided to us, however we only heard back from Windhoek High School. We inquired if we could interview their science teachers to see what teaching techniques they used in their courses, and how they structured the content of the course (Appendix I: Secondary School Faculty Interview Questions). We were able to get in contact with three science teachers there and interviewed them through phone calls, WhatsApp, and email. We also looked into how they generated students' interest in the subject matter, as scientific studies were not the main focus of the university students taking the *Basic Science* course at NUST. These interviews provided us with information on how teachers engage students in foundational science material.

The methods outlined here allowed us to conduct research towards our goal. The next chapter will describe the results and data we collected.

Chapter 4: Results & Analysis

The goal of this project was to research why the *Basic Science* course at NUST has a low pass rate, especially among distance students, and to provide recommendations on how to increase the overall pass rate. Our objectives were to determine the pedagogical issues with the NUST *Basic Science* course on campus and for distance learning and to identify ways to engage students in the course. In order to accomplish this, we interviewed faculty and full-time students, we surveyed part-time and distance students, and we held focus groups for distance students. We also contacted secondary school science teachers in Windhoek. This chapter covers the results of the data we collected during our research.

4.1 Objective 1

The first objective was to determine issues with the *Basic Science* course on campus. We found that faculty struggle to teach the course at a low level, and students struggle with the course set up and disinterest in the material. The following results are from the data we collected through our surveys and interviews of on-campus faculty and students.

4.1.1 Faculty Interviews

The *Basic Science* course is lecture-style for all of the full-time and part-time students. The full-time students meet four times a week for one hour each, while the part-time students meet twice a week for one hour each. The students will have one week of either biology, chemistry, or physics, and then rotate to the next subject the next week. The lecture slides are posted on the eLearning site for reference. There are two assignments and two exams over the course of the semester, each containing biology, chemistry, and physics questions.

All of the faculty that were interviewed have degrees in various relevant fields, such as Analytical Chemistry, Biological Physics, Medical Biochemistry and Biology. The *Basic Science* course includes topics so simple that professors find it challenging for them to teach. One professor stated that it was difficult to explain to the students what an atom is, as it is so simple to him. The course is not considered a university level course, so the faculty are typically overqualified to be teaching it.

The faculty use the eLearning site through NUST to post the notes and study guides for the students to access. It was the opinion of many of the faculty members that the students needed access to the eLearning site in order to succeed in the course. One of the professors stated that he posted links to additional YouTube videos online. Another faculty member described the time that he created weekly online quizzes for the chapter that had been taught that week. The students did very well on these quizzes, as they were able to either look up the answers or work with other students, even when there was a time limit enforced. The students would fail the exams, as they had not actually learned anything.

The faculty also noticed that many students are not engaged or interested in the material. Any background knowledge in the basics of science is often lacking, especially since not all the students are straight out of secondary school. While some students have taken science within the past few years, many have not taken a science course in 10-15 years. One lecturer suggested grouping students by the level they are learning at. The faculty claimed that students also do not understand why they have to take a science course when they are not in a STEM-related major. The large class sizes make it difficult for the faculty to engage all the students, especially without many practical examples.

One faculty member cited a lack of effort from students. He felt that he was there to lecture, not to teach, and that the students need to put in more effort by reading the materials on their own.

4.1.2 Full-Time Student Interviews

We interviewed 18 full-time students to hear their thoughts and opinions of the course. Lectures meet at a different time depending on the day of the week, and we found that most students will only attend lectures at 9:30 am and 10:30 am, choosing not to attend the 7:30 am or 2:00 pm lectures. They said the material is not interesting and the course format makes learning the material confusing. Switching professors every week makes the course more difficult for students because of the different teaching styles of professors, and the constant switching of subjects makes it hard for students to comprehend the material. Some of the students struggle with terminology because they have not taken a science course since Grade 10, making it hard for them to grasp the concepts. The biggest issue for the full-time students is the lack of interest in the course. They do not see the importance of this course as it does not directly apply to their major. They do not feel the need to put as much effort into this course as they would courses related to their major. Multiple students have claimed they start studying for exams only a few days before taking them. We also asked the students if they thought an online course would be beneficial and most of them said it would not be a good choice because face-to-face lectures are helpful.

4.1.2 Part-Time Student Survey

We sent a survey out to all 261 part-time students enrolled on eLearning. We received 19 responses (Appendix J: Part-Time Student Survey Results). These results might be biased based on the sample we collected data from, which was only students willing to respond to a survey. We asked the students why other students may not be succeeding in the course and 36.8% of them said they are lacking the background necessary for the course. When asked how long ago they had last taken a science course, only 22.3% claimed they have taken a science course in the past five years (Figure 1).

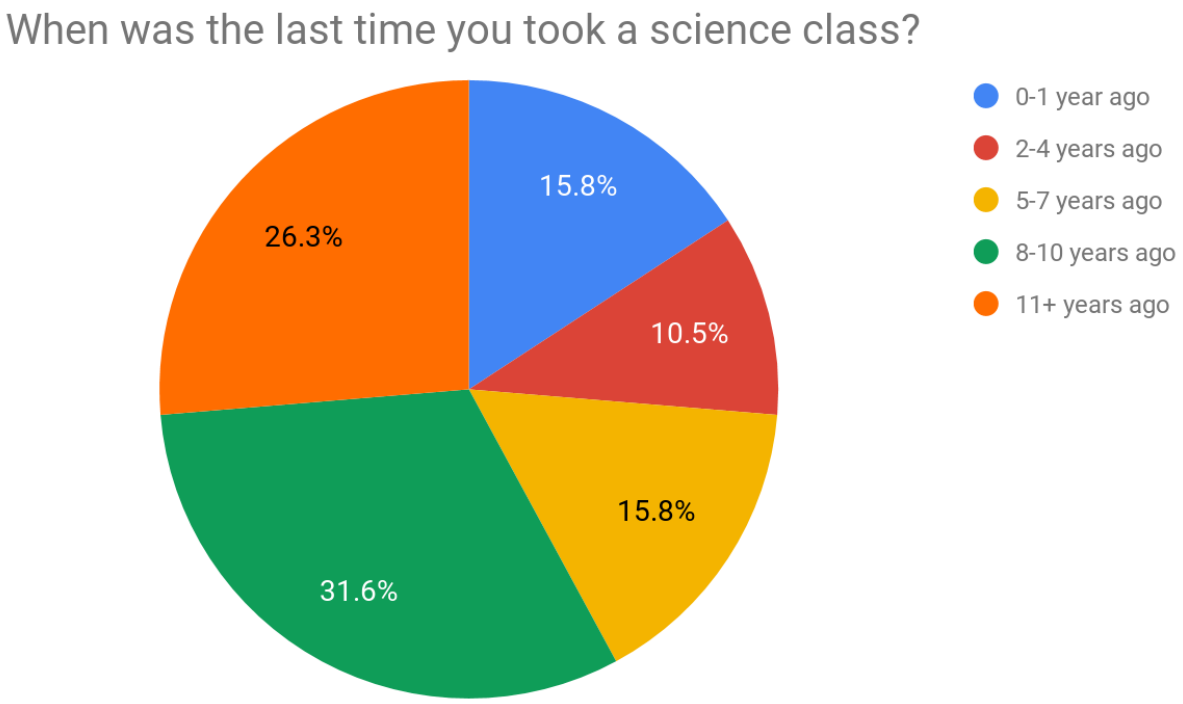

Figure 1: *When was the last time you took a science class?* Responses

We asked the students how often they attend lecture and 78.9% said they attend every lecture. This indicates that the main issue for these students is the lack of background stemming from the length of time since their last science course.

4.2 Objective 2

The second objective was to determine issues with the *Basic Science* course on distance mode. We found that distance students do not attend the contact sessions for a variety of reasons, and that there are discrepancies with how they are expected to get all the information for the course. The following results are from the data we collected through surveys and interviews of distance students and tutors.

4.2.1 Distance Student Survey 1

A survey was sent out to all 500 distance students enrolled on eLearning to try to gain the most feedback possible. We only received responses from 70 of the 500 students (Appendix K: Distance Student Survey 1 Results). Not all distance students are enrolled on eLearning, so we were unable to send the survey out to everyone registered for the course. We found that the majority of the students who filled out the survey are a part of the Management Science faculty (64.3%). The next largest faculty is Human Sciences at 28.6% of students enrolled, 4.3% are a part of Health and Applied Sciences, and 2.9% are a part of Natural Resources and Spatial Sciences faculty. Most of the students enrolled in the course currently have a job, and the hours

they work per week vary equally between 0-10 hours and 30-40 hours, with slightly more working over 40 hours a week. Over half the students have not taken a science course in more than six years, while only 14.3% of them took a course within the last year of their education. This is also the first time 72.9% of students are taking *Basic Science* while the other 27.1% are retaking the course.

When asked if the distance students thought that putting the course completely online would be beneficial or not, the students were split almost evenly, with a slight preference for putting the course online (Figure 2). The high number of students who responded 'No' could be attributed to the biased sample of the population. All the students we collected data from in Walvis Bay were attending the face-to-face sessions and benefiting from them, so they might be less likely to want an online course. We could not reach other distance students if they did not respond to the survey sent to them, so we do not have a sample from the whole population, and this data may be biased based on the students we were able to collect data from.

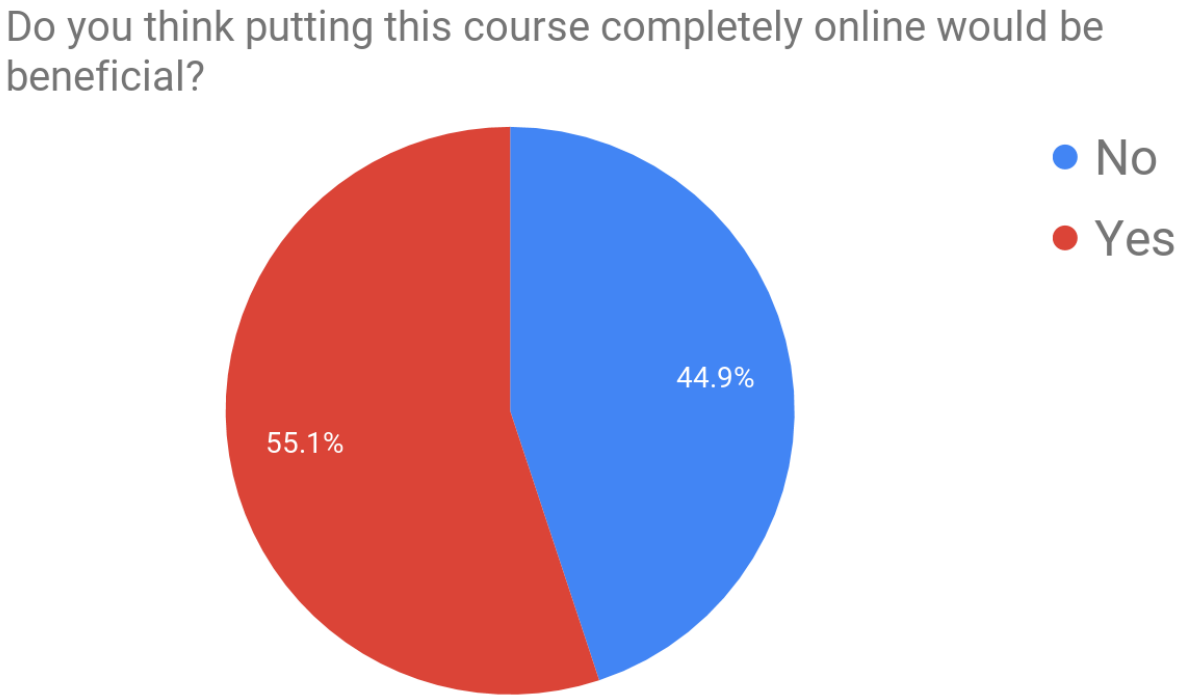

Figure 2: *Do you think putting this course completely online would be beneficial?* Responses

We listed all the resources provided to the distance students by COLL and asked students taking the survey to rank how often they use them on a scale of 1-5, with 1 being never and 5 being very frequently. The majority of the students ranked that they attend face-to-face contact sessions very frequently, but the second highest percentage were those who do not attend at all (Figure 3).

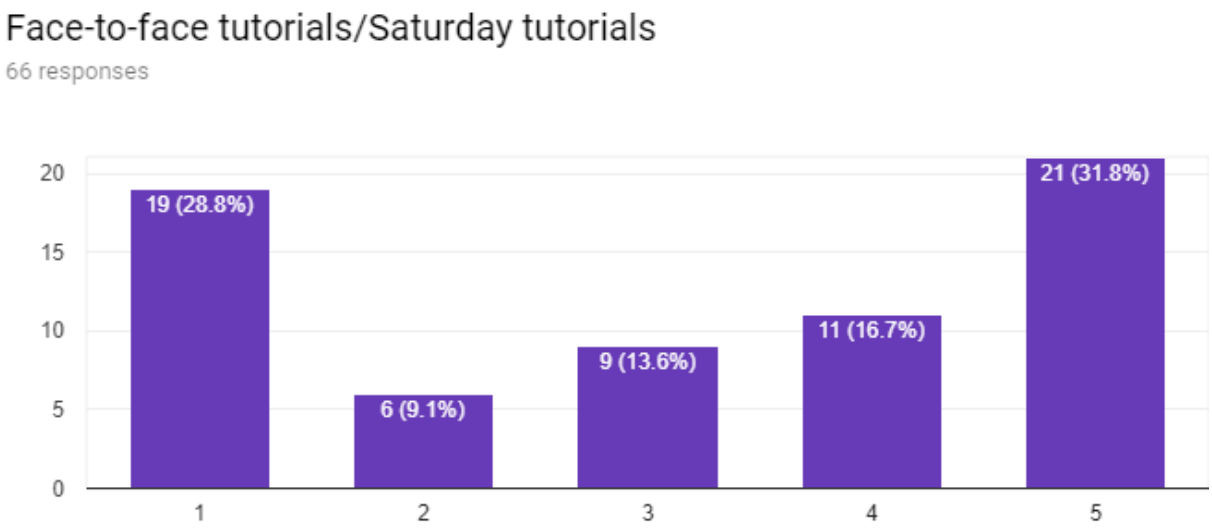

Figure 3: Face-to-face tutorials/Saturday tutorials Usage

We asked the students how frequently they logged on to the eLearning platform, and while most of them said they use it frequently, the second largest portion of the students ranked it as something they never use (Figure 4).

