Unlocking Imaginary Boundaries:

Promoting STEM careers in the Girl Guides' Association.

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Abstract

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The motivation for this qualitative study is driven by the author's desire to investigate initiatives aimed at promoting the participation of women in STEM careers, within the Malta Girl Guides. Its purpose was to identify the factors that actuate girls and women to take on STEM careers, to design a STEM badge curriculum programme for Maltese Ranger Guides (aged 13-15), and to observe and report its outcomes. The STEM badge curriculum provided the Ranger Guides with the opportunity to explore the various possibilities of a career in the STEM areas. The objective of this study was to evaluate the implementation of the badge curriculum programme and provide recommendations when putting it into practice.

This research project took the form of a case study within the Malta Girl Guides, carried out among a group of Ranger Guides who participated in a day long workshop in which the Badge Curriculum was put into practice. Focus groups were chosen as the main form of data collection within this research study. Two focus groups were held, one at the initial stage of the study, through which the participants' perceptions on STEM subjects and careers were identified, and another a few weeks after the implementation of the badge, in which the badge curriculum was evaluated. The data collected through the focus groups was supported by reflective diaries which were completed by the participants during the day workshop.

The research highlights the role non-formal educational settings such as the Malta Girl Guides has, in reducing the gender gap in STEM careers and provides an understanding on how a badge curriculum as an initiative of the Malta Girl Guides, can be used to encourage girls to take on STEM careers.

M.Ed

May, 2019

WOMEN IN STEM, MALTA GIRL GUIDES, CASE STUDY.

Statement of Authenticity

I, the undersigned, declare that the work being presented is authentic and has been carried out under the supervision of Dr Deborah Chetcuti.

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CHIARA ATTARD

Dedication

I dedicate this dissertation to all women who go against all odds to follow their dreams.

Acknowledgements.

While this work is in my own name, this dissertation was not an individual effort and would not have been possible without the help and support of many people who deserve recognition.

First and foremost, I would like to express my gratitude to my dissertation supervisor, Prof. Deborah Chetcuti, who supported and guided me throughout the course of this journey and whose advice and insights were indispensable for this work to be made possible.

This study was carried out among members of the Malta Girl Guides. It is for this reason that I would like to thank the Chief Commissioner of the Malta Girl Guides and fellow Guiders, who accepted my invitation and encouraged me to carry out this dissertation within the Association.

My great appreciation also goes to the six participants of the study who wholeheartedly participated in the focus groups and workshop sessions, their respective guardians who granted them permission to participate, and to the STEM professionals who gave their time to make the implementation of the badge curriculum a memorable experience for the participating Ranger Guides.

This dissertation would not have been possible without the constant encouragement and support of my family and friends who believed in me and were present when I truly needed them. Finally, I am indebted to the Malta Girl Guides, my own Guiders and other members of the Association who throughout my years as a member of the Association, played a crucial role in my formation.

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Chapter 1

Introduction

1.1 Rationale of this Study

Non-formal educational organisations such as the Malta Girl Guides, which forms part of World Association of Girl Guides and Girl Scouts (WAGGGS), are striving to work on the participation of women in Science, Technology, Engineering and Mathematics (STEM). In the face of growing concerns about the lack of input and contribution of women in different STEM careers, these associations have started thinking about innovative ways to incorporate STEM initiatives in their programmes (Bullock, 2017). Many of these initiatives aim to develop stronger STEM identities which is defined by Kim, Sinatra and Seyranian, (2018) as the "based identity grounded in the extent to which individuals see themselves and are accepted as a member of a STEM discipline or field." (p.591). This is done with the hope of inspiring more girls and women to pursue STEM careers. Some of these programmes are already proving their worth, however more research into their added value and actual contribution, is required (Girl Scout Research Institute, 2012). I am a member of the Malta Girl Guiding Association, and the recent initiatives within the Association encouraged me to embark on this research study, investigating the STEM gender gap and initiatives within Girl Guiding Associations.

In addition, further interest in the research topic was generated from personal experiences of encountering boundaries upon considering STEM as a career. A major drawback was the lack of information on STEM career options. This lacuna, added to the already prevalent gender stereotyping of STEM careers and lack of encouragement amongst my peers and family drove me away from seriously considering a STEM path for my studies. My personal experiences, together with my years as a member of MGG led me to realise that there is not enough

information, opportunity and encouragement for female students to bridge the STEM gender gap.

As a Science educator and member of the Malta Girl Guides, a full Member of WAGGGS, I believe that girls should be encouraged and have increased opportunities to choose STEM related careers. This is why, through my research, I wanted to explore the possibility of providing girls with STEM career information and experiences within an informal setting. My objective was to develop a programme that could encourage girls and young women towards taking up STEM related careers, through the Guiding Association. I am confident that the Guiding association can, through its unique approach to learning – working in small groups, progressive self-development and learning by doing – provide an ideal setting for inquiry-based STEM programmes which encourage girls and young women towards STEM careers. Therefore, through this research study my main aims were to:

a. develop an initiative within the Malta Girl Guides in order to promote STEM careers amongst its members.

This initiative complements other efforts carried out by the Association also targeting the gender gap that exists within STEM areas. This initiative could also serve as a basis of experience that could encourage and inform the design of future initiatives to promote STEM careers amongst members of the Association and within other non-formal educational settings.

b. inform and improve my personal development as Leader within the Malta Girl Guides and as Educator.

As an educator in both formal and non-formal settings, I have the opportunity to influence a large number of young people. This research offers the opportunity to better understand the factors which enable more girls and young women to

take up STEM studies and develop a stronger STEM identity. Through an improved understanding I place myself in an advantageous position to provide a more meaningful experience of STEM for the young people I meet, in turn leading them towards a stronger STEM identity.

c. inform wider practice.

While this study, was carried out within the Malta Girl Guidess, the Ranger Guides' experience of the badge curriculum, and its outcomes can provide an understanding of the different factors that make STEM initiatives effective in strengthening STEM identities and reducing the existing gender gap in STEM. Hence, this study, may provide valuable insights for the development of other similar initiatives in various non-formal (and formal) educational settings.

1.2 Aim of the Study

The main aim of this study was to develop a badge curriculum for Maltese Ranger Guides (aged between 13-15), and encourage them to pursue STEM careers. Before I could develop the badge curriculum, it was necessary to explore the factors that increase interest towards STEM careers amongst girls. This path of inquiry led me to the first research question:

1. What factors motivate girls to choose STEM related careers?

Using these factors as a basis, I then wanted to develop a badge curriculum that could be used with the Rangers in order to motivate them to choose STEM related careers. Therefore, the second research question was:

2. How can a badge curriculum as an initiative of the Malta Girl Guides, be used to foster interest towards STEM careers, amongst members?

In order to answer these questions, I met with the Rangers and conducted a focus group interview with them as participants to find out more about their views of STEM subjects and careers. Based on their ideas, I developed a badge curriculum with the aim of motivating more girls to take up studies in STEM areas. This badge curriculum, was then implemented with the same group of Rangers who provided feedback and evaluated it, for best practice in reaching the aim of developing a badge curriculum that could bridge the gender gap in STEM areas.

1.3 The Contents of this Dissertation

This dissertation is divided into six distinct chapters, which are all directed to one common goal, that of answering the research questions identified in section 1.1. Within this first chapter, I provide a brief introduction of the study, explaining its aims and the research questions being discussed in this study. Next, I identify the experiences that inspired me to embark on this study, and the purposes of this study.

Before designing the MGG badge, it was crucial to have a clearer idea of the gender gap that exists within the different STEM fields and the elements which lead to these differences. In fact, Chapter 2, is dedicated to the literature review, in which I seek to better comprehend the role of women in STEM, and the factors which keep females away from STEM careers.

In Chapter 2, I also illustrated existing initiatives aimed at promoting STEM careers amongst girls and young women and identified the common factors which make these programmes effective. Within the final section of the literature review I took a closer look at how Girl Guiding can provide the ideal setting for the development of an initiative aimed at promoting STEM careers.

A description of the methodology used within this research study, highlighting the theoretical framework surrounding the study and the research methods used, can be found in the third chapter. In Chapter 3, I provided a thorough description of the different stages of the research design and the ethical considerations that influenced decisions along the process; concluding the chapter with an account of the data analysis process used.

Chapter 4 is divided into two major sub-sections. Within the first section, an analysis of the participants' views and ideas about STEM subjects and careers is presented along with their perception of the opportunities they believe are available within STEM fields. Instead, the following section focuses on the badge curriculum designed and implemented along the course of this research study. It draws attention to the experiences of the participants of the badge curriculum, and how the different approaches used within the badge were effective in reaching the objectives.

In Chapter 5, I linked the findings of Chapter 4 with literature in order to answer the research questions of this study. In this chapter I sought to identify the different elements that make up the badge curriculum presented within this study, and understand the effects these elements had on the participating Ranger Guides.

In the final chapter of this dissertation, I conclude by identifying the limitations of this study, provide recommendations for the development of future initiatives and emphasise the need for further research on programmes aimed at reducing the gender gap in STEM.

Chapter 2

Literature Review

2.1. Women in STEM: A Gender Gap

2.1.1 The Current Situation.

2.1.1.1 International

The past 40 years have seen a significant progress in the number of young women embarking in STEM related careers (Archer et al., 2013). A study carried out by the European Commission (2012), reported that women make up the majority of undergraduate students around Europe. Despite these facts, gender differences are deeply engrained in people's perceptions towards STEM and female participation in STEM courses is still low. This results in under representation of women in STEM careers, predominantly the physical sciences and engineering (Archer et al., 2013).

