MARKETING COMMUNICATION OF CAREER OPPORTUNITIES FOR STUDENTS IN THE SOUTH AFRICAN SPACE INDUSTRY

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DECLARATION

I, **Khanya Philani Zuma,** declare that the dissertation entitled “Marketing communication of career opportunities for learners in the South African Space Industry” is a result of my own investigation and research. It has never been conducted nor submitted in part for any degree at any institution. All sources have been duly acknowledged.

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ABSTRACT

The South African Space Industry is growing rapidly but is lacking in commercialization. Based on the literature review, the industry is not introduced to citizens at the stage at which they begin to plan their careers. Many learners venture into careers due to peer influence and choose careers that they do not have knowledge of. There are also barriers to communication between the industry and the Department of Higher Education, as shown by the fact that there are few high school students who have progressed to participate in the space industry.

The main aim of the study was to explore high school students' awareness of the South African space industry; how career opportunities have been promoted to these students; and what has influenced such awareness, or lack thereof. The objectives of the study were to identify students' levels of awareness of the South African space industry; to identify students' perceptions of employment opportunities in the South African space industry; to identify the knowledge of the educational requirements to gain employment in the space industry; to determine the demographic differences of levels of awareness of the space industry in South Africa (male/female, grades 10, 11 and 12, types of schools); and to identify the marketing communication factors that influence students' levels of awareness about the South African space industry.

A quantitative, descriptive study was employed, and structured questionnaires were administered to 171 respondents. Purposive and quota sampling methods were used for the study. The SPSS statistical package (version 23 for windows) was used to analyze the data. The study was conducted in selected high schools located in rural, urban and sub-urban areas within the EThekwini municipality region. In terms of validity, relevant statistical tests were undertaken to ensure the validity and reliability of the instrument. Confidentiality and anonymity was ensured. In term of ethical issues, permission was granted from the KwaZulu Natal Department of Education.

Some of the main findings of the study were that the majority of respondents indicated awareness of the space industry as a discipline in the field of science and technology. The respondents had limited knowledge about career opportunities. However, due to inadequate resources in rural schools the respondents' knowledge about career opportunities was insufficient in these schools. Due to the lack of resources, the respondents did not have sufficient information to choose a career opportunity in space. Furthermore, differences in terms of resources (electricity supply, Internet access, classroom size, furniture and fittings, travelling time to and from school) and the location of school were noted. It was also noted that respondents are unclear about how and where to apply for space-related subjects. The space industry was found lacking in terms of marketing itself in South Africa. Thus, the marketing communication strategy needs to be developed and taken into consideration. It is recommended that the South African space industry should develop more outreach programmes; engage with the Department of Higher Education; sponsor science and technological projects; provide more scholarships; and create a Space Science University (SSU).

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INTRODUCTION

1.1 BACKGROUND

The South African Space Industry is growing rapidly but is lacking in commercialization. Many learners venture into careers due to peer influence and consequently choose careers that they do not have knowledge of. There are also barriers to communication between the industry and the KZN Department of High Education as there are few high school learners who have progressed to participate in the space industry. This is not good for the future of this industry. According to literature reviewed, no previous research has been done locally to determine learners' attitudes and perceptions towards the space industry in South Africa.

The purpose of the study was to analyse grade 10-12 high school learners' attitudes and perceptions towards the space industry in South Africa. The research that was conducted was descriptive in nature. This chapter discusses pertinent concerns such as the research problem; aim and objectives of the study; rationale; and delimitation, as well as limitation of the study. It concludes with the structure of the dissertation.

1.2 CONTEXT OF THE RESEARCH

The space industry (through, for example, remote sensing and Global Positioning System - GPS data) assists people to manage and sustain the natural environment and resources; increases the mobility of people and products; and deals with health, safety and security (SANSA, 2011). It offers instant communications, enables people to accurately observe and locate any spot on earth and empowers people to timeously foresee and deal with economic and human catastrophes. Furthermore, South Africa is a technologically progressive country and as part of the global village, has become dependent on space-based services and applications (SANSA, 2013).

According to SANSA (2011: 20), mankind is continuing to be more reliant on space systems and sub-systems for a wide range of social benefits and economic endeavours. Industrialized nations identify the space industry as a fundamental and vital instrument to achieve social, economic and foreign policy goals. Many governments worldwide are increasing their expenditure on space-related activities, thereby aiming to intensify the unification and progress of their general ability in space (SANSA, 2011: 20). Therefore, there are a large number of countries operating in space, with satellites intended for different duties and most of these countries aim to be more advanced in science and technology.

Wood and Weigel (2008: 221) posit that most countries worldwide utilise space technology and resources to solve societal issues; to develop costly satellite services; make unique scientific discoveries; enhance various technology applications; and create new economic opportunities. SANSA (2011: 10) states that the South African Government acknowledges the possible role of Space Science and Technology to deliver on a wide range of national priorities, including environmental and resource management; urban planning and rural development; economic growth and global competitiveness; food security and health; job creation and poverty alleviation; human capital development; technology development and innovation; science advancement amongst the youth; public engagement in science; and fostering global partnerships.

Space is a significant area for young people to be informed about in terms of the possibilities in their future. In order to secure workforces for future space development, it is a good idea to teach learners more about space science and technology and give them experience in entertaining space activities (Lee, Jo and Choi, 2011: 730). Thus, it is essential for the South African Space Industry to involve more youth. Grasser, Goswami, Rossler, Vrecko and Hinghofer- Szalkay (2009: 688) suggest that Educational Outreach programmes use provable and assessable methods and emerging technologies in order to convey space-related studies, engineering and mathematics to learners so that they can play a crucial part in human capital development, contribute to the workforce development of the space industry and attract learners to space-related careers. Having a well-educated, trained and skilled youth to replace older professionals is necessary for the sustainability of South Africa’s activities in space.

“Space life sciences curricula modules that are age-appropriate, based on sound content and culturally resonant can inspire and motivate learners. African educators will have opportunities to develop space life sciences educational modules that capture the cultural imperatives of their respective cultures, while increasing learners' understanding of, and interest in science content" (International Academy of Astronautics, 2010: 193).

The best long-term expenditure of money or effort on Space Science and Technology is to continuously encourage and motivate the youth so that they can play an important role in terms of science and technological development. Capturing the hearts and minds of the youth to pursue scientific and technological studies and careers is the single largest sustainable economic multiplier for a country, especially amongst developing nations (SANSA, 2011:19). Kanas (2006: 194) advocates the concept and states that introducing programmes to be done past-school can allow learners to better their execution by creating skills and increasing the desire to strive for advanced education and improved attitudes towards studying. Therefore, the South African Space Industry needs to exploit such opportunities in the order to get more talent and fresh ideas to optimize the industry. They must facilitate additional marketing activities, raise awareness and get more youth involved.

1.3 RESEARCH PROBLEMS AND AIM

The South African Space Industry has a number of space programmes which are significant for the development of the country. For example, environment and resource management; health, safety and security; and innovation, economic growth and social development (SANSA, 2011). It also plays a crucial part in science and technology. However, the major concern in the industry is the assurance of a capable workforce to take over in the future and ensure sustainability. Lukaszczyk and Karl (2010: 89) suggest that the space industry has a problem in terms of a capable workforce that will replace the old professionals when they reach retirement. However, it is still difficult for youngsters who are inspired by space related activities to take part in the sector and make a difference. Lukaszczyk and Karl (2010: 89) also state that the space industry attracts many youngsters globally. Many young space enthusiasts dream of going up into space in order to explore the universe.

According to Lester (2011: 89), there is much controversy over the sponsoring of individuals on a space programme. The benefits of such a programme to the nation could be tremendous. The arguments assert that many young boys and girls can be motivated to study mathematics and science by seeing humans in space. Schmidt, Landis and Oleson (2010: 42) suggest that if there are no humans going to space, children will be less motivated or inspired to study these subjects, and thus mathematics and science results from an educational point of view will decline.

There has been little youth involvement in the sector, little commercialization and little promotion of the industry. As a result, SANSA (2013) has come up with a strategy to support societal and human capital and improve quality of life by using space science technology for societal benefits; training and developing critical skills; promoting science appreciation amongst the youth; and improving scientific literacy and engagement of the people. However, grade 10-12 learners' attitudes and perceptions towards the South African Space Industry are not known. Nor is there a platform for them to learn about and take part in the space industry.

Little research has been conducted to determine the role played by the space industry as perceived by the youth or the improvement of teachers' capacity in the space science field. Based on an online search conducted by the researcher, as shown on appendix 5, a table was developed to justify that inadequate research has been conducted on the marketing of the space industry in South Africa. Popular sites such as Google Scholar and Science Direct were used to search for information pertaining to the topic and almost all found studies which were conducted in other countries.

Antonutto (2003: 283) points out that in order to produce a well-educated workforce for worldwide space life sciences, it is important to attract more learners and also involve more teachers. Things have changed in Africa. Many countries in Africa, for example South Africa and Nigeria, are trying to tackle issues dealing with the development of the workforce and other space activities by utilizing more space technology (Louks-Horsley, Love, Stiles and Mundry, 2003: 192). This indicates a lack of knowledge about the youth's attitudes and perceptions towards the industry and about the perceived opportunities in the industry available to them.

1.3.1 Aim and Objectives

The main aim of the study is to explore high school learners' awareness of the South African space industry; how career opportunities in this industry have been promoted to these learners; and what has influenced such awareness, or lack thereof.

The aim of the study is achieved through the following objectives:

- To identify learners' levels of awareness of the South African space industry;

- To identify learners' perceptions of employment opportunities in the South African space industry;
- To identify the knowledge of the educational requirements to gain employment in the space industry;
- To determine the demographic differences of levels of awareness of the space industry in South Africa (male/female; grade 10, 11 and 12, types of schools); and
- To identify the marketing communication factors that influence learners' levels of awareness about the South African space industry.

1.4 RATIONALE FOR THE STUDY

This investigation is of great value to both South African learners and the South African Space Industry. Obtaining an understanding of student's awareness, knowledge and attitudes towards space as a career could help the South African Space Industry to raise awareness of the space industry to the youth, attract more applicants to the industry and benefit from getting young blood with fresh ideas to improve the industry. The research can also help the industry to replace the many employees who will be retiring in the near future.

1.5 DELIMITATION AND LIMITATIONS OF THE STUDY

The study is conducted in the Durban area amongst specific high schools and only amongst Grades 10 – 12 learners. Therefore, the findings may not be generalizable to other regions. Since the sample was essentially a convenience sample, the results should be treated with care and no attempt should be made to draw conclusions beyond this data or beyond the sample.

1.6 SUMMARY OF RESEARCH METHODOLOGY

The research methodology provides a plan on how the study is conducted. It covers aspects such as the target population, the sampling method, data collection, data analysis, validity and reliability.

1.7 STRUCTURE OF THE REPORT

The current study is structured as follows:

Chapter 1: Introduction

Chapter one provides a background/summary to the study; the context of the research; research problem; aim and objectives; rationale for the study; and delimitations and limitations of the study.

Chapter 2: Literature Review

The literature review contains sub-topics which make up the foundation of the study. The information provided in the chapter gives a clear idea of what the space industry is and why it is important. It covers space opportunities for national development, education and issues with regard to youth in the space industry. Marketing theory related to perceptions and attitudes is also covered.

Chapter 3: Research Methodology

Chapter three include the research design for the study. It covers the sampling techniques, sample size and target population that was chosen for the study. It also describes the methods of collecting data and the statistical techniques used to analyse the data.

Chapter 4: Data Analysis and Results

This chapter focus on the results of the study presented in the form of tables and graphs, as well as inferential statistics.

Chapter 5: Conclusions and Recommendations

This chapter provides conclusions for the study, as well as recommendations based on the findings of the study. Recommendations for future research are also made.

1.8 CONCLUSION

Chapter one provided a clear indication of how the study is implemented. This includes the research problem to be resolved; the aim and objectives; rationale – why the study is important; and also the delimitations and limitations of the study. The next chapter describes the background of the study in detail through a literature review. All the sub-headings pertaining to the topic are explained.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

The previous chapter discussed the aims and objectives of the study; the research problem as well as the limitations; delimitations; scope and significance of the study. In this chapter, literature on issues such as exploring the concept of space, space technology, technology transfer, satellites, the space industry, space education, outreach and careers, space awareness, marketing and communication will be reviewed. The literature review is based on the study objectives described in the previous chapter.

2.2 EXPLORING THE CONCEPT OF SPACE

According to the Council for Scientific and Industrial Research (2008), space is defined as the area beyond the earth's measurable atmosphere which has fewer particles of any size and is flooded with electromagnetic energy. Many countries are growing their involvement in space in terms of scientific and technological research. In the recent past many space technologies have been developed, including satellites created for different intentions. Some examples of these space technologies are tele-communications and tele-health (Erwin, 2010: 55). Countries worldwide are attracted to the space sector by these technologies and activities such as spaceflight and exploration (Cornell, 2011: 1131).

Outer space is governed by international law, the Outer Space Treaty of 1967, which orders equality in terms of the sharing of space resources and any benefits derived from space. The Treaty wants everybody worldwide to have a share of the benefits. The public is welcome to participate in space related activities and the space community is very keen to involve the public in outer space development (Weeks and Faiyetole, 2014). Balogh, Canturk, Chernikov, Doi, Gadimova, Haubold and Kotelnikov (2010: 185) maintain that space pioneers in the past decades foresaw the benefits that could be derived from space, long before the Space Age. In addition, millions of people on earth are reliant on space activities. Space has been discovered as an important place for the survival of human beings on earth. Within the past fifty years, people have observed things such as the launch of satellites that orbit in space; scientific and technological discoveries; formation of an International Space Station; and planetary exploration. The Russians were the first to take advantage of the space breakthrough with the launch of the first artificial earth satellite, Sputnik, in 1957. This gave space scientists valued information about the atmosphere, ionosphere and radio pulses. Space assets have been the controller of processes on land, sea and air. Consequently, many countries after the 1991 Gulf War opted more for military space applications. Today, space has been converted into a place of economic, practical and strategic development (Thakur, 2012).

Pagkratis (2011: 335) states that space is at the center of human activities as it plays a vital role in much that humans are involved in. Scientific research and exploration have all come to depend on the use of space. Researchers in all scientific fields have been stimulated by the potential shown by space and now work together and use space to innovate their projects. Space has been a driving force behind technological development and growth, as well as being an advocate of knowledge. It also assists from the socio-economic perspective.

2.2.1 Space Technology

Space technology refers to the technology that links satellites and ground systems. Furthermore, space technology distributes critical services on earth such as weather services, images of the earth, communication and navigation. Space technology is of value to people on earth. As it supports people with managing natural resources, assisting in disaster and peace-keeping operations and also monitoring agricultural perspectives (SAASTA, 2009: 1). Space systems generally facilitate aspects like cell phones, Automated Teller Machine (ATMs), the Internet and satellite TV broadcasts and has been an integral part in modern society for many years (SAASTA, 2009: 1).
Peter, Afrin, Goh and Chester (2006: 445) report that the exploitation of space technology and space resources stands out as the main component with regard to the fast tracked quality of life of people and socio-economic development. The use of space technology has helped developing countries to strengthen areas such as resource management, food security, communication and power to transform their national development.

Wood and Weigel (2008: 221) claim that most countries worldwide utilise space technology and resources to solve societal issues and develop costly satellite services, unique scientific discoveries, various technology applications and new economic opportunities. SANSA (2011: 10) states that the South African government acknowledges the possible role of Space Science and Technology to deliver on a wide range of national priorities, including environmental and resource management; urban planning and rural development; economic growth and global competitiveness; food security and health; job creation and poverty alleviation; human capital development; technology development and innovation; science advancement amongst the youth; public engagement in science; and fostering global partnerships.

Leloglu and Kocaoglan (2008) state that developing countries consider space technology critical in achieving technological development as it effects the economy, science and people's lives. Additionally, they reveal that a number of developed countries such as the USA, Australia and Germany, have put space technology at the top of their priorities for scientific and economic development. The budget spent on space systems during the development of an original space industry basically yields back to the country's economy via indirect means. For example, learners who were taught and trained about certain aspects of space in the space system go back to their communities with knowledge, giving back and helping with development.

The execution of a sustainable development approach can be improved by having adequate information. However, Peter et al (2006: 447) contend that space technology applications are lacking in awareness by the developing communities and especially by learners. It is essential for learners to be knowledgeable about space technology application services. Space-based systems have played a major part in services such as tele-medicine, wireless communications and distance teaching. In support of distance learning, Jazebizadeh, Tabeshian and Taheran (2010: 1323) assert that space technology education is vital and essential in developing countries as it can broaden the understanding of space technology, especially for the youth who are the future generation and need to develop more skills.

2.2.2 Technology Transfer

Petroni, Verbano, Bigliardi and Galati (2013: 1) define technology transfer (TT) as the process whereby scientific findings (e.g. skills, knowledge, technology and methods of manufacturing) are transferred amongst different actors belonging to different industries, allowing the development and exploitation of technology into new products, processes, applications, materials or services. They further claim that many companies face difficulties when they have to produce new products in a short time while having to keep up with the escalating expense of research and development of those products. New sources of technology can be easily shared through the development and distribution of information technology. The space sector requires the strengthening of technology transfer processes. The space industry is a complex environment filled with products of high cost and value but which are produced in small numbers. Many different sectors have obtained a competitive edge from space technology. Therefore, increased technology transfer in these sectors can assist to improve the fields of healthcare products, weather monitoring, telecommunications, and broadcasting, as well as earth observation and natural resources management (Petroni, et al. (2013: 1).

The commercial use of advanced technologies was noted as an appropriate way to grow returns on the expenditure of money made by space agencies during the recent financial crisis. The process of technology transfer from space applications to earth applications has brought many benefits to people and industries and has improved the linkage of national companies, while it has especially developed the aerospace industry. Technology transfer a positive effect on earth as it attracts innovation in business and commerce, assists economic growth and offers a return on public investment in research and development. Some of the benefits derived from technology transfer were reported by the National Aeronautics and Space Administration (NASA) in 2011 and they report that there are about 100 companies which have used spin-off technologies, more than 9200 jobs have been created, savings of more than 6.2 billion dollars have been realized and more than 12000 lives saved (Venturini and Verbano, 2014: 98).

2.2.3 Satellites

Satellites are some of the space resources that add value to life on earth, bring financial and technological benefits and that are in high demand. Some developing countries have been uplifted by involvement in space, made possible by their capabilities for the design and creation of satellites in combination with advanced technologies for navigation, communication, remote sensing and space sciences (Peter, Afrin, Goh and Chester, 2006: 447).

Peter et al (2006: 447) state that telecommunication satellites have been very useful in circulating information through Wi-Fi in remote areas. They attract local and global use with the range of services they offer such as data information, videos and voices, and are mostly utilized by commercial and government organizations. Certain developing nations are focusing their attention on rural communities using satellite communications to provide services like education and health to those communities (Peter et al, 2006: 447).

Information derived from space technology is being used for several reasons, especially to protect the natural resources on earth. For example, water, land, the ocean and also to protect human beings. Satellites are supportive of numerous activities on earth, including transport management, security, natural resource sustainability and energy supply. However, it can be argued that the public (including learners) are unaware of and lacking in terms of knowledge about the importance of space and the role space plays in human activities and in benefitting the earth (Pagkratis, 2011: 335).

Space science satellites contain tools that help measure some aspects in space which are important to human beings. For example, information about the earth and knowledge about the universe, including its features such as stars, planets and galaxies. The needs in developing countries connect very well with the services provided by satellites in terms of earth observation, navigation, space science and communication. Scientific research, communication infrastructure, and safe transportation are some of the challenges faced by developing countries. Such issues can be resolved through the use of satellite communication. In terms of communication infrastructure, satellites play a significant role as they are used for radio and television broadcasts, phone calls and the Internet and they improve the technology used by firms (Wood and Weigel, 2011: 1110).

It is however advised that countries think through designing and using small satellites if they are organizing a space plan because there are plenty of learning techniques and training opportunities for learners related to the creation and manufacturing of a spacecraft. Learners can get experience and a chance to be exposed to the design and development of a spacecraft and this can be an inspiration and a motivational factor for them to pursue a career in space-related studies (Balogh and Haubold, 2009: 1848).

2.2.4 Small Satellites

Universities and space-related organizations are escalating worldwide and are fascinated by space technology education. They are quickly engaging more in the development of small satellites which may soon dominate in the space environment. An example was the launch of a small satellite in South Africa, designed and built by Cape Peninsula University of Technology (CPUT) postgraduate learners (SANSA, 2012). This nano satellite was built to assist in the monitoring of space weather and it was the first nano satellite to be launched by South Africa. Therefore, this shows that developing countries can optimize their capabilities in the space environment and more importantly, attract and involve learners so that they can improve their skills and gain experience.

It has been noted by Balogh and Haubold (2009: 1849) that small satellites play a noteworthy role in terms of the use and improvement of space technology. The significance of space technology concerning education programmes should be taken into consideration as it can teach and encourage learners. Small satellite programmes might create awareness about the importance of science and technology, inspire learners, promote research and development, optimize the quality of education and of industries and improve the quality of life (Balogh and Haubold, 2009: 1849).
Agreeing with the aforementioned statement, Curto and Hornstein (2005: 490) indicate that small satellites have simplicity, do not take much time in terms of development, are inexpensive and have more specific scientific objectives. These satellites usually take a short period of time to develop, which allows more time to test new technologies, saves costs and is an opportunity to introduce innovative concepts (Curto and Hornstein, 2005: 490).

2.2.5 The Space Industry

2.2.5.1 The significance of the space industry

Burnett (2005: 16) reveals that the main area that requires new research and technologies is the space industry. It is a crucial tool for commercial markets globally, especially markets involving the manufacturing of satellite and space applications. The space industry should not be presumed to be an easy industry. The intention behind space activities have changed and they are not the same as in the past decades where developed countries would showcase their power. Today, people are reliant on space as it ensures their safety and security and makes life easier with the use of space technology, examples of which include the use of telephones, television and Global Positioning Systems (GPS) (Collins, 2006: 400).

Thakur (2012) states that many nations have come to depend on space based applications for economic development. For nations to have an advantage in global space power, space-based applications are the main factor. In addition, space power is defined as the ability of a nation to exploit the space environment in pursuit of national goals and purposes and includes the entire astronautical capabilities of the nation (Thakur, 2012). Countries involved in the space power union usually do not emphasize military applications. They focus their capabilities on aspects like earth observation, building communication satellites, which help everybody in the world, and for weather management.

Through, for example, remote sensing and Global Positioning System (GPS) data, the space industry assists people to manage and sustain the natural environment and resources; increases the mobility of people and products, and deals with health, safety and security (SANSA, 2011). It offers instant communications, enables people to accurately observe and locate any spot on earth and empowers people to timeously foresee and deal with economic and human catastrophes. South Africa is a technologically progressive country and is part of the universal village and has become dependent on space-based services and applications (SANSA, 2013).

SANSA (2011: 20) reports that mankind continues to be more reliant on space systems and sub-systems for a wide range of social benefits and economic endeavours. Industrialized nations identify the space industry as a fundamental and vital instrument to achieve social, economic and foreign policy goals. Furthermore, many governments worldwide are growing their expenditures on space-related activities, aiming to intensify their general ability in space. This might be the main reason why there are a large number of countries operating in space, with satellites intended for different duties, and why most of these countries aim to be more advanced in science and technology.

Le Roux and Evans (2011: 109) suggest that South Africa has now come to depend on technology derived from space. Space applications are so embedded in modern life that most people are unaware of how much use they make of space technology every day. The authors also state that the government is a significant user of space technology and is often the actor in the space value chain that picks up the costs of space application and infrastructure. Accordingly, two crucial themes of the South African National Space Agency have been identified:

- To develop rare and transferable skills in space science and engineering; and
- To ensure science advancement and public engagement – nurturing awareness of and interest in science amongst the general public, including the youth (Le Roux and Evans, 2011: 116).