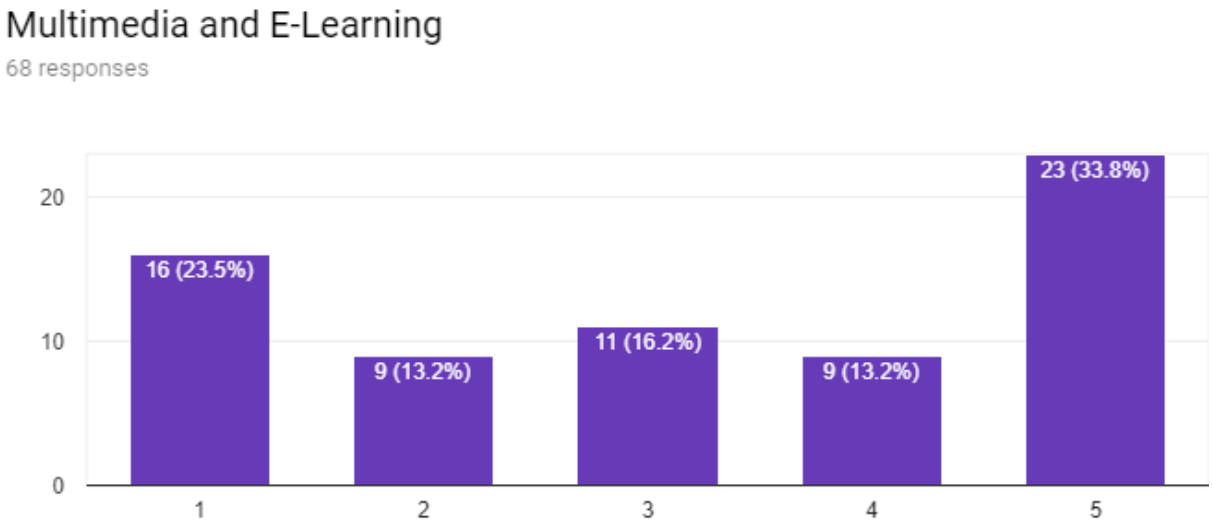

Figure 4: Multimedia and eLearning Usage

Of the other resources listed, radio tutorials was used the least, with 96.9% of respondents claiming that they have never used it. Vacation school was spread out in responses, with 49.2% saying that they never use it, but 20% saying that they use it very frequently. Nearly 75% of students said that they never use telephone/e-mail tutoring, however the respondents that said they did use it were evenly spread out on how often.

When asked which topics within each subject were most difficult for students, 65.2% said microbiology and biotechnology was the most difficult biology topic. 37.9% said acids, bases, and salts is the most difficult chemistry topic, and 39.1% said electricity is the most difficult physics topic (Appendix K: Distance Student Survey 1 Results).

We received 30 responses to the open-ended question: *Is there anything else you would like us to know about the* Basic Science *course or distance learning in general?* Notably, nine of these 30 student respondents stated that they did not see the importance of taking the course.

"I personally just don't see the importance of doing basic science on the field of Human Resources. Where in my real work life does this subject fits in? [sic]"

"it's an unnecessary and expensive class"

"Why does commercial subjects have to take Basic Science?"

"Why am I even having basic science while I'm not doing a science course, I am doing management."

"I dont understand why this course is incorporated in every field of study. If i last had science in grade 10, why should i be doing science again at tertiary level if for instance i am studying HR or Marketing [sic]? "

Five students cited that there was too much content in the course.

"The work is way too much for a semester course, too many chapters to cover and not a clear scope, from my first test experience the scope given was too broad and contradicting because the lecturers said if we did Assignment 1 we are basically covered for the test, which was not the case and to study three chapters of almost 200 pages of information in less than four weeks when you have other modules to prepare for, that is not on. It is too much information in too short a space of time."

"The Course Volume/content is too much. Consider Splitting it to A and B"

"Basic Science is too much and lot of things to learn. Its very confusing, when you are busy enjoying bilology then all of the sudden is physics and chemistry [sic]."

Nine students stated that they did not have enough support for distance mode.

"why do they add questions in the exam which are not part of the things we were taught or in the study guide."

"It would be helpful if tutors are more readily available telephonically or through email than they are now. It sometimes a struggle to get hold of them, or they take ages to reply to one's enquiries and concerns."

"Also, the support service from COLL is below standard. NUST should understand that all students are fresh from high school. Some students are grown people who have been working for many years and are also service providers within their own scope of work. It is demotivating to have to do deal with support staff who want to treat students like small children."

"the main reason why we are failing Basic Science is because some of us we do not have any idea about science and we are hardly attending classes due to time and some centers do not offer classes like, Opuwo centre just to mention some."

"A supplementary test offering would be very beneficial."

"Organizing of Tests were very poor for Test 1, test started very late and not enough papers when eventually started, very frustrating as you were aware of the number of students that registered for the course. Also some questions in the test that were not covered in the Distance booklet but probably done with full/part time students puts distance learners in a disadvantage."

"Feedback on Tests and Assignments for distance learning are not returned soon before the next. The process does not allow to see the our performance, so that we could anticipate in doing better in the next Test or Assignment. It becomes a bit discouraging, though I am aware that one should at all times strive to do good. However, that is usually a motivation to myself."

4.2.2 Distance Student Survey 2

A follow-up survey was sent to the 500 distance students based on the data collected from the first survey. The goal of this survey was to determine why students chose to attend or not attend the contact hours. We received 42 responses out of the 500 students (Appendix L: Distance Student Survey 2 Results). We found that 47.6% of them do not attend the contact sessions (Figure 5). The most prominent reason behind the lack of attendance for 55% of these students is having a time conflict with the sessions. Other reasons stated for not attending were that there are no contact hours, the distance center is too far away, and that they are not interested enough in the subject.

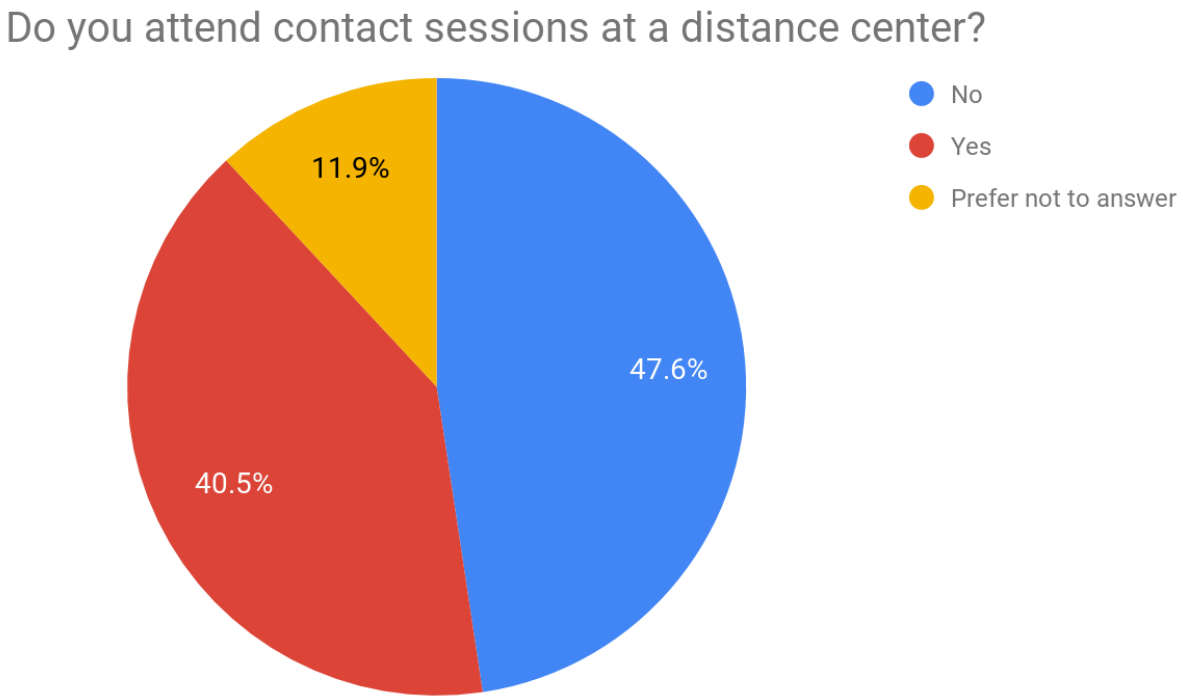

Figure 5: *Do you attend contact sessions at a distance center?* Responses

If the students answered 'Yes' to attending contact hours, they were prompted with a question asking why they attend. Out of these students, 58.8% said that they attend contact sessions because the tutor is helpful. Other responses were that they paid for the course, the material is too hard to learn by themselves, and that the material was too much so they were hoping they could get hints from the tutor about what would be on the exam. When asked why other students do not attend contact sessions, the most common answers were time conflicts and the distance center being too far away (Appendix L: Distance Student Survey 2 Results).

At the end of the follow-up survey, there was an open-ended question asking: *How could the* Basic Science *course be made more interesting or relevant?* Of the 21 total responses to the

survey, 15 students answered this. Three of them continued on the trend of not having enough time to attend the sessions.

"Do away with test session and let us concentrate on assignments, because we do not have time to write test thus why we registered as distance students. Remember we are working adults as well so time is not always on our side."

"the night and in group, every weekend, some people work until late, while others work night time, all must be catered by both slots"

Five of the responses related to the lack of interest from the students.

"Rather remove the module as it waste money and time and some of use had science in grade 10 last which is over 15 years ago"

"It is difficult to introduce a subject like that to some students who never had science in high school. Also I honestly think it's not relevant at all."

Four of the students gave suggestions on ways to change the class.

"Less technical terms and more practical explainations [sic]."

"frequent sessions (every Saturday)"

"Maybe by introducing videos during the lesson."

"They can cover less chapters and do some classwork where we complete quizzes in groups and swap answers."

4.2.3 Windhoek Distance Student Survey

There are 445 students registered under the Windhoek distance center, and only ten attended the contact session we observed. Of these ten students, we received seven responses to the survey. We found that most of the students attend every lecture because they find the tutors helpful and the material too much to learn alone. They also stated they are learning on distance mode because they do not have time to attend the on-campus lectures since they are working full

time, and one student said he was too old to enroll as a full-time student. One student had conflicting responses, claiming to attend every full-time lecture but also claiming to be on distance mode because he does not have time to attend the lectures on campus.

4.2.4 Windhoek Distance Student Focus Groups

From the focus groups, we found that for distance students the major issue is time. Students with no science background will also struggle because all of the content is new to them. Students are working full time so they think it is unreasonable for them to read the whole study guide. They said that the contact sessions were very helpful because most of the material they remember was from the contact sessions rather than their outside reading. We found that some distance students do not have the revised 2016 study guide. They are learning from the 2011 one, which does not have all the material the exams cover. The students come to the contact sessions because their study guide does not provide enough details on the material and the tutor goes much more in depth. One student said that he uses the study guide for 20% of the assignment and the internet for the rest. An issue with the contact sessions is that some classes are scheduled at the same time. Students need to attend the sessions for both courses and are forced to choose which class they need to attend more. Some exams are also scheduled during the contact sessions. Students need to take their exams to pass, causing them to miss the contact sessions for other courses.

The students in one focus group mentioned that they understood why some concepts in the *Basic Science* course were important. Topics such as energy use and the environment are important for students to be aware of because they directly relate to their lives. One student said that he knows science is meant increase memory skills, which is useful for everyone. Another student agreed that being educated on the environment is important, but does not understand the need to memorize all the formulas, as he will never need them as a human resource major.

4.2.5 Contacting Distance Centers

We reached out to all ten regional centers (Figure 6), and asked for contact information for the *Basic Science* tutors (Appendix M: Distance Center Data). We found that three of the centers currently do not have a tutor for the *Basic Science* course; Keetmanshoop, Otjiwarongo, and Tsumeb. Tsumeb is currently looking for a *Basic Science* tutor, as the previous one was relocated. Keetmanshoop and Otjiwarongo both stated that there were not enough students attending contact sessions to warrant keeping a tutor, and cancelled the contact sessions. Otjiwarongo only had 1-2 students attending and Keetmanshoop had 2-3 students attending, stating that they cancelled contact sessions because less than five students were attending. This is not consistent between all distance centers, as Gobabis and Katima Mulilo only have four students attending, yet they still hold contact sessions every week. The distance center in Opuwo had no regional coordinator listed, and calls to the phone number listed failed, so there is no data on that distance center. Of the remaining distance centers, excluding Windhoek, an average of 42% of the students registered attend the contact sessions.

When we asked the tutors why students do not attend the contact sessions, the tutors suggested work, distance, family, and personal issues as reasons. Two of the tutors mentioned that the material given to the students in the study guides is inconsistent with the exams that the students take. They stated that the study guides were missing information, and that the material was too shallow with the exams being too deep. We investigated this by looking at the exams given to the students and comparing them to the information provided in the study guide. We found that some of the questions were not found in the study guide, but only in the lecture notes posted on eLearning. One of the tutors also stated that the center had no materials to do any demonstrations, and that he takes the students to his school to show them practical examples, as they resonate more with the students.