McCullough (2011) states that girls often display less-positive attitudes towards STEM subjects. These differences in outlooks are the consequences of social factors rather than biological ones. While in the past the difference in attitudes between boys and girls was attributed to the performance of both genders in the subject, recent studies have showed that this is no longer the case. Trends in International Mathematics and Science Study (TIMSS) results have shown no significant differences between the performance of boys or girls in STEM subjects (Sinnes and Løken, 2012). Sinnes and Løken (2012) also cite other studies to show that while the differences in performance between boys and girls is minor,

there is significant disparity between the interest shown by boys in relation to STEM careers when compared to girls' interest.

This gender gap is more prevalent as women progress through their education and career from one stage to the next (Robnett, 2015). Like other researchers, Halpern et al., 2007, likens the situation to a "Leaky pipeline", in which female students are gradually moving away from STEM related subjects at different stages of their education and throughout their careers.

Norway ranked second "most gender equal society" in the Gender Gap Report published by the World Economic Forum (WEF) (Hausman, Tyson, and Zahidi, 2010); in which more than 60% of University students are females. However, women were still a minority in physics, mathematics, computer science, technology and engineering (OECD, 2010). A study carried out by the EU in 2012 found that while females constituted the majority of undergraduate students in the European Union, STEM courses were male dominated (European Commission, 2012).

This underrepresentation also persists at higher and leadership levels. While, one in every four Deans or Heads of Department in the United States. is a woman, the number of Deans or Heads of Department for science institutions, declines to one in every twenty (McCullough, 2011).

Data by the National Science Foundation (2011) shows that the biggest deficit of women in STEM is found within the areas of physics, engineering and computer sciences. According to the same study, women are overrepresented in biology and social sciences and are on par with males in fields such as mathematics and earth sciences (McCullough, 2011). This reality is also echoed by Cheryan, Ziegler, Montoya and Jiang (2017), who in a study about the gender gap across different STEM subjects in the United States, assert that there is no

underrepresentation of women in science subjects which are often considered "softer", such as biology.

According to the 2018 Annual report on Gender Equality, published by the European Commission, in EU member states only one in three female STEM tertiary graduates are pursuing STEM related careers; while only 10% of female vocational education graduates are in STEM occupations. This differs greatly from the 50% of tertiary level male graduates currently working in STEM professions and the 41% of male vocational education graduates in STEM occupations.

2.1.1.2 Local Context

Comparing subject choices within Maltese schools to the international scenario is problematic and might yield contradictory results (Ventura, 1992). This is because the Maltese Educational system differs from other systems in a number of aspects and this might have an effect on subject choice and the perception of science subjects amongst students. While some aspects that Ventura (1992) mentions in his study have changed over the years, there are others that remain and hence still have an effect on the attitudes of students about science subjects and their choices. One of these aspects is the fact that in the majority of state schools and in many private and church schools, physics is a compulsory subject.

Another aspect that might still distinguish Malta's experiences from those of other countries is the fact that for years, government schools in Malta have been single sexed (Ventura, 1992). Although this has recently changed, the results of having co-ed schools might still not have materialized, considering that the first cohort of co-ed students are still finishing secondary school.

Despite these differences within Malta's Educational System, it seems that the realities being faced at an international level, can also be attributed to the local scenario. The research carried out in Malta very often relates to the individual subjects of physics, chemistry and biology.

In a study carried out by Chetcuti (2008) Maltese teachers were asked about the performance of girls and boys in science subjects. The majority of participating teachers agreed that they perceive no major differences between the ability of boys and girls in science and that the major differences between students are not because of gender, but rather because of the individual traits of each and every student. Some teachers who felt that girls performed better than boys, had the perception that this is because girls tend to work harder and are more thorough than boys. On the other hand, teachers who believed that boys outperformed girls in sciences, did so because boys give more concise and to the point answers. This shows that there seems to be no innate difference in abilities between boys and girls. A study conducted by Gatt and Borg Marks (2004) also found no significant differences between the performance of boys and girls in Physics at SEC level, however the study suggests that less girls than boys chose Physics as one of the optional subjects at post-secondary levels. This reality also emerged in the Matriculation Certificate Examinations 2017 Statistical Report which shows that the number of males sitting for the Physics Advanced level exam was twice as much as that of girls. Gatt and Borg Marks (2004) attribute this disparity to a negative attitude towards the subject and the perception of physics as a masculine subject.

This disparity between males and females in STEM persists and continues to grow as students enter higher education. In a study conducted by the National Commission for Further and Higher Education Malta (2015), about the pursuit of higher education in the Maltese islands shows that girls tend to opt out of subjects and careers related to engineering, science, mathematics and computing, and instead select subjects that can lead them into the health and

welfare sector. In fact, only 28% of tertiary-level students enrolled in STEM studies in Malta, are female (World Economic Forum, 2015).

2.1.2 Explaining the Gender Gap.

"Nobody becomes a scientist overnight." (Sonnert, 1999, p. 39) In order to become a scientist, one has to pass through a long educational and professional process that is often referred to in literature as the "science pipeline" and which starts earlier on in life. It is through different stages within this process that females start leaking out, and choosing pathways that would take them away from STEM subjects and careers (Sonnert, 1999).

A difference in the attitudes towards STEM subjects between boys and girls may be identified at an early stage within the educational system and is more likely to be reinforced as a student progresses through the schooling years. This would eventually lead to significant gender gaps in career choice and career progression (Levine, Serio, Radaram, Chaudhuri, and Talbert, 2015). The following section identifies some of the leading factors contributing to the Gender Gap in STEM throughout the life of a female, from when she is still a child, as she progresses through her education and when she is in the workplace.

2.1.2.1 Stereotypes

The best way to understand the factors distancing girls and women from STEM is by first looking at the several myths about STEM that have persisted throughout the years (Castillo, Grazzi, and Tacsir, 2014). Castillo et al. (2014), gathered a list of myths that still persist to this day, namely the belief that women do not have the necessary abilities and skill sets for STEM, the assumption that women are not as competitive as men and the idea that the system has worked without the participation of women and hence we should leave it as it is. It is

these beliefs that have kept women away from STEM for all these years and have caused young girls and women to perceive themselves as being ineligible in STEM (Watermeyer, 2012).

2.1.2.2 Early Socialization

From an early age, boys and girls are encouraged to develop their personalities and attitudes to conform to their own sex (Reinking and Martin, 2018). Reinking and Martin, (2018) assert that gender stereotypes start to be set in early childhood, through the process of socialization. From a very young age, children start developing ideas about gender and they start distinguishing between male and female practices. In a model highlighting the relationship between a child's sex to a child's behaviours and decisions, Eccles (2014) suggest that the toys and experiences that are made available to children at a very young age would have an influence on the perception of girls and boys on STEM. Within this study, the author finds that parents are more likely to provide a son rather than a daughter with specific experiences such as carrying out science activities at home, working or playing on a computer and building and making things. On the other hand, the study suggests that girls are more likely to be encouraged to participate in experiences which are considered to be stereotypically female, such as music lessons and indoor chores. These experiences shape a child's self-perception and identity and determine what skills and attributes they gain and master. It is through this process of socialization that ideas and stereotypes about STEM start developing and attitudes are formed, resulting in a lack of confidence in STEM amongst girls (Shapiro and Williams, 2012).

2.1.2.3 Effects of Schooling on the Gender Gap

Western Societies are experiencing gender differences in subject choices within middle and secondary education (Smyth and Darmody, 2009). Dare, and Roehrig,

(2016) state that evidence shows that it is during secondary or middle school that females develop their perceptions about STEM subject.

Levine et al. (2015) identifies three major reasons that are pushing girls away from STEM subjects, all of which are widely discussed in research. The first reason is the stereotype that STEM is a discipline for white males. The authors attribute this idea to the lack of female role models. The second factor is girls' self-identity and their attitudes towards STEM; another factor is society's perception of STEM subjects and careers and reinforcing these ideas amongst girls and young women (Levine et al. 2015).

2.1.2.4 Educational Resources

In a study carried out by Kerkhoven, Russo, Land-Zandstra, Saxena and Rodenburg, (2016) about the portrayal of Scientists and STEM professionals in educational resources retrieved from the Scientix and OER commons websites, it is evident that the majority of STEM professionals were illustrated as males whereas, more females were portrayed as teachers. As argued by Watermeyer (2012) when STEM is portrayed, promoted and represented by white males, and targeted at the same demographic, it comes as no surprise that girls feel that STEM is not for them.

2.1.2.5 Self-identity and Gender Roles

Research identifies "individual attitudinal factors" (p.273) as another one of the main elements influencing students' subject choice in secondary education (Smyth and Darmody, 2009). Smyth and Darmody (2009), state that students are more likely to choose subjects if they perceive them as interesting, relevant and useful for their career prospects. In a study about the reasons why students opted for or out of STEM Subjects, Holmegaard, Madsen and Ulriksen, (2012) found that

students opted for subjects they perceived interesting, relevant to their everyday lives and that provided them with job prospects that would coincide with their own identity. The study showed that students who opted for other subjects rather than STEM subjects, felt it would be "difficult to construct a desirable identity within those disciplines" (p.208). The issue of personal identities also emerged in other studies. Dare and Roehrig, (2016), explain that while some female students might enjoy STEM subjects and find them interesting, they would not perceive a science career as a career they would like to pursue. They tend to distinguish between the idea of "doing science" and "being a scientist". While these students can associate with doing science because this is what they do at school, they perceive being a scientist as a prospect that is not suitable for themselves. What leads to this distinction is the labelling of specific subjects as "male" or "female" through stereotypical beliefs (Levine et al. 2015). These ideas lead students to choose subjects to fit their gender identity, causing girls and women to move away from STEM subjects and careers (Smyth and Darmody, 2009).