2.2.5.2 Space Development

According to James, Akinyede and Halilu (2014), a space economic development model is essential for those developing countries that still wish to join the space arena, since it is necessary to help sustain the space programme. Most of the life-threatening challenges faced by human beings on earth such as food and agriculture, diseases and climate change may be solved and minimized through the utilization of space. The International Space Station has also made an enormous impact in terms of the use of space for research and development. Some developed and developing nations that are space-driven are facing a knowledge and experience gap that exists with space science and technology. Financial expenditure in space science and technology education may be a solution to this issue. There is a spectrum of investment opportunities in the space sector. The development of outer space can help create new strategies and new technologies that can improve the quality of life for people and provide people with tools, which can help on social and survival related issues (James et al, 2014).

Stakeholders in outer space development such as government and private organizations have made it their main objective to actively create more awareness and interest in the global public about outer space development (Weeks and Faiyetole, 2014). Furthermore, the Young Earth Space Scientists (YESS) programme is also in line with the development of outer space as they aim to educate, develop and train earth and space scientists, non-scientists and environmentally aware leaders for the future, but mainly education driven people. Weeks and Faiyetole (2014) argue that amalgamating social and behavioural sciences with outer space science and technologies can help assist people to contribute to the coming space economy. This may help create a positive perception about space development amongst people as they might be fascinated and inspired. Featuring space development studies in the education curriculum used by primary and secondary education, including the curriculum of universities from all over the world, together with social and behavioural science studies, can help to increase the spread and movement of outer space development and ensure equality for all (Weeks and Faiyetole, 2014).

2.2.6 Space Opportunities

Collins (2007: 395) claims that space technology and applications play a big role in the survival of nations through uplifting the standard of living, making transactions easier and forcing countries to develop skilled engineers and professionals who are essential for the benefit of nations. Space-based applications are being used in order to address social issues such as poverty, economic growth and, job creation. They also contribute by enabling the development of resource management and make services like tele-medicine and tele-education easier to deliver (Autino, 2002: 23). New developing space industries arise with innovative opportunities that many people do not know about. Space specialists are eager to share their knowledge with interested parties and ensure equality for all (Weeks and Faiyetole, 2014:167).

Schor (2005: 309) suggests that the space industry will need additional skills in order to improve the implementation of space products and services. He further states that countries around the world should unite; work together; and open up opportunities, especially for learners in the education sector; and solve problems by producing well trained professionals. Space-based applications are an important resource for the development of nations. They also play a significant role in scientific and technological progress. This sector is the main source of advanced technology and helps developing countries improve the quality of life for people (Ashford, 2009: 113). Jazebizadeh et al. (2010: 1323) argue that many developing countries are making incorrect decisions when investing. They often invest in military and security institutions, instead of choosing civil institutions. The money is well spent on civil institutions, it circulates and helps resolve problems faced by society. Civil institutions also invest in university graduates who have gained in-depth knowledge in the field, giving them experience and jobs. Players within civil institutions include non-government organizations (NGOs), community-based organizations (CBOs) and politics.

2.2.6.1 Health services derived from space

Balogh et al. (2010: 185) state that the number of diseases in many countries is rapidly growing. About 1400 transferable diseases are found in developing countries and most of these diseases result in death. An example would be malaria, which affects about 300 million people a year and kills nearly one million. Tele-health, tele-medicine applications, satellite communications and tele-communication technologies all have been important tools for medical experts located in different areas. They enable doctors separated geographically to be in contact with each other or with their patients and helps patients receive treatment via telecommunication, as well as saving costs.

Another social application that satellite communication helps with is tele-medicine. Wood and Weigel (2011: 1110) point out that tele-medicine refers to the connection and supply of medical information to healthcare workers located in isolated locations. Providing good tele-medicine, especially in rural areas, is a great challenge in many developing countries.

2.2.6.2 Space Tourism

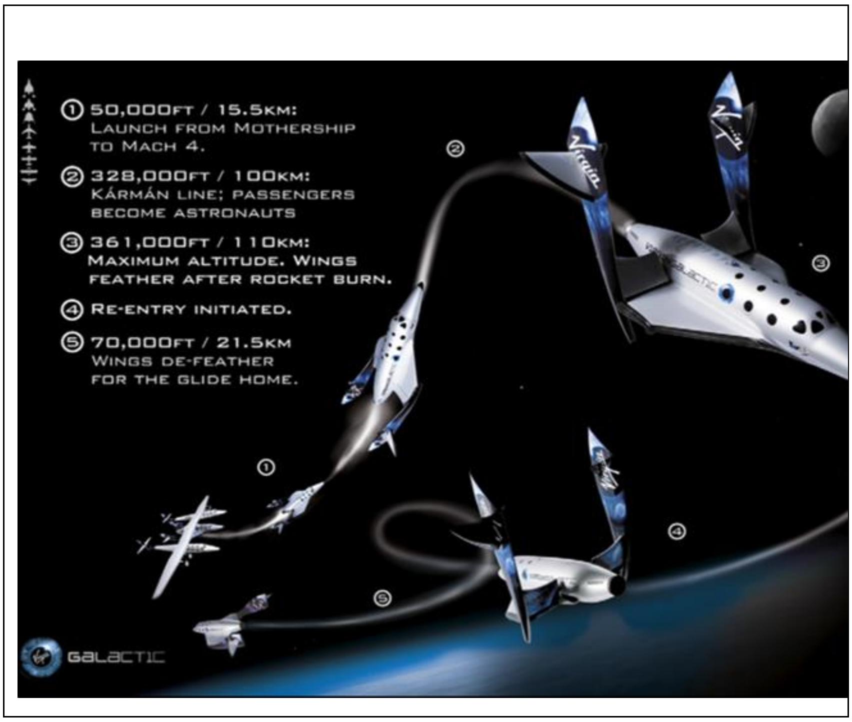
A non-profit promotion organization in the US called The Space Tourism Society defines space tourism as an area which involves in-earth orbit experiences; beyond-earth orbit (such as Lunar and Mars) experiences; earth-based simulations, tours and entertainment experiences; and cyber space tourism experiences (Cater, 2010: 838). Cater (2010: 838) suggests that for many years, many people have been attracted by the potential for space tourism. In support of this statement, about 100, 000 people signed up on a spaceflight waiting list on the Pan American World Airways, also known as Pan Am, in the 1970s.

Today, the likes of businessman Richard Branson, the founder of the Virgin Group and other private companies, are making it more convenient for private citizens to engage in space travel. Space travel was beyond the reach of most people in the past decades but

things today have changed. The prices for space travel have been reduced and it is affordable (Crouch, Devinney, Louviere and Islam, 2009: 441). Santoro, Ajay and Ram (2014: 98) advocate the aforementioned statement and state that NASA and commercial companies have been busy working together to make it more convenient for people who want to engage in space travel at much reduced prices. There are many initiatives that are developing in the USA which aim at attracting paying tourists to enroll for space travel, experience the unknown world and the feeling of the absence of gravity.
Beery (2012: 25) comments that there has been a massive transformation in space travel over the past decade. Private companies now have the privilege of conducting space travel. This comes after changes in budgetary policy and regulations in the United States. In addition, actors such as firms, investors, entrepreneurs, markets, states and consumers are shaping the tourism industry. Entrepreneurs who have huge investments in entrepreneurial aerospace design and manufacturing strongly support and promote technological and regulatory changes of space tourism (Beery, 2012: 25).

Cater (2010: 838) notes that Richard Branson has affiliated with some companies to make the space travel concept successful. This type of business will run under his brand Virgin Galactic. As shown by Figure 2.1, space tourists will experience weightlessness, being taken to 110 km in altitude and have a clear view of the earth’s curvature.

Figure 2.1: Spaceflight



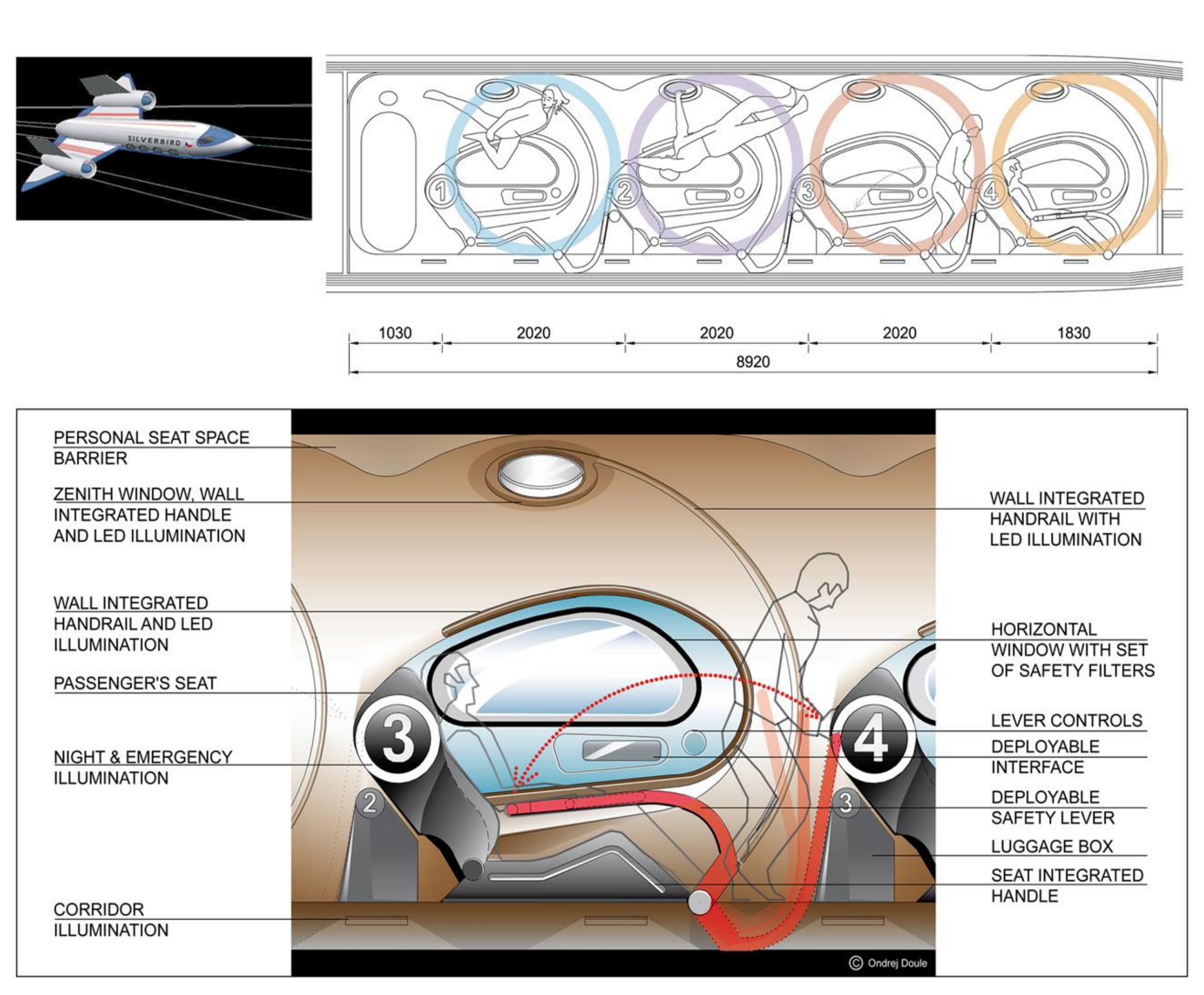
Source: Cater (2010: 838)

2.2.6.3 Customer requirements for personal spaceflight

Peeters (2010: 1625) reveals that commercial failure results when companies ignore customer requirements. A number of customer-oriented companies have noted the demand and request for personal spaceflight and this has made the global space industry aware of the desire of the public to explore the space field. The features, advantages and benefits of spaceflight would attract many people, thereby increasing the prospective size of the market for public space travel. Surveys have been conducted recently in order to determine the number of people who are keen about going to outer space, as well as their expectations from the spaceflight. In addition to expectations, many future space passengers expect to experience weightlessness and being able to float freely in zero gravity; viewing space and earth; experiencing astronaut training; communicating from space; and being able to discuss the adventure in an informal way. These expectations will need to be taken into consideration, together with aspects such as: guaranteed safe return, sufficient training time and minimum medical restrictions

Peeters (2010: 1625) illustrates the design of a spaceflight that includes some of the aforementioned expectations and additional features in Figure.2. 2

Figure 2.2: Tourist Spacecraft



Source: Peeters (2010: 1625)

The spacecraft shown in Figure 2.2 is designed with chairs which move in accordance with different loads in the different phases of travel; windows are designed to ensure visibility at all phases and seating positions; a safety bar is designed to assist passengers' back into chairs before they return; communication devices are built in to the individual seats; cameras on board, run by the co-pilot, record the different phases; and the dress code would be of astronaut type suits and helmets to minimize possible injuries (Peeters, 2010: 1625).

The medical perspective of the spaceflight is considered the most important. Space passengers would have to be treated more like astronauts, ensuring pre-medical checks before travel, and ensuing that sufficient medical facilities are on board, for example medical kit and tele-medicine support (Peeters, 2010: 1625).

Space travel is a modern adventure and this kind of business will soon grow at a rapid rate since there is high demand for it. However, businesses usually go through a life cycle after being introduced and the product life cycle of space tourism will be shown and explained in the next section.

2.2.6.4 The Product Life Cycle concept

According to Peeters (2010: 1625), the product life cycle (PLC) is a marketing philosophy which clarifies the stages through which the product or service is expected to go, from the introduction stage to the decline stage. There are four things indicated by the PLC that products have in common, namely:

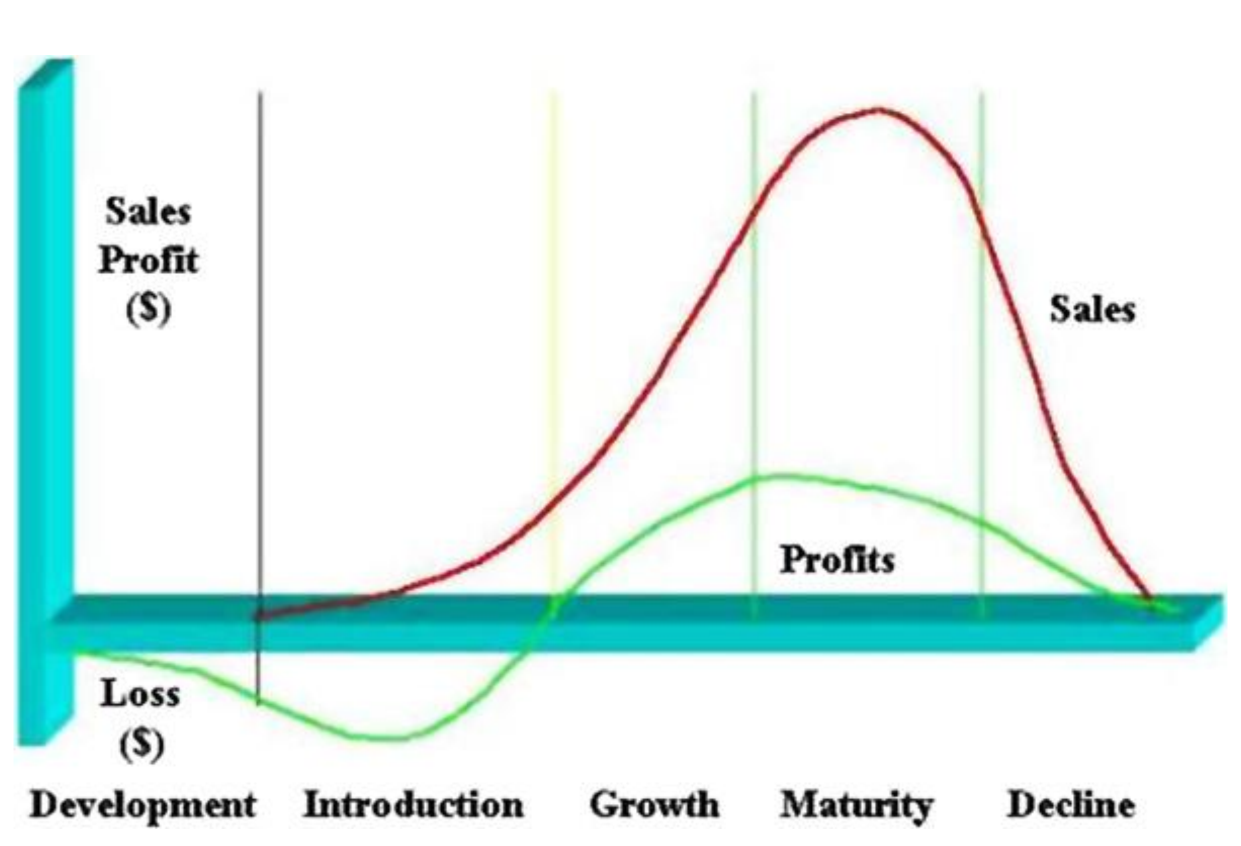
- They have a limited lifespan;
- Their sales pass through a number of distinct stages, each of which has different characteristics, challenges and opportunities;
- Their profits are not static but increase and decrease through these stages; and
- The financial, human resources, manufacturing, marketing and purchasing strategies that products require at each stage in the life cycle varies (Peeters, 2010: 1625).

Chang and Chang (2003: 1259) support the above and indicate that over the past four decades, the product life cycle (PLC) concept has been widely discussed for a number of purposes such as product management, strategic planning, cost and financial aspects, retailing, purchasing, international trade, production planning and inventory control.

Santosh et al. (2012: 408) also claim that manufacturing and innovation capabilities are generic across PLC stages since they yield improvement in cost, quality, delivery and product and process innovation capabilities, as may be variously emphasized and required at different stages of the PLC. Furthermore, Santosh (et al, 2012: 408) state that product life cycle (PLC) means the life cycle stage of the buying firm's focal product. It characterizes the product-market context and it is a well-recognized external contingent factor that helps explain a firm's operations strategy, linking product life cycle stages to alternate supply chain strategies. The product-market context across the PLC stages includes the influence of competition.

Wong and Ellis (2007: 145-146) suggest that the PLC concept is a well-known symbol for describing and explaining market dynamics within the marketing sector. The crux of the PLC is that product-markets evolve through four discrete and temporary stages, which can be distinguished in terms of unique demand and competitive conditions. The PLC is a descriptive framework that classifies the evolution of product-markets into four stylized stages: introduction, growth, maturity, and decline.

Figure 2.3: Product Life Cycle Curve



Peeters (2010: 1628)

Figure 2.3 shows a generalized product life cycle curve, with a fluctuation in sales and profit in each stage from the introduction stage to the decline stage.

- Introduction phase: This is the phase where the customer is unaware, lacks information about the product or service and sales tend to grow slowly.
- Growth phase: Sales start to grow at a rapid pace at this stage. Profits increase, especially if it is a technological product, when the market leader enjoys a competitive edge over other companies who will still be trying to acquire that technological advantage.
- Maturity phase: The market leader is more likely to get competition at this stage. New opponents will enter the market with new improved products and that may force prices to be reduced. A decline in profit can be expected.
- Decline phase: Sales deteriorate rapidly during the decline stage. This usually results if there is a new product with innovative features being offered on the market or when the market or consumer behaviour has changed. Prices would have to be cut to get rid of the

remaining stock (Peeters, 2010: 1625 and Wong and Ellis, 2007: 145). Therefore, the spaceflight business should be aware and fully prepared for these stages in their business.

2.3 SPACE EDUCATION, OUTREACH, AND CAREERS

2.3.1 Space Education

Balogh et al. (2010: 185) suggest that many developing countries who aim to grow their capabilities in the space environment put education and research activities in space science at the top of their priorities. Space is a significant area for young people to be informed about the possibilities in their future. In order to secure workforces for future space development, it may be a good idea to teach learners more about space science and technology and give them experience in space activities (Lee, Jo and Choi, 2011: 730). Having a well-educated, trained and skilled youth to replace older professionals is necessary for the sustainability of South Africa's activities in space. Space life sciences curricula that are age-appropriate, based on sound content and culturally resonant can inspire and motivate learners. African educators will have opportunities to develop space life science educational modules that capture the cultural imperatives of their respective cultures, while increasing learners' understanding of, and interest in science content (International Academy of Astronautics, 2010: 193).

MacLeish, Thomson and Moreno (2011) point out that educators in the space education sector around the world are faced by a challenge of not having sufficient workforce and they approve the idea of formulating a well trained workforce which is going to be required in future. MacLeish et al (2011) give an example of the United States University called the National Space Biomedical Research Institute (NSBRI), which is devoted to space life sciences and education. It is trying to tackle some of the educational challenges that are being faced around the world by organizing activities that provide better teacher professional development. They formulate programmes that motivate learners, programmes that permit women better access to space studies, stimulate the awareness of science careers and they build partnerships. Graziani, Piergentili and Santoni (2010) state that the technical component of space education is seen as an instrumental way to up-lift the enthusiasm of learners. They can work as a team and combine their skills when given activities to do. Universities should develop and encourage more learners to be involved in satellite programmes. Since the key objective is the development of education, engaging

learners with such a unique satellite programme would be a great opportunity for learners to be acquainted with the activities taking place in the space industry.
Weeks and Faiyetole (2014: 171) indicate that teachers, articles, books and word-of-mouth can stimulate self-driven learning amongst learners. Learners can practice their skill set on an individual basis, which could prepare them well for the coming space opportunities. This strategy is intended to close the knowledge gap between the space industry and learners. Parents can assist space development since they have the power to influence the education system of primary and secondary education to add outer space studies to curricula.

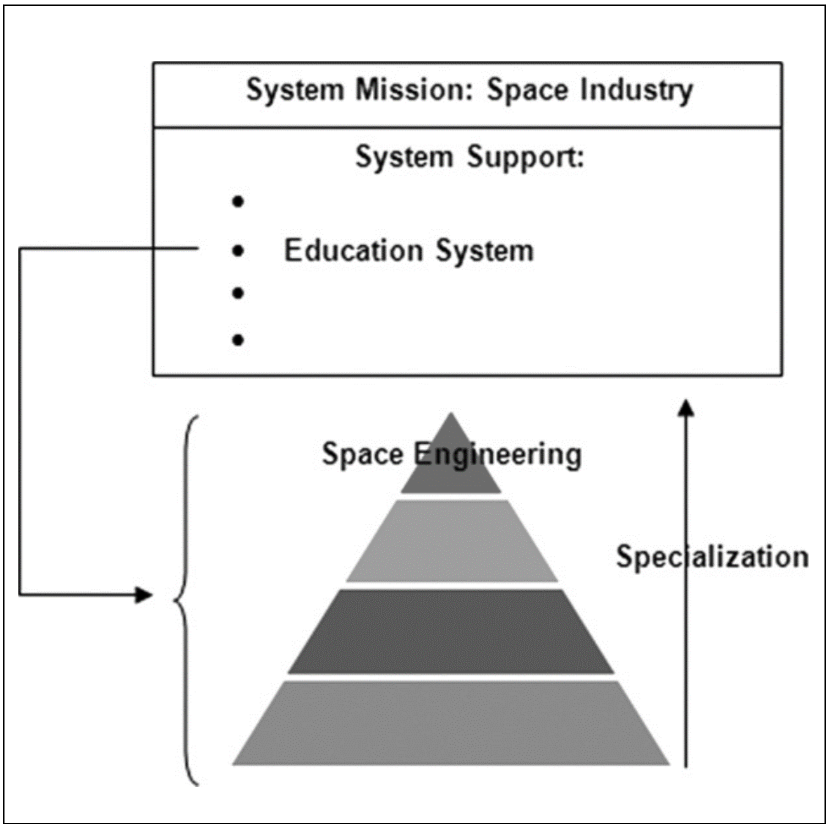
2.3.2 Space Engineering

Ye (2010: 542) discloses that there are many expectations of the engineers of the next generation. As they are required to have outstanding communication skills; have the ability to work faultlessly in different cultures; and be familiar with logistics and the integration and principles of project management. Furthermore, the author believes that engineering graduates should be acquainted with cross-disciplinary engineering issues in multicultural environments. This can boost their knowledge and experience in the engineering field and add value in engineering education.
Ye (2010: 542) suggests that since most higher engineering education graduates work in the manufacturing industries, any change made in higher engineering education would have to suit the requirements of manufacturing industries. However, it should be noted that there are new trends occurring in the manufacturing sector and these trends are putting more pressure on employees, most of whom are engineers. These engineers are expected to be alert, grab many opportunities that are created in the market place, know how to integrate different technologies in product development and in project implementation and also know how to retain the engineering activity's environment as a friendly place (Ye, 2010: 542).