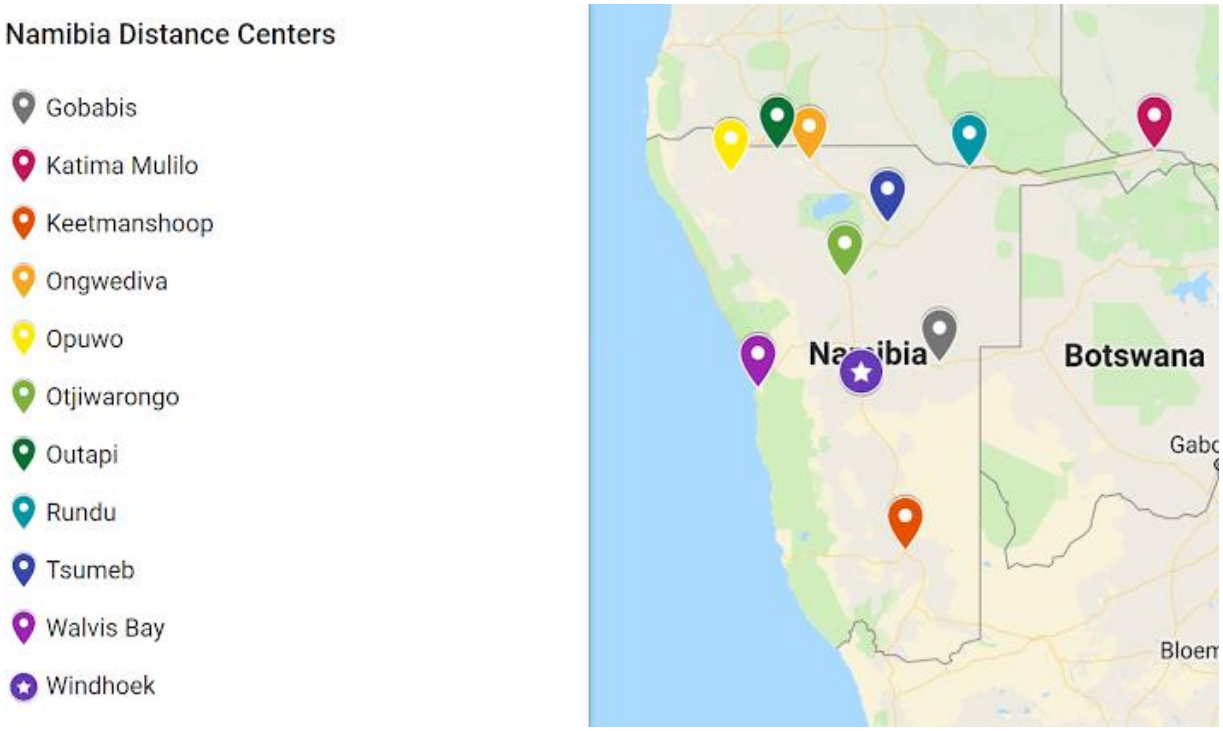

Figure 6: Location of Distance Centers in Namibia

4.2.6 eLearning

All of the students are supposed to be enrolled and using NUST's eLearning site, as there are additional materials posted there. Not all of the distance students are even enrolled on eLearning, and an even smaller percentage have logged on at some point in the semester (Table 1). The lecturers post the slides from class that contain additional information that is not included in the study guide. If the students are not logging on to the site, they are missing out on information that they may be tested on.

	Full-time	Part-time	Distance
Registered	749	261	641
Enrolled on eLearning	99%	100%	78%
Logged on	96%	95%	61%
Logged on in Past 4 Weeks	74%	76%	40%

Table 1: *Basic Science* eLearning participation variation between full-time, part-time and distance students in September 2018.

4.3 Objective 3

The third objective was to identify ways to engage students in the *Basic Science* course starting in secondary school education. We found that teachers are able to keep students engaged in classes when the subject matter is related to their lives, and that supplemental videos or demonstrations are helpful, too. The following are the results of the data we gathered from our contact with Windhoek High School (WHS). While WHS is not necessarily representative of secondary education in Namibia, we were unable to get in contact with other secondary schools. .

We interviewed a tenth-grade teacher from WHS over the phone. She stated her class was more engaged in her lectures than she expected. In grade ten, the curriculum is focused on the human body and students were especially interested in the circulatory and respiratory systems. In her lectures, she found it easy to engage students because she could relate topics that they were learning about to things in their daily lives. For example, many students responded well to examples involving sports. Part of the curriculum involves learning about plants, which the students did not enjoy as much. She said teaching about plants was difficult due to the fact that it was harder to relate the material to the students. We asked the teacher how she accomplished this and she said that she relied on YouTube videos and the internet to supply supplementary material to the students. She said that all the students need is WiFi to get some extra help outside of class.

Other teachers at WHS teach physical science which is not as easily relatable to the students. These teachers understood that this material was not as interesting to the students, so they tried to use everyday examples. The classes were still lecture based due to the larger class sizes, so the teachers tried to incorporate demonstrations to keep students engaged. One teacher said that if a teaching method was not working for her students, she would try other methods until she found one that worked.

We analyzed the data we collected from our interviews, surveys, and research into the course to determine how to achieve our goal. The final chapter concludes our findings and describes the recommendations we made to NUST.

Chapter 5: Conclusions & Recommendations

This chapter covers our conclusions based on the results of our data analysis. We found that disinterest and the course structure are the main issues with the *Basic Science* course. Based on our data, we recommend that NUST try to make the subject matter more relatable to students' lives, provide adequate support for students on all learning modes, and improve the online resources available to students. This will potentially solve the issues we have identified.

5.1 Disinterest

We determined that students are disinterested in the *Basic Science* course. Students stated through interviews and survey responses that since science is not directly related to their majors, they do not believe it is necessary to learn more about it. They also stated that they often spend minimal time studying for this course, preparing for exams only a few days before taking them. In addition, many students have not taken a science class in many years, so it is difficult to keep up with the subject.

We recommend that NUST implement ways to make the course more engaging for students. Secondary school teachers stated they provide videos for their students to watch rather than lecturing at them for the duration of class. NUST could implement videos into their lectures to make them more interesting. Labs and other interactive simulations are also beneficial because they allow students to have a hands-on approach for learning (Odom and Bell, 2015). Students will be more interested if they have an active role in their learning experiences. Finally, relating science to everyday life is important when engaging students in science subjects. Examples such as how food is converted to energy or how seatbelts are used to prevent injury during a collision are all ways to relate science to students' lives.

5.2 Updated Course Design

We determined that learning three subjects at the same time is difficult for students. Students stated that they have trouble remembering concepts when they switch subjects weekly. Having different teachers is also difficult because not all lecturers have the same teaching style, and students said they struggled with the change of lecture style. Faculty also stated that the class size is too large, leading to the students sitting in the back of the lecture hall to be at a disadvantage since the professors cannot help everyone at once. Student responses in the interviews and surveys varied in how prepared they felt for the course. Some of the students had taken a science course in the past year or two, while others had gone over ten years since taking one.

We recommend that NUST restructure the course. A way to restructure the course would be to take it one subject at a time instead of switching at a weekly basis. By finishing biology before transitioning to chemistry or physics, students will be able to better retain all the content instead of trying to remember what they learned three weeks ago. Some of the content overlaps

by subject, and teaching it so that all students are learning it in the same order will help them fully understand all the subjects taught. Rutgers University has previously offered a class very similar to the *Basic Science* course at NUST (S. Lawrence, personal communication, September 17, 2018). The course was designed so that three different professors taught different topics that related to a main problem. They found that the organization of the course was not effective and students did not respond well to it.

Another way to restructure the course would be to divide it into separate courses. Offering a separate biology, chemistry, and physics course allows students to study the subject they are most interested in. By choosing the class, students will feel like the course is less of an obligation and more of their own choice. Professors will feel more comfortable teaching the courses because they will be able to go more in depth for each subject than the course currently allows. Many large universities offer different options for fundamental science classes so students can choose which ones suit their interests (UMASS Amherst, 2018). If this is not an option, doubling the number of lecturers would decrease class size by half. This would allow the students to have more attention individually which would be beneficial when seeking help in class. It would make the class more enjoyable for lecturers because they would be able to interact with the students more and teach more in depth. The course could also be split up by level. By determining the preparedness of students with a placement exam, there could be a course for students with more science background, and a beginner course for those who need to be retaught the information. The students who have the background would not be bored learning material they already know and the students without the background could move at a slower pace in order to grasp the fundamentals

5.3 Discrepancies in Learning Modes

We determined that distance students were not receiving the same support as on-campus students. All students are given the same study guide which contains all the material in the course, according to faculty. According to multiple distance center tutors, there is material missing from the study guide that is on the exams. We found that the on-campus lecturers were providing additional information for the students in their lecture slides. This is a problem for distance students who are not enrolled on eLearning or cannot log on because they do not have access to the lecture notes that are posted online. We observed in the Windhoek distance contact session that the students had the 2011 copy of the study guide, instead of the revised 2016 copy that the lecturer was under the impression they had. Students in focus groups there informed us that the material in the study guide often did not line up with exams and assessments.

We recommend that NUST reevaluate its resources available for off-campus students. Since lectures have extra information that the study guide does not have, a way to help those off-campus would be to record the lectures and post them online. This will be beneficial for the distance centers that do not have contact hours because the recorded lectures will simulate face-to-face lectures, enabling students to have more sources of information rather than relying solely on reading. This also helps students who cannot attend the sessions due to being too far from the

centers or having prior time commitments because they can view the lectures at their own convenience. Extra information is given to students during lecture and then put on the tests. For equity, lecturers should not teach extra material in class that is not included in the study guide. If the lecturers feel the extra information is really important, that information should be added to the study guide so even students that do not log on to eLearning can have access to it.

5.4 Distance Centers

We determined that the distance centers do not effectively educate the students on distance mode. The professors teaching the *Basic Science* course on campus do not check in with the tutors to make sure all students are learning at the same pace. NUST never sent any faculty to the distance centers to make sure that the contact hours are actually happening. COLL is in charge of helping to support the distance students but also does not have all the information about various centers. COLL informed us that they did not keep attendance records, but we observed an attendance sheet being passed around at both sessions we attended. We also found that a major reason for students not attending contact sessions was due to a time conflict. Students stated that some contact sessions occurred at the same time as contact sessions for their other courses, so they had to choose which one to attend. In addition, there were inconsistencies with the number of students that made it worthwhile to hold contact sessions. One of the centers claimed that they cancelled contact sessions because there were not at least five students attending, however, other centers had three or four students attending and continued contact sessions. A standard should be set for all distance centers to follow to counteract these inconsistencies.

We recommend that the department head of the *Basic Science* course at NUST and COLL communicate with each other and the regional coordinators and tutors at each center regularly. The tutors could request materials from the university if needed. Some centers do not currently have a tutor for the *Basic Science* course and NUST was unaware of this fact. It is important that NUST know when the students are not being taught because the contact sessions are a valuable resource for distance students. Many students are unable to attend the contact sessions when they are offered so tutors should have set times when they are available for students to contact them with any questions they have outside of the contact sessions. This allows students to still be able to ask questions about the material and assignments. Some centers do not hold contact sessions because so few students attend them. They should still hold contact sessions for those who can attend because those students in attendance need help from the tutors.

5.5 Online Basic Science Course

The goal for the *Basic Science* course is to put it completely online in the next five years. The current online resources for distance students are not as effective as they could be. Out of all the distance students, only 78% are enrolled on the eLearning site, and only 61% of those students have ever logged on. We do not know if the students do not log on because they simply

do not think that they need the materials on eLearning or because they do not have access to technology they would need to log on. If the students do not have enough time to go to the distance center for the contact sessions, then the online course could encourage them to pursue their studies on their own time. On the other hand, if students do not have the access to technology, then the online course will not be helpful to them. We cannot conclude why these students are not attending the centers as they have not responded to the surveys we sent out, and we have no way of contacting them.

In order for NUST to successfully transition the course to an online platform, we recommend that the course be structured similar to how an on-campus lecture would be. The online course should have recorded lectures, so students can follow along with the professor as if they are sitting in on a face-to-face lecture. A resource to record lectures is Echo360, which allows a narration of a presentation or whatever the lecturer would like to display on the screen (Dona, 2017). This also adds an interactive aspect because students are not just reading from presentations or books. However, theses lectures should not be a replacement to the study guide, only an additional resource in case some students do not have internet access. Online simulations will allow students to have visual representations of the material they learned. There should be suggested activities that students can do on their own relating to the material they are learning, as well as additional resources for extra help if the students need it. There would need to be checkpoint assessments after each section to make sure students are fully grasping what they are learning. For the online course, a professor still needs to be available for students to reach via email or discussion forum if they need assistance or have any questions.

The transference of exams to an online platform is a difficult task. As one of NUST's faculty noted, when giving weekly assessments online, the students would cheat on them and continue to fail the exam. This aligns with previous research done on psychology students when comparing exam scores from students taking it with a proctor versus no proctor (Daffin, 2018). While placing all of the assessments online might increase the pass rate of the *Basic Science* course, it would not necessarily mean that the students are learning more. A way to combat this would be to continue to hold face-to-face exams, or ensure that the structure of the exam would make cheating as difficult as possible. This would involve more essay or short-answer questions, as well as a time limit for the assessment.

Currently, the exams for the course contain material from all three subjects. Students would benefit from taking three tests instead of two. One test should cover all biology topics, another should cover all chemistry topics, and another should cover all physics topics. This way all the questions on each test relate to each other, and students do not have to prepare for three subjects worth of information.

NUST may use some of these recommendations in order to improve the *Basic Science* course so that students not only pass, but gain crucial knowledge from the material. At NUST, our preliminary research of the distance centers can be used to improve them in the future, which would allow for the students on distance mode to have better access to the resources available to

them. Our research on pedagogical and structural approaches can be used by lecturers in the Faculty of Health and Applied Science as well as the other faculty on campus. The research done in Namibia applies to issues with education across the globe. Schools all over the word struggle to get students interested in the material they are teaching. These recommendations may be specific for this one course at this one university, but they can be applied to the courses throughout the world that are encountering the same struggles.

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Appendix A: Faculty Interviews

Location:
Date:
Time:

Personnel:

Host: Namibia A18 NUST Basic Science Team

- Lead:
- Secretary:
- Members Present:

Guest:

- Department:
- Years in this department:

Statement of Project and Goals

We are students from Worcester Polytechnic Institute working with the Namibia University of Science and Technology to learn more about why the *Basic Science* course has a high fail rate. We wish to interview you to hear your thoughts and opinions on the current *Basic Science* curriculum and resources available to you at the main campus of the Namibia University of Science and Technology.

Statement of Confidentiality

Your participation in this interview is completely voluntary and you may withdraw at any time. We will not ask for your name or any other personal identifying information and refer to you as "faculty", unless you agree to have us use your name. Any information that you share with us in response to these questions may be published on the internet in our final report, which will be accessible to the public. If there are any questions you do not feel comfortable answering, you are not required to do so. A copy of our interview notes will be made available to you upon request. Do you have any questions? At this time, we will begin the interview.

Agenda

Question 1: What is your background in science?

Where did you go to school?

Question 2: How do you teach your class?

Lecture style or something else?

How often do you give assignments?

Question 3: How often are exams given, and how are they structured?

How long are they?

Are they broken up by subject?

What study materials are given to the students?

Question 4: How do you incorporate technology into your class, if you do so?

Do you use blended learning?

Are there any online assignments, if so, can you describe them?

How much access to technology do students need to succeed in this course?

Question 5: What topics do you think students struggle with more than others?

Why do you think that they struggle with these topics in particular?

Question 6: How engaged are students in your class?