2.1.2.6 Societal and Environmental Factors

The attitudes of students towards a particular subject may also be attributed to social factors (Dare and Roehrig, 2016). Leaper, Farkas, and Brown (2011) identify other peoples' views, perceptions and actions as social factors that will influence the attitudes of young women when selecting STEM subjects.

Teachers, parents and peers, are the main contributors to the attitudes young women hold towards STEM (Franz-Odendaal, Blotnicky, French, and Joy, 2016). A study carried out by Smyth and Darmody (2009), found that female students did not feel discouraged by their parents to pursue STEM subjects, yet their parents still held gendered beliefs about what would be a beneficial choice, through which they might have influenced their daughters. In this study, the authors also highlight the role played by peers in influencing or even regulating

the behaviour and attitudes of students towards a subject. While at times the encouragement of parents and peers can be positive and results in a more positive attitude towards the subject, at other times, female students might feel pressured out of STEM subjects to fit in and feel similar to other girls (Leaper et al., 2011).

Furthermore, teenage girls want to feel accepted and supported by their peers, and this is why adolescents tend to be influenced so much by their peers (You, 2011). Crosnoe, Riegle-Crumb, Field, Frank, and Muller, (2008), explain that the likelihood of adolescents to choose a mathematics course, depends on the academic achievement of their friends and course mates and the perceived interest these peers show towards the subject. Crosnoe et al., (2008), assert that this pattern is more significant amongst girls rather than boys, having a greater effect on the gender gap within STEM.

Teachers also play their part in shaping student attitudes towards STEM careers amongst students, with them bringing in their gendered perceptions, ideas and stereotypes (Chetcuti, 2008). The way an educator presents STEM subjects also leaves its mark on the perception of the subject amongst students. In their study, Holmegaard et al., (2012) found that students who opted out of STEM subjects had experienced these subjects in a rigid, rigorous and cold manner, in which they were not encouraged to discuss and experience the subject. Despite the fact that these students liked the subjects and perceived the content as being interesting, they felt that the subject conflicted with their own identity (Holmegaard et al., 2012). Because of existing cultural stereotypes depicting masculinity as cold and unemotional, female students tend to associate these traits with a masculine identity and tend to reconsider taking up STEM subjects (Sarseke, 2017).

2.1.2.7 Progressing from Education to Careers

While completing their tertiary level of education, female STEM students, also face a number of gender specific impediments ranging from lack of financial support and mentoring, intimidating environments and very little support and encouragement (Sonnert,1999). Literature shows that males in STEM courses reported receiving much more support and positive reinforcement than their female counterparts. Female students at tertiary level also reported lower levels of confidence when compared to males who were faring the same or worse than them (Sonnert,1999).

Another belief that greatly influences female graduate students to think twice before opting for a STEM career, is the idea that women in STEM careers find it very challenging to balance their personal and home life with their career prospects (Sarseke, 2017). Many women working in STEM careers tend to wait longer to have children or decide to leave their profession and find a career that allows for more flexibility (Sarseke, 2017). Some researchers challenge this idea, stating that women left STEM careers mainly because they were not happy with their career prospects and pay, rather than because of issues relating to family and work-life balance (Sassler, Michelmore, and Smith, 2017). The lack of conclusive research about how motherhood and marriage effect the retention of females in STEM, leads to contradictory conclusions. While researchers found that a number of women left STEM careers because of family, it is also evident that marriage and motherhood, do not pose direct and unmanageable challenges to a women's career in STEM (Sonnert, 1999).

Hill, Corbett, and St. Rose., (2010), make reference to Heilman, and Okimoto 's (2007) research which describes how females who already occupy careers in STEM, are often discriminated against when it comes to promotions, salaries and acknowledgements. Women are often viewed as less competent because of the lack of performance criteria, even when they display the same level of

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proficiency. When a woman's competence is undeniably superior than her male counterparts, she is then regarded with a level of dislike. This reality is what causes females to leave STEM careers more often than male.

The lack of females in STEM faculties and departments may also have a hindering effect on women who are thinking about pursuing a career in STEM or who already occupy that position. Interaction with colleagues is essential for all scientists and STEM professionals, however it has a more lasting effect on females. With the lack of females in several departments and workplaces, women in STEM feel a sense of isolation and dissatisfaction that might give them an even better reason to leave STEM careers (Hill et al., 2010).

2.1.3 The Need to Encourage More Women in STEM.

A low participation of women in STEM areas is considered as a major issue within European Union member states for several reasons (European Commission, 2017). In a world which is developing rapidly, in which science and innovation are considered as the yardstick with which a nation's status and resourcefulness is measured, no country can afford to do away with half its population from the field of STEM subjects (Castillo et al. 2014).

We are living in a society which is highly dependent on scientific professions and therefore, having a shortage of specialized people working in STEM would be considered a political issue in a world that is rapidly changing through scientific and technological advances (Sarseke, 2017). Economic growth depends a lot on the human resources a country has, namely STEM professionals (Sarseke, 2017). Hence having more women in science and technology would conversely help in the development and growth of a nation's economic wellbeing (Castillo et al. 2014).

A study carried out by the European Commission (2017), states that if the gender gap in STEM is reduced, the European Union would increase the Gross Domestic Product of countries in the European Union by a considerable amount. This idea was also echoed by a number of American policy makers who claimed that unless the lack of STEM professionals is addressed, the country's economic and political wellbeing would be negatively affected (National Academy of Sciences 2003). The biggest issue with the gender gap is that countries are not making use of all their resources (Castillo et al. 2014). Women bring about a different perspective to research and technology, and their participation would be more beneficial than having design teams composed of only men (Cheryan et al, 2009). Furthermore, having a larger pool of people to choose from when selecting and recruiting scientists ensures a more talented cohort and diversity in the workplace. It would also mean that you would have better results, because inclusivity would lead to a larger variety of experiences, interests and viewpoints (Castillo et al. 2014).

The lack of female engagement in STEM also reinforces and legitimizes gender stratification within other areas of life and society at large (Fox, Sonnert and Nikiforova, 2011). The relation between participation in STEM and the status of women in society emerges from the prestige and esteem these STEM subjects enjoy in society (Fox, Sonnert and Nikiforova, 2011). It is a widely accepted idea that men and women should have the same career opportunities, however, women are missing out on the prospect of being part of professions that provide a higher pay and more prestige, such as STEM careers (Sarseke, 2017).

2.1.4 Motivating Girls and Young Women Towards STEM.

The best way to ensure a larger cohort of females taking up STEM, is to improve the perception females have of STEM and to foster more interest amongst girls (Tyler-Wood, Ellison, Lim, and Periathiruvadi, 2011). Tyler-Wood et al., (2011) highlight how important timely interventions are, in order to develop positive

attitudes towards STEM subjects, even though the STEM gender Gap would not be so prominent among younger children.

To increase the number of females in STEM, researchers stress the importance of developing positive attitudes towards Sciences while students are still young and to foster this interest throughout the years (Tyler-Wood et al., 2011).

2.1.4.1 Hands-on *Approach*

One way to stimulate and foster interest in STEM at a young age, is through the use of hands-on experiences via outreach programmes (Levine et al., 2015). Burkam, Lee and Smerdon (1997) suggest that involvement of girls in scientific experiments and hands-on practical work, is one way to ensure gender equality in STEM fields, as these allow girls to be innovative and increase their engagement in science and technology, leading to a greater interest in the subjects. Tyler-Wood et al., (2011) affirm this idea, and state that programmes and initiatives aimed at promoting STEM among girls and young women should include a variety of hands on, real life experiences, and verbal components. This approach would ensure that girls are equipped with the necessary skills they would require in science subjects such as cooperative learning and innovation.

2.1.4.2 Role Models and Non-Gender Specific Educational Resources

Levine et al., (2015) suggests that the lack of female role models in STEM is affecting the interest of girls and young women in STEM. Fatoorehchi (2017), emphasizes the importance of gender roles and non-gender-specific educational resources, in shaping girls' perceptions of STEM careers. Using positive role models and more images which depict females in STEM, would increase the interest of girls in STEM.

Providing experiences through which girls can get to know about female role models is beneficial to a girl's perspective of STEM careers (Reinking and Martin, 2018). Girls can be exposed to female role models through stories, research, articles, and also by meeting female STEM professionals working in their local community (Reinking and Martin, 2018). A study by Hughes, Nzekwe and Molyneaux (2013) suggests that the interest of girls in STEM subjects and their STEM self-identity improved when girls were exposed to role models which they could relate to. Furthermore, as a result of positive role models' girls were more likely to picture themselves in STEM careers (Reinking and Martin, 2018).

2.1.4.3 Challenging Stereotypes

Stereotypes can have lasting effects on girls and young women, effecting their confidence in STEM subjects. These stereotypes can be eliminated by exposing girls and young women to role models, talking about young women and girls who are making achievements in STEM, and by making girls aware of the gender gap and how this is affecting society (Hill et al., 2010). Making girls aware of the discrimination and challenges women face in STEM, is another way of increasing girls' interest in science and technology. This together with an opportunity to learn about feminism and gender equality, is closely related to better academic accomplishments amongst girls (Leaper et al., 2011).

2.1.4.4. Parental and Peer Support

It is a known fact that support and a positive attitude from both parents and peers would also benefit girls who are thinking of pursuing STEM subjects (Leaper et al., 2011).