2.3.2.1 Educational system for space engineering

Jazebizadeh et al. (2010: 1323) illustrate that the system of education shown in Figure 2.4 consists of a large variety of specialized training sessions for learners throughout their pre-university years in areas of space exploration such as Space Engineering and Space Law.

Figure 2.4: Educational system for space engineering



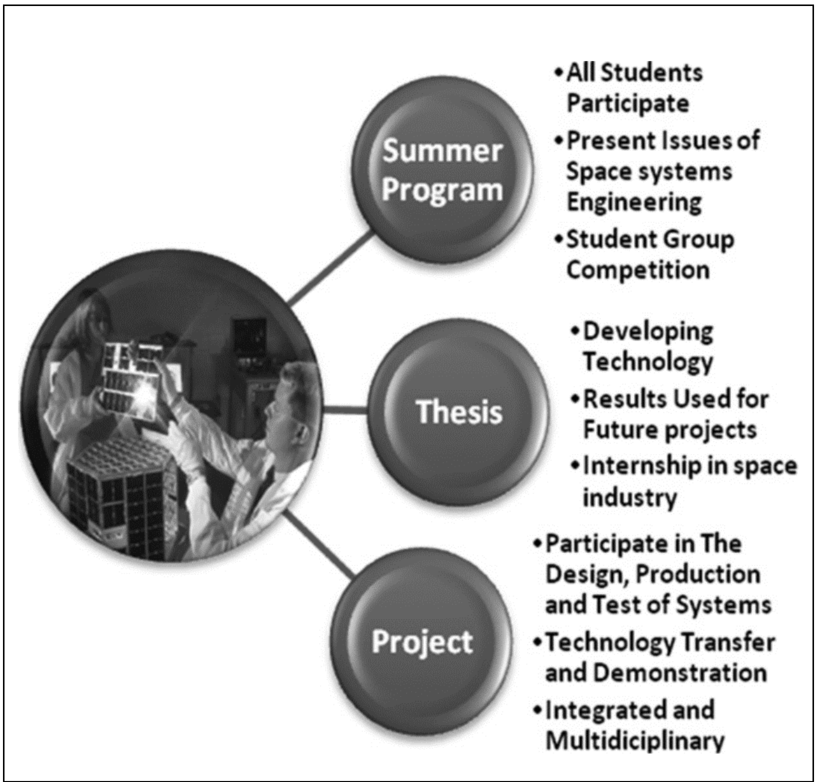
Source: Jazebizadeh et al. (2010: 1323)

In space engineering, the system is built on condition that it provides education services, it gives back to communities and everybody benefits. This system is open to everybody, particularly learners, and anybody else who wants to be knowledgeable. People responsible for the operation of the educational system in the space industry will be assessing the progress of learners in each region of space exploration. They will interact, build a relationship with the learners during the training, and then provide a report in terms of the success or failure of the educational system. However, Jazebizadeh et al. (2010: 1323) also argue that there is a problem faced by the space industry and its education system, namely gaps that occur between the industry and learners. The problem is due to the fact that learners are not taught enough about space and hence are lacking in terms of understanding space, its importance, activities and terminology.

Jazebizadeh et al. (2010: 1323) note that educational services such as industrial training and designing are created in the system of education in space engineering. Learners are the main users of this system. The target groups in the country that obtain this type of education system are the space industries and firms that provide space-related services.

The most important factor they consider is the performance of the system and preparation of learners in space technology. If the space industry receives good products, such as worthy graduate learners who are well trained and technologically knowledgeable, it continues its investment in the education system.

Figure 2.5: Summer Projects

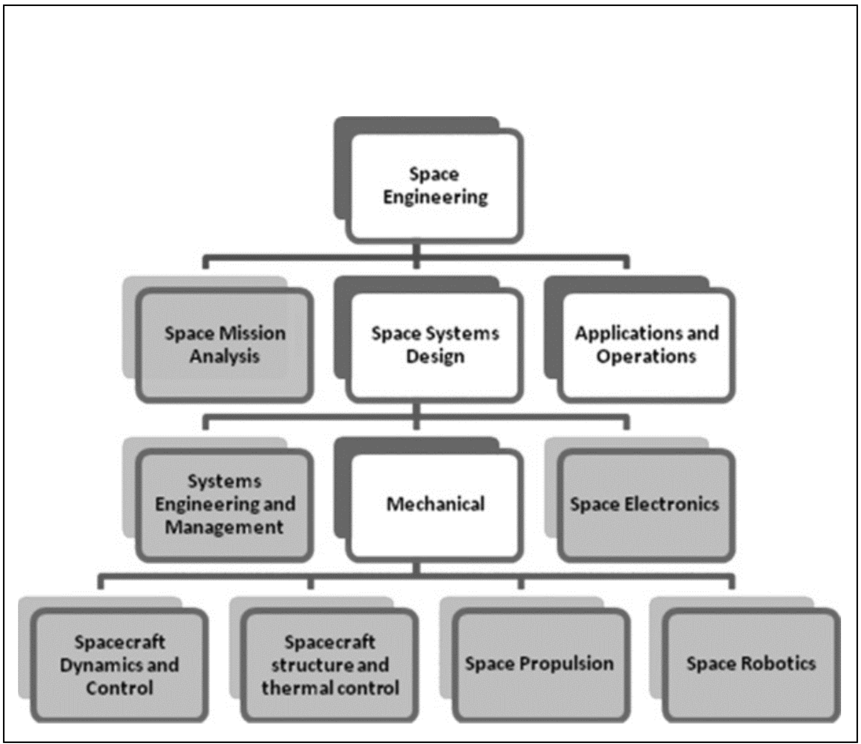


Source: Jazebizadeh et al. (2010: 1323)

Jazebizadeh et al. (2010: 1323) point out that summer programmes, student projects and thesis-based research, shown in Figure 2.5, are also found in the space engineering education system. Therefore, it is encouraged that learners participate in such programmes because these programmes are aimed at solving space-related issues faced by many countries today. Learners can return with knowledge and be of help. Learners can meet with other learners coming from other parts of the world, work as a team and be familiar with the activities and decisions taken. Learners who will carry out these projects will gain experience as they will be involved in the design, manufacturing and testing of the space system, which is part of the module, and be guided by their supervisors.

The system of education in space engineering consists of many modules, as illustrated in Figure 2.6, which give learners a wide range of modules to choose from.

Figure 2.6: Course Modules



Source: Jazebizadeh et al (2010: 1323)

These course offerings are intended to meet the requirements of the space industry, thereby meeting the country's capabilities both technologically and scientifically, as well as keeping learners informed with new knowledge. When learners enrol in this programmer, they are trained and receive as much experience as possible so that they become an asset to their corresponding fields (Jazebizadeh et al, 2010: 1323).

2.3.3 Outreach Programmes

In the United State of America (USA), the National Aeronautics and Space Administration (NASA), Morehouse School of Medicine (MSM) and the National Space Biomedical Research Institute (NSBRI) decided to unite (MacLeish and Thomson, 2010: 1285). Their objective was to come up with a strategy to reach out to learners, teachers and the public and educate them about space life science research and space exploration. The group wanted to educate society and learners about space exploration; the importance of space science; the benefits derived from space; and emphasize science, technology, engineering and mathematics (STEM) which are the critical skills that must be obtained and instilled in the next generation in order to help them succeed in this competitive world (MacLeish and Thomson, 2010: 1285). Grasser, Goswami, Rössler, Vrecko and Hinghofer-Szalkay (2009:

688) suggest that Educational Outreach programmes use provable and assessable methods and emerging technologies convey space-related studies, engineering and maths to learners so that they can play a crucial part in human capital development, contribute to the workforce development of the space industry and attract learners to space-related careers.

The space exploration education vision and outreach programmes created by the collaboration of NASA, MSM, NSBRI and EPOP (Education and Public Outreach Programme) will help motivate learners to pursue careers in STEM-related fields. It will also help improve science education and teachers' knowledge, create a buzz in classrooms, create fun and change the perception of those learners who find science boring. The main reason behind this is to strengthen and expand the talent pool, teach, train and maintain the best and brightest learners who will come with fresh ideas and skills, join the workforce and ensure a better future (MacLeish and Thomson, 2010: 1285). MacLeish et al. (2011) indicate that the US space programme makes educating learners about space and providing learners with hands-on activities their main aim as they look to develop a skilled and proficient workforce for the future. It also claims that the International Space Station should be completely used, particularly for education and research. The US space programme is preparing to innovate and ensure human capital development in their space industry by assembling a group of the best and brightest learners, scientists and engineers from all over the world to ensure a sustainable space industry.

MacLeish et al. (2011) suggest that NASBRI's EPOP educational initiative has made a tremendous impact on the quality of education globally, which has been shown by the support of up to eight institutions, namely Baylor College of Medicine (BCM), Colorado Consortium for Earth and Space Science Education (CCESSE), Massachusetts Institute of technology (MIT), More House School of Medicine (MSM), Rice University/The University of Texas Medical Branch (RU/UTMB), Mount Sinai School of Medicine (MSSM) and Texas A and M University (TAMU). In addition, EPOP activities include enriching learners' and teachers' knowledge about space life sciences, thereby improving learners' learning by providing more practical hands-on tasks for them to do. It allows learners to use tools that will increase their understanding of the universe and space exploration, engaging more women and disadvantaged minority learners to achieve excellence in STEM-related subjects, and promoting awareness about the impact of space exploration on real life through the use of marketing tools. For example, television, radio, internet, after school clubs, museums and science centers (MacLeish et al, 2011).

Countries like Australia are aggressively pushing their capabilities in the space arena. The Australian Government has even started an Australian Space Research Programme (ASRP) which is intended to uplift Australia's space capabilities by improving skills, innovation and space related research. ASRP has put space education development projects and space science and innovation projects at the top of their priorities as they have spent most of the grants they received from their sponsors on those projects (Dougherty, Oliver and Fergusson, 2014). Nottingham University has developed a programme where they meet with learners and show them space and pixel art in order to inspire them to be interested in subjects such as science, mathematics, engineering and technology. During this programmer, learners are taught about the importance of space technology and the role it plays in people's lives. Learners and teachers interact with each other, share knowledge and also use some of the space instruments like Global Positioning System (GPS) receivers and digital devices (Roberts, 2014: 34).

NASA's education programme includes a Summer of Innovation programme that comprises programmes which consist of NASA scientists and is aimed at motivating undergraduates and their teachers. NASA is also looking to improve higher education STEM curricula, as these are the essential subjects in space education (Ehrenfreund, Peter and Billings, 2010). Weeks and Faiyetole (2014: 171) share the same idea that introducing aspects such as space art, space history and space co-operation into the education curricula might be a good approach for attracting learners to STEM subjects. Activities like painting and drawing of space phenomena; storylines for space phenomena; animated space ideas for development; mock ups; and practical activities can be included in the primary and secondary school education curriculum to entice learners to STEM subjects.

NSBRI's EPOP (Education and Public Outreach Programme) is aligning well with the science education of the US as it utilizes the space exploration concept as a basis to attract the knowledge and expertise of science educators; stimulate learners to follow subjects such as science, technology, engineering and mathematics (STEM); and partner with other countries towards a space exploration vision. NASA's Education Strategic Coordination Framework is to enhance learners' involvement with STEM subjects and to promote the awareness of NASA. NASA's mission to enlighten people about the space exploration benefits and opportunities, that it embraces for life on earth, for scientists, learners and teachers, is also supported by activities done by EPOP (MacLeish et al, 2011: 1615).

According to MacLeish et al. (2011: 1615), NSBRI and their EPOP (Education and Public Outreach Programme) are aiming at gathering and expand their talent pool with graduate and post-graduate learners from all over the world who will come with different expertise and add value. NSBRI's EPOP educators get great opportunities through international outreach as they meet with other educators from related fields in other countries, share ideas on how to adjust space education, promote science, build partnerships for knowledge exchange and create tactics for learners to have access to space exploration education. People must think big, collaborate with people from other parts of the world, create networks and share knowledge. They need to be positive-minded and take full advantage of the jobs and educational programmes that will come with the development of outer space. Outer space is there for people to exploit, participate in, hold active roles in and enjoy its benefits (Weeks and Faiyetole, 2014).

2.3.4 Careers

There is a project in Australia called Pathways to Space. The project is managed by the ASRP programme and it groups education, science communication research and research with astrobiology and robotics. The project has confronted some of the space exploration challenges by attracting learners to studying and opting for careers in science and engineering. Their emphasis is mostly on grades 9 - 10, namely 15 - 16 year olds. The Pathways to Space project was created to investigate if showing learners the actual scientific and engineering research in the outside world, showing them things like robotics and astrobiology, would make a difference to their choice of studies and careers (Dougherty et al, 2014: 185). Furthermore, learners' perceptions of science is a problem experienced throughout the world and in Australia young people tend to avoid science at an early age and that makes it even worse for the nation.

A decline in the number of learners doing science at secondary school is a problem for Australia's space-related activities. Even though there are many companies associated with space-related activities in Australia, Australia itself does not have a space agency that might assist with the aforementioned challenges. Should Australia need to improve their competencies in the global space arena, it would require a workforce for the future and that workforce as noted might be still at secondary school. Hence, this is the main reason why the Pathways to Space project are so vital for Australia. It can reach out to secondary school learners and convince them to choose space-related studies at tertiary level (Dougherty et al, 2014).

Weeks and Faiyetole (2014) state that they want to motivate learners to strive for careers in scientific fields, to do science, technology, engineering and mathematics. Since many people perceive science as difficult, involving them in outer space development programmes might change their perception, making the STEM subjects tempting, inspiring learners and even increasing the group of manpower and workforce for outer space development.

2.4 SOUTH AFRICA'S EDUCATION AND OUTREACH PROGRAMMES

The Department of Science and Technology in South Africa has established a Space Programme that will involve the design, building, establishment and maintenance of space segments (SANSA, 2014). Munsami (2014: 05) suggests that the national space programme is being established to benefit the people, and therefore people are mandated to be thankful and supportive. Aspects such as quality of life, improved health and safety of people will determine the success of the space programme. Therefore, it is important for the national space programme to be driven in the direction of public outreach.

South Africa is planning to be independent in the space arena, develop more power for their satellite system; develop new advanced technologies that will be at the cutting edge in the global space market, human capital development, and science advancement in space engineering; and create more related skills (SANSA, 2014). The space programme is important in South Africa as it is a developing country and a significant player in the Space Industry. This programme can help teach learners about Space, Science, Technology, Engineering and Mathematics. It can motivate them to acquire good results in those subjects and choose space-related courses at tertiary level. Companies involved in the space industry can be boosted in terms of the workforce.

2.4.1 Careers offered in South Africa

The best long-term expenditure of money or effort on Space Science and Technology is to continuously encourage and motivate learners so that they can play an important role in terms of science and technological development. Capturing the hearts and minds of learners to pursue scientific and technological studies and careers is the single largest

sustainable economic multiplier for a country, especially amongst developing nations (SANSA, 2011:19). Kanas (2006: 194) advocates the concept and states that introducing programmes to be done after school can allow learners to better their execution by creating skills and increasing desire to strive for advanced education and improved attitudes towards studying. Therefore, the South African Space Industry needs to exploit such opportunities, in order to get more talent and fresh ideas to optimize the industry. They must facilitate additional marketing activities, raise awareness and get more youth involved.
Roberts (2014: 34) agrees with the subject and suggests that capturing learners at an early age and getting them to choose science and mathematics subjects can help create a positive perception of such subjects from learners and have more learners engaged in science-related activities. Jazebizadeh et al (2010: 1323) share the same idea and state that grooming learners in Space Engineering up to masters' level, giving them experience, teaching them about semantics and the technological/digital aspect of the space field is set to enrich the workforce and add value to the space industries of their respective countries.

According to Roberts (2014: 35), statistics show that the number of learners pursuing education in Science, Technology, Engineering and Mathematics in South Africa is deteriorating. This decrease is due to the perception that learners have of these subjects. They find these subjects boring and not suited for their careers. They perceive scientists as being boring, not having fun and certainly not good for them. That is why they opt for other fields. South Africa will have to come up with a solution if they want to expand the pool of scientists and engineers and have a larger workforce in the space industry. Having enough productivity and proficiency is essential for any industry. Learners can play a crucial role in problem solving and increase opportunities in the space industry. Universities should have facilities, instruments/tools, and lecturers, all of high quality. However, that comes at exclusive prices. Not funding the education system and solving this problem will make the concept of space worthless to learners (Jazebizadeh et al, 2010: 1323). South African learners can help add numbers to the workforce, contribute to space activities and ensure a sustainable South African Space Industry.

SAASTA (2009) claims that there is an infinite need for learners who will specialize in the areas of space science, engineering, technology and remote sensing in South Africa. These learners can help add numbers to the group of South Africa's scientists, space engineers and technologists who help with solutions to the problems faced by Africa. For example, weather management, famine, drought and urbanization. Thus, a call must be made to primary, secondary and tertiary education sectors regarding the need for learners to take part in the development of the space industry. Learners with the appropriate skills and who excel at school need to be 'captured' for the future of the space industry (Weeks and Faiyetole, 2014: 170).

SANSA (2014) illustrates that they host a Space Science Winter School in Cape Town (at Hermanus) every year during the month of July. The Winter School gives learners a chance to learn and explore the fields of space physics. Learners are shown how subjects like Mathematics, Physics and Engineering can be fun and important. The agency has created a platform for learners, providing plenty of opportunities for them, including internship programmes. They will be privileged to work with exclusive, sensitive and specialized equipment, use facilities of high value and work in a friendly environment. SANSA (2014) notes that many young people in South Africa between the ages of 15 and 34 years who are unemployed are also having difficulties with education. However, Cell C is trying to solve some of the challenges faced by the youth as they have established a Cell C's Take a Girl to Work initiative. This initiative is intended to give young girls an opportunity to explore the world of work and help them pursue good careers (SANSA, 2014).

2.4.2 Educational challenges for the South African space industry

There are 23 universities in South Africa. Seventeen are traditional universities and 6 are universities of technology. Space-related studies are offered at eleven universities, namely Cape Peninsula University of Technology; University of the Western Cape; Free State University; North-West University; Rhodes University; University of Johannesburg; Stellenbosch University; University of Pretoria; Wits University; University of South Africa and the University of KwaZulu-Natal. The aforementioned universities offer courses such as Astronomy, Astrophysics, Space Science and Satellite Engineering.

South Africa needs to grow rapidly in terms of science and technology. This will be assisted by the Square Kilometer Array (SKA) project and the satellite engineering programme at the Cape Peninsula University of Technology. SKA is a big scientific project won by South Africa in 2012. This project is being hosted in the Karoo area in the Northern Cape Province and it is noted as an impressive center for scientific and cutting-edge technology research.

When it is in operation, it will help astronomers with their universe research faster than any other system which is used currently. In addition, SKA has potential to optimize the South African educational system, enhance knowledge, create jobs, develop opportunities and even support the financial and economic strength of the country (The Mercury, 2014: 4).

With regard to education, the number and results of learners studying STEM (Science, Technology, Engineering and Mathematics) subjects is deteriorating and is cause for concern. Buthelezi (2014: 13) clarifies that academics and economists do understand that South Africa has scarce skills shortage, even though there was a small increase in the mathematics and science pass rate for the 2013 matriculation results. However, it was not enough. Buthelezi (2014: 13) reports that South Africa was ranked as the worst performer of 148 countries for the quality of its mathematics and science education by the World Economic Forum in the 2012/13 Global Competitiveness report. It was ranked in 146th place for the quality of its education system, below countries such as Russia, Brazil, India and China.

Furthermore, the Department of Higher Education revealed that few learners, less than half, elected to do mathematics as a subject. Professor Jill Adler from the Wits School of Education was quoted by Buthelezi (2014: 13) as saying that “until the number of As and Bs improve, South Africa will not be able to produce all the scarce skills it needs. The problem is not with the level of passes but the distribution of those passes. Until South Africa shifts beyond passing mathematics with 30 percent, they are not out of the woods.” In accordance with the aforementioned statements, Ngcobo (2014: 4) suggests that in order to improve mathematics performance in South Africa, more work needs to be done. Learners in the classrooms are not using their intellectual capacity effectively when studying mathematics and therefore do not understand it.

2.5 SPACE AWARENESS, MARKETING AND COMMUNICATION

2.5.1 Space Awareness

Weeks and Faiyetole (2014: 166) report that there is a lack of awareness about outer space. People are not informed about outer space goals and activities and are therefore careless about its development. A number of people still perceive space activities like space travel and asteroid mining as ‘far out’ and not suited for them. People have the ability to showcase their capabilities to the new space industries because there are plenty of opportunities available in these industries. Learners from all levels of education can learn and be exposed to space activities. Munsami (2014: 5) also perceives the above problem and reveals that South Africa is faced with a challenge in terms of participation and performance in science and mathematics education. This is a great challenge as the country is in the process of moving from a resource-based economy to a knowledge-based economy. Space science and technology has long been known as a factor that can attract and excite learners to choose careers in science, engineering and technology. Hence, increasing awareness and promoting space science and technology at all levels of education and in society is vital.

SANSA (2014) emphasises that they want women to be empowered in this male-dominated country. In addition, they state that women must be informed about the benefits and challenges of choosing a career in the field of space science, engineering and technology. Women will make knowledgeable decisions about their future careers if they are taught and shown good places where they can undertake those careers. Most secondary school learners are not aware of the space-based field, the opportunities it contains, or the careers available that learners can choose from. Learners may think that these careers are in the science and engineering sector only, which is not true as there are plenty of careers to choose from. MacLeish and Thomson (2010: 1286) suggest that in order to create a global space education community, decision makers will have to expand much effort. They should involve learners, teachers and the public and convince them about how space exploration education can benefit everybody, how space exploration education can help protect planet earth and how it can support global societies to resolve future challenges.

It is believed that most developing countries are confronted by the problem of brain drain and forming a space industry can be a solution. A number of academics, scientists, engineers and doctors are emigrating to developed countries, either to further their studies or to work there, leaving their country of origin with fewer skills. When this happens, developing countries are forced to import those skills, employ professors, lecturers and other highly rated professionals from foreign countries to come and help out, and they do not come cheap (Leloglu and Kocaoglan, 2008). Therefore, establishing a space industry might attract academics both locally and abroad to teach, train and maintain the industry.

Ehrenfreund et al (2010) state that space exploration is a complex venture and will always be a great challenge. Many countries have made it one of the components of their political programmes. While the competition is rapidly increasing in the global space arena, there is a lack of awareness by the public at large about space exploration activities. People are unaware of the benefits derived from space exploration. Space agencies need to conduct an aggressive marketing strategy, create awareness and inform the people about their work, with supporting reasons for the work they do and how people will benefit from it. This can help achieve the goals of space exploration. Visionary thinkers are required in this system as they can assist to intensify public awareness about the subject of the new space age (Weeks and Faiyetole, 2014: 170).