What makes them interested/not interested in the class?

Question 7: Is there anything else you would like us to know about the class that you believe could help improve it?

Is there anything that you think is missing that would make it easier to teach?

Final Remarks:

Thank you for your participation in this interview. Would you like to receive a copy of our notes? If so, please provide us with your email address. In addition, if you think of any other comments that you think would help us or have any other concerns, please email us at namibiabasicscience@wpi.edu.

Appendix B: Student Interview Questions

Location:
Date:
Time:

Personnel:

Host: Namibia A18 NUST Basic Science Team

- Lead:
- Secretary:
- Members Present:

Guest:

- Major/Faculty:
- Year:
- Mode:

Statement of Project and Goals

We are students from Worcester Polytechnic Institute working with the Namibia University of Science and Technology to learn more about why the *Basic Science* course has a high fail rate. We wish to interview you to hear your thoughts and opinions on the current *Basic Science* curriculum and resources available to you at the main campus of the Namibia University of Science and Technology.

Statement of Confidentiality

Your participation in this interview is completely voluntary and you may withdraw at any time. We will not ask for your name or any other personal identifying information and refer to you as "student". Any information that you share with us in response to these questions may be published on the internet in our final report, which will be accessible to the public. If there are any questions you do not feel comfortable answering, you are not required to do so. A copy of our interview notes will be made available to you upon request. Do you have any questions? At this time, we will begin the interview.

Agenda

Question 1: What previous education do you have in basic science?

When was the last time you took a class in science before coming to NUST?

How do you feel your previous science education prepared you or did not prepare you for university?

Question 2: How do you think you are doing in this class?

How often do you attend lecture?
How long do you spend on it per week outside of class?
How do you utilize the resources provided to you?

Question 3: Why do you think students aren't succeeding in the class?
How many students typically come to class?

Question 4: How does this class compare to the other classes you are currently in?
Is it harder or easier? Why?
What sets it apart?
Do you think that it could be taught another way?

Question 5: Which topics do you think are most difficult?
Why are these topics difficult to understand?
Are there any that you are particularly uninterested in?
Does disinterest in these topics make it harder to learn about them?

Question 6: How could this course be more interesting?

Question 7: Do you know anything about the students taking this course on distance mode?

Question 8: How would you feel about making this class completely online?
Do you think you benefit from the face-to-face lecture time?

Question 9: Is there anything else you would like us to know about the class that you believe could help improve it?

Final Remarks:

Thank you for your participation in this interview. Would you like to receive a copy of our notes? If so, please provide us with your email address. In addition, if you think of any other comments that you think would help us or have any other concerns, please email us at namibiabasicscience@wpi.edu.

Appendix C: Part-Time Student Survey Questions

Statement of Project and Goals

We are students from Worcester Polytechnic Institute working with the Namibia University of Science and Technology to learn more about why the *Basic Science* course has a high fail rate. We wish to survey you to hear your thoughts and opinions on the current *Basic Science* curriculum and resources available to you at the main campus of the Namibia University of Science and Technology.

Statement of Confidentiality

Your participation in this survey is completely voluntary and you are not required to turn this in. We will not ask for your name or any other person identifying information and refer to you as "part-time student". Any information that you share with us in response to these questions may be published on the internet in our final report, which will be accessible to the public. If there are any questions you do not feel comfortable answering, you are not required to do so.

How often do you attend lecture?

a. Every lecture
b. Once a week
c. Every other week
d. Once a month
e. Never
f. Prefer not to answer

How many courses are you currently taking?

a. 1
b. 2
c. 3
d. 4
e. 5+
f. Prefer not to answer

Do you have a job?

a. Yes
b. No
c. Prefer not to answer

How many hours a week do you work?

a. 1-10
b. 10-20

c. 20-30
d. 30-40
e. 40-50
f. 50+
g. Prefer not to answer

When was the last time you took a science class?
a. 0-1 year ago
b. 2-4 years ago
c. 5-7 years ago
d. 8-10 years ago
e. 11+ years ago
f. Prefer not to answer

Is this your first time taking this course?
a. Yes
b. No
c. Prefer not to answer

Do you think putting this course completely online would be beneficial?
a. Yes
b. No
c. Prefer not to answer

Why do you think other students might not be succeeding in this course?
a. They do not study
b. They do not attend lecture
c. They do not have the background to prepare them for this class
d. They are not interested
e. They do not have enough time for the course
f. Prefer not to answer
g. Other_____

Is there anything else you would like us to know about the basic science course or distance learning in general?

Final Remarks

Thank you for your participation in this survey. If you think of any other comments that you think would help us or have any other concerns, please email us at namibiabasicscience@wpi.edu.

Appendix D: Distance Center Tutor Survey Questions

Statement of Project and Goals
We are students from Worcester Polytechnic Institute working with the Namibia University of Science and Technology to learn more about why the *Basic Science* course has a high fail rate. We wish to survey you to hear your thoughts and opinions on the current *Basic Science* curriculum and resources available to you at the main campus of the Namibia University of Science and Technology.

Statement of Confidentiality
Your participation in this survey is completely voluntary and you are not required to turn this in. We will not ask for your name or any other person identifying information and refer to you as "distance center tutor". Any information that you share with us in response to these questions may be published on the internet in our final report, which will be accessible to the public. If there are any questions you do not feel comfortable answering, you are not required to do so.

What distance center do you teach at?
a. Gobabis
b. Katima Mulilo
c. Keetmanshoop
d. Ongwediva
e. Opuwo
f. Otjiwarongo
g. Outapi
h. Rundu
i. Tsumeb
j. Walvis Bay

When are contact session held for the *Basic Science* course?

How many students usually attend contact sessions for the *Basic Science* course?

How many students are registered at your contact center for the *Basic Science* course?

Is it typically the same group of students that attend each week?

Why are some students not attending contact sessions?

Is there anything else you would like us to know about the *Basic Science* course on distance mode, or any improvements that could be made?

Final Remarks

Thank you for your participation in this survey. If you think of any other comments that you think would help us or have any other concerns, please email us at namibiabasicscience@wpi.edu.

Appendix E: Distance Student Survey 1 Questions

Statement of Project and Goals
We are students from Worcester Polytechnic Institute working with the Namibia University of Science and Technology to learn more about why the *Basic Science* course has a high fail rate. We wish to interview you to hear your thoughts and opinions on the current *Basic Science* curriculum and resources available to you at the main campus of the Namibia University of Science and Technology.

Statement of Confidentiality
Your participation in this survey is completely voluntary and you are not required to turn this in. We will not ask for your name or any other person identifying information and refer to you as "distance student". Any information that you share with us in response to these questions may be published on the internet in our final report, which will be accessible to the public. If there are any questions you do not feel comfortable answering, you are not required to do so.

What is your major?

What faculty are you in?
a. Computing and Informatics
b. Engineering
c. Health and Applied Sciences
d. Human Sciences
e. Management Sciences
f. Natural Resources and Spatial Sciences

Where are you from?

What distance center are you registered under?
a. Gobabis
b. Katima Mulilo
c. Keetmanshoop
d. Ongwediva
e. Opuwo
f. Otjiwarongo
g. Outapi
h. Rundu
i. Tsumeb
j. Walvis Bay
k. Windhoek

l. Other

How many classes are you currently taking?

a. 1
b. 2
c. 3
d. 4
e. 5+

Do you have a job?

a. Yes
b. No

How many hours a week do you work?

a. 0-10
b. 10-20
c. 20-30
d. 30-40
e. 40+

How long ago did you last take a science class other than this one?

a. 0-1 year
b. 2-3 years
c. 4-5 years
d. More than 6 years ago

Is this your first time taking this course?

a. Yes
b. No

Do you think putting this course completely online would be beneficial?

a. Yes
b. No

Please rank how often you use the following resources with 1 being never and 5 being very frequently.

Marker-tutoring	1	2	3	4	5
Telephone/email tutoring	1	2	3	4	5
Face-to-face tutorials/Saturday tutorials	1	2	3	4	5
Vacation Schools	1	2	3	4	5

Radio tutorials	1	2	3	4	5
Multimedia and eLearning	1	2	3	4	5
Library Services	1	2	3	4	5
COLL SMS Services	1	2	3	4	5

Are there any other resources you use that are not listed above?

Which biology topic is the most difficult for you?

a. Living Things
b. Microbiology and Biotechnology
c. Chemistry of Food
d. Ecosystem

Which chemistry topic is the most difficult for you?

a. Properties and Structures of Matter
b. The Periodic Table
c. Acids, Bases and Salts
d. Measurements in Science

Which physics topic is the most difficult for you?

a. Graphs
b. Energy sources
c. Electricity
d. Radioactivity
e. Effects of Forces
f. Sound

Is there anything else you would like us to know about the basic science course or distance learning in general?

Final Remarks

Thank you for your participation in this survey. If you think of any other comments that you think would help us or have any other concerns, please email us at namibiabasicscience@wpi.edu.

Appendix F: Windhoek Distance Student Survey Questions

Statement of Project and Goals

We are students from Worcester Polytechnic Institute working with the Namibia University of Science and Technology to learn more about why the *Basic Science* course has a high fail rate. We wish to interview you to hear your thoughts and opinions on the current *Basic Science* curriculum and resources available to you at the main campus of the Namibia University of Science and Technology.

Statement of Confidentiality

Your participation in this survey is completely voluntary and you are not required to turn this in. We will not ask for your name or any other person identifying information and refer to you as "distance student". Any information that you share with us in response to these questions may be published on the internet in our final report, which will be accessible to the public. If there are any questions you do not feel comfortable answering, you are not required to do so.

What is your major/faculty?

_____

How often do you attend the contact sessions?

a. Every other week
b. Once a month
c. Never

Why do you attend contact sessions?

a. The tutor is helpful
b. Material is too hard to learn on my own
c. I like learning the material
d. Other _____

How often do you go to full-time lectures?

a. Never
b. Sometimes
c. Often
d. Very frequently

How often do you log onto eLearning?

a. Never
b. Sometimes
c. Often

d. Very frequently

How often do you contact your tutor outside of contact sessions?

a. Never
b. Sometimes
c. Often
d. Very frequently

How many hours a week do you work?

a. 0-10
b. 10-20
c. 20-30
d. 30-40
e. 40+

Why are you taking this course on distance mode?

a. Another course I'm taking conflicts with the basic science course
b. I don't want to go to class
c. The full-time/part-time lectures were full
d. I don't have time to go to full-time lectures
e. Other _____

What biology topic is most difficult for you?

a. Living things
b. Microbiology and biotechnology
c. Chemistry of food
d. Ecosystem

What chemistry topic is the most difficult for you?

a. Properties and structures of matter
b. The periodic table
c. Acids, bases, and salts
d. Measurements in science

What physics topic is most difficult for you?

a. Graphs
b. Energy sources
c. Electricity
d. Radioactivity
e. Effects of forces

f. Sound

Is there anything else you would like us to know about the basic science course?

Appendix G: Distance Student Focus Groups

Location:
Date:
Time:

Personnel:

Host: Namibia A18 NUST Basic Science Team

- Lead:
- Secretary:
- Members Present:

Guest:

- Mode:

Statement of Project and Goals

We are students from Worcester Polytechnic Institute working with the Namibia University of Science and Technology to learn more about why the *Basic Science* course has a high fail rate. We wish to interview you to hear your thoughts and opinions on the current *Basic Science* curriculum and resources available to you at the main campus of the Namibia University of Science and Technology.

Statement of Confidentiality

Your participation in this focus group is completely voluntary and you may withdraw at any time. We will not ask for your name or any other personal identifying information and refer to you as " distance student". Any information that you share with us in response to these questions may be published on the internet in our final report, which will be accessible to the public. If there are any questions you do not feel comfortable answering, you are not required to do so. A copy of our notes will be made available to you upon request. Do you have any questions? At this time, we will begin the focus group.

Agenda

Topic 1: Tell us more about the resources available to you in this course.

Technology, library, textbooks, tutoring, etc.

How do you utilize these resources?

Topic 2: What topics have you found most interesting to learn about?

Why did you find these interesting?

Can you relate these topics to your day-to-day life/do you feel they are relevant?

Topic 3: Are there any science topics you would like to know more about that aren't covered in the curriculum?

Do you think other students would like to learn more about these too?

Topic 4: How do you feel about the assignments and exams?

Is the exam material relevant to what you've learned?

Topic 5: What are the biggest challenges with taking this course on distance mode?

Topic 6: Is there anything else you'd like us to know about this course?

Final Remarks:

Thank you for your participation in this focus group. Would you like to receive a copy of our notes? If so, please provide us with your email address. In addition, if you think of any other comments that you think would help us or have any other concerns, please email us at namibiabasicscience@wpi.edu.

Appendix H: Distance Student Survey 2 Questions

Statement of Project and Goals
We are students from Worcester Polytechnic Institute working with the Namibia University of Science and Technology to learn more about why the *Basic Science* course has a high fail rate. We wish to interview you to hear your thoughts and opinions on the current *Basic Science* curriculum and resources available to you at the main campus of the Namibia University of Science and Technology.

Statement of Confidentiality
Your participation in this survey is completely voluntary and you are not required to turn this in. We will not ask for your name or any other person identifying information and refer to you as "distance student". Any information that you share with us in response to these questions may be published on the internet in our final report, which will be accessible to the public. If there are any questions you do not feel comfortable answering, you are not required to do so.

Do you attend contact sessions at a distance center?
a. Yes
b. No
c. Prefer not to answer

Why do you attend contact sessions?
a. The tutors are helpful
b. I like learning the material
c. The material is too hard to learn on my own
d. Prefer not to answer
e. Other:_____

How many students usually attend the contact sessions?
_____

Why don't you attend the contact sessions?
a. There are none
b. The distance center is too far away
c. I have a time conflict/don't have time
d. I am not interested enough
e. I don't feel the need to
f. Prefer not to answer
g. Other:_____

Why don't other students attend contact sessions?

a. There are none
b. The distance center is too far away
c. They have time conflicts/don't have time
d. They aren't interested
e. They don't feel the need to
f. Prefer not to answer
g. Other:_____

How often are the contact sessions held?

a. Never
b. Every week
c. Every 2 weeks
d. Every 3 weeks
e. Once a month
f. Prefer not to answer
g. Other:_____

Can you contact your tutor by phone or email?

a. Yes
b. No
c. Prefer not to answer

Which distance center are you registered under?

a. Windhoek
b. Gobabis
c. Katima Mulilo
d. Keetmanshoop
e. Ongwediva
f. Opuwo
g. Otjiwarongo
h. Outapi
i. Rundu
j. Tsumeb
k. Walvis Bay
l. Prefer not to answer

How could the basic science class be made more relevant or interesting?