Peer support during adolescence is also a major predictor of academic achievement (Leaper et al., 2011). In a study by van Hoorn, van Dijk, Meuwese, Rieffe, and Crone (2016), the researchers found that positive behaviour in teens is reinforced through the positive feedback by peers. However, these positive

behaviours decrease when adolescents are faced with negative feedback from peers or no feedback at all. This means that while girls who are being supported by their peers to persue STEM are more likely to do so, peer groups can also push girls away from STEM courses (van Hoorn et al., 2016). One way to encourage a positive outlook of STEM amongst peers is to encourage girls to interact together through informal STEM learning environments. These peer STEM learning environments would help girls connect through a hands-on approach that moves away from marking systems and grades (Reinking and Martin, 2018).

Parents also have an important role to play in reducing the gender gap in STEM (Reinking and Martin, 2018). In a study, carried out by Eccles (2014), it became evident that parents of girls are less likely to believe in their daughters' talents in STEM subjects than parents with sons. These parents believe that their daughters are doing as good as the boys in STEM subjects, simply because they are working harder (Eccles, 2014). Through this study, it becomes evident that these ideas emerge from the stereotype that males are better in STEM subjects than females. Challenging these ideas and encouraging parents to present a more positive outlook of their daughters' ability in STEM subjects, would be the way forward to empower more girls to feel more confident in these subjects (Eccles, 2014).

2.1.4.5. Exploring STEM Careers

Girls should be provided with the opportunity to explore different career options and to imagine their own lives in different STEM careers (Tyler-Wood et al., 2011). One of the main reasons why girls tend to prefer life sciences over physical sciences is their perception that through health sciences they would have an opportunity to help others. It is thus important to expose girls to different STEM careers for them to be able to identify the positive influence these careers have on people's lives and the world around them. Apart from appreciating the benefits of STEM careers, exposure to STEM would make girls rethink the stereotypes associated with STEM careers. This exposure to different STEM

careers can be actuated through mentoring and job shadowing (Tyler-Wood et al., 2011).

2.1.4.6. Teaching Girls Perseverance and confidence

While boys have no difficulty in recognizing that their good performance in STEM subjects would be suitable to become a STEM professional, girls tend to fail to associate the proficiency in STEM subjects to their suitability to enter a STEM career. Hence, linking the skills learnt at a young age with the different STEM professions, would make girls realize that they do possess the right skill set and knowledge to become STEM professionals (Hill et al., 2010).

Another practice that will help girls develop the confidence in pursuing STEM careers, is by showing girls that no one is born an expert and that over time, through hard work and determination, they will be able to learn new things. This can be achieved by praising a girl when she makes an effort and works hard. In this way, girls will learn that it is through challenges, determination and hard work, that scientific and technological advancements are made (Hill et al., 2010).

Furthermore, developing spatial skills from a young age is also beneficial to develop skills which enhance the confidence of girls in STEM subjects and to ignite a sense of interest towards STEM subjects amongst girls. Spatial skills can be developed by allowing girls to play and experiment with toys that require the player to fit objects into different places, and in which students should use their hands (Hill et al., 2010).

2.2. Promoting STEM Careers

2.2.1 Programmes and Initiatives.

Within European Union States, a number of initiatives have been launched to target the existing gender gap within STEM careers (European Youth Portal, 2018). A programme that is currently gaining momentum is the *Hypatia* project, a collaborative venture between different stakeholders, such as schools, industries, science museums and academics to encourage more girls towards STEM (Hypatia Project - Expect Everything, 2018).

The Women in Research and Innovation campaign is another initiative by the European Union aimed at decreasing gender discrepancies in research careers and institutions (European Youth Portal, 2018). These initiatives followed a number of other initiatives with similar objectives, namely the *Science: It's a girl thing!* campaign (European Youth Portal, 2018). Over the years, these initiatives proved beneficial in challenging stereotypes related to STEM subjects and careers and encouraged more girls and young women to choose subjects that would lead them to STEM careers (European Youth Portal, 2018).

In Malta, apart from several projects meant to popularize science, an initiative that is specifically targeting girls is the *Teen Science Café* (TSC) programme, which for the first time is providing female students with the opportunity to familiarise themselves with STEM careers thus encouraging them to pursue STEM careers (Teen Science Café Girls, 2018).

A great majority of existing programmes have been targeting schools and higher-level educational institutions; however, these form part of a larger "learning ecosystem" in which students take a more central role (Krishnamurthi Krishnamurthi, Ballard and Noam,2014). While the formal educational system plays an essential role in forming young people, there are many other influences that leave their mark, such as family, peers and out-of-school institutions (Krishnamurthi et al., 2014).

Several STEM related programmes and initiatives are now taking place outside the traditional school context. These programmes which are taking place during after-school hours, offer a different take from the way popularisation programmes are implemented within formal education institutions (Sahin, Ayar, and Adiguzel, 2013). The aim of after-school programmes is to enable young people to develop in all aspects. Research shows that good after-school activities and programmes enable participants to have a higher self-esteem and improves their overall behaviours (Krishnamurthi et al., 2014).

Programmes that are specifically aimed at the popularization of STEM and at promoting STEM careers, are making a significant difference in the way participants perceive STEM subjects and in developing STEM proficiencies. This change in attitude gives them the confidence to imagine themselves as possible future STEM professionals (Krishnamurthi et al., 2014).

Other organizations that provide after-school programmes have started including STEM in their programmes, as they recognize that the approaches used in STEM such as hands-on and collaborative work, are in line with their own objectives and approaches. Such organisations that have long included STEM within their programmes include the Girl Guiding and Girl Scouting association, the worldwide organisation 4-H and even Girls Inc (Krishnamurthi et al., 2014).

2.2.2 A Detailed account of Some Initiatives.

This section will be providing a detailed account of three different initiatives aimed at encouraging more girls towards STEM. One of the programmes was set up for research purposes, while the other two programmes already existed, and were studied by researchers to evaluate their outcomes. All three programmes are unique in the way they were planned and executed, thus provide a varied view of how out-of-school programmes can be used to encourage girls and young women to pursue STEM careers. I have chosen to review these programmes since

they inspired the development of the STEM career programme developed for the Ranger Guides in the current study.

a. Chemistry Camp on Rhodes Island

Levine et al., (2015) developed a weekend long chemistry camp for teenage girls on the island of Rhodes, with the aim of tackling the gender gap in STEM and to make use of hands-on science to educate students about how chemistry can be applied in everyday life. This programme included field trips to different locations, meeting female scientists, and participating in hands-on science workshops related to the properties of materials and non-Newtonian fluids. The hands-on approach was greatly beneficial in generating interest and curiosity amongst participants. Field trips were used as a tool to encourage interest (Levine et al., 2015). The programme was evaluated by using and comparing questionnaires, issued to participants before and after the study. Findings about the program show that the goals of the camp, to relate science to everyday life and to educate girls about different career paths in STEM were reached. The results show that this initiative was effective in improving girls' perception of STEM (Levine et al., 2015). While the participants showed increased interest and enthusiasm towards STEM careers after the camp, the study was unable to track their interest over the years and to analyse whether their perceptions changed as years went by (Levine et al., 2015). This programme's point of interest, was the use of hands-on approach. Through this approach the participants were not only encouraged to carry out tasks themselves, but to try out and experiment without specific instructions. The activities carried out in this research study also follow the hands-on approach, through which the participants are allowed to think and investigate.

b. Bringing Up Girls in Science (BUGS)

Bringing Up Girls in Science (BUGS) was an after-school programme for girls which took place between 2001 and 2005 in Texas, USA. In this case, apart from providing positive learning experiences, the aim was to improve academic achievement in Science (Tyler-Wood et al., 2011). An integral feature of the programme was the use of mentoring by female professionals to support the participants and to encourage girls towards STEM careers by changing their perception about science. The study carried out by Tyler-Wood et al., (2011) found that girls participating in the programme made more academic progress when compared to the contrast group who did not participate. The girls in this programme also showed a greater sense of appreciation towards STEM subjects and displayed more confidence and a positive attitude towards STEM subjects. The researchers were not able to tell at that point in time, whether this programme had an effect on the participants' choice of career (Tyler-Wood et al., 2011). Again, a unique characteristic of this programme which struck me and which I tried to make use of in my own study was its mentoring aspect. Within this programme, female professionals were used both as role models who could have a great influence on the participants and as mentors who were facilitating sessions and working together with the participants. This aspect and combination of roles was used within my sessions to be able to provide the participants of this study with a more authentic portrayal of who these STEM professionals are.

c. Discover!

Discover was a Saturday science-activity club for girls of secondary school age, carried out in Cardiff, UK. Developed by a Careers Advisory Agency, this programme provided authentic experiences of STEM subjects and occupations

that girls were not aware existed or that they always shied away from (Watermeyer, 2012). The aim of this programme was to challenge stereotypes and attitudes causing girls, to move away from STEM as a subject and as a profession. This informal programme takes place in the first years of secondary education before the participants choose their optional GCSE subjects (Watermeyer, 2012). Discover! seeks to kindle the participants' imagination and a sense of interest in STEM and moves away from the acquisition of science knowledge and attainment in STEM. It is an opportunity for participants to move away from gendered beliefs that kept girls away from STEM for decades, and confirm their legitimacy to participate actively in STEM (Watermeyer, 2012).

Through his research, Watermeyer, (2012) analyses the way that this project instigates participants to rethink their gender identity in STEM through interactions with each other and their mentors. The researchers also reflect on how the informal, single-sex setting is beneficial in helping girls develop their confidence in the subject and in recognizing the role of female STEM professionals in different fields (Watermeyer, 2012).