A well-planned approach to reach the public and inform them about space exploration activities, challenges and benefits is therefore a necessity, especially the youth who can be of help to the workforce (Ehrenfreund et al, 2010). Moreover, Ehrenfreund et al (2010) also argue that not getting support from the public who carry most of the associated financial burden is a major concern for the space programmes. Public awareness is still an issue, regardless of the initiative made by NASA (National Aeronautics and Space Administration) of reaching the public using public information policy surveys, marketing and advertising studies. However, an ironic finding on some of these initiatives is that a portion of the public that is aware and backing the space programme and perceive space exploration as a worthy venture is against the idea of government spending on space-related missions.

2.5.2 Marketing

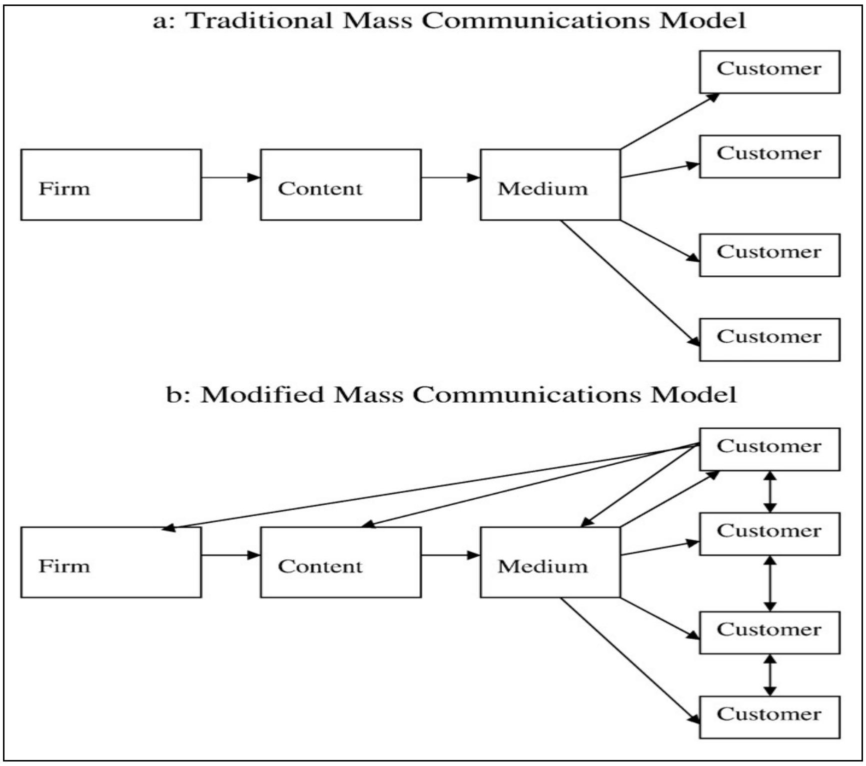
According to Lewis and Chambers (2001), marketing communications is referred to as a collaborative way of connecting between the firm and the target market. Marketing communication normally leads to relationship marketing, provided how well the firm communicates with it target market which in turn is determined by the feedback it receives from the target market. The manner in which to market to consumers has changed. Firms used to use communication channels such as direct marketing, mass advertising, personal sales, public relations, publicity, sales promotion and merchandising, but now they have found new advanced channels which are more effective (Lewis and Chambers, 2001). The introduction of the Internet has brought in new communication channels for marketers to use and has also made it more convenient for consumers as they can do many things like shopping, compare prices and purchase online (Malthouse and Shankar, 2009). Moyo (2014: 5) reveals that Wireless technology (Wi-Fi), which has been implemented at some of the taxi ranks in Johannesburg, has permitted passengers to access the Internet while waiting in the taxi or taxi line. Wi-Fi helps passengers to be connected, do business, pay bills, connect to social networks and even download songs or movies at much reduced prices. For example, one can download a song for only R2, all online.

Russell (2009: 108) supports the aforesaid statements, stating that the use of the internet which began in the 1990s, created an influx of marketers and certainly changed the marketplace. The Internet has become an advertising medium for marketers and has improved the communication tools that marketers have been using for decades such as: radio, television, print (magazines and newspapers) and outdoor. These communication tools are still being used effectively today as advertising agencies continue to spend large amounts of money on traditional media. Radio and outdoor advertisements are still effective and they are boosted by digital technology as it attracts more communication with customers. Business-to-business companies and retailers still find newspapers and magazines important, even though they are negatively affected by the new media.

Shanker and Malthouse (2009) warn that marketers are in danger of not reaching their consumers, many of whom have trained themselves to ignore marketing attempts. The advertisements created by marketers are easily mocked and teased by consumers on YouTube and should the customer be dissatisfied about a product or service, they can simply spread the word around the globe about their bad experience on channels like blogs, Facebook and website bulletin boards. Competition has made it easy for consumers as they can just click for any product from whichever company has the best offer around the world. Customers can shop and purchase easily online.

Russell (2009: 108) suggests that contemporary marketers are providing new communication strategies for their customers; they want to interact more with their customers; enable the customer with quick ways to give feedback about their products; and experience that kind of connection between the two parties. Marketers opt for this route because it is problematic to do this with traditional media. This is more likely to favor the seller than the buyer. These trends have changed the marketplace. Many people, especially learners, are extreme users of social media, and companies can interact with them on channels such as Facebook, Twitter and Mixit effectively. This creates more ways for reaching out to consumers.

Figure 2.7: Classic Communication Model



Winer (2009: 109)

Figure 2.7 (a) shows a traditional mass communication model used by firms. With this model, marketers presumed they had the power over the flow of communication that runs from the company and passes through the media to the consumers. The Modified Mass Communication Model in Figure 2.7 (b) shows interaction between the firms and customers. There is more communication between the parties, following both ways.

Communication and marketing industries currently face the challenge of changing communication channels. The history of communications is being changed by the present digitalization of media. The change in media strategy has always been determined by the change in technology and consumer behaviour (Royle and Laing, 2014). A combination of consumer experience and communication channels forms a good understanding of interactive marketing. Interactive marketing is defined as an integrated exchange process by which an organization uses the understanding of consumer behaviour, technology and other resources to create and manage customer value and collaborative relationships and enhance shareholder value through relevant brands; product/service offerings; ideas and messages; communicated and delivered to the right customers through appropriate channels and contact points at appropriate times (Shanker and Malthouse, 2009).

Lewis and Chambers (2001) indicate that communications from the firm not only create expectations in the target market but also give warnings if the target market is not responding well, not satisfied or if the market is changing. Emerging technologies are constantly bringing challenges and opportunities for experts in the research and education sectors, including industrial sectors. Social networking sites like Twitter and Facebook have revolutionized the way firms are communicating and they are the preferred tools to use now (Royle and Laing, 2014). Lewis and Chambers (2001: 445) report that the communications mix consists of five elements, namely advertising; sales promotion; public relations and publicity; merchandising; and personal selling.

2.5.3 Communication Strategy

Communication strategies comprise the implementation, control and planning of influential communication to the target market. Strategies imply plans, while tactics imply actions (Lewis and Chambers, 2001: 445). Leeflang et al (2014) state that the use of online communications has grown, while communications done on newspapers and magazines are slowly deteriorating. Firms are facing a challenge of keeping up with the digital revolution and changes in society. Ye (2010: 542) approves the idea of online communication and reveals that the modern technology of communication and transportation is recognized as a major factor that enables companies to conduct their business in any part of the world using the Internet. The Internet also supports many small and medium sized enterprises to work together in remote areas and do their business online.

2.5.4 Digital Marketing

Royle and Laing (2014) warn that before a firm can even engage in digital marketing techniques, it is vital for the firm to fully understand digital marketing. Digital marketing is defined as the utilization of digital technologies to produce joined and directed communications which will assist to obtain clients and build relationships between parties. Royle and Laing (2014) further claim that digital marketing is rapidly changing the market-place as firms are quickly adapting to digital marketing techniques, which consist more of online tools such as social media and e-marketing. This type of marketing allows goods and services providers to communicate effectively with their clients on a one-to-one basis, easily receive feedback and even offer personalised solutions for clients.

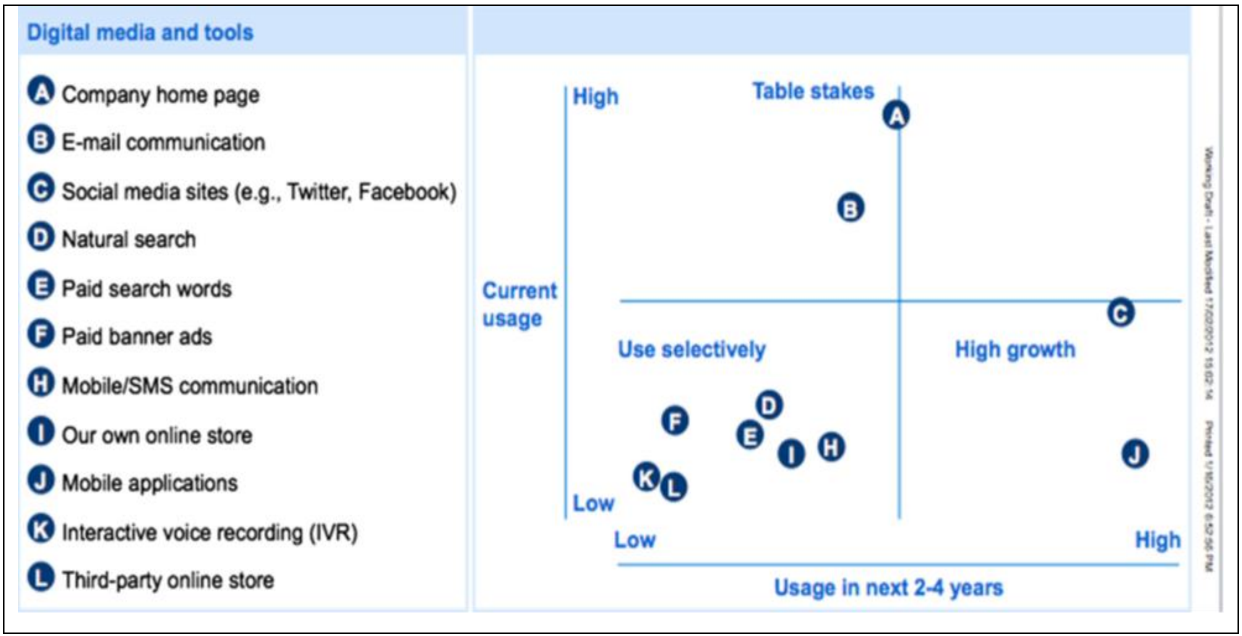
Leeflang, Verhoef, Dahlström and Freed (2014) indicate that digitalization is increasingly bringing more challenges for marketing experts, who are confronted by difficult markets that are ever-changing and uncontrollable. However, some firms have got used to the changes in the markets and can deal with them well. Royle and Laing (2014) define digital marketing as a substitute branch of traditional marketing which utilizes modern digital channels of communication and places products in a quick and convenient way, for example downloading music. Digital marketing is also the main factor in business progress as it permits communication with stakeholders such as investors and customers about the brands and products. Marketing approaches can be improved by digital marketing skills. Therefore, it may be useful to combine the two. Some of the most important digital marketing skills are: search engine optimization (SEO); website construction; and exploitation of social media tools like Twitter and Facebook. Industries that do not use these digital marketing skills may lose out to the competition, have insufficient capability to communicate quickly with their clients and not be able to determine which digital approaches work well for their firms (Royle and Laing, 2014).

2.5.5 Challenges and Solutions for marketing in a digital era

Even though there is a rapid change in the forces of market breakup, the use of the Internet is noted as the key factor in the broadening gap. Marketers have found the Internet to be significant marketplace, where they can easily trade and it is inexpensive. Online transactions are increasing. For example, the spending behaviour of consumers online in the United States exceeded 100 billion dollars in 2007, with growth in terms of products such as magazines, books and software (Leeflang et al, 2014).

Digitalization is bringing new tools to the market-place and companies are wasting no time in exploiting these tools. Figure 2.8 shows a matrix of digital marketing tools, indicating their current usage and future usage.

Figure 2.8: Digital marketing tools



Leeflang at al. (2014)

In Figure 2.8 the tools are listed alphabetically. Companies were asked about their current usage of digital media, their future usage and were rated from low to high on the map. On the current usage, company home pages, e-mail communications and social media sites are mostly used. On future usage, social media and mobile applications were the two digital media tools that companies would use the most (Leeflang et al, 2014).

2.5.6 Circumstances in the non-profit marketing sector

According to Kirtis and Karahan (2011: 260), the financial state of the economy influences organizations' marketing methods and buyers' recognitions. During and after an economic decline, marketing communication functions carry crucial role in the survival of the organisation or keeping up profits and maintaining customers. Iyer et al (2014: 59) supports this and reveals that marketing communication functions are extensively being utilized as a key instrument by organizations to improve and maintain a positive brand identity for their products or services. Nevertheless, the recession still affects many organisations and they are now searching for ways to deal with this challenge. As a result, organizations are joining social media to save costs and also achieve their other goals. Social media is believed to have remarkable advantages in business areas such as audience relations, customer relations and cost advantages (Kirtis and Karahan, 2011: 260).

The authors (Kirtis and Karahan, 2011: 262) also reveal that “Social Media roughly means different way in which Internet users interact with one another online, involving activities like creating and commenting on blogs, sharing content or communicating with friends via social networking sites like Facebook or MySpace. When new members join such a site, they typically create an online profile page which makes them get in touch with other members via email or instant messaging”.

Chad et al (2014: 342) state that a number of executive members of non-profit organizations are faced with the problem of competition in the market and that forces them to engage new improved strategies if they want to achieve their goals. However, the crux of the issue is that these executives have serious anxieties and misunderstand the marketing concept. They believe that organisations who are engaged in marketing activities are doing it with the purpose of making money and that marketing is not suited for their non-profit organizations. Chad et al (2014: 343) define the marketing concept as “the marketing management philosophy which holds that achieving organisational goals depends on knowing the needs and wants of target markets and delivering the desired satisfaction better than competitors”.

A lack of funds, which is caused by the recession, has affected non-profit organisations’ financial stability and it seems as if the marketing concept can be of use to improve organisational performance (Chad et al, 2014: 342). The choice of media is another factor that has an influence on customers’ perception of a marketer’s brand (Iyer et al, 2014: 59). One of the ways in which the firm can bring down its expenses is by moving to social media marketing (Kirtis and Karahan, 2011: 260). Thus, since the space industry is a non-profit organization, it would be wise for the organization to exploit marketing tools such as social media as it contains many advantages, such as costs and audience.

2.6 CONCLUSION

This chapter explained the concept of space. It has covered the background of space, the significance and benefits of space applications, space opportunities and the space industry. Aspects such as space education, outreach programmes and careers both locally and internationally have also been explained. Space awareness, marketing communication and the non-profit sector has also been touched on. This was significant in relation to some of the sub-objectives of the study. The next chapter details the methods that were used in obtaining the required results.

CHAPTER THREE

RESEARCH METHODOLOGY AND DESIGN

3.1 STUDY TYPE

Research design is a plan of how the study is to be conducted (Mouton, 2006: 55) and for solving the research problem (Leedy and Ormrod, 2005: 85). Mouton (2006: 107) adds that research design is a strategy that predicts ways in which to collect and analyse information through a well-developed plan, in order to help the researcher to avoid mistakes. The type of research conducted in this study is descriptive in nature. Best (2012: 259) suggests that descriptive surveys are of good use when used to measure a range of demographic characteristics such as age, gender, race, sexuality, as well as data on people's behaviors, beliefs and attitudes. A significant element of a descriptive survey is comparison, how does one group differ from another group. As a result, a descriptive survey is vital for the study as it will determine the respondent's knowledge, perception and awareness of the South African space industry.

According to Creswell (2003: 75) and Gomm (2009: 271), quantitative research seeks to know and comprehend what variables or factors that influence an outcome. It collects and studies data and searches for the cause and effect of the problem. Hence, a quantitative data collection via a survey is used.

3.2 TARGET POPULATION

The target population refers to a sub-group of the total population that is made up of units from various sub-groups in which the researcher might be interested (Wegner, 2001: 169). The target population is thus that portion of the population or group which the researcher is intending to use for the study (McMillan and Schumacher, 2008). The target population for this research was secondary school learners in grades 10, 11 and 12 from schools within the Umlazi district. These grades were chosen as at this stage that learners start considering careers and when they receive career guidance. The Umlazi district was selected for convenience reasons, as well as the fact that it includes urban, sub-urban and rural schools. When interviewed on 24 May 2013, Mr Coetzee (Department of Education Deputy Director) stated that the population size of learners doing grades 10, 11 and 12 in this district was approximately 15 000. The schools at Umlazi district were convenient for the researcher to access and they were also suggested and agreed to by the KZN Deputy Director in the Department of Education.

3.3 SAMPLING METHOD

Purposive sampling was selected as the first stage of sample selection as the chosen schools were categorized into rural, urban and sub-urban areas. The reason behind this selection is that learners in schools located in different regions may be expected to have different understandings and perceptions of outer space. There is probably a big gap between a student who is studying in a rural area and a student who is studying in an urban or sub-urban area, as those in the urban or sub-urban area are more likely to be exposed to and have greater access to mass media. Quota sampling was then used in the second stage of the sampling process to ensure a spread across the population. Due to the impracticality of developing a sampling frame to select units for each of the quota cells, convenience sampling was used to select respondents for each cell.

3.4 SAMPLE SIZE

Table 3.1 illustrate how the sample size was structured.

Table 3.1: Sample Size

School location	Secondary schools	Grade 10	Grade 11	Grade 12	Total per school
Rural secondary school	Mhawu	21	21	21	63
Rural secondary school	Skhwama	21	21	21	63
Urban secondary school	KwaMakhutha	21	21	21	63
Urban secondary school	Commercial	21	21	21	63
Sub-urban secondary school	Sastri College	21	21	21	63
Sub-urban secondary school	Burnwood	21	21	21	63
Sample size					**378**

According to Sekaran and Bougie (2010), a population size of 15 000 requires a sample size of 375. A sample size of 378 respondents with 63 within each of the sampling units (local secondary schools in Umlazi district) was selected, consisting of both males and females, with an equal split between the three grades and the two genders. Regarding the selection of six schools, the researcher was guided by the sample size of 378, meaning it had to have an equal size in all schools and grades.

3.5 DATA COLLECTION

Hawkins, Mothersbaugh and Best (2007: 750) suggest that surveys are methodological ways of putting together data if the population is large by using questionnaires. A questionnaire is a collection of pre-determined questions which will capture data from the members of the population (Hair, J., Babin, B., Money, A. and Samouel, P. 2003: 130).
After obtaining permission from the KZN Department of Education and the school principals, the researcher made appointments with the principals to conduct research with the learners. Questionnaires which consisted of both closed-and-open ended questions, with the aim of determining learners' knowledge, perception and awareness of the space industry, were prepared and ready to be used, together with consent forms. The questionnaire was divided into 5 sections, namely Demographic information; Respondent's knowledge of the space industry; Awareness of careers in the space industry; Assessment of knowledge on career opportunities in the space industry; and Marketing communications. All these sections comprised 31 questions, including those in Likert scale format. They covered all the objectives of the study, as illustrated in Table 3.2.

Table 3.2: Questions and covered sections

Sections	Questions	Covered sections
Demographic information	4.1.1, 4.1.2, 4.1.3, and 4.1.4	**Sub-objective 4**: To determine the demographic differences of levels of awareness of a space industry in South Africa (male/female, grade 10, 11, and 12, types of schools).
Respondents' knowledge of the space industry	4.2.1 to 4.2.9	**Sub-objective 1**: To identify learners' level of awareness of the South African space industry. **Sub-objective 2**: To identify learners' perceptions of employment opportunities in the South African space industry. **Sub-objective 3**: To identify the knowledge of the educational requirements to gain employment in the space industry.
Awareness of careers in the space industry	4.3.1 to 4.3.11	**Sub-objective 1**: To identify learners' level of awareness of the South African space industry.
Assessment of knowledge on career opportunities in the space industry	4.4.1 to 4.4.4	**Sub-objective 2**: To identify learners' perceptions of employment opportunities in the South African space industry.
Marketing communication	4.5.1 to 4.5.3	**Sub-objective 5**: To identify the marketing communication factors that influence the learners' level of awareness about the South African space industry.

The researcher met with the learners in a nearby hall during their break times, between 10:00am and 12:00am. The hall was equipped with writing materials nicely prepared by the teachers. The researcher explained all the concepts of the space industry, its significance, benefits and opportunities before the questionnaires were distributed to the learners. The researcher went through each and every question with the learners before they could answer. In order that everybody could follow, understand and be in line with other learners. Regarding the schools in the rural area, some of the learners had difficulties with English. Therefore, the researcher explained every question in the language they understood such as IsiZulu. The process of data collection took 45 minutes with each school, which was sufficient for the study and the overall data collection process took 2 months, between 01 February and 31 March 2015.

3.6 DATA ANALYSIS

Birley and Moreland (2014: 588) state that the purpose of coding data is to render the data in a form which can be presented and analysed. After data was collected, questionnaires were checked, cleaned and analyzed using the SPSS statistical package (version 23.0). Descriptive statistics, which summarizes the results in the form of graphs and tables, were used and other inferential statistical methods such as Kaiser-Meyer-Olkin (KMO) and Bartlett's test; Correlation Coefficient 2-tailed test; Pearson Chi-square test; and Hypothesis test were also utilised. KMO and Bartlett's test false under factor analysis and are used only for Likert scale items. The Correlation coefficient 2-tailed test was used to check the relation or relationship between the tested variables using the p – value of 5% ($p > 0.05$). The Pearson Chi-square test was done to determine the scoring patterns per statement using the p – value of 5% as well. The Hypothesis test was used to determine the significant difference between the level of agreement and disagreement on the tested variables, similarly guided by the p – value of 5%.

3.7. VALIDITY

According to Leedy and Ormrod (2005: 31) validity refers to the extent to which the tools being used assess or evaluate what is expected. Validity of the questionnaire was ensured as it was designed under the guidance of the supervisor and a statistician.

3.7.1 **Face validity**: This was ensured by going through the questionnaire together with the respondents; explaining each section on the questionnaire before tasking the respondents to complete it on their own. The pilot study, which was conducted at the nearest secondary schools also played a major role.

3.7.2 **Content validity**: This was ensured by aligning the questions with the objectives or research issues that were meant to be achieved. The researcher also made certain that there were sections in the literature review that covered those questions.

3.8 RELIABILITY

Peter and Churchill (1986) have shown empirically that the measuring instrument has the greatest influence on the reliability of data. These authors suggest that the characteristics of measurements are best controlled by the careful construction of the instrument, such that a well-designed questionnaire can boost the reliability and validity of the data to acceptable tolerances. Sekaran (2006: 203) posits that the reliability of an assessment reflects the range to which there will be no favouritism. Therefore, it guarantees coherent assessment upon different tools that are being used to collect data. Cronbach’s alpha co-efficient was used to ensure the reliability of the study, with a required coefficient of 0.7, which is used for newly developed questionnaires.

3.9 CONCLUSION

This chapter explained the methods and research design, with to be the aim of completing the study. Each sub-heading (target population, sampling technique, sample size, data collection, data analysis, validity and reliability) was then defined and explained in line with how it was incorporated into the study. After these methods were implemented, results were achieved and they are presented in the next chapter.

CHAPTER FOUR

FINDINGS, INTERPRETATION AND DISCUSSION

4.1 INTRODUCTION

The main aim of the study is to explore secondary school learners' awareness of the South African space industry, how career opportunities have been promoted to these learners and what has influenced such awareness, or lack thereof.

The aim of the study is achieved through the following objectives:

- To identify learners' levels of awareness of the South African space industry.
- To identify learners' perceptions of employment opportunities in the South African space industry.
- To identify the knowledge of the educational requirements to gain employment in the space industry.
- To determine the demographic differences in levels of awareness of the space industry in South Africa (male/female; grades 10, 11 and 12; types of schools).
- To identify the marketing communication factors that influence learners' levels of awareness about the South African space industry.