_____

Appendix I: Secondary School Teacher Interviews

Location:
Date:
Time:

Personnel:

Host: Namibia A18 NUST Basic Science Team

- Lead:
- Secretary:
- Members Present:

Guest:

- School:
- Years teaching:
- Ages of students:
- Subject:

Statement of Project and Goals

We are students from Worcester Polytechnic Institute working with the Namibia University of Science and Technology to learn more about why the basic science course has a high fail rate. We wish to interview you to hear your thoughts and opinions on how to best engage students in a science curriculum.

Statement of Confidentiality

Your participation in this interview is completely voluntary and you may withdraw at any time. We will not ask for your name or any other personal identifying information and refer to you as "secondary school teacher", unless you agree to have us use your name. Any information that you share with us in response to these questions may be published on the internet in our final report, which will be accessible to the public. If there are any questions you do not feel comfortable answering, you are not required to do so. A copy of our interview notes will be made available to you upon request. Do you have any questions? At this time, we will begin the interview.

Agenda

Question 1: How big are your classes?

What grade do you teach?

Are the students typically interested in science or other fields?

Question 2: How do you teach your class?

Lecture style or something else?

How often do you give assignments and exam/assessments?
What study materials are given to the students?

Question 3: How engaged are students to your class?
What makes them interested/not interested in the class?

Question 4: How do you incorporate technology into your class, if you do so?
Do you use blended learning?
Are there any online assignments, if so, can you describe them?
How much access to technology do students need to succeed in this course?

Question 5: How do you simplify the complex topics in science?

Question 6: What topics do you think students struggle with more than others?
How do you explain these topics / capture their interest?

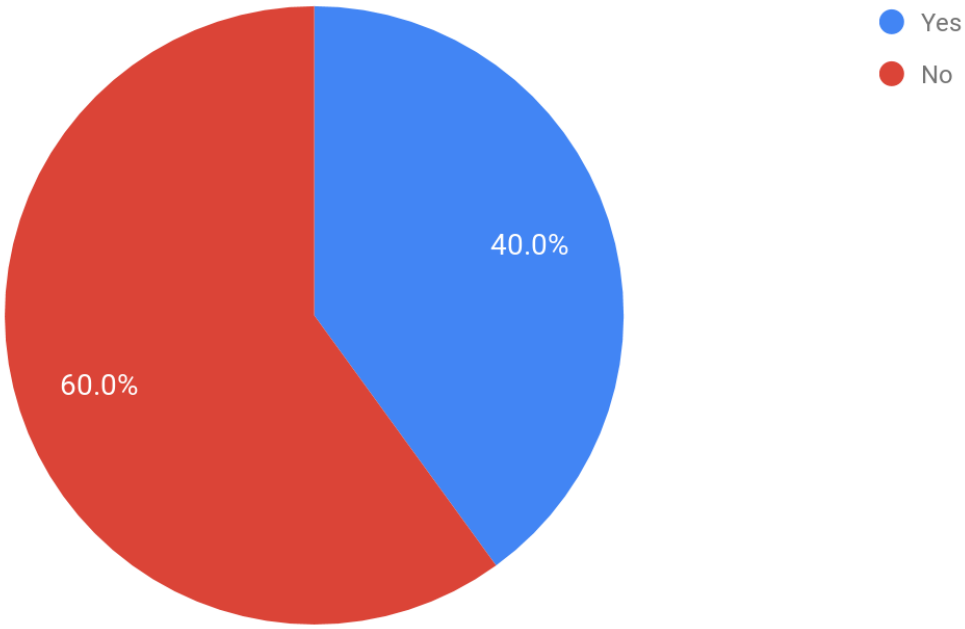
Question 7: Do you have any other comments or helpful tips about teaching science at the secondary level?

Final Remarks:

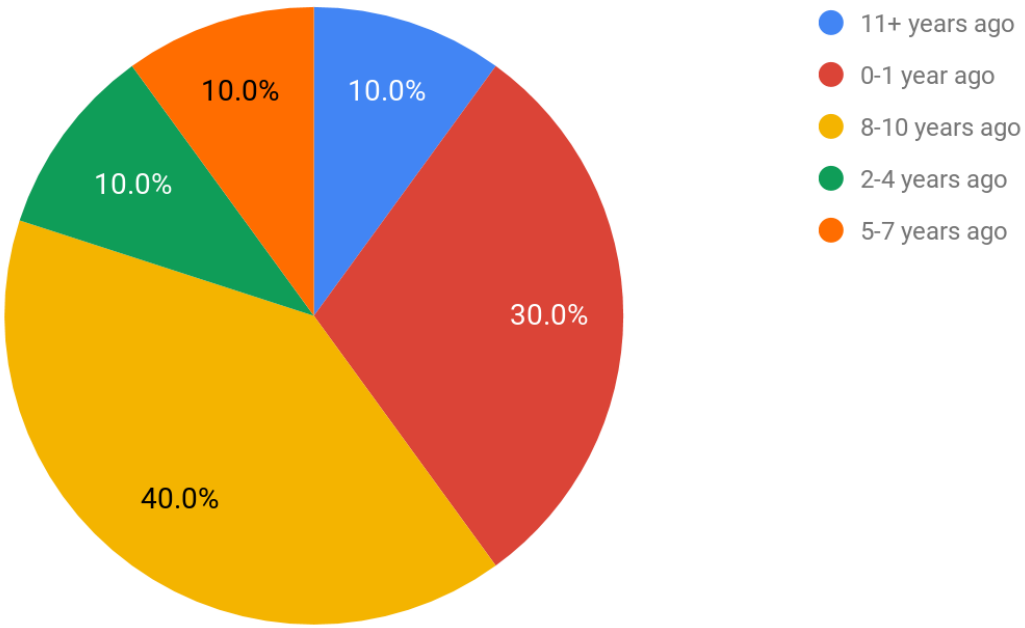
Thank you for your participation in this interview. Would you like to receive a copy of our notes? If so, please provide us with your email address. In addition, if you think of any other comments that you think would help us or have any other concerns, please email us at namibiabasicscience@wpi.edu.

Appendix J: Part-Time Student Survey Results

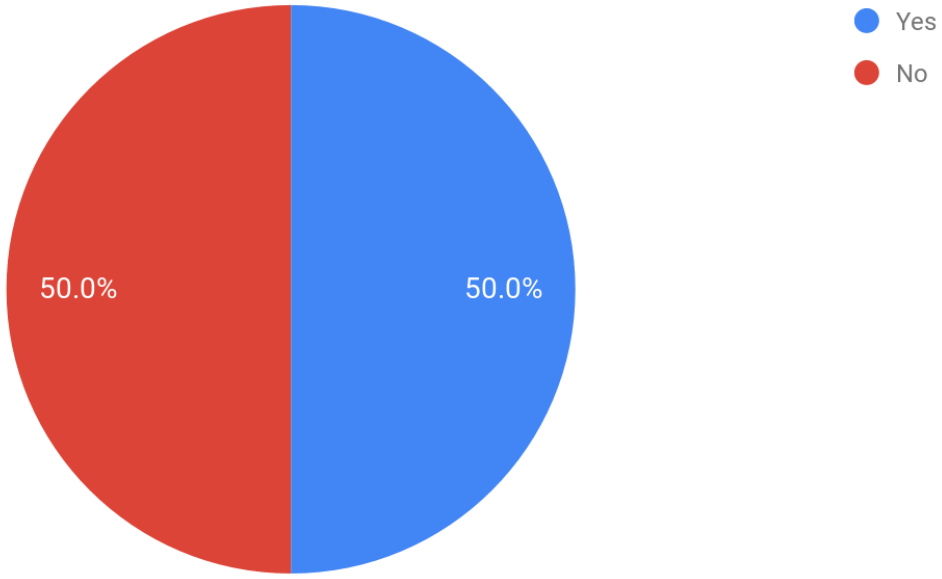
Do you have a job?



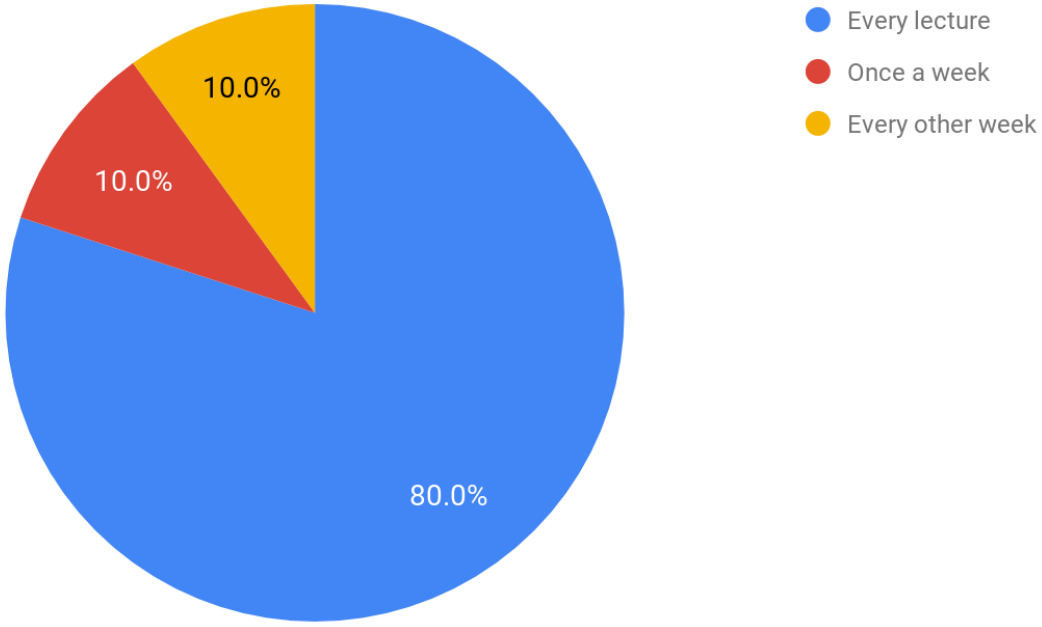
When was the last time you took a science class?



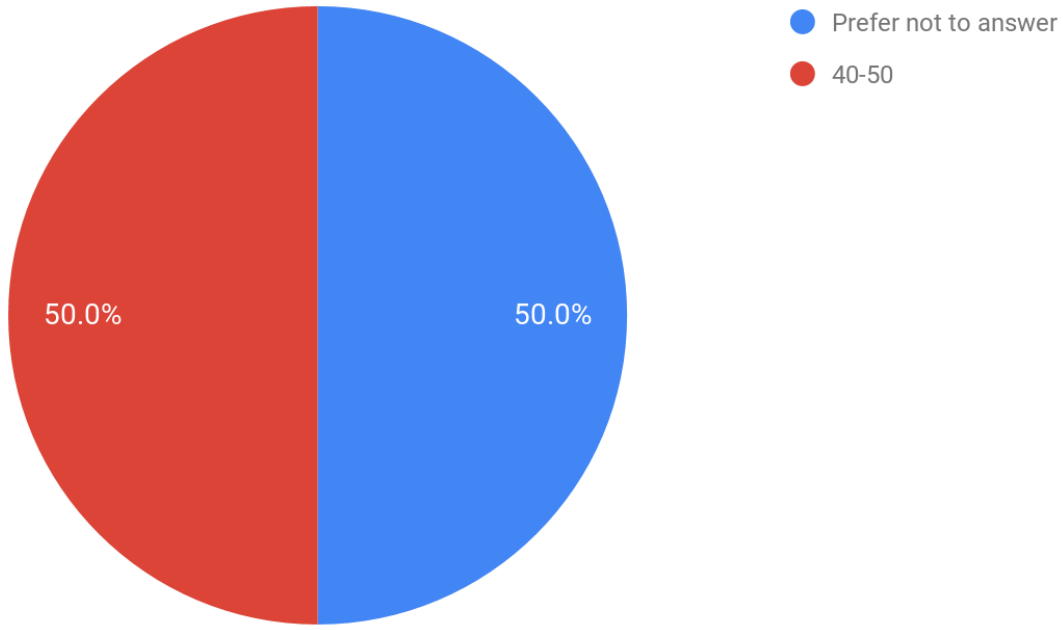
Do you think putting this course completely online be beneficial?



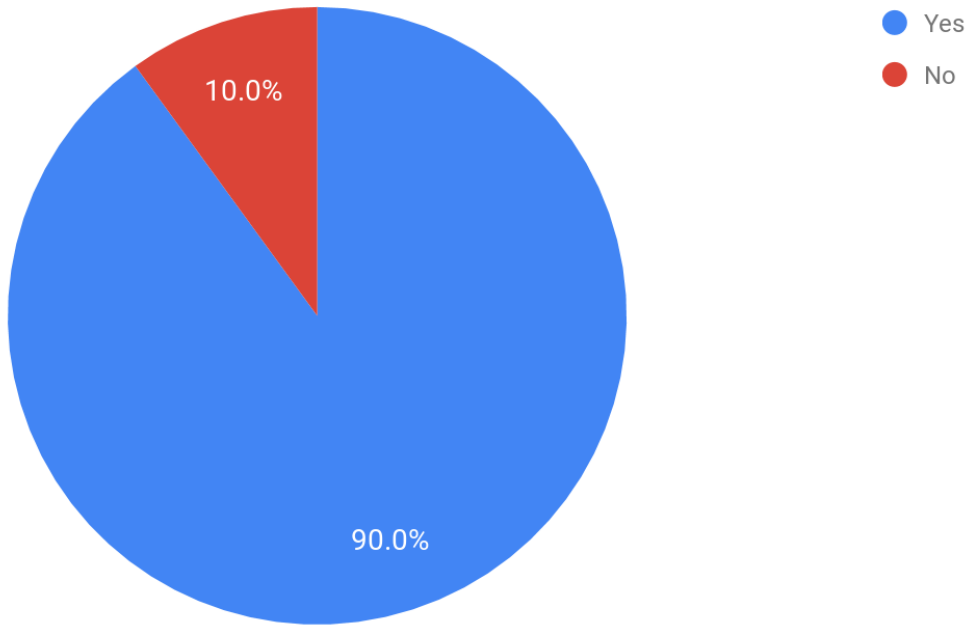
How often do you attend lecture?