While it is difficult to identify the long-term effects of this programme, this study shows that the girls participating in the study were more proactive in their science classrooms (Watermeyer, 2012). It also allowed the girls to think about and imagine a career in STEM. The researchers found no conclusive proof that the same-sex environment used in this programme is beneficial for girls participating in the programme to reach its goals. While some parents and participants felt that having a girls-only environment created a positive atmosphere in which girls were made to feel more confident, others felt that this lead to emphasise the gender inequality that exists in STEM (Watermeyer, 2012). When reading about this programme, I felt that its aims coincided with the aims of the badge curriculum, I was aiming to develop. This programme also emphasised the use of the single-sex environment that is also the reality that I am addressing through this research study.

Through this brief description of different after-school initiatives aimed at promoting STEM careers with girls, one would be able to observe the similarities and differences that these programmes have. While there are various differences between the programmes mentioned, particular aspects make them unique and distinctive. A common aspect they all possess are the objectives of challenging stereotypes about females in STEM and developing a STEM identity amongst female participants.

In all three cases, the researchers identified the short-term benefits of these projects, but were unable to observe and record the long-term effects of the programmes. This happens because most of the outcomes of after-school programmes are not immediate and it would take years for these objectives to be actualized (Krishnamurthi et al., 2014).

2.2.3 Objectives of Programmes to Encourage Girls Towards STEM

One of the major reasons why youth and young people move away from STEM subjects and careers is the lack of a STEM "Identity" (Krishnamurthi et al., 2014). A study carried out by Krishnamurthi et al., (2014) the found that young people tend to have high aspirations, but very little of these were related to careers in research and innovation, even though the participants of the study reported that they liked STEM subjects and were doing well in these subjects. What kept these participants from aspiring for careers in STEM was the perception of scientists as white males coming from a middle-class background (Krishnamurthi et al., 2014).

Krishnamurthi et al., (2014) state that one of the main predictors of students opting for a STEM career is not the grades these students get in the subject, but rather the interest one shows towards STEM subjects. This is why, several after-school programmes aimed at increasing STEM participation, identify the initiation of interest amongst their participants as one of their main goals.

Although within certain programmes, such as *Bringing Up Girls in Science* (BUGS), increasing academic achievement is mentioned as one of the objectives of the initiative, the goal of motivating and increasing participants' interest in STEM is considered to be more important (Tyler-Wood et al., 2011).

Krishnamurthi et al., (2014), identify three main outcomes of after-school, STEM programmes. These outcomes include:

a. generating interest towards STEM subjects and activities related to STEM;
b. developing the ability and skills to participate in STEM activities;
c. creating positive attitudes towards STEM and appreciating the value of STEM.

These objectives are also echoed by the initiatives discussed in the previous section. The programme *Discover!* aims to change and improve students' relationship towards STEM and increase participation in STEM within the community (Watermeyer, 2012). The chemistry science camp researched by Levine et al., (2015), also had the aim of familiarizing participants with STEM and enhancing their interest in chemistry, while applying STEM to solve everyday life problems and situations.

Krishnamurthi et al., (2014), suggest a number of indicators that show that these objectives are being reached, while identifying different initiatives that are reaching these goals. These indicators are discussed in detail below.

> 1. These programmes engage and retain participants who are diverse and who are coming from different backgrounds. Nowadays, youth have several other opportunities, and they can choose from a variety of after-school programmes.

> 2. Participants in these programmes show a great deal of interest and engage in the activities being carried out, extending this interest to the school environment and beyond.

3. The initiative is helping participants gain a variety of STEM skills that would help them carry out the tasks within the programme. Such skills may include problem-solving, designing innovative projects and engaging in scientific inquiry.

4. Participants also develop other life skills, that although these are not directly linked with STEM careers, would help them throughout their lives. Such skills include communication skills, team work and time management skills.

5. Participants start relating STEM to their everyday life, leading them to appreciate the contribution of STEM and STEM careers to their communities. Within the BUGS programme, the programme team try to move away from the constraints of a curriculum to present STEM as relevant.

6. The initiative exposes different STEM career options and the participants indicate awareness of the different choices they can make.

7. STEM programme is having an effect on the academic achievement of the participants.

These indicators show that while the main aim of after-school STEM initiatives might be to ensure a greater number of young people are entering STEM careers, their effects are far more wide spread than that (Krishnamurthi et al., 2014). The activities within after-school initiatives provide an opportunity for participants to collaborate, develop a STEM identity and learn from each other. These skills and benefits are long-lasting and beneficial even to those who might not be interested in pursuing STEM careers (Sahin, Ayar, and Adiguzel, 2014).

2.2.4 Characteristics of Existing Programmes

In order to reach the goals and objectives mentioned above, initiatives which are aiming and encouraging more girls and young women towards STEM subjects and careers, are making use of several techniques. The following section will provide an in-depth analysis of the different approaches adopted by programme organisers or identified by researchers as methods to engage girls in STEM.

2.2.4.1 Mentoring

The *BUGS* project, provided the participants with a mentor, as it was indicated that a mentor creates an environment that encourages interest, confidence and participation (Tyler-Wood et al. 2011). These mentors were STEM professionals who guided the participants throughout their educational journey within the programme by helping the participant think reflectively and provide encouragement (Tyler-Wood et al. 2011). Apart from boosting the confidence of participants, the role of a female mentor is to help girls develop several STEM skills, such as problem-solving. Mentoring can also help participants develop a positive attitude towards STEM and helps girls to identify with STEM careers (Packard and Nguyen, 2003). Tyler-Wood et al. (2011) describe mentoring as an essential tool to bring girls closer to STEM and to expose girls to STEM careers.

2.2.4.2 Role Models

In the informal programme *BUGS*, the mentors were women who were successful in several STEM fields and hence, apart from mentoring the participants, they also served as a role model for participants (Tyler-Wood et al. 2011). Castillo, Grazzi, and Tacsir, (2014) identify the absence of female role models in STEM careers as a major influence on young girls' career choices. When girls have

female family members who are STEM professionals, they are more likely to follow suit. This happens because the girls would already have an experience of that person's career. Interventions and initiatives aiming to reduce the gender gap in STEM make use of female role models as one of their approaches to target the idea that STEM is a masculine subject (Sinnes and Løken, 2012).

The *Chemistry Camp* on Rhodes Island, provided participants with various opportunities to get to meet and interact with female scientists, in which participants had the opportunity to discuss STEM careers with these professionals through question and answer sessions (Levine et al., 2015). The programme *Discover!* also made use of role models to make participants aware of gender inequalities in the field of STEM and to challenge stereotypes related to females in STEM (Watermeyer, 2012).

Furthermore, Sinnes and Løken, (2012) suggest having role models who do not fit the male stereotype and whose characteristics vary from those of males. They suggest that the role models chosen to challenge gender stereotypes, make use of feminine aspects to change the perception that feminine values are not in line with STEM. Sinnes and Løken, (2012) note that very often, interventions made use of gender differences to challenge the stereotype of STEM as a masculine subject.

2.2.4.3 Hands-on Approach

An important aspect of after-school programmes is a hands-on approach and experiential learning. Hill et al., (2010) suggest hands-on discovery and play to generate interest towards STEM from a very young age. Hands-on activities in afterschool programmes can contribute to a participants' academic achievement. It also provides participants with the opportunity to discover and thus generate interest in STEM. Hands on activities also provide students with a clearer

representation of what STEM careers entail and how scientists work (Dare and Roehrig, 2016).

This hands-on approach was also incorporated in programmes aimed at promoting STEM with girls. The *Discover!* project developed hands-on activities and an experiential learning experience for participants that allowed them to imagine their careers in STEM (Watermeyer, 2012). Within the *Chemistry Camp* on Rhodes Island, participants were engaged in solving real life problems through hands-on activities that allowed them to apply science to their daily lives (Levine et al., 2015). These activities proved to be effective in generating interest and enthusiasm among participants. To further extend the experiential aspect of the programme, the participants were also taken out on field trips (Levine et al., 2015). Levine et al., (2015) reported that although field trips proved to be expensive and logistically difficult to organise, the trips to different work places, proved to be a beneficial tool in exposing participants to STEM careers.

2.2.4.4 Groupwork

A study carried out by Dare and Roehrig, (2016) found that girls described hands-on experiences in science as enjoyable and exciting and they identified experiential learning as one of the reasons why they liked science in school. This sense of enjoyment results from the fact that girls associated the group work taking place in hands-on experiences with a social aspect, which is important for them since they value the opportunity to work with other people and the benefits this brings about. In the same study, girls stated that group work and collaboration were not part of a STEM career. The researchers linked this to the reason why females think of STEM careers as lonely and cold.

Gil-Doménech and Berbegal-Mirabent, (2017) also support the idea that girls are more eager to participate in activities that involve groupwork. Girls also prefer

and are more willing to work in teams in which the majority of participants are females. In such a setting, they give more of an input (Dasgupta, Scircle, and Hunsinger, 2014), cited in Dasgupta and Stout (2014). Furthermore, involving female scientists and STEM professionals in activities that involve groupwork, helps girls realise that STEM careers involve a social aspect they enjoy, and challenges the perception of STEM careers as cold and isolated (Gil-Doménech and Berbegal-Mirabent, 2017). Apart from challenging stereotypes, collaborative learning, aids in the learning process. Groupwork makes difficult and challenging tasks possible to accomplish, as one person's weakness is compensated by someone else's abilities and strengths. This leads to better learning and a greater sense of accomplishment giving participants the confidence they require to engage further in STEM (Sahin, Ayar, and Adiguzel, 2013).