This chapter presents the results and discusses the findings obtained from the questionnaires in this study. The questionnaire was the primary tool that was used to collect data and was distributed to learners at schools in different location categories. The data collected from the responses was analysed with SPSS version 23.0 for windows. The descriptive statistics will be presented in the form of graphs, cross tabulations and other figures for the quantitative data that was collected. Inferential techniques include the use of correlations and chi square test values.

4.1.1 Demographics

In this study, demographics refer to elements such as age, gender, race/ethnicity, school location and grade. Demographics form the foundation of the survey and thus the results of it are shown in Tables 4.1 and 4.2 and Figure 4.1.

4.1.2 Gender and age

Gender and age were found to be significant for the study as they determined the exact group that had the most effect on the research.

Table 4.1: Gender distribution by age

			Gender		**Total**
			Male	Female	
Age (years)	14 - 16	Count	29	51	**80**
		% within Age	36.3%	63.8%	**100.0%**
		% within Gender	38.2%	53.7%	**46.8%**
		% of Total	17.0%	29.8%	**46.8%**
	17 - 19	Count	39	39	**78**
		% within Age	50.0%	50.0%	**100.0%**
		% within Gender	51.3%	41.1%	**45.6%**
		% of Total	22.8%	22.8%	**45.6%**
	20 or over	Count	8	5	**13**
		% within Age	61.5%	38.5%	**100.0%**
		% within Gender	10.5%	5.3%	**7.6%**
		% of Total	4.7%	2.9%	**7.6%**
Total		Count	76	95	**171**
		% within Age	44.4%	55.6%	**100.0%**
		% within Gender	100.0%	100.0%	**100.0%**
		% of Total	44.4%	55.6%	**100.0%**

Table 4.1 illustrates that the majority of respondents were females (55.6%) and between the ages of 14 and 19 (92.4%). The "% of total" rows show that there is a reasonable split of respondents across the gender and 14-16 and 17-19 age categories. As expected for a study of school learners, the number of respondents of 20 and over was small, only 7.6% of the total. Thus, the achieved sample appears to be adequately representative of a school-going cohort.

4.1.3 Grades in the schools

Only three grades were selected in each school for the study, and that was grade 10, 11 and 12 and their results are shown in Figure 4.1.

Figure 4.1: Grades of the respondents

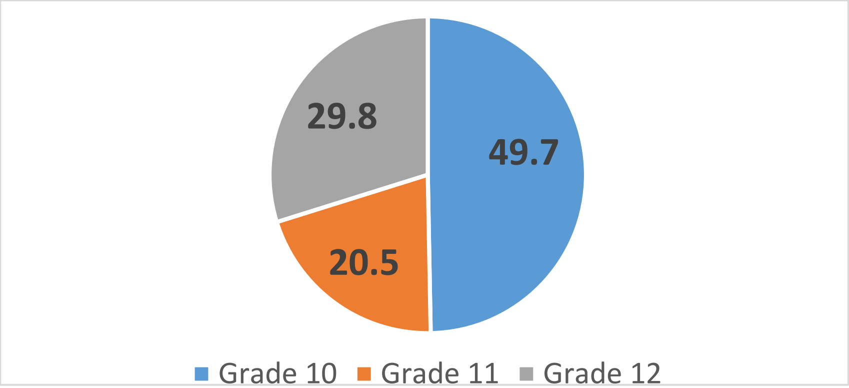


Figure 4.1 indicates that the study was dominated by grade 10 learners, which had 49.7%; followed by grade 12 with 29.8%; and the least was grade 11 with 20.5%. Although more Grade 12s were interviewed than planned for, this is not a problem as the entire sample is still shown to be within the overall delimitations. Furthermore, Grade 12 opinions are probably of greater value, as they are much closer to having to take decisions about tertiary study or employment.

4.1.4 Location of the schools

The location of the schools (rural, urban and sub-urban) played a crucial role as it influenced the respondents' impact on the study.

4.1.4.1 Circumstances in the schools that were visited for data collection

An interview was conducted with one of Statistics South Africa's (Stats SA) Geographic Information System (GIS) specialists about the ArcMap. Rajah (2016) revealed that there is an ArcGIS programme called ArcMap that uses satellite imagery to display the topological features on the ground. ArcMap was thus used to map or outline the schools for the study, as shown in appendices number 1.

Schools in the rural area

With regard to the two schools that were selected in the rural area, the situation is as follows:

- The schools are located between 10 and 15km away from Umlazi Township.
- In the first school, a library which had better facilities was allocated for the researcher. However, the turnover was massive. More than 50 respondents participated and the library became too small as other respondents had to stand during the data collection process.
- In the second school, a classroom which also consisted of more than 50 respondents (all grades combined) was used.
- The facilities were bad, with no air conditioners, few tables and chairs, and some respondents had to stand for the entire duration of the data collection.
- Both venues were not in a conducive condition for the study.

Schools in the urban area

The following circumstances were observed in the urban schools:

- Umlazi Commercial secondary school is between 10 and 12 km away from Durban central.
- Kwamakhutha secondary school is 10 km away from Isipingo central.
- Both schools organised a classroom for the researcher to meet with all respondents.
- The venues were not conducive as they were too small for respondents of all grades.
- The facilities were insufficient.

Schools in the sub-urban area

The school in the sub-urban area had the following conditions:

- Sastri College is 2km away from Durban central.
- A big, well organized hall was used to meet with the respondents.
- The facilities (air conditioner, tables and chairs) were very good.
- The venue was very conducive to data collection.
- All respondents were seated and paid full attention to the researcher.

Table 4.2: Location of schools

	Frequency	Percent
Rural	59	34.50
Urban	56	32.75
Sub-urban	56	32.75
Total	171	100.00

Table 4.2 reveals that the sample is almost evenly split between the rural, urban (townships) and sub-urban regions, as planned for in the quota sample.

4.2 Descriptive Statistics

The results have been summarised into graphs and tables through descriptive statistics which summarise large volumes of data into a few summary measures. When large volumes of data have been gathered, there is a need to organize and extract the essential patterns and information contained within this data for communication to relevant stakeholders. This is the role of descriptive statistics (also called exploratory data analysis). It seeks to paint a picture of a problem scenario. Through summary measures such as tables and graphic displays (Wegner, 2007: 8).

4.2.1 The response rate

The total population size in the study was 15 000 and according to Sekaran and Bougie (2010) a sample size of 375 is adequate. However, a sample size of 378 was selected for the study to facilitate splits between categories. Of the 378 questionnaires despatched, only 171 were returned. This was due to the unavailability of the required respondents. Thus, a response rate of 45.2% was achieved. This low response rate might risk respondents and non-respondents being different in some way. However, this is less of a problem since this is an exploratory study.

4.2.2 Reliability and Validity Statistics

The two most important aspects of accuracy are **reliability** and **validity**. Reliability is computed by taking several measurements on the same subjects. A reliability coefficient of 0.70 or higher is considered as "acceptable" (Frost et al, 2007).

Table 4.3 reflects the Cronbach's alpha score for all the items that constituted the questionnaire.

Table 4.3: Reliability statistics

Reliability Statistics - Q3

Cronbach's Alpha	N of Items
.730	9 of 11

Reliability Statistics - Q4

Cronbach's Alpha	N of Items
.395	3 of 4

Questions 3 and 4 are the core of the questionnaire, collecting the data required to answer the main research problem. Therefore, reliability and validity testing is done only on these questions.

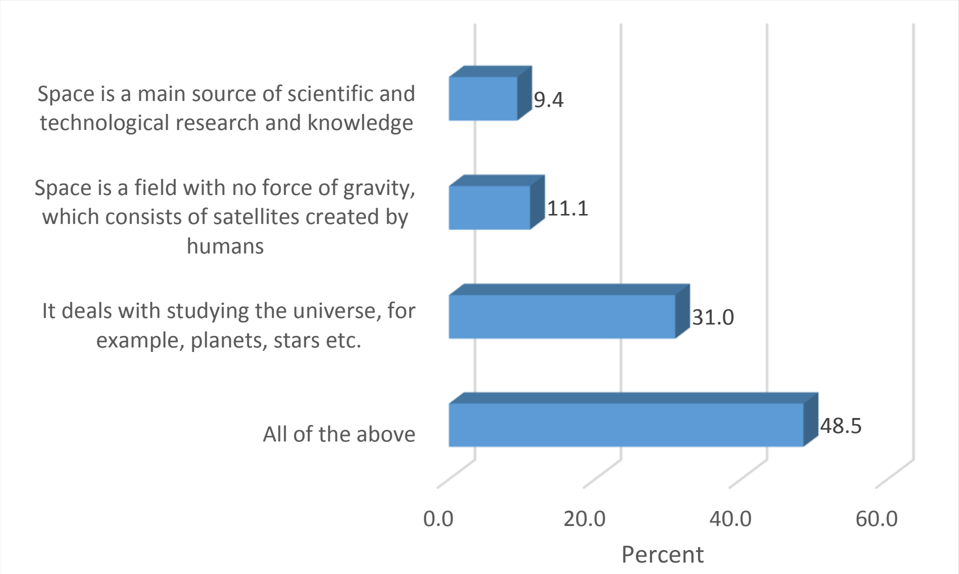
The reliability scores for question 3 exceed the recommended Cronbach's alpha value of 0.70 for a newly developed construct. This indicates a degree of acceptable, consistent scoring for these sections of the research. Values of alpha ranging from 0.70 to 0.90 are acceptable (Tavakol and Dennick, 2011).

Question 4 had a low score. This is mainly due to the minimum number of statements that constituted the section. Respondents had variations in their interpretations of the statements, resulting in the lack of consistency.

4.3 Findings: Section B: Respondents' knowledge of the space industry

This section summarises the respondents' knowledge of the space industry.

Figure 4.2: Which of the following do you associate with the space industry?



Based on the findings in Figure 4.2 majority of the respondents which made 48.5% opted for all of the above when asked about certain alternatives that associate with the space industry. And about 31% associated space with the study of the universe. This simply shows that the respondents were familiar with the space industry.

Figure 4.3: Space technology help with important service/s on earth such as...

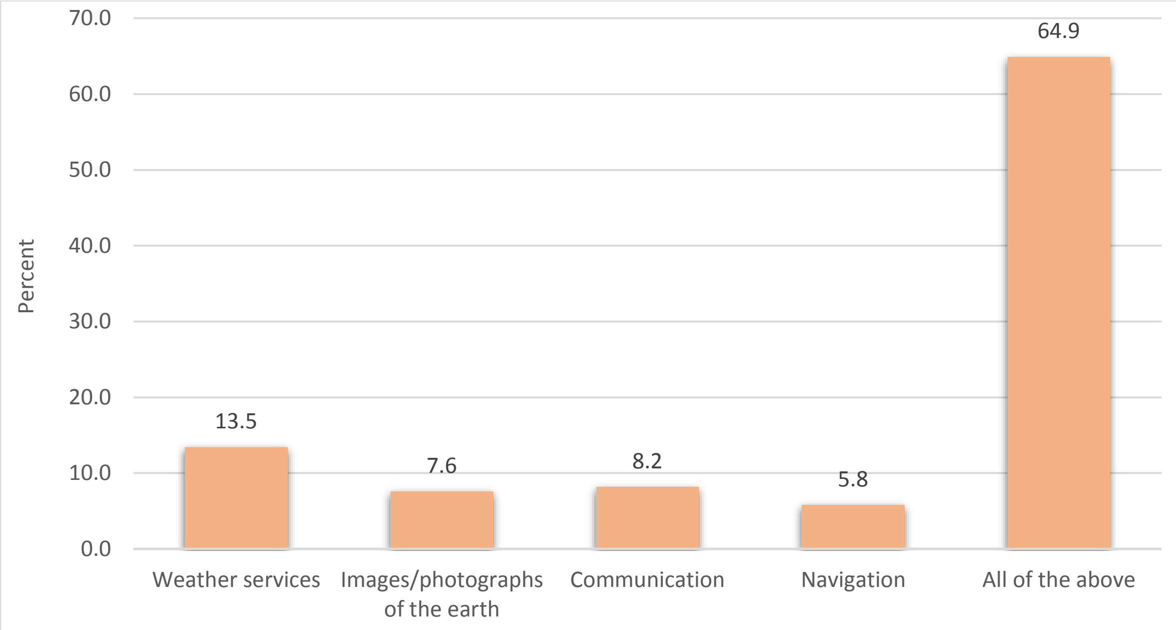


Figure 4.3 shows that many respondents understood what space technology is and how it helps on earth. This was shown by the average of 64.9% (94%) for the all of the above option, with the minority choosing other alternatives.

Figure 4.4: Which of the following are examples of space technology?

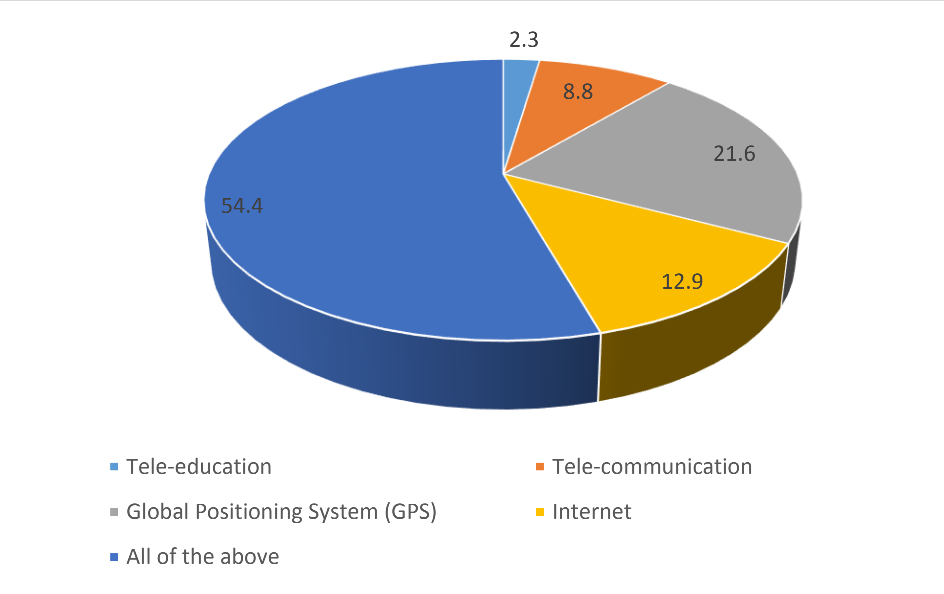


Figure 4.4 comprised examples of space technology and the respondents were asked to choose one that was most suitable amongst the given alternatives. Most (54.4%) of the respondents chose 'all of the above'; 21.6% chose Global Positioning System; 12.9% went for Internet; 8.8% selected Tele-communication; and the least (2.3%) chose Tele-education. This shows that the majority of the respondents knew many things about space technology, again showing a reasonably high level of understanding.

Figure 4.5: The following professions are found in the space industry...

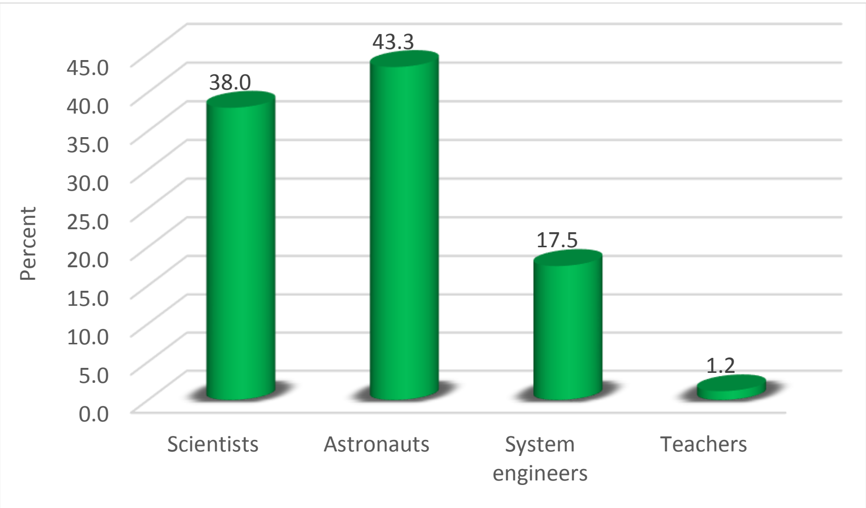
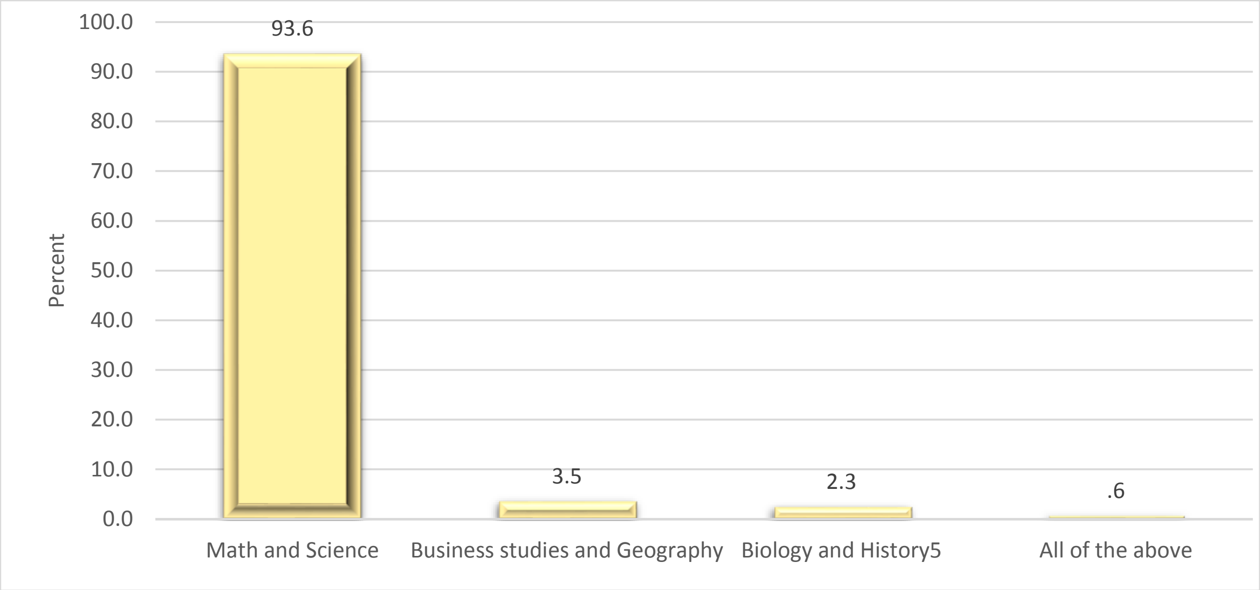


Figure 4.5 shows that more than 80% of the respondents chose Scientists and Astronauts as the professions that are found in the space industry, whereas only 17.5% went for

System engineering and 1.2% selected Teachers. It is thus questionable whether many respondents actually understand the wide variety of careers available in the space industry.

Figure 4.6: In order to qualify for space-related studies, one needs to get outstanding results in...



According to Figure 4.6, a significant majority of 93.6% respondents identified mathematics and Science as being the core subjects that were required for space studies. For business studies and Geography, it was 3.5%; 2.3% chose Biology and History; and the least (6%) selected ‘all of the above’. This shows that many learners are aware of what studies are of main priority with regard to careers in the space industry. However, it possibly shows a lack of understanding of jobs other than science and engineering in the space industry, i.e. the need for accountants, marketers, managers, etc. in space-related companies.

Figure 4.7: Which of the following job opportunities are found in the space industry?

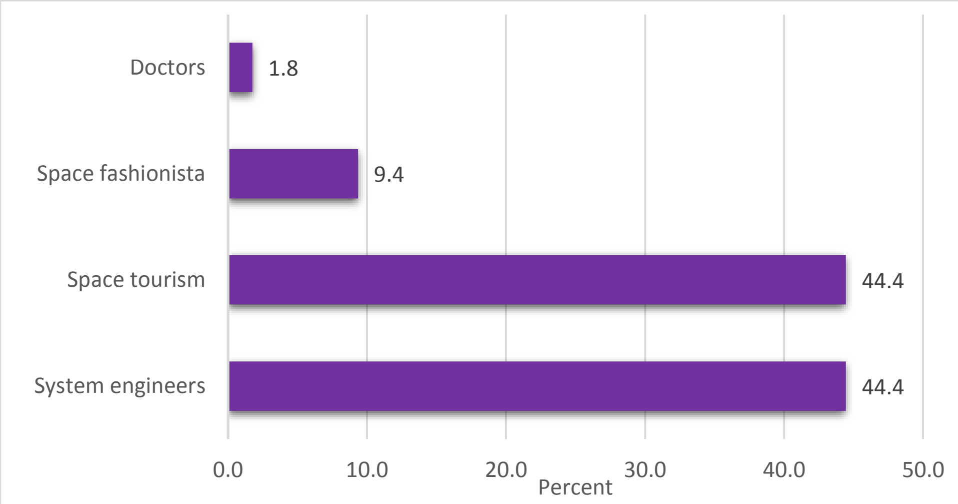


Figure 4.7 indicates that there is a significant number of respondents who are familiar with System Engineering and Space Tourism, both having 44.4% (90%). There was a big difference with other alternatives, as Space fashionista only had 9.4% (20%) and Doctors the least with 1.8% (5%). This indicates that awareness may be a function of media coverage, which space tourism has received a lot of.

Table 4.4: The space industry helps the country in terms of...

	Frequency	Percent
Safety and Security	12	7.0
Science and Technology development	138	80.7
Societal issues	5	2.9
All of the above	11	6.4
None of the above	5	2.9
Total	171	100.0

Table 4.4 shows that more than 80% of the respondents know the space industry as being of help on only Science and Technology development. Only about 7% chose Safety and Security; 6.4% chose all the alternatives given; 2.9% selected Societal Issues; and the remaining 2.9% chose 'none of the above'.

Table 4.5: Attending university and career advisor

Table 4.5 indicates the cross-tabulation between “Attending university is necessary to work in the space industry” and “Our career advisor has mentioned the space industry as a career”.

			Our career advisor has mentioned the space industry as a career.			Total
			Yes	No	We don’t have a careers advisor	
Attending university is necessary to work in the space industry.	True	Count	65	42	58	**165**
		% of Total	38.0%	24.6%	33.9%	**96.5%**
	False	Count	1	2	3	**6**
		% of Total	.6%	1.2%	1.8%	**3.5%**
Total		Count	66	44	61	**171**
		% of Total	38.6%	25.7%	35.7%	**100.0%**

Regarding attending university, the table shows that almost all the respondents (96.5%) responded positively towards attending university. About the career advisor, even though the number of schools that have career advisors is slightly higher, 38.6% said careers advisers had mentioned the space industry as a career. However, there are still many secondary schools that do not have a career advisor, 35.7% of them. The other 25.7% said they do have a career advisor but that advisor has never mentioned the space industry as a career.