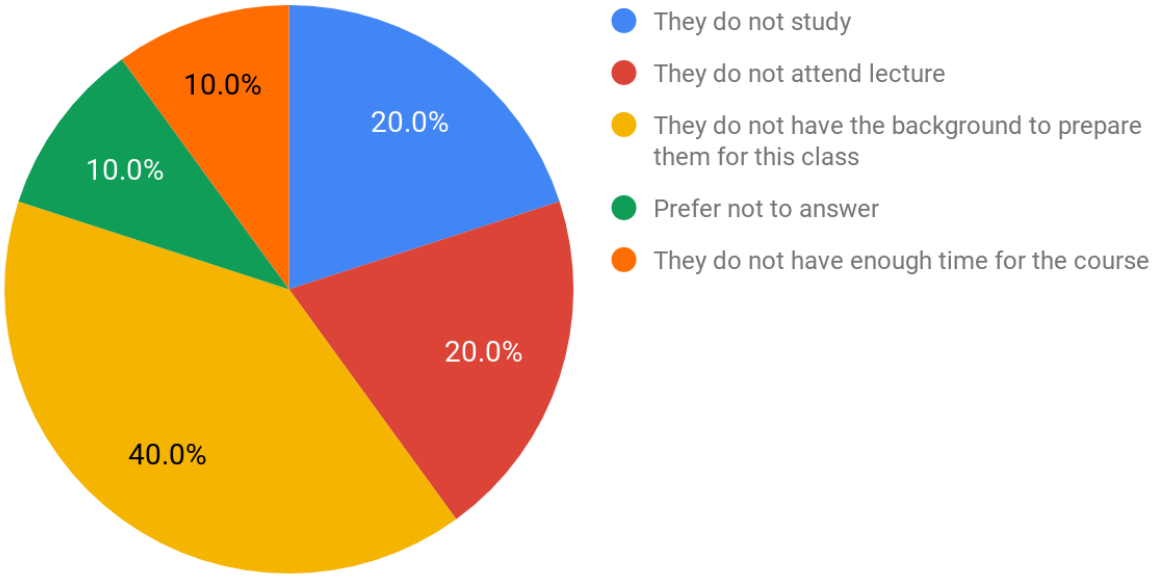
How many hours a week do you work?



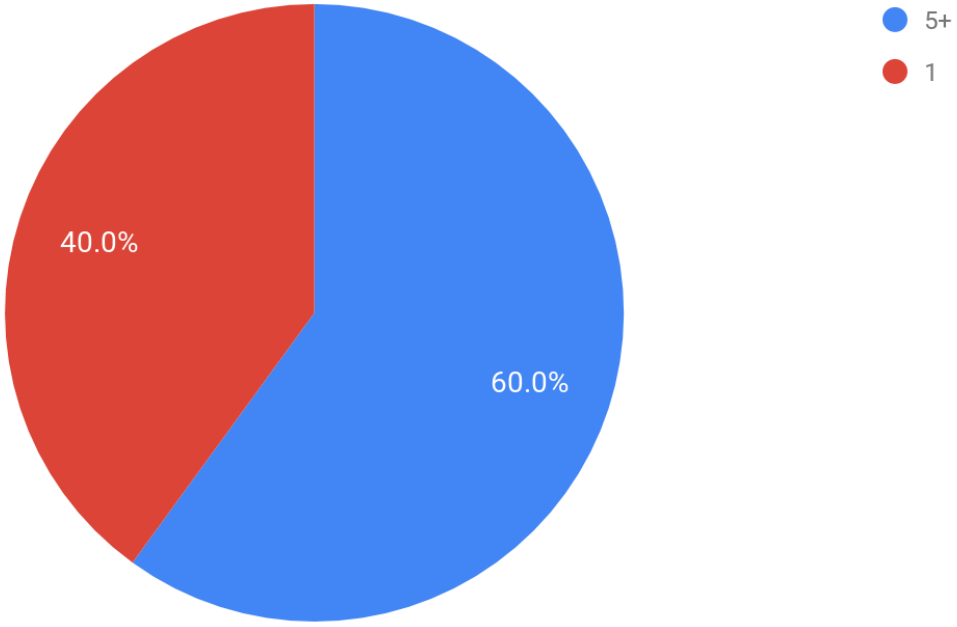
Is this your first time taking this course?



Why do you think other students might not be succeeding in this course?

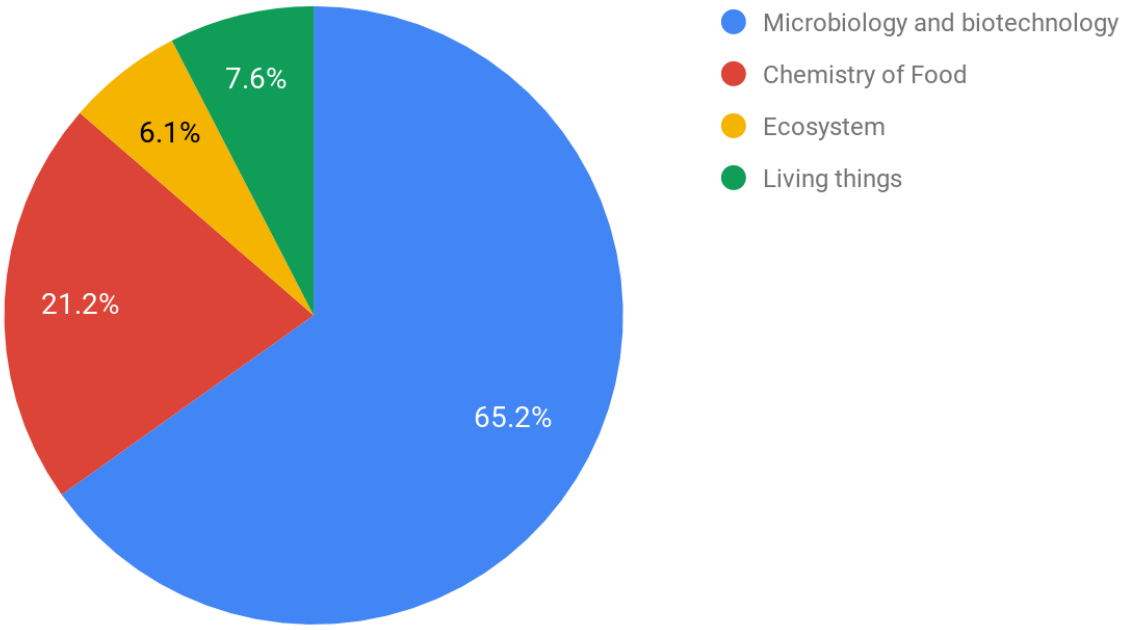


How many courses are you currently taking?

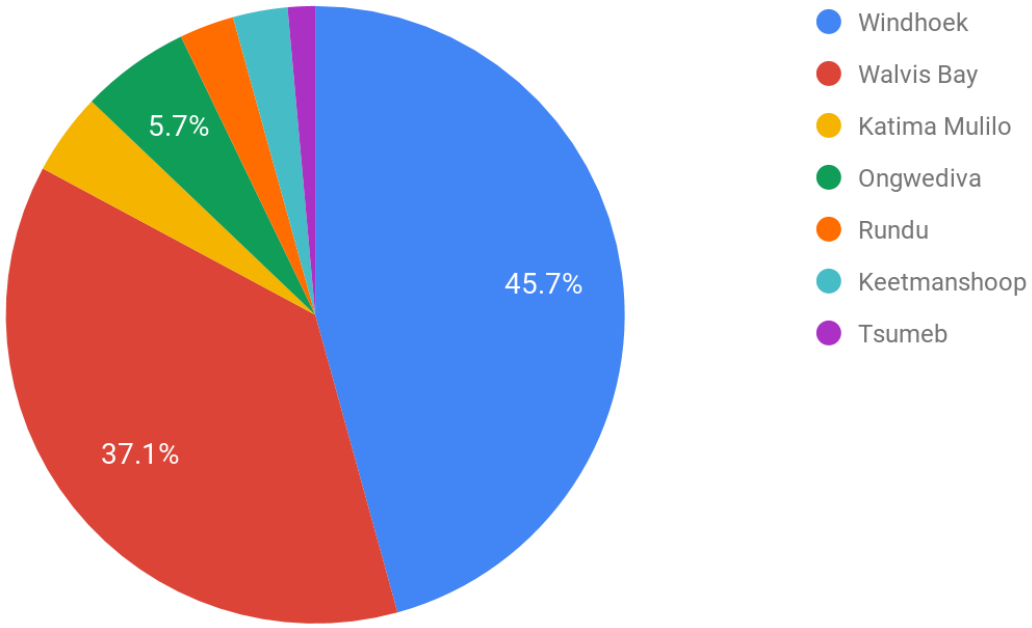


Appendix K: Distance Student Survey 1 Results

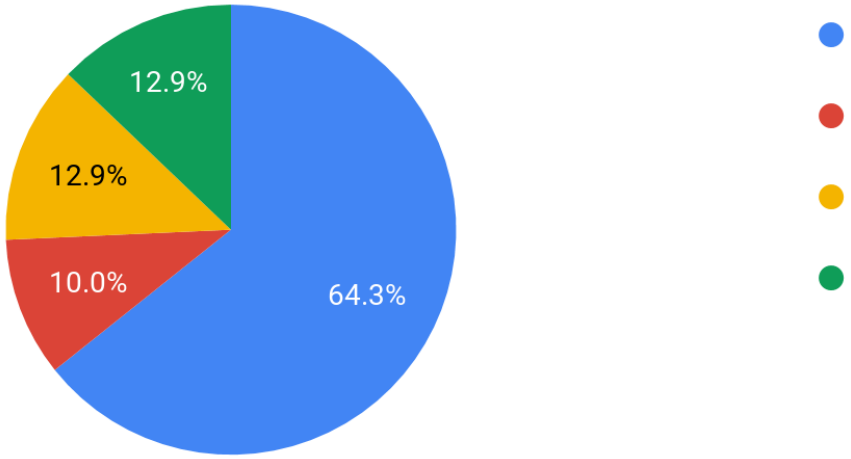
Which biology topic is the most difficult for you?



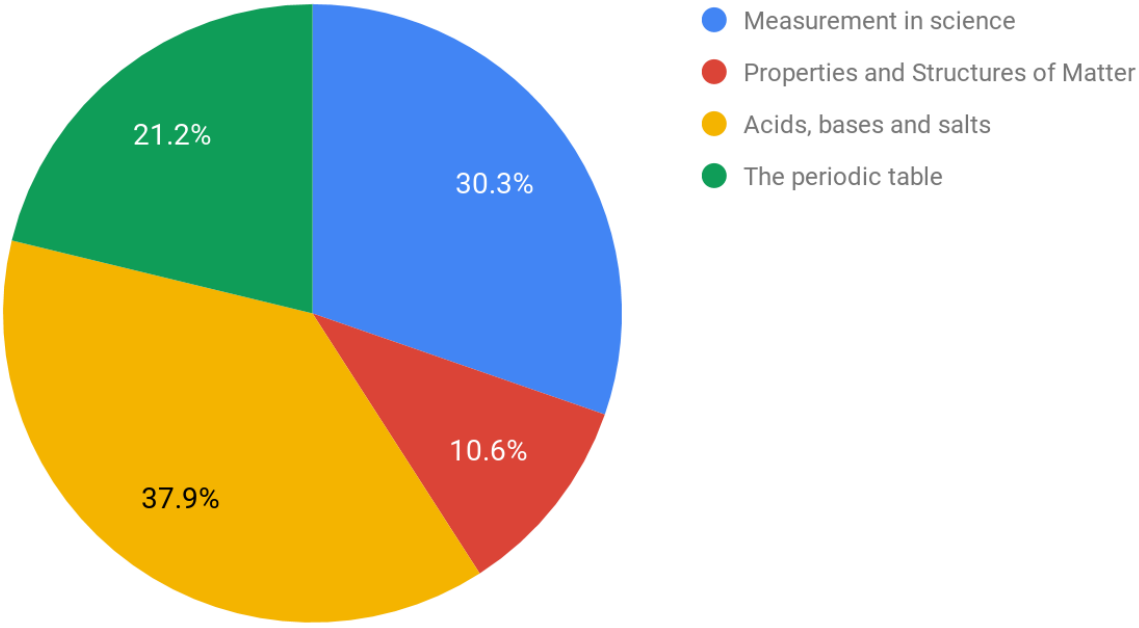
What distance center are you registered under?



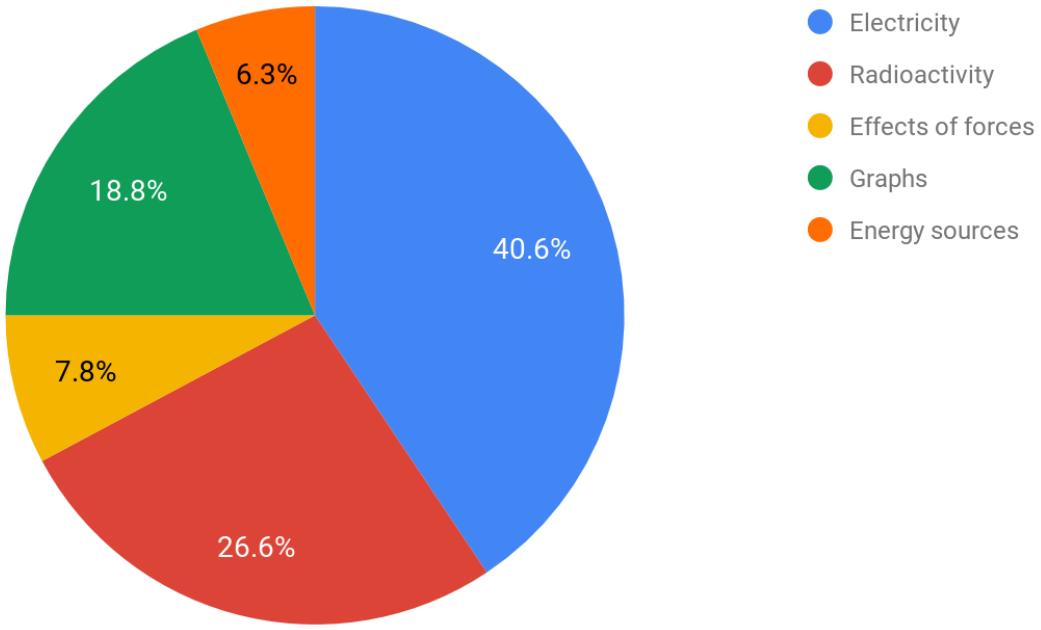
How long ago did you last take a science class other than this one?