2.2.4.5 Informal Environment

Watermeyer, (2012). considers informal learning as a method that supports young girls and women in the discovery of their own STEM Identities. The National Research Council (2009), emphasises the benefits an informal environment would have on the process of science learning. The National Research Council (2009), identifies six aspects that are the basis of learning STEM in informal settings:

1. Generate interest, motivation and passion towards STEM subjects.
2. Make use of scientific concepts, models and knowledge in everyday life.
3. Relate STEM concepts and models to the world around them.
4. Think about and appreciate science as a process that could lead to change.
5. Participate actively in STEM activities and gain STEM skills.
6. Identify with STEM subjects and develop a STEM identity which helps them contribute to science.

Although these strands overlap with those of formal school settings, the first and last aspect, are "particularly relevant for informal environments" (National

Research Council, 2009, p.4). Informal settings provide the ideal environment to develop the excitement that would lead to interest and motivation while allowing participants to develop the kind of identity that would help them persist in science.

The programmes discussed earlier, all name informality as one of their main approaches. Special emphasis on the informal aspect of afterschool programmes was made by Watermeyer. (2012), in the analysis of the programme *Discover!*. The participants in the programme *Discover!* are allowed to be free to explore the activities in their own ways with little intrusion from the leaders and no formal assessments. Through this method, the focus was moved away from the learning of science and more towards providing a positive experience of STEM to the participants, and the development of a STEM identity. Through this programme, the researchers display that through the informal aspect of a programme, participants would have an opportunity to increase their interest and imagine their futures in STEM (Watermeyer, 2012).

This informal approach to learning is adopted within the Girl Guiding Association, which as a non-formal education setting, provides members with the opportunities to explore and learn (World Association of Girl Guides and Girl Scouts, WAGGGS, 2014). The following section will provide an overview of how this approach to learning within the Guiding Association is being used to develop effective STEM initiatives.

2.3. The Guiding Association

2.3.1 The World Association of Girl Guides and Girl Scouts (WAGGGS)

With a total of 10 million members coming from 150 countries, the World Association of Girl Guides and Girl Scouts (WAGGGS) is a worldwide voluntary movement for girls and young women. This association which has been around

for a hundred years, seeks to help girls develop to their fullest potential. This aim is reached through the association's non-formal educational programme, its work on advocacy, work in the community and leadership development (World Association of Girl Guides and Girl Guides, WAGGGS, 2018).

National Girl Guides and Girl Scout Associations worldwide, can be either full members or associate members of WAGGGS. All these member associations work in accordance to the values and criteria established by WAGGGS, which is divided into five regions: Africa, Arab, Asia Pacific, Europe and the Western Hemisphere regions. These regions form part of WAGGGS governance to ensure that different member associations work towards WAGGGS main goal, that of empowering girls and young women (WAGGGS, 2018).

2.3.2 Malta Girl Guides (MGG)

The Malta Girl Guides (MGG) is a full member of WAGGGS and forms part of the European Region within the same association. The association serves as a regulatory body of Guiding within the Maltese islands and aims to promote and develop Guiding in Malta. The MGG aims to provide girls and young women with the opportunity to develop their character based on the values established by the founder Lord Baden Powell. This sense of commitment towards the character development of girls and young women is echoed in the MGG's association vision "to be a relevant movement where each girl and women is valued, empowered and given a voice" (Malta Girl Guides, 2016).

Members within MGG are grouped into the following sections, depending on their age. Dolphins are aged between five and seven years, Brownies may be between seven to ten years, Guides are ten to 13-years-old, Rangers 13 to 16 and Senior Rangers should be between 16-22 years of age (Malta Girl Guides, 2016) [Refer to Appendix 1]. MGG welcomes all girls and young women, irrespective of their

social class, race, religion and nationality. While membership and participation are voluntary, all members stand for and abide by the fundamental principles of the association (Malta Girl Guides, 2016). The fundamental principles of the Malta Girl Guide Association are based on those of the World Association of Girl Guides and Girl Scouts (WAGGGS) and are communicated through the promise and the Laws as quoted below. The Guides, Rangers and Seniors promise, states:

"I promise to do my best, to do my duty to God, serve my country, help other people, and to keep the guide law." (Malta Girl Guides, 2016)

Each member within the Guiding association also abides by the following law, as is stated in the Statute of the Malta Girl Guides (2016):

A Guide

(i) Is loyal and can be trusted.

(ii) Is polite and respectful.

(iii) Is helpful and considerate.

(iv) Is friendly, cheerful and shares in the sisterhood of guiding.

(v) Makes good use of her time and her abilities.

(vi) Protects the environment and respects all living creatures.

Although, it has established itself as a girls-only association, as it is believed that the single sex setting provides the best setting for girls to develop their fullest potential, the MGG embraces values of equality and inclusion. The association works continuously to ensure that no person is discriminated against. It also celebrates diversity and shows commitment to equality through all the workings of the association (Malta Girl Guides, 2016). The association also proves itself in the work done to empower girls and women in our society. Through participation in a variety of activities and leadership programmes, the association provides members with the opportunity to grow in different areas of development. Within

the MGG, members at all levels are involved in decision-making through their participation in local and international youth forums and working groups (Malta Girl Guides, 2016).

2.3.3 Empowering Women in the Guiding Association.

The association recognizes the fact that stereotypical beliefs are all around us, and although they can take different forms around the world, they all keep us from being ourselves and behaving in certain ways. WAGGGS is working with different member organisations to empower women and to challenge these stereotypes, which in most cases are related to gender (World Association of Girl Guides and Girl Scouts, WAGGGS Europe Region, 2016).

The Guiding Association identifies the impact it can have on a child's development from an early age. Hence, it also recognizes its unique role in not only talking about gender and diversity but also acting upon it to challenge barriers and to help develop personal identities based on the individual's personal limits and not based on society's expectation of who they should become (WAGGGS Europe Region, 2016). It is believed that through this work, the association will be moving closer to its mission, that of providing the opportunity for its members to develop their full potential (World Association of Girl Guides and Girl Scouts, WAGGGS, Europe Region, 2018).

Within the document *The World We Want for Girls beyond 2015*, WAGGGS (2014) identifies eight themes that need to be tackled by the association to guarantee gender equality. These eight themes emerged from discussions with girls and young women from different parts of the world. The themes that arose were:

1. Attitude, behaviour change and fair portrayal of girls and young women;

2. Quality education;

3. Creating safe spaces for girls;

4. Eliminating violence, early marriage and harmful practices;

5. Girls and young women's voices, civic engagement and leadership;

6. Comprehensive health;

7. Decent employment;

8. Environment and climate change.

The first theme, that of changing negative stereotypes, attitudes and behaviours towards girls and young women, is acknowledged as the most important aspect for women to overcome gender inequalities and to feel empowered (WAGGGS, 2014). While changing norms, beliefs and attitudes towards women might be time-consuming and rather challenging, it is an essential move to provide a better world for girls and women. By eliminating stereotypes and negative attitudes towards girls, one would be paving the way to tackle the other themes (WAGGGS, 2014).

WAGGGS (2014), asserts that these attitudes can be changed through the way females are portrayed. Giving a more realistic and holistic portrayal of women, inspires girls and young women to believe in themselves. One of the main approaches the Guiding Association is using in addressing social norms, and attitudes is by portraying successful female role models in non-traditional career paths. (WAGGGS, 2014).

The association's commitment to enable girls and young women to develop their personalities without being restricted through stereotypes and prejudices also arises from the fact that it recognizes that women make up half the population and thus half the talent base of Europe and the world. Any restrictions and boundaries women face, would mean that a country or an association would not

be making use of, and appreciating the talent of half its talent pool (WAGGGS Europe Region, 2016).

2.3.4 WAGGGS: Education

2.3.4.1 Non-Formal Education in WAGGGS

The best way to describe the WAGGGS educational programme is as a non-formal educational programme. WAGGGS is one of the six biggest international youth organisations known as the Big Six which use non-formal educational methods to create change through youth work (WAGGGS, 2014).

WAGGGS' Europe Region, (2018) define non-formal education as a continuous spectrum of approaches which lie between formal and informal education. In non-formal education, the learning is planned by trained leaders, but it is mostly directed by the learner through participation and self-directed approaches.

One of the identified benefits of self-directed learning is the promotion of lifelong learning. Through the culture in which a participant is responsible to decide what and how to learn, a person develops a sense of responsibility towards their own learning (WAGGGS, 2014). In order to ensure self-directed learning, a bottom-up approach should be implemented within non-formal educational settings. Organising activities which involve participation, does not necessary mean that leaders are allowing participants to take control over their own learning. A bottom-up approach is one in which the learner is the person directing the learning (WAGGGS, 2014).

In light of this understanding of non-formal educational settings, the Guiding and Scouting educational programme should:
      1. Include clear learning objectives.
      2. Provide a variety of activities that are engaging.

3. Provide an accessible and inclusive setting.

4. Incorporate a learner-centred approach.

5. Allow each individual to choose and identify what and how to learn.

6. Provide competent and trained leaders.

7. Provide mentoring and evaluation processes.

<div align="right">(WAGGGS, 2014)</div>

2.3.4.2. The Educational Programme

The educational programme of Girl Guides and Girl Scouts associations takes into account three distinct aspects:

- what youth members do (the activities);
- how they do it (the Girl Guide and Girl Scout method);
- why they do it (the purpose).

<div align="right">(WAGGGS, 2014, p.7)</div>

This approach is what distinguishes activities done in Girl Guiding and Girl Scouting Associations from any other activities carried out by youth organisations. What makes the Educational Programme of the association unique is the link between the activities and the adopted method and purpose. While the connection of activities to the aim or purpose of the activity nurtures values and brings about consciousness of different global issues, the method empowers members and develops a sense of leadership and responsibility within themselves (WAGGGS, 2014).