4.4 Findings: Section C: Awareness of careers in the space industry

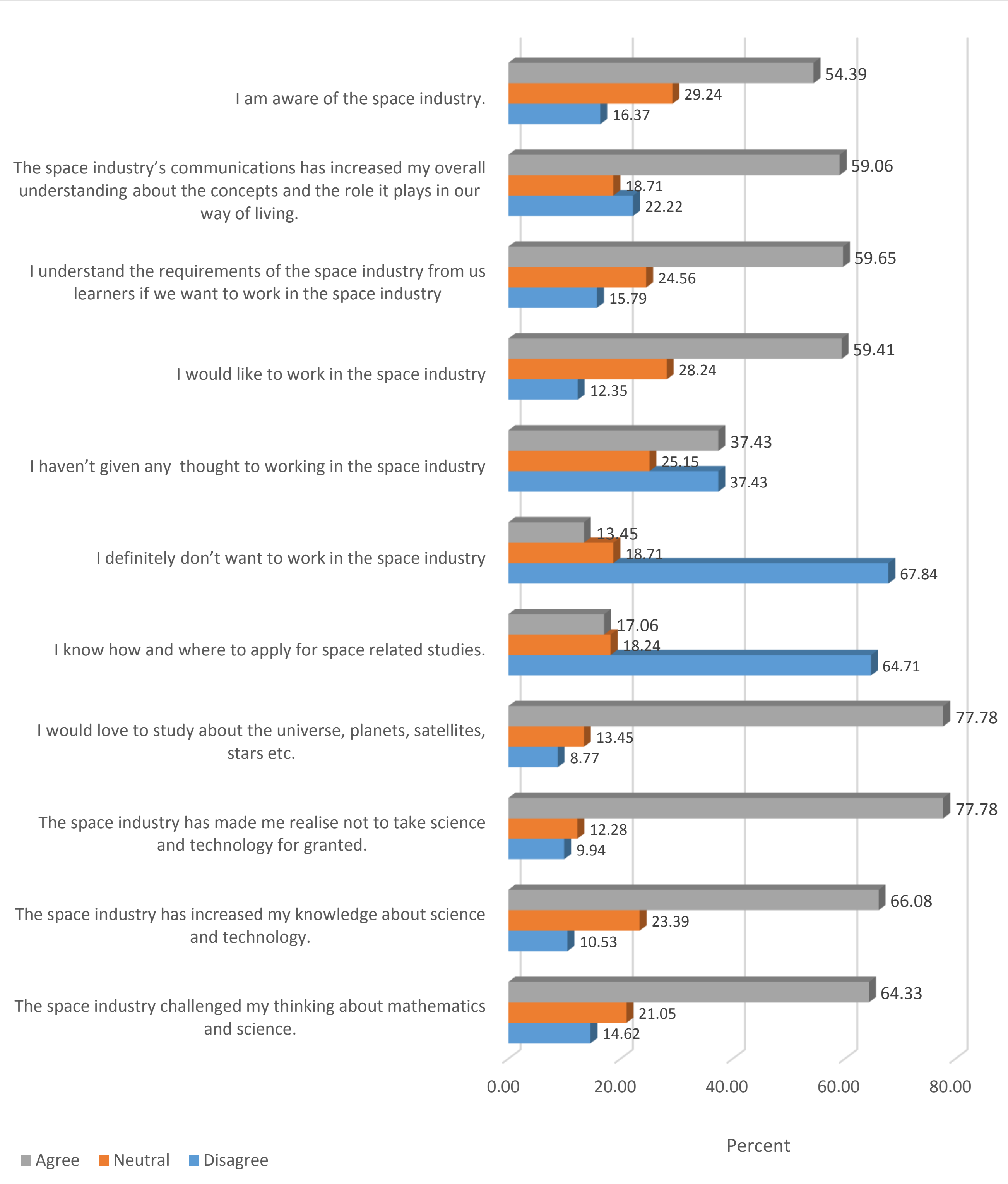
Section Analysis

This section analyses the scoring patterns of the respondents per variable per section. Where applicable, levels of disagreement (negative statements) were collapsed to show a single category of “Disagree”. A similar procedure was followed for the levels of agreement (positive statements).

The results are first presented using summarised percentages for the variables that constitute each section. Results are then further analysed according to the importance of the statements.

This section covers the first objective which is “to identify learners’ level of awareness of the South African space industry”. The results in Figure 4.8 show a clear indication of what the learners think; their perception of the industry; and what it does for them. For example, challenging their minds.

Figure 4.8: Awareness of the space industry as a career



According to Figure 4.8, the majority of respondents were aware of the space industry. More than 60% indicated that they understand the role played by the space industry, including the requirements if they want to work there. In addition, they would love to work and also study space-related courses as the space concept enlightens them about the importance of maths and science. However, a large number (64.71%) of these respondents do not know how and where to apply for space-related studies, whilst others, (37.43% - 50%) have not given any thought to working in the space industry. Thus, as much as the majority are aware and would like to work and study the space industry, there are still many respondents who see the space industry as a sector of high calibre and not for them. They even lack knowledge of the sources of information about the industry. This, however, shows that the industry still has a deficiency in terms of promoting career opportunities and providing a platform for learners.

To determine whether the scoring patterns per statement were significantly different per option, a chi-square test was done. The null hypothesis claims that similar numbers of respondents scored across each option for each statement (one statement at a time). The alternate states that there is a significant difference between the levels of agreement and disagreement. The results of the chi square test are shown in Table 4.6

Table 4.6: Chi square test for awareness questions

	Chi-Square	df	Asymp Sig.
I am aware of the space industry.	38.351	2	.000
The space industry's communications has increased my overall understanding about the concepts and the role it plays in our way of living.	51.263	2	.000
I understand the requirements of the space industry from us learners if we want to work in the space industry	55.263	2	.000
I would like to work in the space industry	58.459	2	.000
I haven't given any thought to working in the space industry	5.158	2	.076
I definitely don't want to work in the space industry	92.316	2	.000
I know how and where to apply for space related studies.	75.329	2	.000
I would love to study about the universe, planets, satellites, stars etc.	152.561	2	.000
The space industry has made me realise not to take science and technology for granted.	152.14	2	.000
The space industry has increased my knowledge about science and technology.	86.772	2	.000
The space industry challenged my thinking about mathematics and science.	74.982	2	.000

Table 4.6 shows that almost all the significant values (p-values) are less than 0.05 (the level of significance), which implies that the distributions were not similar. That is, the differences between the way respondents scored (agree, uncertain, disagree) were significant. This implies that these findings are meaningful and can be seen as true reflections of the opinions of the sample and not results that have been obtained purely by chance. The one anomaly is "I haven't given any thought to working in the space industry". As shown in Figure 4.8, this had a significance of 0.076. The distribution for this question is similar, meaning that many respondents, although being attracted to the industry, do not see any opportunities for themselves. This could be due to chance but is more likely due to a large number of respondents not having been exposed to the space industry as a career

opportunity or them perceiving the need for good grades in mathematics and science, which most learners do not get.

4.5 Findings: Section D: Assessment of knowledge on career opportunities in the space industry

One of the research objectives, “perceived opportunities in the space industry”, is illustrated in this section. Different statements were given to test the learners’ knowledge of opportunities offered in the space industry.

Figure 4.9: Knowledge of career opportunities in the space industry

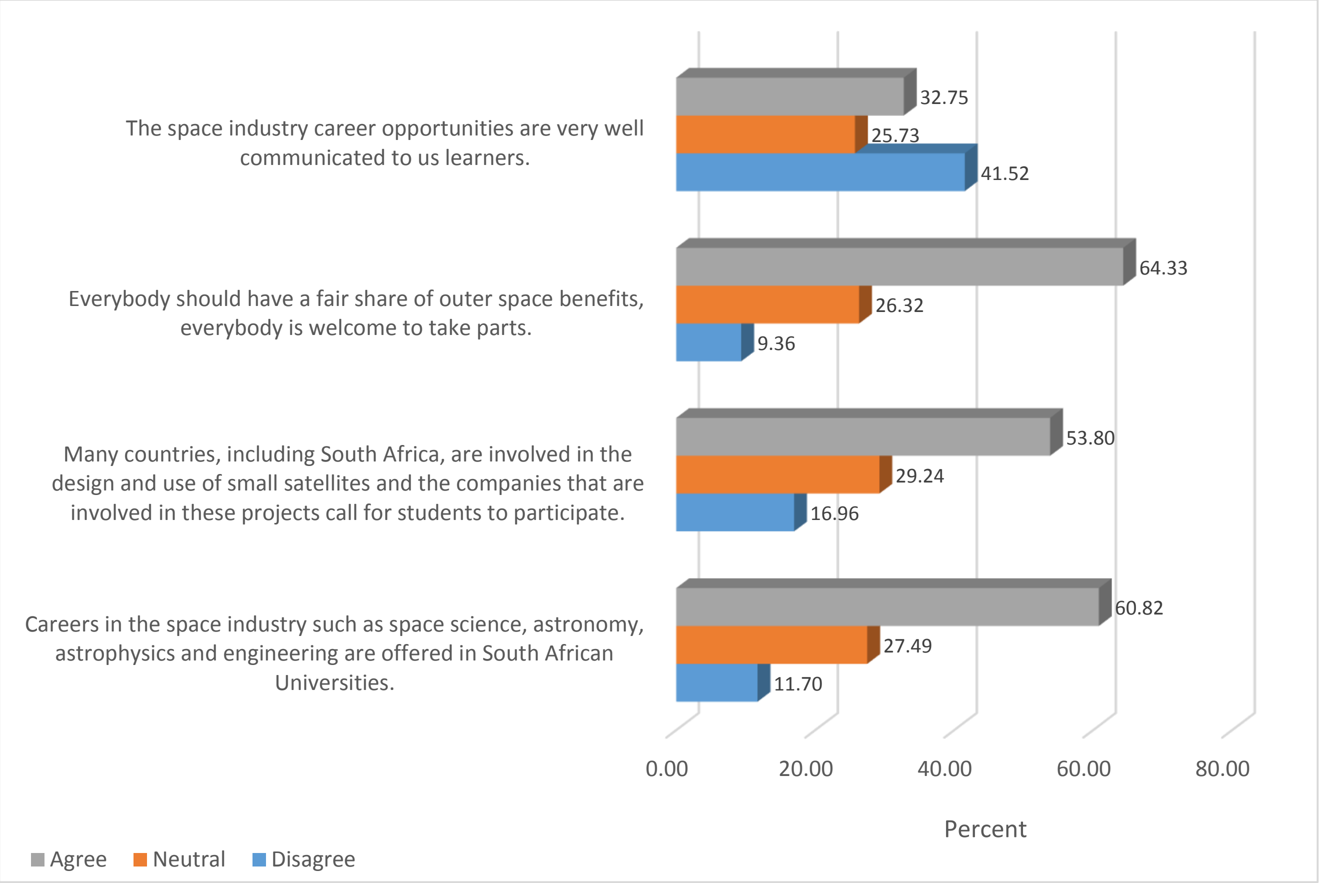


Figure 4.9 shows that 41.5% of the respondents do not know about the career opportunities available in the space industry as it is not communicated to them. A majority (64.3%) do understand the space field and its benefits. Half of them (53.8%) do know that South Africa is a player in the industry and that the country is involved in the design and use of small satellites and the industry is open to learners to participate. The last statement talked about

training for careers such as space science, astronomy, astrophysics and engineering in South African universities. Hence, 60.8% of respondents knew that such courses are offered in South African universities, possibly meaning that they are observers of the space industry and its careers.

The chi-square tests for these questions are shown in Table 4.7:

Table 4.7: Chi-square tests for career opportunity questions

	Chi-Square	**df**	**Asymp Sig.**
The space industry career opportunities are very well communicated to us learners.	6.421	2	**.040**
Everybody should have a fair share of outer space benefits, everybody is welcome to take parts.	81.298	2	**.000**
Many countries, including South Africa, are involved in the design and use of small satellites and the companies that are involved in these projects call for learners to participate.	36.105	2	**.000**
Careers in the space industry such as space science, astronomy, astrophysics and engineering are offered in South African Universities.	64.526	2	**.000**

All of the patterns are significantly different per statement. Again these are significant, and can be believed to be true reflections rather than chance results, as shown by significant values below 5% ($p<0.05$).

4.6 Findings: Section E: Marketing Communication

The last part of the survey is directed to marketing. It covers objective number 5, which is “to identify the marketing communication factors that influence the learners’ level of awareness about the South African space industry”.

Table 4.8: Do you believe there is sufficient marketing of the space industry in South Africa?

	Frequency	Percent
Yes	42	**24.6**
No	129	**75.4**
Total	**171**	**100.0**

Table 4.8 shows that many respondents (75.4%) do not believe that there is sufficient marketing of the space industry in South Africa. In other words, the space industry is not marketing itself enough to the learners.

Table 4.9: Which communication media would you prefer to learn about the space industry from?

	Frequency	Percent
Internet	52	**30.4**
Magazines and Newspapers	17	**9.9**
SMS	2	**1.2**
Social Media	25	**14.6**
All of the above	73	**42.7**
None of the above	2	**1.2**
Total	**171**	**100.0**

Table 4.9 indicates that most respondents opted for all the alternatives (42.7%) when asked about which communication media they prefer to learn about the space industry from. The Internet, with 30.4% was the second most preferred media, followed by social media with 14.6%. Other alternatives had lower scores, with magazines and Newspapers getting 9.9%; SMSs and none of the above being the least with 1.2%. Clearly, if the industry wants to create awareness among learners, they need to use the ‘new media’.

In addition to the aided recall questions mentioned in Table 4.9, respondents were also offered an open ended question on what the industry could do to improve its marketing of careers, the results of which are given in Table 4. 10

Table 4.10: How can the space industry improve its marketing of careers?

	Frequency	Percent
Advertise more	84	**49.1**
Advertising more	19	**11.1**
By advertising themselves more	1	**.6**
Hold more talk shows explaining about space	1	**.6**
Improve its marketing methods on careers	1	**.6**
Inform institutions	25	**14.6**
Informing institutions	11	**6.4**
More talk shows	1	**.6**
Take people into space	1	**.6**
Teach the public interesting news about space	1	**.6**
There should be more marketing on careers	1	**.6**
They must send people who will inform and educate the public	1	**.6**
Through publicity	2	**1.2**
Total	**149**	**100.0**

Table 4.10 illustrates that the majority of the respondents, approximately 75%, believe that the space industry can improve its marketing of careers through advertising. Advertising more would therefore educate more learners about space and may even stimulate them to choose space related careers. The second most frequently mentioned method was the better ‘informing of institutions’ (21%), which can be taken to imply better information being supplied to schools and career guidance councillors.

4.7 INFERENTIAL STATISTICS

According to Cooper and Schindler (2003: 520), statistical inference is an application of inductive reasoning. It allows one to reason from evidence found in the sample to draw conclusions one wishes to make about the population. Wegner (2007) reveals that Statistical inference is the process of making an estimate, prediction or decision about a population based on the sample data. Inferential statistics is a body of methods used to draw conclusions or inferences about characteristics of populations based on sample data (Wegner, 2007).

If the calculated ***p*** (probability/chance) is small, it is likely that the null hypothesis is false. The null hypothesis would therefore be rejected and the alternate hypothesis would be accepted. Statisticians often use a cut-off point of $p=0.05$, or 5%. This cut-off value is known as critical *p*. A null hypothesis with a less than 5% chance of being true is rejected. When the null hypothesis is rejected, the differences observed between groups or the relationships observed between variables, are said to be statistically significant (Corder, and Foreman: 2014).

The inferential statistics in this study include three tests, namely: Correlation test, Chi-square test and Hypothesis test. Factor analysis is also explained.

4.7.1 Hypothesis Testing

The traditional approach to reporting a result requires a statement of statistical significance. A **p-value** is generated from a **test statistic.** A significant result is indicated with "$p < 0.05$". These values are highlighted in Table 4.11.

Table 3.11: Hypothesis test

		Location of the school	Gender	Age	Grade
		1	2	3	4
Which of the following do you associate with the space industry?	Sig.	.000*		.000*	.000*
Space technology helps with important service/s on earth such as:	Sig.	.007*			
Which of the following are examples of space technology?	Sig.	.042*			
The following professions are found in the space industry:	Sig.	.012*			
In order to qualify for space related studies, one needs to get outstanding results in:	Sig.	.014*			
Which of the following job opportunities are found in the space industry?	Sig.	.001*		.042*	.004*
The space industry helps the country in terms of:	Sig.	.001*			
Our career advisor has mentioned the space industry as a career.	Sig.	.000*		.004*	.000*
Attending university is necessary to work in the space industry.	Sig.		.026*		
I am aware of the space industry.	Sig.		.033*		
The space industry's communications has increased my overall understanding about the concepts and the role it plays in our way of living.	Sig.	.000*	.002*		
I would like to work in the space industry	Sig.	.014*			
I definitely don't want to work in the space	Sig.			0.08	

industry					
I would love to study about the universe, planets, satellites, stars etc.	Sig.	.000*		.001*	
The space industry has made me realise not to take science and technology for granted.	Sig.	.027*			
The space industry has increased my knowledge about science and technology.	Sig.		.043*		
The space industry challenged my thinking about mathematics and science.	Sig.	.001*	.039*		
The space industry career opportunities are very well communicated to us learners.	Sig.	.002*		.001*	.004*
Many countries, including South Africa, are involved in the design and use of small satellites and the companies that are involved in these projects call for learners to participate.	Sig.	.002*	.028*		
Which following communication media would you prefer to learn about the space industry from?	Sig.		.041*	.042*	

The table shows that the location of the schools played a major role in terms of the understanding of the space sector. Respondents did know and understand the space industry. However, their levels of understanding were not the same, according to the table. This is supported by the results from the hypothesis test, as most values under the location of the school had significant importance with the matched variables (achieving values below 0.05%). This is then followed by their age, gender and grade.

Table 4.12: Understanding of the space sector according to school location

Location of schools			
	Rural	**Urban**	**Sub-urban**
Q2.1	39%	33.09%	73.02%
Q2.2	54.02%	60.07%	80.04%
Q2.3	59.03%	50%	53.06%
Q2.4	30.05%	37.05%	62.05%
Q2.5	84.07%	96.04%	100%
Q2.6	40.07%	28.60%	64.03%
Q2.7	72.09%	89.03%	80.04%
Q2.8	35.06%	44.06%	26.08%
Q2.9	96.06%	94.06%	98.02%
Count	**100%**	**100%**	**100%**

Questions 2.1 to 2.9 checked the respondents' knowledge of the space industry. Based on Table 4.12, the sub-urban school had higher percentages on most questions, followed by urban and rural schools. This means that respondents from the sub-urban school had a better knowledge and understanding of the space industry in comparison to respondents from urban and rural schools. The results also speak to sub-objective 4, which is "to determine the demographic differences of levels of awareness of a space industry in South Africa", particularly the types of schools. This means that there was significance in terms of the demographic differences and the levels of awareness of the space industry from the respondents. There could be a number of factors that may influence the levels of awareness of the respondents from sub-urban schools. For example, they might have a science centre where space-related careers are marketed; they might hear about space opportunities at career exhibitions; they might be more exposed to the Internet; and other factors. One might find that the situation is not the same in the rural and urban areas as they do not have a science centre, they do not have a library and they could be struggling to access the Internet. Therefore, they have a low level of awareness of the space industry.

4.7.2 Correlations

Bivariate correlation was also performed on the (ordinal) data. The results are found in appendices 6.

The results indicate the following patterns:

Positive values indicate a directly proportional relationship between the variables and a negative value indicates an inverse relationship. All significant relationships are indicated by a * or **.

For example, the correlation value between “The space industry has increased my knowledge about science and technology” and “I am aware of the space industry” is 0.384. This is a directly related proportionality. Respondents indicate that the more aware they are of the space industry, the more knowledge about space is gained, and vice versa. This, for example, shows that if one wants to increase knowledge of science and technology, one needs to increase awareness of space.

Negative values imply an inverse relationship. That is, the variables have an opposite effect on each other: as one increases, the other decreases.

For example, the correlation value between “The space industry challenged my thinking about mathematics and science” and “I definitely don’t want to work in the space industry” is -0.314. That is, the more challenging maths and Science becomes, the less respondents would want to work in the space industry.

4.7.3 Factor Analysis

Why is factor analysis important?

Factor analysis is a statistical technique which is aimed at data reduction. A typical use of factor analysis is in survey research, where a researcher wishes to represent a number of questions with a small number of hypothetical factors.

The matrix tables are directed by a summarised table that reflects the results of KMO and Bartlett's Test. The requirement is that Kaiser-Meyer-Olkin Measure of Sampling Adequacy should be greater than 0.50 and Bartlett's Test of Sphericity less than 0.05. In all instances, the conditions are satisfied which allows for the factor analysis procedure.

Factor analysis is done only for the Likert scale items. Certain components divided into finer components. This is explained in the rotated component matrix.

Table 4.13: KMO and Bartlett's test

Question	Kaiser-Meyer-Olkin Measure of Sampling Adequacy	Bartlett's Test of Sphericity		
		Approx. Chi-Square	df	Sig.
3	.715	299.289	36	.000
4	.584	20.680	6	.002

Table 4.14: Rotated component matrix

Rotated Component Matrix - Q3	Component		
	1	2	3
I am aware of the space industry.	.669	.301	.079
The space industry's communications has increased my overall understanding about concepts and role it plays in our way of living.	.649	.195	.254
I understand the requirements of the space industry from us learners if we want to work in the space industry	.736	.012	.166
I would like to work in the space industry	.113	.108	.845
I know how and where to apply for space related studies.	.606	.159	-.408
I would love to study about the universe, planets, satellites, stars	.193	.239	.709
The space industry has made me realise not to take science and technology for granted.	.584	.016	.290
The space industry has increased my knowledge about science and technology.	.307	.821	.060
The space industry challenged my thinking about maths & science.	.021	.849	.214

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization
Rotation converged in 5 iterations.

Component Matrix - Question 4	Comp-onent
	1
The space industry career opportunities are very well communicated to us learners.	.532
Everybody should have a fair share of outer space benefits, everybody is welcome to take parts.	.551
Many countries, including South Africa, are involved in the design and use of small satellites and the companies that are involved in these projects call for learners to participate.	.728
Careers in the space industry such as space science, astronomy, astrophysics and engineering are offered in South African Universities.	.638

Extraction Method: Principal Component Analysis
All of the conditions are satisfied for factor analysis.

- That is, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy value should be greater than 0.500 and the Bartlett's Test of Sphericity sig. value should be less than 0.05.
- The principle component analysis was used as the extraction method and the rotation method was Varimax with Kaiser Normalization. This is an orthogonal rotation method that minimizes the number of variables that have high loadings on each factor. It simplifies the interpretation of the factors.
- Factor analysis/loading show inter-correlations between variables.

Items of questions that loaded similarly imply measurement along a similar factor. An examination of the content of items loading at or above 0.5 (and using the higher or highest loading in instances where items cross-loaded at greater than this value) effectively measured along the various components.

It is noted that the variables that constituted question 4 loaded perfectly along one component. This indicates that the statements that constituted this question measured what it set out to measure. Question 3 loaded along 3 components (sub-themes). This means that respondents identified different trends within the section. Within the section, the splits are colour coded.

4.8 Conclusion

This chapter contained findings and showed the results of the study in the form of graphs and tables. Inferential statistics which comprised of chi square, correlation and hypothesis tests were also illustrated and explained. All the objectives which are listed at the beginning were achieved. Based on the findings, a majority of the learners are aware of the space industry and mindful of some of the career opportunities contained in the industry. However, the platform to seek and pursue space related careers still remains a concern as there are many learners who do not know where and how to enrol for space-related studies and jobs. This also shows that the industry has not done enough to market the space sector and open doors for the new generation. The results also illustrate that under demographics, the location of the schools had a major impact as their level of awareness of the space industry was different. There was not any significant difference in terms of age, gender and grade. The findings will then be used to draw conclusion and give recommendations for the study and other future studies.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 DEMOGRAPHICS

According to South African statistics, the population of South Africa is approximately 55 million, 48% males and 52% females. Since there are more females than males in South Africa, it is likely to be the same in schools as well. The findings revealed that there were 55.6% females and 44.4% males in the schools that were selected for the study. These respondents were between the ages of 14 and 19 (both making up 92.4%) and they were mostly in grade 10 (49.7%) and grade 12 (29.8%). There was an equitable distribution of schools (all schools scored below 50%). Knowing the demographic characteristics of the target audience is important from a marketing point of view.

5.1.1 Respondents' knowledge of the space industry

Question 4.2.1 asked "which of the following do you associate with the space industry"? Many respondents opted for 'all of the above' (48.5%) on the given alternatives (for example, it deals with studying the universe (31%); space is the field with no force of gravity (11.1%); space is the main source of scientific research (9.4%); and 'all of the above'). This indicates that the majority of respondents (51.5%) are not well informed about the space industry, as they opted more for certain alternatives instead of "all of the above."