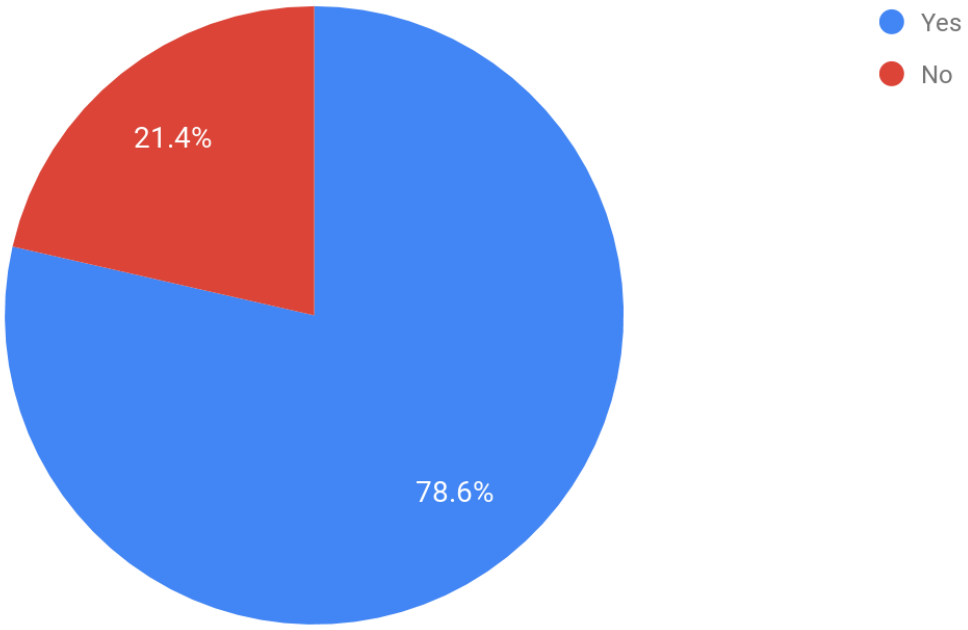
Which chemistry topic is the most difficult for you?



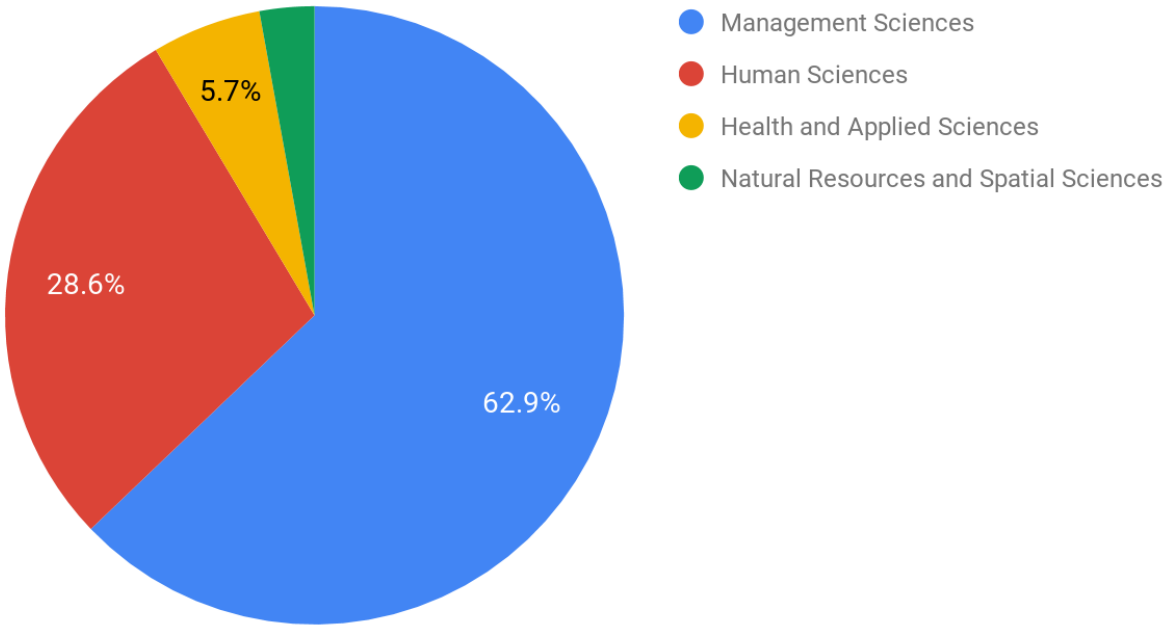
Which physics topic is the most difficult for you?



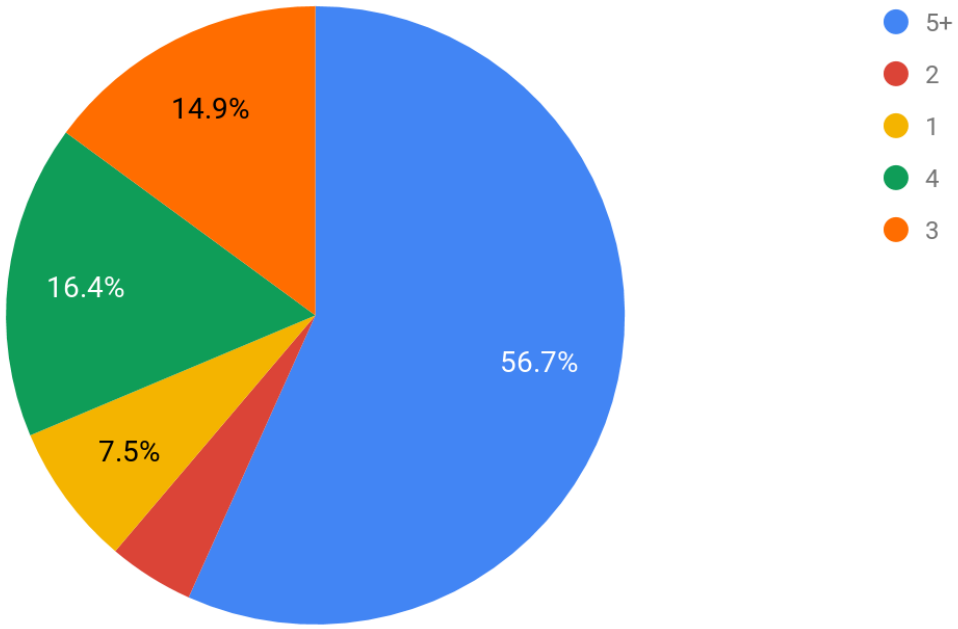
Do you have a job?



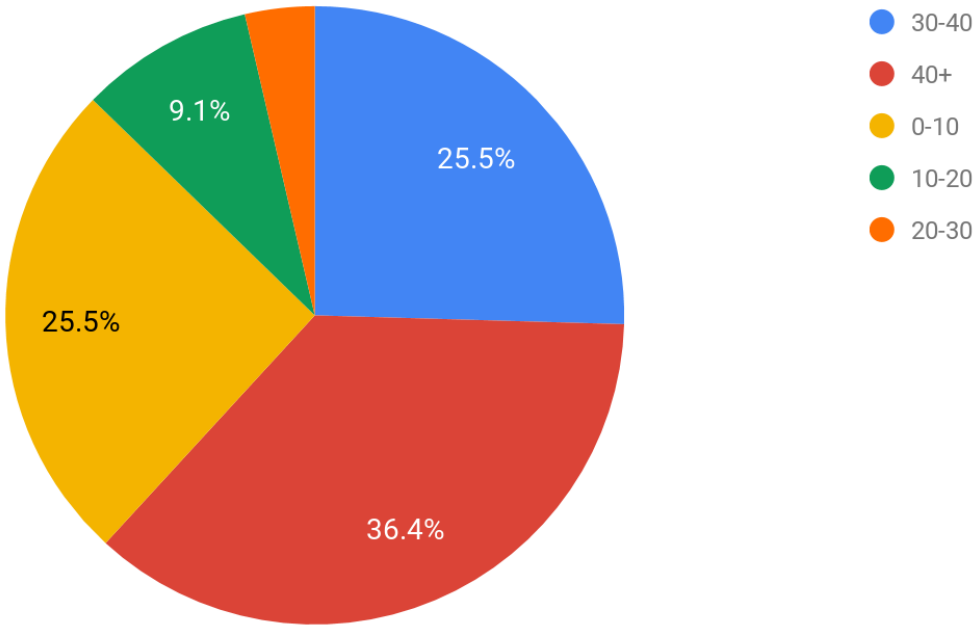
What faculty are you in?



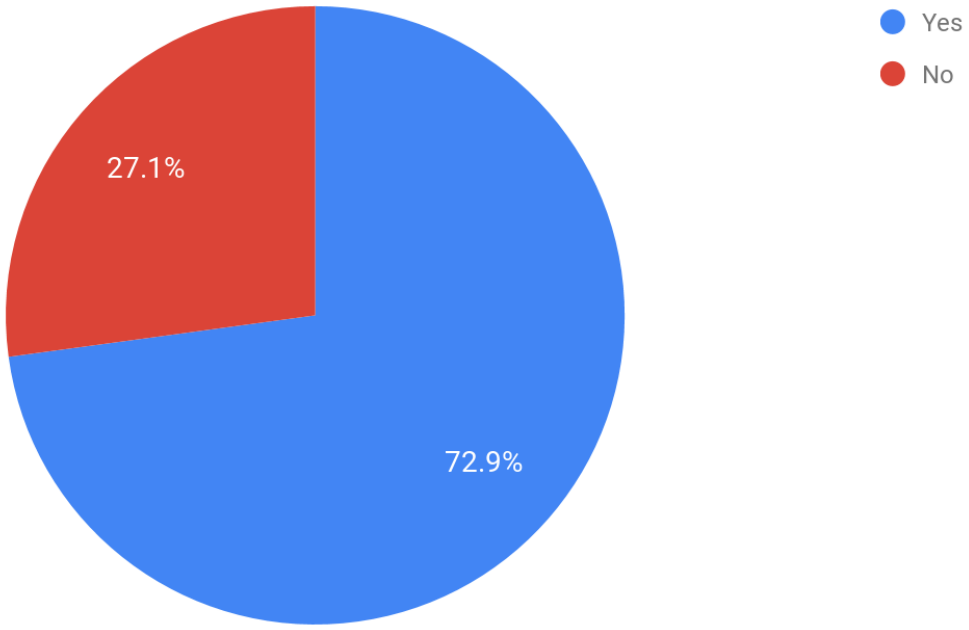
How many classes are you currently taking?



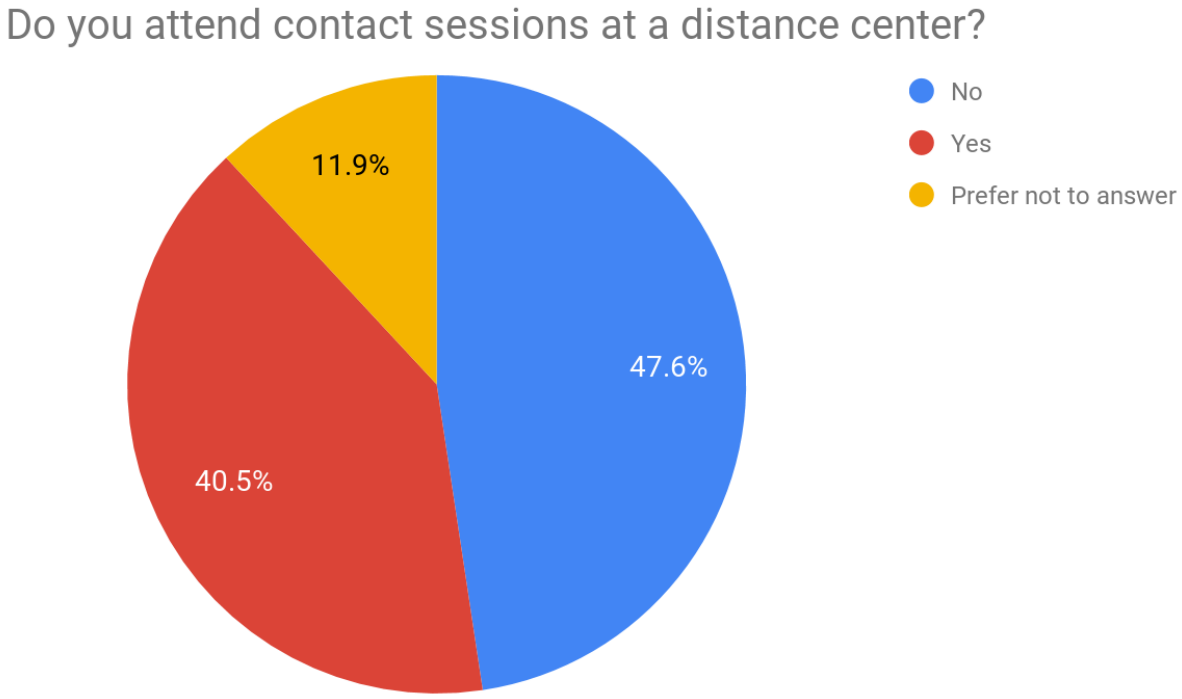
How many hours a week do you work?