2.3.4.3 The Guiding and Scouting Method

The Guiding and Scouting Association makes use of the Guiding and Scouting method as a model to implement non-formal education. This method is made up of five points aimed at enabling non-formal education to occur (WAGGGS, 2014).

1. The Patrol System.

Peers play an important role in the development of our values. The Patrol, as founded by Lord Baden-Powell is a small group of about six to eight members who work together to achieve different goals (World Association of Girl Guides and Girl Scouts, Europe Region, 2012). This method encourages a greater sense of friendship and support amongst members. Through the patrol system, participants also learn how to cooperate giving them a sense of belonging (WAGGGS, 2012).

The patrol system is implemented by splitting up a group into smaller groups called Patrols, made up of girls of different ages. Apart from enabling the Guides to work in groups, practice democratic values and take ownership, the patrol system also provides a mentoring system for new members and an opportunity for older, more experienced members to practice their leadership skills (WAGGGS, 2014).

2. Progressive Self-Development.

WAGGGS recognizes the fact that each person learns using different methods, and at a different pace to others (WAGGGS, 2012). Through progressive self-development, members are encouraged to explore their own routes, by choosing and planning activities themselves. In this way, the leader serves as a facilitator who encourages girls to choose their different paths and work on them at their

own pace. The participants have the freedom to take risks and make mistakes, that would enhance their learning experience. This system is implemented by allowing participants to develop their own targets and awarding badges based on the personal achievement of each individual member. Meetings also involve different learning styles so that each member can become engaged in learning (WAGGGS, 2014).

3. Learning by doing.

The best way for a person to learn is through real-life experiences. Learning by doing is one of the approaches adapted by WAGGGS to engage participants and to encourage them to contribute their skills and knowledge for the success of the group and gain and learn new skills (WAGGGS, 2012). Through learning by doing, Guides would be able to relate what they are learning to their everyday life (WAGGGS, 2012). Another important aspect of learning by doing is advocacy. Members are encouraged to advocate on issues they have close to heart, and be able to bring about positive change. Learning by doing is implemented within the programme by providing several problem solving and outdoor challenges for the participants to gain confidence in themselves and encourage members to learn from each other. These sessions are often followed by an opportunity to share results, discuss and reflect upon the learning process (WAGGGS, 2014).

4. Active cooperation between young people and adults.

While the Guiding and Scouting association, encourages its members to be independent and to be responsible for their own learning, it also believes that guidance from more experienced members or adult members is important to create a system of collaboration and solidarity. Young members require supervision and, as they grow older, youth members require people who can support them, whom they can turn to for advice and who serve as positive role models (WAGGGS, 2012). The adult member's role in the association is to empower members and help them in their decision-making. Retrospectively, older members would also have a lot to learn from younger members. This is why

active cooperation between members of different ages is essential. This sense of intergeneration and cooperation is encouraged not only between members, but also with the outside society, by working with other groups within the community and inviting community figures as speakers during activities (WAGGGS, 2014).

5. Connecting with my world.

An important aspect of Girl Guiding is the connection members develop with the world around them. This connection aids to foster a sense of global citizenship amongst members, by taking part in community projects and talking about advocacy related to issues that they care about. This aspect of the Guiding and Scouting method, incorporates within it three other aspects that were previously separate aspects of the method: relationship with nature, international experience and service in the community (WAGGGS 2012). These aspects were included together, because of the close link they have with the idea of global citizenship. Global citizenship is achieved through work with other charities and organisations, close connections to nature and by advocating about global and local issues. To enhance the experience of the members and broaden their horizons, WAGGGS also provides a number of international experiences for its members (WAGGGS, 2014).

2.3.4.4 Developing Skills

When Lord Baden Powell came up with the idea of Scouting, his main aim was to create an educational system that helps participants to develop a sound character and a sense of global citizenship (WAGGGS, 2014). In order to reach these goals, the association needs to ascertain the skills girls require, not just for today, but also for the future (WAGGGS, 2014). The skills required by young people to create change and take lead roles, are identified by WAGGGS as the six "C" skills described below:

- Character: Working towards developing motivation amongst members to achieve personal goals and to be able to support others in doing so.

- Creativity: Encouraging creative thinking skills which enable participants and members to think creatively to solve problems, use what they know, and apply it to develop solutions.

- Citizenship: Empowering members to work towards a better world by being active in their communities and acting on issues that matter.

- Communication: Developing positive relationships by listening and responding to others empathically, and being able to communicate with different audiences.

- Collaboration: Fostering true team players who can work with others in a positive and productive manner.

- Commitment: Nurturing a sense of responsibility amongst members towards their own learning and the world around them.

(WAGGGS, 2014)

These skills, which more than a century ago were identified by the founder of the Guiding and Scouting association, are also identified by Lawless, Brown, and Boyer (2016) as STEM skills or twenty-first century skills, which are essential in the development of stronger STEM identities within programmes aimed at reducing the gender gap in STEM (National Research Council, 2009).

2.3.4.5 Badge Design

Within the Girl Guiding and Scouting Association, badges can be designed and published by WAGGGS itself, by the different regions and also by separate member organisations. The Malta Girl Guides, apart from making use of badges developed by WAGGGS and the Europe Region, also designs its own badges. The badge curricula within MGG are designed upon the same model and follow the principles established by WAGGGS. A badge curriculum is made up of a number

of suggested hands-on activities dealing with a specific theme, with the aim of reaching a set of objectives. The introductory activity of a badge would be compulsory and its aim would be that of familiarizing the participants with the theme being dealt with throughout the badge. The remaining activities of the badges are optional; however, members have to carry out at least three out of the activities within the badge. The activities within a badge are Patrol tasks and hence are carried out within groups or Patrols. The badge is concluded with an individual task that would help participants reflect more upon their journey while working on the badge.

Within this study, the badge curriculum will be designed in accordance to the criteria set by WAGGGS and MGG, as stated above.

2.3.5 STEM in Guiding Associations.

Throughout the years, Girl Guiding and Scouting associations around the world offered a small number of badges related to science and technology (Girl Scout Research Institute, 2012). These badges often reflected the different changes occurring within their society. A fine example of this is Girl Guiding UK which offered badges such as the Air Mechanic Badge in the 1910s, the Electrician badge in the 1930s when homes were getting electricity and a computer badge in the 1980s when computers were gaining their popularity. Right now, in what could be described as the digital and technological era, the Guiding and Scouting Association, is changing its programme and implementing STEM programmes and badges to reflect the challenges and changes occurring in the twenty-first century (Girl Guiding UK, 2017b).

Several member associations are introducing a number of STEM badges and programmes, that focus on different STEM fields. The aim of these programmes is to engage females with STEM and to allow them to explore STEM in their everyday lives (Girl Scouts of the USA, 2016). Apart from familiarizing members with STEM, these programmes also help girls and young women to develop their leadership skills, change their mindsets and gain other essential life skills (Girl

Scouts of the USA, 2016). The content of these badges differs greatly from one association to another; however, the main objectives are shared (Girl Scouts of the USA, 2016).

The inquiry-based nature of STEM and its hands-on approach coincide greatly with the Guiding and Scouting method, which highlights the most important methodological approaches of the programme within Guiding and Scouting associations (Girl Scouts of the USA, 2016). One of these approaches is cooperative learning, through which girls, and at times even leaders, work together to solve problems, carry out experiments and STEM projects. Through this approach, participants feel that they can work more effectively and learn more (Girl Scouts of the USA, 2016).

Girl Guides working on STEM badges and programmes, also have their say within these programmes and are given an opportunity to choose what to do and how to do it. They are in charge of their own learning and through the idea of progressive self-development, they are also allowed and encouraged to explore (Girl Scouts of the USA, 2016). The opportunity for participants of STEM programmes to take on leadership roles, also encourages the participants to be leaders in other contexts and to transfer what they have learned and gained into their communities (Girl Scouts of the USA, 2016).

The participation of adults also aids in the implementation and effectiveness of STEM programmes within Guiding and Scouting associations. STEM professionals are often invited to share their experiences with members and to provide them with support and inspiration. These STEM professionals provide the participants with more insights into STEM careers and also serve as role models. The participation of leaders is essential as they facilitate the programme, support the members and ensure that each girl is feeling valued (Girl Scouts of the USA, 2016).

Within a study about the effectiveness of *Girls STEAM Ahead*, which is a STEM programme implemented within a Girl Scouts Association, Girl Scouts of the USA (2016), identifies a number of benefits that girls participating in STEM programmes within Guiding and Scouting associations experience. Through the hands-on nature of the programme and the supportive environment developed within Guiding and Scouting associations, girls:

- develop a deeper STEM identity, feel more confident doing STEM related tasks, thus making them more willing to participate in STEM.
- develop a more positive attitude towards STEM, are more open to choosing STEM subjects and more likely to be willing to participate in other STEM programmes.
- become more interested in STEM careers and in taking up STEM courses.
- develop essential STEM-related skills that they would find useful, even if they do not pursue STEM subjects and careers, ranging from problem solving skills, researching a problem and working with other people.
- develop a sense of perseverance when solving challenges and problems.
- learn more about STEM careers and professions, and become aware of what career opportunities exist for girls and young women, by meeting and getting to know STEM professionals and visiting different work places.
- show more appreciation towards STEM and further understand the importance of STEM in their lives.
- develop their leadership skills and feel more confident in working with others.
- developed a more unbiased perception of the abilities of men and women in STEM and challenge stereotypes related to females in STEM careers.