In question 4.2.2 the respondents were asked "which important service/s does space technology help with on earth"? in terms of the options given (e.g. weather services – 13.5%; images of the earth – 7.6%; communication – 8.2%; navigation – 5.8%; and all of the above – 64.9%) a similar majority of respondents selected 'all of the above'. This shows that the services of space technology are recognised by the youth on earth. Even though the minority (35.1%) might be uncertain and choose other options, the majority is knowledgeable about the services of space technology.

Question 4.2.3 asked about the "examples of space technology". The majority (54,4%) of respondents chose all of the above to the options given; which were tele-education – 2.3%; tele-communication – 8.8%; global positioning system – 21.6%; and internet – 12.9%. Therefore, this shows that the respondents are familiar with the products of space technology and possibly the users.

Question 4.2.4 about "the professions found in the space industry" indicated that there was not much of a difference in terms of the scoring on the given options. For example, Scientists – 38%; Astronauts – 43.3%; System engineers – 17.5%; and teachers – 1.2%). However, this might need to be changed and other professions need to be marketed more to the learners, not only scientists and astronauts.

Question 4.2.5 was the question about "the required subjects in space-related studies". Almost all the respondents selected Mathematics and Science (93.6%). To other alternatives (Business studies and Geography – 3.5%; Biology and History – 2.3%; all of the above – 0.6%) there was a minority. This indicates that the respondents are aware. They know the crucial subjects that are required the most for space-related studies.

Question 4.2.6 was the question about the "job opportunities found in the space industry". Most of the respondents were familiar with System Engineers (44.4%) and Space Tourists (44.4%), while the minority chose other alternatives (Space Fashionista – 9.4%; and Doctors – 1.8%). This shows that the learners still need to be made aware of job opportunities available in the space industry. The industry must not limit its careers to engineering and tourism as illustrated, but market other job opportunities as well.

Question 4.2.7: When the respondents were asked about "the services which the space industry helps the country with". The majority chose Science and Technology development (80.7%), while the remainder of respondents selected other given choices (Safety and Security – 7%; Societal issues – 2.9%; all of the above – 6.4%; none of the above – 2.9%. The country's development in terms of science and technology has not gone unnoticed by the youth of South Africa. These findings support that the country is really advancing in that respect. The space industry is of vital importance to the country and the youth does agree with that.

Question 4.2.8, regarding the "space industry being mentioned as a career by career advisor in schools" had very few respondents (38.6%) who agreed with this question; about 25.7% disagreed; and 35.7% revealed that they do not have a career advisor. This shows that as majority (61.4%) of respondents are never advised about space careers, nor do they get advised about careers other than space that they can venture into. This finding supports one of the statement in question 3, which is "I haven't given any thought to working in the space industry." The respondents are unlikely to be eager, dream and think about working and study in the space industry if they are not informed at an early age about space careers. They might perceive space careers as not being worthy, not suited for them if they do not hear other learners or teachers talking about it. One of the marketing communication tools, the "word of mouth", can be of great influence on such aspects.

Question 4.2.9 was the question of the "necessity to attend university in order to work in the space industry". Almost all of the respondents (96.5%) agreed, while 3.5% disagreed. A majority of respondents do acknowledge the significance of attending university and do wish to further their careers there and gain more skills. However, the financial stability of the respondents in urban and rural schools is not so good and that might be a stumbling block for them.

5.1.2 Awareness of careers in the space industry

For question 4.3.1, to the statement "I am aware of the space industry", the majority of respondents (54.3%) agreed, whereas 29.2% were neutral and 16.3% disagreed. This indicates that many respondents are aware of the space industry and its careers. They know what the industry deals with.

In Question 4.3.2, on the subject of the space industry's communications, again many respondents (59%) agreed that the industry's communication is effective and makes them understand its role more. About 18.7% were neutral and 22.2% disagreed. This is an indication that the space industry's communication is doing well and it does make an impact on the respondents about the understanding of space.

Question 4.3.3 was the statement about the "requirements of the space industry from learners". Many respondents (59.6) agreed that they know what is required of them if they want to work in the industry. This statement also talks to the previous section on Question 4.2.5 (in order to qualify for space-related studies one needs to get outstanding results in:) and Question 2.9 (attending university is necessary to work in the space industry). The respondents are mindful of the major subjects (Mathematics and Science) they need to excel in and enrol in at university and to obtain a ticket (certificate) that will help them get in the space industry.

For Question 4.3.4 regarding whether they would like to work in the industry, the majority (59.4%) agreed, while 24.5% was neutral and 12.3% disagreed. This shows that the awareness and understanding of the space industry has made many respondents wish and like to work in the space industry at some point.

Question 4.3.5 on the subject "I haven't given any thought to working in the space industry" the respondents were on level terms, 37.4% agreed, 25% were neutral and 37.4%

disagreed. This proves that career advice/guidance plays a major role in assisting learners with career paths they can embark on. If the learners were educated about space careers, they would have thought about and imagined working in the space industry.

Question 4.3.6 on the statement "I definitely don't want to work in the space industry" had a vast percentage of 67.8% respondents who disagreed; 18.7% were neutral, and 13.4% agreed. This confirms that respondents are inspired by space and they have a desire to work in the industry. This was a key finding of the study.

For Question 4.3.7 with regard to how and where to apply for space-related studies, the majority of respondents (64%) disagreed, whereas 18.2% were neutral and 17% agreed. This demonstrates that respondents lack a platform to apply for space-related studies. Little or nothing has been done to help learners to enrol in space studies. Therefore, as much as they can be aware and wish to work or study in the space industry, not having a platform to pursue those wishes might demotivate them to follow space careers. This was another crucial finding of the study.

For Question 4.3.8 on the statement "I would love to study about the universe", the majority (77.7%) of respondents agreed, while 13.4% were neutral and 8% disagreed. Therefore, it can be confirmed that many learners are attracted by the space industry, whether it is to work or study in the space sector.

Question 4.3.9 on the subject of the space industry making learners not take science and technology for granted, a vast percentage of 77.7% agreed whilst 12.2% were neutral and 9% disagreed. This is an indication that the advancement of science and technology of the country does have an impact on perceptions of these subjects from learners. The space industry makes learners realise the significance these subjects have on the quality of life.

Question 4.3.10 regarding the statement of the space industry increasing learners' knowledge of science and technology relates to the previous statement and similarly, a majority (66%) of respondents agree, 23,3% were neutral and 10.5% disagreed. The role played by the space industry makes learners understand and increase their knowledge about what capabilities science and technology contain.

For Question 4.3.11 regarding the space industry challenging the learners' thoughts about mathematics and science, a majority (64%) agreed, while 21% were neutral and 14% disagreed. This statement communicates to the previous 2 statements and it can again be confirmed that space activities, which mostly include the use of Science, Technology, Engineering and Mathematics (STEM), does have an influence on the thinking of these subjects by learners.

5.1.3 Assessment of knowledge on career opportunities in the space industry

Question 4.4.1: For the statement “the space industry career opportunities are very well communicated to us learners”, the percentages were more or less the same. A majority (41.5%) disagreed, while 25.7% were neutral and 32.7% agreed. This shows a gap between the space industry’s communication of career opportunities and the learners. Many learners are lacking knowledge about career opportunities available for them in the industry.

Question 4.4.2: on the subject of everybody having a fair share of the benefits of outer space, the majority of respondents (64.3%) agreed, but 26.3% were neutral, and 9% disagreed. It can be confirmed that many respondents understand and are aware of the benefits derived from space and that everybody is welcome to participate.

Question 4.4.3: On the statement about South Africa being involved in the design and use of satellites, including the call for learners, many respondents (53.8%) acknowledge and agree. Those who were neutral were 29.2% and those who disagreed were 16.9%. This shows that the respondents are familiar with the country’s involvement in the creation of satellites and that it is an active participant in space application and that they are also welcome to take part.

Question 4.4.4 Regarding the space related careers being offered in South African universities, the majority of respondents (60.8%) agreed, while 27.4% were neutral and 11.7% disagreed. This indicates that space studies are being taught in South African universities and the learners are aware of it. However, it might be that the industry is setting high requirements which most learners do not meet in order to register for space studies, or that the learners do not know much about these careers and how to register for them.

5.1.4 Marketing communications

Question 4.5.1 about the marketing aspect, indicated that the respondents who were asked if there is sufficient marketing of the space industry in South Africa. Mostly (75.4%) disagreed and 24.6% agreed. This clearly shows that the industry is not marketing itself adequately, particularly career opportunities to the learners. This was likewise another key finding.

For Question 4.5.2 regarding the communication media they would prefer to learn about the industry from, many of the respondents (42.7%) selected “all of the above” on the given alternatives (Internet – 30.4%; Magazines and Newspapers – 9.9%; SMS – 1.2%; Social media – 14.6%; and none of the above – 1.2%). This illustrate that the majority (57.3%) of respondents were uncertain about their respective preference of communication media, implying that the industry should research more in this regard or choose a communication media which they believe would be most effective.

Question 4.5.3: When the respondents were asked about how the space industry can improve its marketing of careers, the majority (64.4%) advised that the industry should focus more on advertising of careers. Therefore, this means that marketing will play a vital role in bridging the gap that exists between the space industry and the learners it requires.

5.2 Conclusion pertaining to the research objectives

After the presentation of results on the research questions the study draws conclusions pertaining to the objectives of the study, which are as follows:

- To identify learners' levels of awareness of the South African space industry;
- To identify learners' perceptions of employment opportunities in the South African space industry;
- To identify the knowledge of the educational requirements to gain employment in the space industry;
- To determine the demographic differences in levels of awareness of a space industry in South Africa (male/female; grades 10, 11 and 12; types of schools); and
- To identify the marketing communication factors that influence learners' levels of awareness about the South African space industry.

5.2.1 Sub-objective 1: To identify learners' level of awareness of the South African space industry

According to the findings, a majority (54.3%) of the respondents are aware of the space industry. However, in terms of the levels of awareness, the study discovered that school location and the environment had a major impact as it contained many factors which led to some respondents understanding and being more aware than others. The study revealed that respondents from sub-urban schools are more aware of the space industry, followed by the schools in urban and rural areas. This may be due to the factors like having access to basic needs (electricity, water, housing and food). Some of the respondents who come from rural schools are living below the bread line. They go to school without eating and maybe eat one meal per day, which is supper, and hardly concentrate at schools due to starvation. The same respondents might come back from school and worry about where to get water and not get time to watch television or read newspapers and hear about space news.

However, respondents in sub-urban schools are fortunate in the aforementioned basic needs. They might even have access to the Internet on a daily basis. They may be exposed to science related exhibitions and get to learn more about space and hence be more aware. The respondents from urban schools, are in the middle. They have access to the basic needs but might not be exposed more to the Internet or career exhibitions and hence not understand as much about the space industry. These findings support MacLeish and Thomson (2010: 1286) who suggest that in order to create a global space education community, decision makers will have to put in significant effort. They should involve learners, teachers and the public and convince them about how space exploration education can benefit everybody, how space exploration education can help protect planet earth and how it can support global societies resolve upcoming future challenges. Ehrenfreund et al. (2010) also support the aforementioned statement and state that a well-planned approach to reach the public and inform them about space exploration activities, challenges and benefits is therefore a necessity, especially the youth who can be of help to the workforce (Ehrenfreund et al, 2010). Therefore, it can be concluded that more effort is needed in reaching out to learners, particularly those from the rural areas.

5.2.2 Sub-objective 2: To identify learners' perceptions of employment opportunities in the South African space industry

The study found that the respondents were on level terms regarding this objective. Many do know or are familiar with the professions found in the industry, such as Scientists and Astronauts, meaning that they can opt to study for such professions. In addition, System Engineers and Space Tourists were among the job opportunities which were on top of the minds of respondents. Thus, it can be confirmed that respondents do perceive that employment opportunities are obtainable and they would like to work in the space industry (59.4%).

However, there are still a number of respondents who have not given any thought to working in the industry. This means that they never see themselves working in the space industry, or they do not have any interest in working in the industry. This supports a statement made by Weeks and Faiyetole (2014: 166) that a number of people still perceive space activities like space travel and asteroid mining as far out and not suited to them. It can be advised that career guidance is of vital importance on this aspect. Career advice/guidance plays a major role in assisting learners to choose career paths they can embark on. If learners were educated about space careers, they would have thought about or imagined working in the space industry. In terms of career advisors, the findings indicate that there are still some schools that do not have career advisors (35.7%) and for those schools that do have career advisors (64.3%), almost half of them never mention space as a career. It can therefore be concluded that learners' perception of employment opportunities in the space industry is also influenced by their career advisors. There is a necessity for career advisors in schools and the advisors should be trained and knowledgeable about the space industry.

5.2.3 Sub-objective 3: To identify the knowledge of the educational requirements to gain employment in the space industry

According to literature, the most profound subjects that are of high demand in the space industry are Science, Technology, Engineering and Mathematics (STEM). Weeks and Faiyetole (2014) state that they want to motivate learners to strive for careers in scientific fields and to do science, technology, engineering and mathematics. Since many people perceive science as difficult, involving them in outer space development programmes might change their perceptions, making the STEM subjects tempting, inspiring learners and even increasing the group of manpower and the workforce for outer space development.

The findings revealed that the majority of respondents (above 90%) have an in-depth knowledge about what is required from them if they wish to take part and gain employment in the space industry. In accordance with the aforementioned subjects, the respondents acknowledged the significance of studying and excelling in mathematics and science.

However, it may be argued that knowing the career opportunities together with their requirements might make things easier for the respondents. The respondents might be encouraged to excel in certain subjects with the aim of pursuing a certain career. However, the findings disclosed that the space industry is lacking in terms of communicating to respondents about career opportunities that are available. Thus, the marketing of career opportunities in the space industry still needs attention and catered directly to the respondents.

The findings also revealed that the same respondents who have knowledge about the requirements of the space industry not only lack knowing the career opportunities available, but also lack knowing how and where to apply for space-related studies. Obtaining a certificate (degree) is a requirement in the-work place and if there is no platform created and communicated to the respondents to participate, respondents can reject any idea and any opportunity relating to the space industry in future. Thus, respondents need to be assisted with such issues. Much marketing has to take place.

5.2.4 Sub-objective 4: To determine the demographic differences in levels of awareness of a space industry in South Africa (male/female; grades 10, 11 and 12; types of schools)

Regarding the demographics, the study was mostly dominated by females (55.6). This was no surprise as females are the majority in the country in terms of gender. The respondents were between 14 – 19 years old (92.4%) and mostly in grades 10 and 12. Grade 10 is the level where they start to choose the subjects for future careers and grade 12 is the point whereby they aim for outstanding results and start applying in tertiary institutions.

In terms of awareness, the findings reveal that the majority of respondents who come from sub-urban school between the age of 14 – 19 years and grades 10 and 12, were much aware of the space industry. Gender was on par in most questions. As for the school location, there is little or nothing done, for example career exhibitions which include space studies, in the rural areas. Respondents from rural schools are unfortunate in receiving such opportunities as there is no initiative taken towards them. Thus, it can be concluded that outreach programmes are essential in all places (sub-urban, urban and rural). The budget needs to be directed to schools of all locations.

5.2.5 Sub-objective 5: To identify the marketing communication factors that influence the learners' level of awareness about the South African space industry

Internet and social media have been noted as the main factors in making respondents aware of the space industry. Russell (2009: 108) states that the Internet has become an advertising medium for marketers and has improved the communication tools that marketers have been using for decades, such as radio, television, print (magazines and newspapers) and outdoor. Social media is believed to have remarkable advantages in business areas such as audience relations, customer relations and cost advantages (Kirtis and Karahan, 2011: 260).

The findings, however, disclose that the respondents believe there is insufficient marketing of the space industry in South Africa, implying that the industry still needs to exercise popular sites such as Twitter, Facebook, Instagram and more when marketing to their target audience. Knowing the market segment and the target audience can also work in favour of the industry. "Market segmentation, the process of defining and subdividing a large homogeneous market into clearly identifiable segments having similar needs, wants, or demand characteristics, is an important part of business strategy" (Kannisto, 2016: 174). The study also revealed that the respondents advise more advertising and co-operation with the education sector. Therefore, it can be concluded that more marketing needs to be implemented and it should comprise mostly career opportunities.

5.3 RECOMMENDATIONS

5.3.1 Introduction

Chapter five provides recommendations that were drawn from the research findings. The points that are raised under recommendations align with the sub-objectives of the study and aim to improve where there is a lack.

- It is recommended that the South African National Space Agency (SANSA) should build/form a Space Science University (SSU) that will assist to produce a number of graduates in the fields of Astronomy, Astrophysics, Space Engineering, Satellites Engineering and Space tourism, as well as create artists who will specialise in drawing spaceships, space suits and more. The study revealed that learners do not know where and how to apply for space studies and this will help create a platform for those learners who have a desire to enrol in space-related studies. The SSU can operate like other South African universities, use the Central Application Office (CAO) as an intermediary and the majority of the learners will find this convenient as they are familiar with this system. Should the funds to build the university be the issue, an alternative would be to form a space science department in all 23 universities in South Africa. They should then offer bursaries and scholarships, with minimum requirements to learners who meet certain prerequisites.

- It can be seen that career guidance advisors are a necessity if the industry is serious about seeking more learners to take part in space-related careers. They can be deployed to all the universities and other selected secondary schools in all regions around South Africa to inform learners about the career opportunities available for them in the space industry. According to the findings, most schools in rural and urban areas have little or no guidance advisors to assist learners.

- It would also be a worthy initiative if SANSA or the government could make arrangements with the department of education to include space related subjects in the curriculum and allow the learners to learn about space at an early age. The introduction of subjects like astronomy, geoscience, robotics, etc. at primary and secondary school level where learners get introduced to science subjects will help broaden the knowledge learners have about space science. Subjects like science/physics only give a glimpse of what space science really is. Therefore, providing knowledge at primary and secondary school level will boost the number of learners enrolled in the science faculty and decrease the number of drop outs as learners will be familiar with the challenges of these complex subjects. In addition, they must create space-related projects or competitions that will involve both primary and secondary schools to participate. These projects can also serve as Outreach programmes for the youth. The study indicated that schools located in rural and urban areas tend to miss out on certain opportunities as they struggle to even access the Internet where they can discover more about space. Learners from these schools are aware but not as much as learners who come from sub-urban areas. Hence, outreach programmes should make means to reach out to those isolated schools and capture those bright young minds.

  As per the National Research Foundation (NRF) (2003), one of the leading universities in South Africa ranked number one in terms of academic performances and programmes offered, the University of Cape Town, has an operating programme known as the National Astronomy and Space Science Programme (NASSP), which is aimed at providing knowledge, skills and inspiration about Space Science. It recruits 3rd year undergraduates doing studies of maths/physics, as well as engineering. These are the type of programmes that should be put in place to help boost the space industry in South Africa.

- It is also recommended that the space industry should emphasise more marketing; regularly publish space-related news on newspapers such as Ilanga, Isolezwe, Daily News, Sowetan, Mercury etc; and get people to read and know what is happening in the industry. They should further aggressively engage with the public on social media websites (Facebook, Twitter, Instagram) as suggested by learners; sponsor several projects that are developed by the youth; and gradually market on local radios and on TV.

- According to MacLeish et al. (2011), the space education sector is currently facing the challenge of not having a sufficient workforce. There is a need for programmes to be implemented to further educate the science, technology, engineering and mathematics educators in both secondary and tertiary level in order to raise more awareness and provide more compatible knowledge to learners in terms of Space Sciences, as well as Space Careers to bridge the age gap of professionals in the space industry.

5.3.2 Limitations of the study

- **Obtaining information for literature**

  One of the stressing challenges in the study was obtaining information for the literature review. Little or no studies pertaining to space have been implemented in South Africa in the past, and the researcher had to search more from what has been done in other countries. Regarding research relating to the learners' perception of the space industry and careers, no studies have been implemented before and this is the first for the South African National Space Agency (SANSA).

- **Obtaining authorization**

  Doing research in secondary schools is very difficult as the researcher must obtain authorization from the KZN Head of Department in Education and from the school principals, as well as the EThekwini Municipality. Even after the important records that are required before permission is granted were submitted on time, their procedure of conceding authorization postponed the study for nearly a year. At the point when authorization was granted to visit schools, it was past the point of meeting with learners, as they were preparing for final year exams. Most principals refused and advised for the following year.

- **Issue of transport**

  Transport was an issue in rural areas as the schools were far and the researcher needed to walk long distances to reach to those schools, even on extremely hot and stormy days. Transport costs were an additional issue, as the researcher had no financial support for data collection. In the event that he did not have cash for couple of months, data collection had to be put on hold.

- **Access to Sub-urban schools**

  Sub-urban schools have various strict standards. They demand appointments for everything and after making those appointments they do not reply. Which delays data collection. Only a few understand the significance of research and grant permission to meet with their learners.

5.3.3 Recommendations for future studies

- If a researcher is targeting respondents from schools, they should be aware that getting permission from the head of education takes long and might delay the study. Thus, they should make arrangements for requesting permission early even before they start the study.

- There are few studies that speak to space which have been conducted in South Africa in the past. Therefore, it would be a challenge to get something that speaks to the country for literature. Hence, the researcher should allocate much time for literature searches.

5.4 CONCLUSION TO THE STUDY

South Africa is a scientifically and technologically advancing country. As the industry develops, it will require additional investments; additional support from the public; and also an additional workforce, which is believed to be still in primary and secondary schools at this point. Many developed countries, for example The Unites States (US) and Australia, including the National Aeronautics and Space Administration (NASA), have already implemented programmes which aim at attracting the youth to be involved in space activities. This should be an example to the South African Space Industry, if little or nothing has been done to attract the next generation for the future of the industry.

The aim of the study was to explore secondary school learners' awareness of the South African space industry, how career opportunities have been promoted to these learners and what has influenced such awareness, or lack thereof. It was discovered that the learners are aware of the industry. They had knowledge about the role played by the industry and it overall significance to the country. It was also learned that learners from the rural areas, who tend to miss out on many things, were admirers, were aware and loved to work in the space industry.

However, the study revealed that career opportunities have not been promoted. The learners know so little about the career opportunities contained in the space industry. Even most of the career advisors do not mention space as a career to the learners. Another vital discovery was that learners do not know how and where to apply for space-related studies. There is no convenient platform created for them if they wish to register for space-related studies.

It was also learned that the majority of the learners who participated were females, between 14 – 19 years, and they were mostly in grades 10 and 12. From the marketing perspective, a huge number of the respondents believed that there an inadequate marketing of the space industry in South Africa and it was urged that the industry should focus more on advertising on internet websites and social media. In addition, they should co-operate with the education sector and possibly add space-related subjects to the education curriculum.

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APPENDICES

Appendix 1 (rural Area)

Rural Area

Urban Area

Urban Area

Sub-Urban Area

Appendix 2

Questionnaire

Please place an X in the selected space/box to indicate your answer

1. Demographical information

1.1 What is your gender?

☐ Male ☐ Female

1.2 Which age group do you belong to?

☐ 14-16 ☐ 17-19 ☐ 20 and above

1.3 Which grade do you belong to?

☐ Grade 10 ☐ Grade 11 ☐ Grade 12

1.4 School location (*please tick only one below*)

Rural	**Urban**	**Sub-Urban**

2. Respondents' knowledge of the space industry

2.1 Which of the following do you associate with the space industry?	
1. It deals with studying the universe, for example, planets, stars etc.	
2. Space is a field with no force of gravity, which consists of satellites created by humans.	
3. Space is a main source of scientific and technological research and knowledge.	
4. All of the above.	