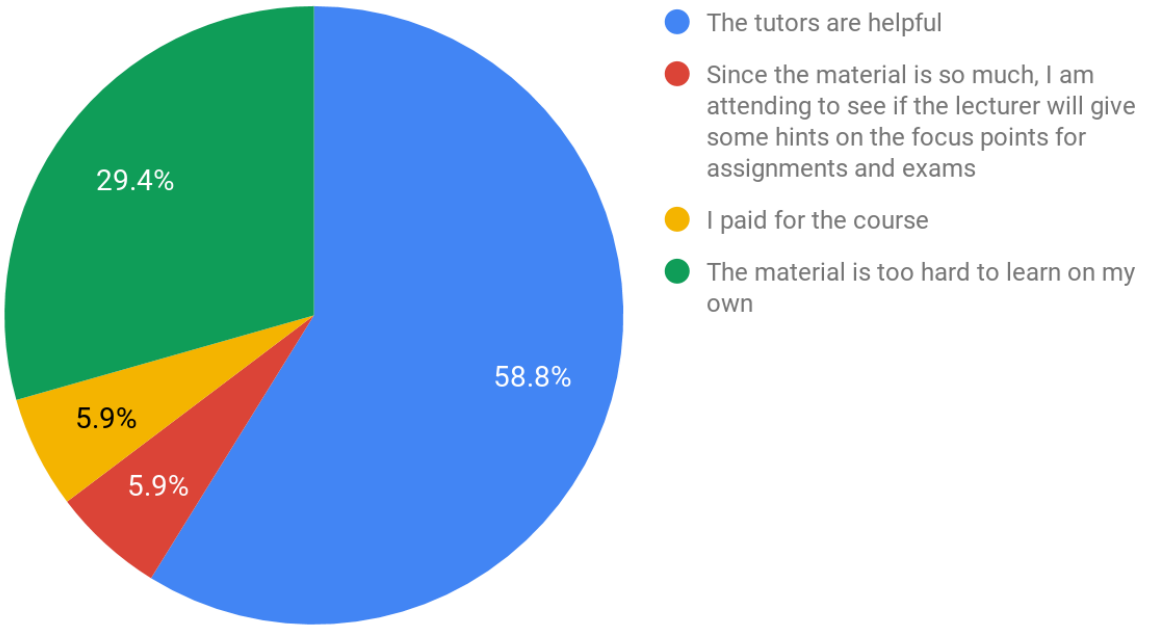
Is this your first time taking this course?



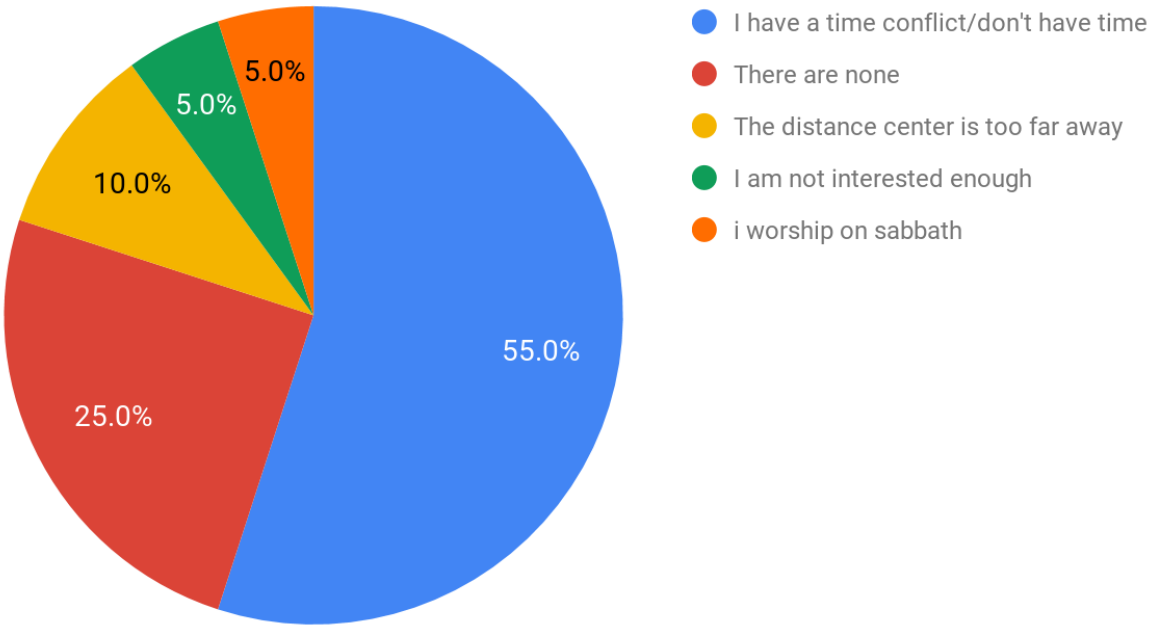
Appendix L: Distance Student Survey 2 Results



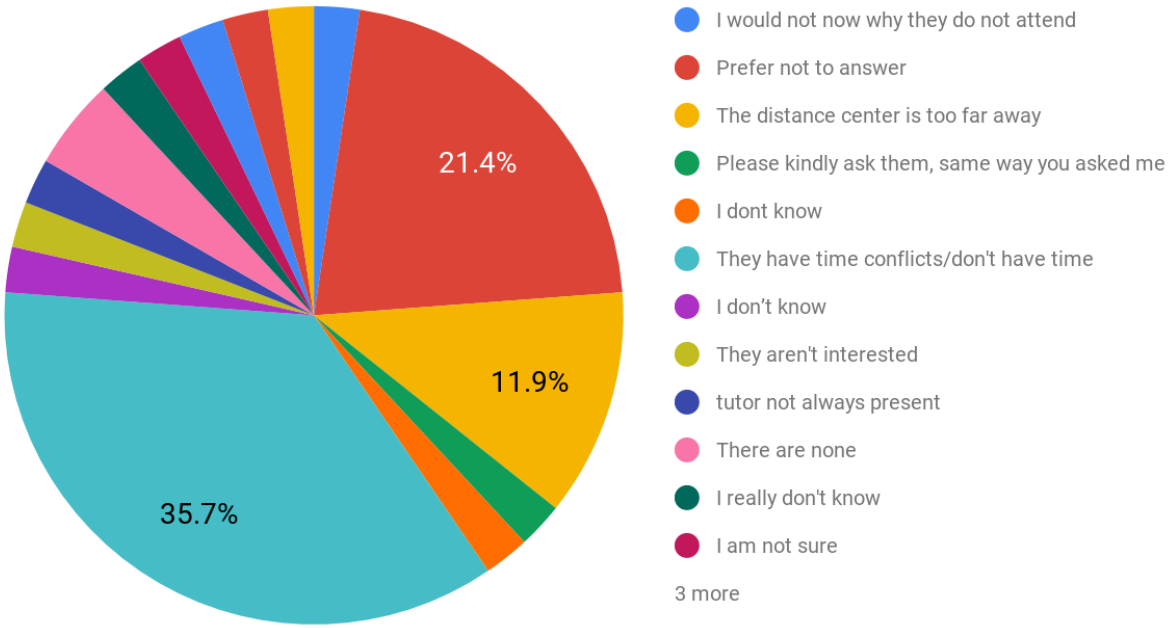
Why do you attend contact sessions?



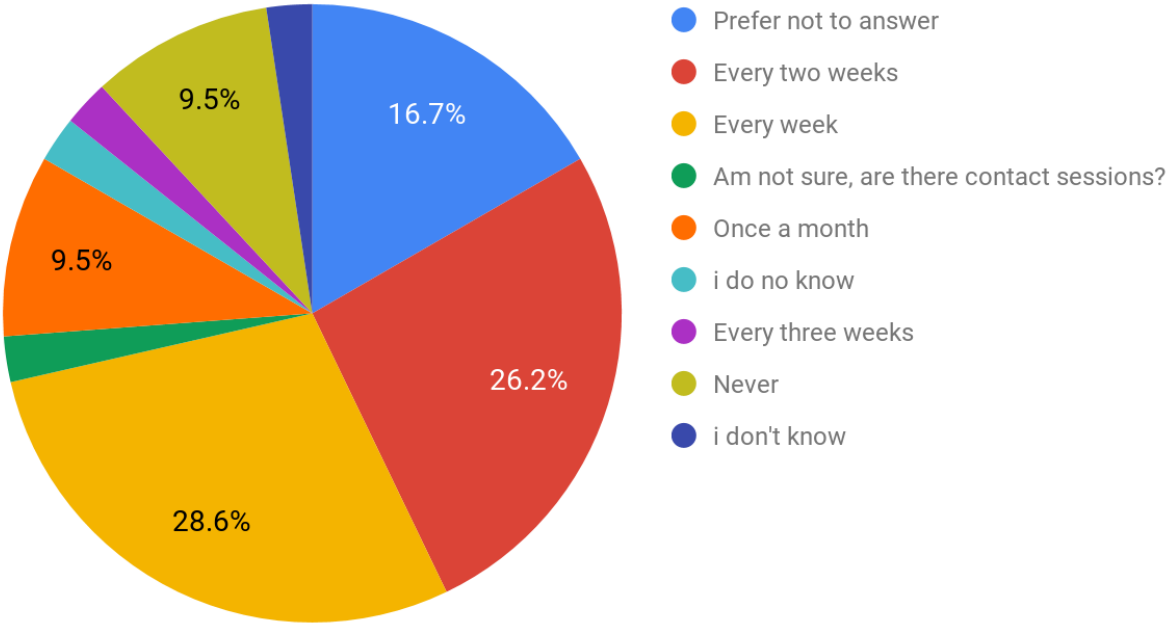
Why don't you attend contact sessions?



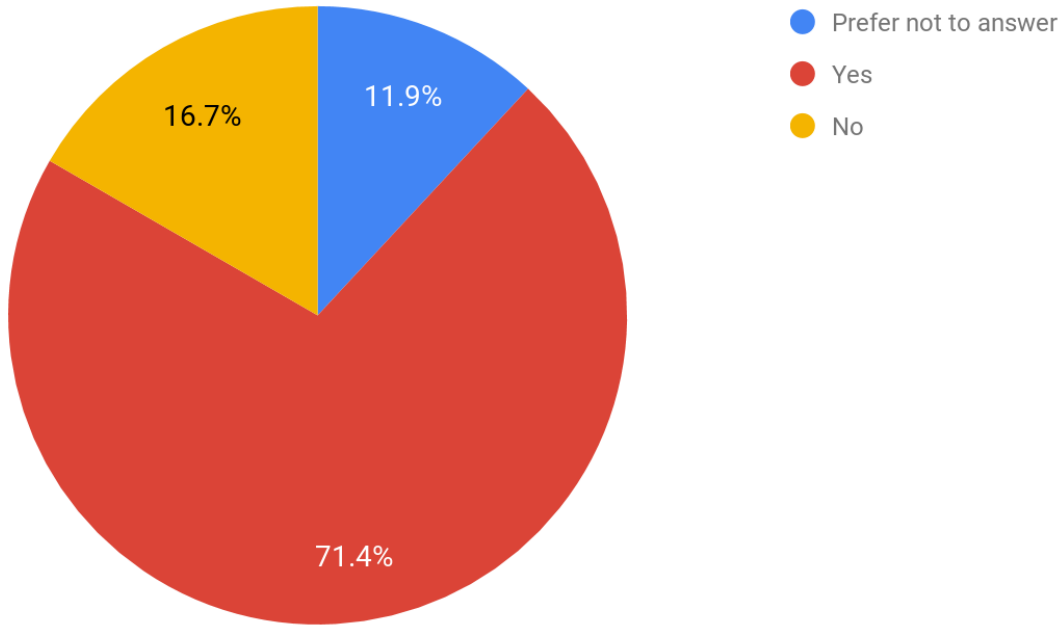
Why don't other students attend contact sessions?



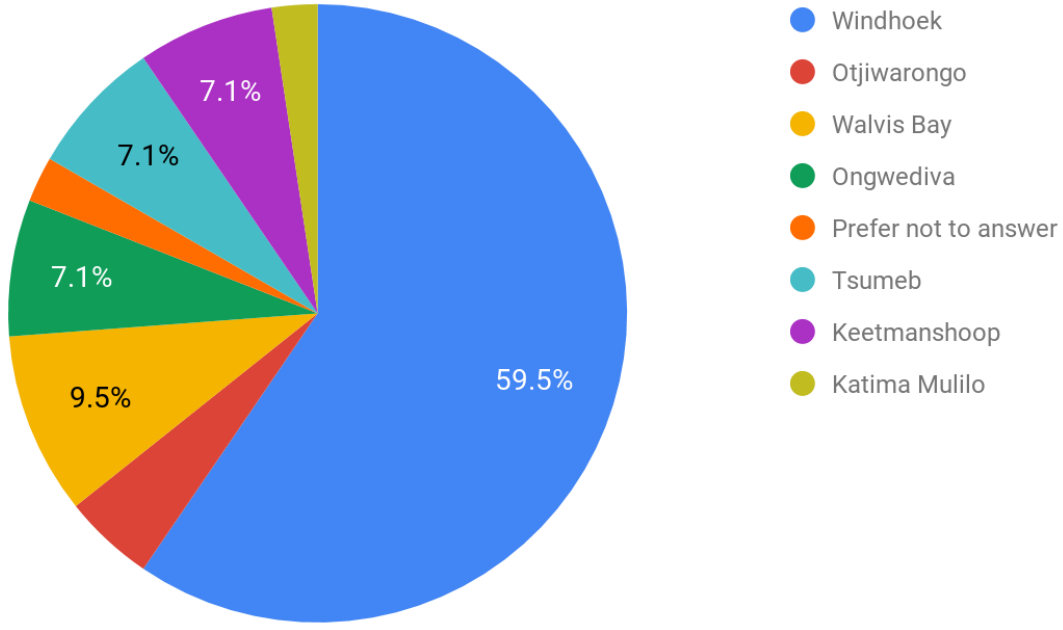
How often are the contact sessions held?



Can you contact your tutor by phone or email?



Which distance center are you registered under?



Appendix M: Distance Center Data

Distance Center	Contact Hours	Students Registered	Students who Attend	Other Info
Gobabis	Saturday 5-7 and Tuesday 9-11	9	4	Students don't attend due to family or being too far away.
Katima Mulilo	Saturday 9-11	5	4	The center needs more materials to be able to carry out even simple experiments. The tutor takes the students to his school to show them the experiments, as he believes that if the students can see something it will be easier to understand. If the students have a problem during the week, they can call him.
Keetmanshoop	None	14	2-3	Only 2-3 students were attending the contact sessions, since it was less than 5 students the contact sessions were cancelled.
Ongwediva	Saturday 10-11	41	10-15	The material given to the students does not line up with what is on the assessments. The material provided is too shallow, with the assignments and exams being too deep.
Opuwo	None	1		No regional center contact listed. Phone number was listed but the call failed.
Otjiwarongo	None	17	1-2	Only 1-2 people were attending the contact sessions, so they were cancelled. Students were not attending because some were not living in the area while others had commitments.
Outapi	Saturday	4	1-7	The students don’t come for various reasons, work, family, etc. Manuals are missing some of the content that is on the assessments.
Rundu	Saturday 9-11	20	9-12	The students may not attend due to work, distance, personal issues.
Tsumeb	None	23		Had a tutor last semester, but tutor was relocated to Windhoek, currently looking for another one
Walvis Bay	Monday 6-8	62	25+	