2.2 Space technology helps with important service/s on earth such as:	
1. Weather services	
2. Images/photographs of the earth	
3. Communication	
4. Navigation	
5. All of the above	

2.3 Which of the following are examples of space technology?	
1. Tele-education	
2. Tele-communication	
3. Global Positioning System (GPS)	

4. Internet	
5. Bluetooth	
6. All of the above	

2.4 The following professions are found in the space industry:	
1. Scientists	
2. Astronauts	
3. System engineers	
4. Accountants	
5. Teachers	
6. Sales people	

2.5 In order to qualify for space related studies, one needs to get outstanding results in:	
1. Math and Science	
2. Accounting and Life Orientations	
3. Business studies and Geography	
4. Biology and History	
5. Art and Culture and Travel and Tourism	
6. All of the above	
7. None of the above	

2.6 Which of the following job opportunities are found in the space industry?	
1. System engineers	
2. Space tourists	
3. Space fashionista	
4. Doctors	
5. Lawyers	

2.7 The space industry helps the country in terms of:	
1. Safety and Security	
2. Science and Technology development	
3. Societal issues	
4. All of the above	
5. None of the above	

2.8 Our career advisor has mentioned the space industry as a career.	
1. Yes	
2. No	
3. We don’t have a careers advisor	

2.9 Attending university is necessary to work in the space industry.	
1. True	
2. False	

3. Awareness of careers in the space industry

On a scale of “strongly disagree” to “strongly agree”, please rate your answer to each statement relating to the space industry.

Dimension	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1. I am aware of the space industry.					
2. The space industry’s communications has increased my overall understanding about the concepts and the role it plays in our way of living.					
3. I understand the requirements of the space industry from us learners if we want to work in the space industry.					
4. I would like to work in the space industry					
5. I haven’t given any thought to working in the space industry					
6. I definitely don’t want to work in the space industry					
7. I know how and where to apply for space related studies.					
8. I would love to study about the universe, planets, satellites, stars etc.					
9. The space industry has made me realise not to take science and technology for granted					

10. The space industry has increased my knowledge about science and technology.					
11. The space industry challenged my thinking about mathematics and science.					

4. Assessment of knowledge on career opportunities in the space industry

Dimension	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
1. The space industry career opportunities are very well communicated to us learners.					
2. Everybody should have a fair share of outer space benefits, everybody is welcome to take parts.					
3. Many countries, including South Africa, are involved in the design and use of small satellites and the companies that are involved in these projects call for learners to participate.					
4. Careers in the space industry such as space science, astronomy, astrophysics and engineering are offered in South African Universities.					

5. Marketing communications

5.1 Do you believe there is sufficient marketing of the space industry in South Africa?	
1. Yes	
2. No	

5.2 Which following communication media would you prefer to learn about the space industry from?	
1. Internet	
2. Magazines and Newspapers	
3. SMS	
4. Social Media	
5. All of the above	

6. None of the above	

5.3 How can the space industry improve its marketing of careers?

Appendix 3

Statistical tests

Correlation Test

		Q3.1	Q3.2	Q3.3	Q3.4	Q3.5	Q3.6	Q3.7	Q3.8	Q3.9	Q3.10	Q3.11	Q4.1	Q4.2	Q4.3	Q4.4
I am aware of the space industry.	Correlation Coefficient	1.000														
	Sig. (2-tailed)															
	N	171														
The space industry's communications has increased my overall understanding about the concepts and the role it plays in our way of living.	Correlation Coefficient	.423**	1.000													
	Sig. (2-tailed)	.000														
	N	171	171													
I understand the requirements of the space industry from us learners if we want to work in the space industry	Correlation Coefficient	.328**	.340**	1.000												
	Sig. (2-tailed)	.000	.000													
	N	171	171	171												
I would like to work in the space industry	Correlation Coefficient	.236**	.188*	.208**	1.000											
	Sig. (2-tailed)	.002	.014	.007												
	N	170	170	170	170											
I haven't given any thought to working in the space industry	Correlation Coefficient	-.051	-.061	-.160*	-.234**	1.000										
	Sig. (2-tailed)	.511	.429	.037	.002											
	N	171	171	171	170	171										
I definitely don't want to work in the space industry	Correlation Coefficient	-.192*	-.210**	-.137	-.390**	.240**	1.000									
	Sig. (2-tailed)	.012	.006	.074	.000	.002										
	N	171	171	171	170	171	171									
I know how and where to apply for space related studies.	Correlation Coefficient	.249**	.159*	.221**	-.083	-.023	.014	1.000								
	Sig. (2-tailed)	.001	.039	.004	.285	.766	.853									
	N	170	170	170	169	170	170	170								
I would love to study about the universe, planets,	Correlation Coefficient	.221**	.311**	.150	.501**	-.205**	-.341**	.081	1.000							

1

satellites, stars etc.	Sig. (2-tailed)	.004	.000	.050	.000	.007	.000	.292								
	N	171	171	171	170	171	171	170	171							
The space industry has made me realise not to take science and technology for granted.	Correlation Coefficient	.219**	.291**	.239**	.200**	-.135	-.258**	.212**	.210**	1.000						
	Sig. (2-tailed)	.004	.000	.002	.009	.078	.001	.006	.006							
	N	171	171	171	170	171	171	170	171	171						
The space industry has increased my knowledge about science and technology.	Correlation Coefficient	.384**	.337**	.186*	.187*	-.039	-.288**	.336**	.248**	.323**	1.000					
	Sig. (2-tailed)	.000	.000	.015	.015	.613	.000	.000	.001	.000						
	N	171	171	171	170	171	171	170	171	171	171					
The space industry challenged my thinking about mathematics and science.	Correlation Coefficient	.257**	.257**	.129	.209**	.002	-.314**	.053	.198**	.276**	.514**	1.000				
	Sig. (2-tailed)	.001	.001	.092	.006	.976	.000	.495	.009	.000	.000					
	N	171	171	171	170	171	171	170	171	171	171	171				
The space industry career opportunities are very well communicated to us learners.	Correlation Coefficient	.157*	.240**	-.012	-.055	-.027	.040	.214**	.042	.039	.131	.065	1.000			
	Sig. (2-tailed)	.041	.002	.879	.473	.724	.606	.005	.589	.611	.087	.400				
	N	171	171	171	170	171	171	170	171	171	171	171	171			
Everybody should have a fair share of outer space benefits, everybody is welcome to take parts.	Correlation Coefficient	.143	.170*	.139	.009	.057	-.074	.246**	-.023	.244**	.062	.097	.057	1.000		
	Sig. (2-tailed)	.062	.026	.070	.909	.458	.338	.001	.788	.001	.421	.205	.461			
	N	171	171	171	170	171	171	170	171	171	171	171	171	171		
Many countries, including South Africa, are involved in the design and use of small satellites and the companies that are involved in these projects call for students to participate.	Correlation Coefficient	.134	.185*	.178*	-.077	-.078	.012	.161*	-.049	.147	.144	.115	.114	.219**	1.000	
	Sig. (2-tailed)	.079	.015	.020	.318	.311	.878	.036	.522	.054	.060	.133	.136	.004		
	N	171	171	171	170	171	171	170	171	171	171	171	171	171	171	
Careers in the space industry such as space science, astronomy, astrophysics and engineering are offered in South African Universities.	Correlation Coefficient	.274**	.232**	.140	-.059	.067	-.100	.176*	.030	.113	.191*	.136	.126	.118	.233**	1.000
	Sig. (2-tailed)	.000	.002	.068	.441	.385	.192	.022	.701	.142	.012	.075	.100	.124	.002	
	N	171	171	171	170	171	171	170	171	171	171	171	171	171	171	171

2

On the correlation test the variables were tested against each other, from 3.1 to 4.4. This was done to determine if they are related using the $p < 0.05$. Below are all the variables that had correlation and their scores highlighted.

The significant p value of 3.2 and 3.1 is .000, meaning the two variables are related to each other.

Variable 3.3 is related to both 3.1 and 3.2 as the p value is .000 for both variables.

For variable 3.4, it relate to 3.1 (.002), 3.2 (.014) and 3.3 (.007).

Variable 3.5 narrate with 3.3 (.037) and 3.4 (.002) only.

Variable 3.6 is in connection to 3.2 (.006), 3.4 (.000) and 3.5 (.002).

Variable 3.7 is significant to 3.1 (.001), 3.2 (.039), and 3.3 (.004)

Variable 3.8 is significant to 3.1 (.004), 3.2 (.000), 3.4 (.000), 3.5 (.007), and 3.6 (.000)

Variable 3.9 is in line with 3.1 (004), 3.2 (.000), 3.3 (.002), 3.4 (.009), 3.6 (.001), 3.7 (.006) and 3.8 (.006)

Variable 3.10 is related to 3.1 (.000), 3.2 (.000), 3.3 (.015), 3.4 (.015), 3.6 (.000), 3.7 (.000), 3.8 (.001) and 3.9 (.000)

Variable 3.11 is in connection to 3.1 (.001), 3.2 (.001), 3.4 (.006), 3.6 (.000), 3.8 (.009), 3.9 (.000) and 3.10 (.000).

Variable 4.1 has a significance with 3.1 (.041), 3.2 (.002) and 3.7 (.005).

Variable 4.2 relates to 3.2 (.026), 3.7 (.001), and 3.9 (.001)

Variable 4.3 relates to 3.2 (.015), 3.3 (.020), 3.7 (.036), and 4.2 (.004).

3

Appendix 4

Objectives, Literature sections and Questionnaire table

COMPARISON BETWEEN OBJECTIVES/ISSUES, LIT REVIEW SECTIONS AND QUESTIONNAIRE

OBJECTIVES/ISSUES BEING RESEARCHED	LIT REVIEW SECTIONS COVERING THESE ASPECTS	QUESTIONS FROM QUESTIONNAIRE	Statistics – Correlation test (values)
RESEARCH PROBLEMS			
knowledge about the youth's attitudes and perceptions towards the industry	Space awareness	**Q 3.1 to 3.11**	**Q 3.2 vs 3.1 (.000)** **Q 3.3 vs 3.1 and 3.2 (.000)** **Q 3.4 vs 3.1 (.002)** **Q 3.4 vs 3.2 (.014)** **Q 3.4 vs 3.3 (.007)** **Q 3.8 vs 3.1, 3.2, 3.4, 3.5, and 3,6 had values between (.000) and (.007)** **Q 3.9 vs 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, and 3.8 had values between (.000) and (.009)** **Q 3.10 vs 3.1, 3.2, 3.3, 3.4, 3.6, 3.7 3.8, and 3.9 had values between (.000) and (.015)**
perceived opportunities in the industry	Space Opportunities	**Q 2.6 and 4.1 to 4.4**	**Q 4.3 vs 4.2 (.004)**
is there a platform to learn about and take part in the space industry	Space education and outreach programs	**Q 2.5, 2.8, 2.9, 3.3, 3.7, 4.1, and 4.4**	**Q 3.3 vs 3.1 and 3.2 (.000)** **Q 4.1 vs 3.7 (.005)**
OVERALL AIM/OBJECTIVE			
explore high school students' awareness of the SA space industry	Space Awareness	**Q 3.1 to 3.9**	**Q 3.2 vs 3.1 (.000)** **Q 3.3 vs 3.1 and 3.2 (.000)** **Q 3.4 vs 3.1 (.002)** **Q 3.4 vs 3.2 (.014)** **Q 3.4 vs 3.3 (.007)** **Q 3.8 vs 3.1, 3.2, 3.4, 3.5, and 3,6 had values between (.000) and (.007)** **Q 3.9 vs 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, and 3.8 had values between (.000) and (.009)**
how career opportunities	Careers	**Q 4.1 to 4.4**	**Q 4.3 vs 4.2 (.004)**

have been promoted to these students			
what has influenced such awareness, or lack thereof	Space Awareness	**Q 2.8, 5.1 to 5.3**	
SUB- OBJECTIVES			
Sub-objective 1: To identify students' level of awareness of the South African space industry	Space Awareness	**Q 2.1, 2.2, 2.3, 2.7, and 3.1 to 3.9**	**Q 3.2 vs 3.1 (.000)** **Q 3.3 vs 3.1 and 3.2 (.000)** **Q 3.4 vs 3.1 (.002)** **Q 3.4 vs 3.2 (.014)** **Q 3.4 vs 3.3 (.007)** **Q 3.8 vs 3.1, 3.2, 3.4, 3.5, and 3,6 had values between (.000) and (.007)** **Q 3.9 vs 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, and 3.8 had values between (.000) and (.009)**
Sub-objective 2: To identify students' perceptions of employment opportunities in the South African space industry	Space Opportunities	**Q 2.4, 2.6, 3.4, 3.5, 3.6, and 4.1**	**Q 3.4 vs 3.1 (.002)** **Q 3.4 vs 3.2 (.014)** **Q 3.4 vs 3.3 (.007)**
Sub-objective 3: To identify the knowledge of the educational requirements to gain employment in the space industry	Outreach programs	**Q 2.5, 2.9, and 3.3**	**Q 3.3 vs 3.1 and 3.2 (.000)**
Sub-objective 4: To determine the demographic differences of levels of awareness of space industry in SA (male/ fem, grade 10, 11 & 12, types of schools)..	Demographical Information	**Q 1.1 to 1.4**	
Sub-objective 5: To identify the marketing communication factors that influence the students' level of awareness about the South African space industry	Marketing and Communication	**Q 3.2, and 5.1 to 5.3**	**Q 3.2 vs 3.1 (.000)**

The above statistics were testing the correlation, the relation between the variables in question 3 (Awareness of careers in the space industry) and in question 4 (Assessment of knowledge on career opportunities in the space industry) and the values are given on the table. The test was done using the statistical significance of "p > 0, 05". Since most variables had values below 0.05% this means that there was a connection between the variables. On the other hand it shows that the respondents are aware of the space industry and the careers, as results are positive.

Schor (2005: 309) suggests that the space industry will need additional skills in order to improve the implementation for space products and services. He further states that countries around the world should unite, work together and open up opportunities, especially for students in the education sector and solve such problems by producing well trained professionals. This therefore means that since students are aware of the space industry, many outreach programs need to be created, and more marketing activities to be implemented as well.

Appendix 5

Table that confirms the aforementioned statement about the little research that has been done in South Africa about the space industry

Title	Authors	Year
The role of digital technology in tourism education: A case study of South African secondary schools	Adukaite, A., van Zyl, I. and Cantoni, L	2016
Destination marketing: The use of technology since the millennium	Li, S.C., Robinson, P. and Oriade, A	2017
Investigation of a governance framework for an African space programme	Munsami, V. and Nicolaides, A	2017
Strategic Marketing Communication in Pilgrimage Tourism	Štefko, R., Kiráľová, A. and Mudrík, M	2015
A marketing communications approach for the digital era: Managerial guidelines for social media integration	Killian, G. and McManus, K	2015
India's policy for outer space	Lele, A	2017
Space and Open Innovation: Potential, limitations and conditions of success	Johannsson, M., Wen, A., Kraetzig, B., Cohen, D., Liu, D., Liu, H., Palencia, H., Wagner, H., Stotesbury, I., Jaworski, J. and Tallineau, J	2015
Space science innovation: How mission sequencing interacts with technology policy	Szajnfarber, Z	2014
Priorities in national space strategies and governance of the member states of the European Space Agency	Adriaensen, M., Giannopapa, C., Sagath, D. and Papastefanou, A	2015
How to bridge the gap between its stated and perceived intentions	Wu, X	2015

Appendix 6

DUT DURBAN UNIVERSITY OF TECHNOLOGY — FACULTY OF MANAGEMENT SCIENCES — RESEARCH ETHICS COMMITTEE

MANAGEMENT SCIENCES: FACULTY RESEARCH ETHICS COMMITTEE (FREC)

12 December 2013
Student No: 20821351
FREC No: 29/13FREC

Dear Mr KP Zuma

MASTERS DEGREE IN TECHNOLOGY: MARKETING

TITLE: **MARKETING COMMUNICATION OF CAREER OPPORTUNITIES FOR STUDENTS IN THE SOUTH AFRICAN SPACE INDUSTRY**

Please be advised that the FREC Committee has reviewed your proposal and the following decision was made: Full Approval (Ethics Level 1)

Approval has been granted for a period of one year, after which you are required to apply for safety monitoring and annual recertification. Please use the form located at the Faculty. This form must be submitted to the FREC at least 3 months before the ethics approval for the study expires.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the FREC according to the FREC SOP's.
Please note that ANY amendments in the approved proposal require the approval of the FREC as outlined in the FREC SOP's.

Yours Sincerely

[redacted]

Prof N Dorasamy
FREC: Chairperson

Appendix 7

kzn education
Department:
Education
KWAZULU-NATAL

Application for Permission to Conduct Research in KwaZulu Natal Department of Education Institutions

Applicants Details

Title : **Mr**

Surname: **ZUMA**

Name(s) Of Applicant(s): **KHANYA PHILANI**

Email: **zumaphilani@gmail.com**

Tel No:

Fax:

Cell: **0722017967**

Postal Address: **D84 INGOME ROAD KWAMASHU DURBAN. 4360**

Proposed Research Title: Marketing communication of career opportunities for learners in the South African space industry

Have you applied for permission to conduct this research or any other Research within the KZN DoE institutions?	Yes	No
		√

If "yes", please state reference Number: _______________

Is the proposed research part of a tertiary qualification?	Yes	No
	√	

If "yes"

Name of tertiary institution : Durban University of Technology

Faculty and or School : Faculty of Management Sciences

Qualification : M.Tech : Marketing

Name of Supervisor : Dr M Maharaj Supervisors Signature___________

If “no”, state purpose of research: ____

Briefly state the Research Background

The South African Space Industry is rapidly growing but lacking in commercialization. Based on the literature review, the industry is not introduced to citizens at stages at which they begin to plan their career. Many learners venture into careers due to peer influence and choose careers that they do not have knowledge of. There are also barriers to communication between the industry and the Department of Education and there are few secondary school learners who participate in the space industry. This is not good for the future of this industry. The conducted literature review also indicates that no research has been done locally to determine learners ’ attitudes and perceptions towards the space industry in South Africa.

What is the main research question(s)

The main research questions are that:
Are the learners aware of the Space Industry in South Africa?
How do learners perceive the industry?
Are there any opportunities available for learners in the industry?

Methodology including sampling procedures and the people to be included in the sample:

The research that will be conducted will be descriptive in nature. Questionnaires will be given to respondents to collect primary data. The target population will be grade 10-12 secondary school learners amongst rural, urban and sub-urban secondary schools in the Durban area. A sample size of 378 respondents will be selected. Obtained data will be evaluated and analysed in the form of graphs and tables, using descriptive and inferential statistics where relevant.

What contribution will the proposed study make to the education, health, safety, welfare of the learners and to the education system as a whole?:

The study is intending to determine learners' knowledge and perception of the space industry and also teach or make them aware of the space industry and the role it plays in people's way of living. This may inspire or motivate learners to do well in subjects such as Math and Science, since they are the crucial requirements in order to qualify for space related studies. Improvement on the results of the subjects will mean good for the nation from the scientific point of view.

KZN Department of Education Schools or Institutions from which sample will be drawn – If the list is long please attach at the end of the form

Umlazi district		

Research data collection instruments: (Note: a list and only a brief description is required here - the actual instruments must be attached):

Only questionnaires will be used to collect information about the learners' knowledge, attitudes and perceptions about the space industry from the respondents in this study.

11. Procedure for obtaining consent of participants and where appropriate parents or guardians:

After obtaining permission from KZN Department of Education, permission to conduct the study will be requested from the school principals. Examples of permission letters are attached as appendices. The researcher will explain what the space industry is, to the learners, before distributing the questionnaires, and also make them aware of assistance should they come across any problems with answering the questions. The questionnaire will consist of closed and open ended questions, with the aim of determining learners' knowledge, attitudes and perception of the space industry. Self- administered questionnaires will then be given to respondents during their break time at school. They will answer just a few questions pertaining to the space industry, and around the topic, and that information will be kept safe and confidential.

Procedure to maintain confidentiality (if applicable) :

No identification will be required on the questionnaire and a sealed box will be used to collect the questionnaires, so all answers will be anonymous. The questionnaires will be retained for five years in the Department of Marketing and Retail at Durban University of Technology and then shredded.

13. Questions or issues with the potential to be intrusive, upsetting or incriminating to participants (if applicable):

No questions will be intrusive, upsetting or incriminating to participants, therefore, not applicable. Questions will relate to respondents' knowledge and opinion about space related issues.
Additional support available to participants in the event of disturbance resulting from intrusive questions or issues (if applicable) : **The researcher will be present during the time of the study with the respondents and will assist them should they come across any problems with answering the questions. Thus, additional support is ensured. However, the nature of the questions will be such that respondents will not be disturbed.**
15. Research Timelines **Data collection will take place during September or October and will require a maximum time of 30 minutes from the learners in each school.**
Declaration I hereby agree to comply with the relevant ethical conduct to ensure that participants' privacy and the confidentiality of records and other critical information. **I KHANYA PHILANI ZUMA, declare that the above information is true and correct** __________________________ ____________________ **Signature of Applicant** **Date**
Agreement to provide and to grant the KwaZulu Natal Department of Education the right to publish a summary of the report. I/ agree to provide the KwaZulu Natal Department of Education with a copy of any report or dissertation written on the basis of information gained through the research activities described in this application. I/We grant the KwaZulu Natal Department of Education the right to publish an edited summary of this report or dissertation using the print or electronic media. __________________________ ____________________ **Signature of Applicant(s)** **Date**

Return a completed form to:

Sibusiso Alwar

The Research Unit; Resource Planning; KwaZulu Natal Department of Education

Hand Delivered:

Office G25; 188 Pietermaritz Street; Pietermaritzburg; 3201

Or

Ordinary Mail

Private Bag X9137; Pietermaritzburg; 3200

Or

Email : sibusiso.alwar@kzndoe.gov.za

Appendix 8

education

Department:
Education
PROVINCE OF KWAZULU-NATAL

Enquiries: Nomangisi Ngubane Tel: 033 392 1004 Ref.:2/4/8/245

Mr KP Zuma
D84 Ingome Road
KwaMashu
DURBAN
4360

Dear Mr Zuma

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"MARKETING COMMUNICATION OF CAREER OPPORTUNITIES FOR STUDENTS IN THE SOUTH AFRICAN SPACE INDUSTRY"**, in the KwaZulu-Natal Department of Education Institutions has been approved. The conditions of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and Institutions are not identifiable in any way from the results of the research.
5. A copy of this letter is submitted to District Managers, Principals and Heads of Institutions where the intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 01 September 2014 to 31 December 2014.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Connie Kehologile at the contact numbers below.
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report / dissertation / thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education (Umlazi District).

[redacted]

Nkosinathi S.P. Sishi, PhD
Head of Department: Education
Date: 15 September 2014

KWAZULU-NATAL DEPARTMENT OF EDUCATION

POSTAL: Private Bag X 9137, Pietermaritzburg, 3200, KwaZulu-Natal, Republic of South Africa ...dedicated to service and performance
PHYSICAL: 247 Burger Street, Anton Lembede House, Pietermaritzburg, 3201. Tel. 033 392 1004 **beyond the call of duty**
EMAIL ADDRESS: kehologile.connie@kzndoe.gov.za / Nomangisi.Ngubane@kzndoe.gov.za
CALL CENTRE: 0860 596 363; Fax: 033 392 1203 WEBSITE: WWW.kzneducation.gov.za

Appendix 9

ETHEKWINI MUNICIPALITY
Community and Emergency Services

ITRUMP Office
Warwick Junction
22 Stratford Road
Warwick Ave
Durban, 4001
P O Box 680
Durban, 4000

14 August 2014

TO WHOM IT MAY CONCERN

This letter serves to confirm that Mr. Khanya Philani Zuma (student number 20821351) was interviewed by Safer Cities and ITRUMP, of the EThekwini Municipality.

Safer Cities and ITRUMP supports Mr. Zuma on his research Project.

Should you require any further information please do not hesitate to contact me.

Yours Faithfully

Hoosen Moolla
Senior Manager
Safer Cities and ITRUMP
Tel: (031) 322 4770