2.3.5.1 STEM Programmes and Initiatives within Member Associations

Several member organizations within WAGGGS are currently targeting the reality of under-representation of women in STEM by creating programmes and badges to encourage more girls and young women into the field (Bullock, 2017). This is being done by teaming up with other shareholders and institutions which have the matter close to heart. An excellent example of this is the Girl Scouts of the USA Association which in the past few years have worked on several STEM Based projects, namely *First Robotics*, *Girls STEAM Ahead* and *Imagine your STEM Future* (Girl Scouts of the USA, 2016). This member association, which totals 2.4 million members, have partnered with several organizations such as NASA and the National Science Foundation to develop programmes which provide an authentic experience of STEM to its members (Girl Scouts of the USA, 2016). This association is also working on an advocacy programme with the aim of challenging stereotypes about females in STEM areas, within the local community, amongst public officials, and other leaders at different levels of society (Girl Scout Research Institute, 2012).

In the meantime, in India, the Guiding Association and artificial intelligence company Nvidia are piloting the *Screen Girls* project in which guides who have just completed secondary school are given the opportunity to participate in a computer course, with the aim of boosting their employability (Bullock, 2017). Guides in Tanzania have partnered with *Techchix*, to develop mentoring programmes which promote science and engineering amongst girls (Bullock, 2017).

In the United Kingdom, the Girl Guiding Association is working with Microsoft and Google to develop new badges about coding and Mechanics (Bullock, 2017). In the past few years, this association also conducted a survey about the perception of STEM subjects amongst girls (Girl Guiding UK, 2016) and developed other badges related to STEM such as the Clever Cogs Engineering

Challenge (Girl Guiding UK, 2017a). Other badges issued by Girl Guiding UK, are related to app design, space and vlogging and are aimed at members coming from different backgrounds (Plummer, 2017).

This trend in STEM programmes within Guiding associations also caught up in Canada, where the Canada Girl Guides have also developed a set of STEM Badges (Girl Guides of Canada, 2015). One such badge is the Engineering Crest which is a badge developed by Engineers Canada for Girl Guides Canada, to be issued to girls who complete a number of STEM related activities with the mentorship of an engineer. The activities within this pack help girls link engineering to their everyday lives and involves hands-on activities related to simple machines, vehicles and different products (Engineers Canada, 2018).

2.3.5.2 STEM Initiatives within the Malta Girl Guides

The Malta Girl Guides has also been working on STEM initiatives to promote STEM among its members. One of the major initiatives aimed at reducing the Gender Gap in STEM was the *iCan do Science* camp held during the Easter Holidays in 2015. This camp was aimed at Guides and Ranger Guides between the ages of ten to fifteen, held in collaboration with the Malta Centre for Science and Technology. Within this camp, participants had the opportunity to meet female scientists and other STEM professionals who shared their experience in STEM. The participants also participated in a number of hands-on STEM activities, ranging from tinkering, building electrical circuits and soap-making. Its objectives were challenging gender stereotypes and encouraging girls to pursue careers in science (Malta Girl Guides, 2015). It was supported by other institutions and organisations such as the science student organization S-Cubed, Agenzija Zghazagh, the International Federation of Business and Professional Women – BPW Valletta and the European Commission's campaign *Science: It's a girl thing!* (Malta Girl Guides, 2015).

In the meantime, the Association has also published a small number of STEM related badges, such as the water badge and bio-diversity badge for Dolphins, the Explorer badge and Nature Detective Badge for Brownies and Space badges for Guides and Rangers. The Association is also seeking to increase their work on challenging stereotypes related to STEM and encouraging more girls to pursue these subjects and STEM-related careers, through the addition of more STEM badges.

2.3.5.3 Final Thoughts about STEM Initiatives in Girl Guiding Associations

While most learning processes take place in a school setting, non-formal educational settings are perceived as a beneficial addition to an individual's developmental process, especially when it comes to the development of a positive STEM identity (Dorsen, Carlson and Goodyear, 2006). In fact, a Scientix report suggests that collaboration between formal and non-formal educational providers through the use of STEM programmes and initiatives, can lead to an increased interest in STEM subjects and ensure growth in STEM based careers (Kearney, 2016). In view of these benefits, non-formal educational settings can provide, girl guiding could be perceived as the perfect opportunity to fulfil the goals of STEM programmes, i.e. in inspiring more girls and young women to take up STEM (Girl Scouts of the USA, 2016). Through its informal programme structure and the Guiding and Scouting method, discussed in previous sections, a Girl Scouts of the USA (2016) study, found that this association was effective in not only challenging attitudes amongst girls and motivating them to take up STEM, but also in strengthening outcomes which the association considers pivotal to its programme, such as leadership skills, collaborative learning and exploration. It is this overlap in the objectives, that makes the Girl Guiding Association's non-formal educational setting effective in its STEM programmes.

Chapter 3

Methodology

3.1 Introduction

Cohen, Manion, and Morrison (2007) define methodology as a "range of approaches used in educational research to gather data which are to be used as a basis for inference and interpretation, for explanation and prediction." (p..47).

This chapter provides a detailed account of the methodology applied for this research study. It highlights the rationale of the research design used and also goes into the procedures applied throughout the data collection process to ensure the authenticity and transparency of the research study. Ethical considerations, challenges and limitations will also be discussed in depth in a specific section of this chapter. The same applies for the data analysis, which will be discussed in more detail in the final section of the chapter.

3.2 Objectives of this Study and Research Questions

The National Research Council (2002) underscores the importance of making use of appropriate research methods which answer the research question directly. This idea is also emphasised by Hawkesworth (2006), who argues that in order to gather evidence which is reliable and meaningful to the research questions, one must make use of suitable methodology. Ratner (2002), compared the methodology used by researchers to the measuring instruments used by a scientist. Just as there are appropriate instruments to take scientific measurements, there are also conventions on what methods are used within educational research to gather reliable and relevant results. Therefore, before deciding on which research methodology is to be applied for this study, a

thorough look at the research questions, aims and objectives of the research is necessary.

The ultimate aim of this research study was to develop an initiative within the Malta Girl Guides to help girls make better-informed decisions and choices; and encourage them to embark in STEM-related careers.

Through my research, I answered the following questions:

1. What factors motivate girls to choose STEM related careers?

2. How can a badge curriculum as an initiative of the Malta Girl Guides, be used to foster interest towards STEM careers, amongst members?

3.3 Qualitative Research Methods

The questions and objectives posed within this study required an in depth and thorough exploration of STEM Programmes within out-of-school educational settings and it is for this reason that qualitative research methods were used. Qualitative research depends on personal accounts which are analysed by the researcher through observation, reports, recordings, written and visual information, to gather knowledge (Denscombe, 2010). This approach varies greatly from quantitative research methods which rely mainly on numerical interpretation of information and standardised research instruments (Denscombe, 2010). It is primarily because of the involvement of the researcher, that qualitative research methods provide insights which are in depth and rich (MacDonald and Headlam, 2009). Unlike quantitative research methods, which are rigid, qualitative research methods are more adaptable and allow the researcher more spontaneity and freedom to ask questions with the aim of delving deeper into the subject (Cohen et al., 2007).

Furthermore, this research study sought to follow closely the experience of Ranger Guides throughout the implementation of a STEM career badge to gather insights about the development of a STEM career badge. McMillan and Schumacher, (2006) state that qualitative research perceives reality as an experience which is shared amongst people and communities and which can be understood and explained. It is through these experiences that knowledge is shaped and produced. This sense of emphasis on experience and how individuals perceive it provided another reason to opt for this kind of research approach.

The same characteristics that make qualitative research the ideal option for this research study, also pose a number of issues. Denscombe (2010) highlights several disadvantages of qualitative research and how these drawbacks can be attributed to the most essential characteristics of qualitative research. In order to produce detailed descriptions and accounts of a particular context, the researcher has to look at a smaller sample size. This would mean that the data collected would not be a good representation of the whole population (Denscombe, 2010). Meyer (2000), argues that the extent to which this is a problem can be established depending on the study and its aims and objectives. Another disadvantage Denscombe (2010) highlights is that the researchers' identity, background and beliefs might have direct influence on the interpretation of the data. The data might also be distorted through the process of coding, as through this process the context might be lost and this might result in the distortion of a situation or the loss of meaning. Also, through the coding process, the researcher might play down or dismiss data that does not fit the whole picture (Denscombe, 2010). These weaknesses in the qualitative research method have helped foster a more cautious and analytical approach when using this type of research method (Cho and Trent, 2006). Fraser (2014) highlights the role of "credibility, transferability, dependability and confirmability" when using qualitative approaches, to eliminate biases as much as possible. Within this research study, these aspects of trustworthiness were applied whenever possible to ensure more rigorous and reliable results. The credibility of the research was ensured by making use of member checking. Through this process, suggested by

Cho and Trent (2006), to ensure credibility, the participants were asked to review the transcripts, complete reflective diaries and correct and clarify any misconceptions. Cope (2013) also suggests that the researcher provides a detailed description of the data collection experience, how the data was recorded and interpreted, and sufficient information to allow transferability. Through this section of the research study, a thorough description of all these aspects will be presented to ensure truthfulness and transferability.

3.3.1 My Role as a Researcher and an Insider.

The very fact that a researcher chooses one research topic over another, the premises made at the start of the research, the methods the researcher makes use of, and the way the observations are interpreted are all subjective decisions a researcher makes. This is why a researcher is encouraged to reflect critically about the values that they adopt within the research study (Ratner, 2002). In the case of this study, I will be carrying out research within an organisation which I am greatly familiar with, in which I am a member and currently a leader. As a researcher, I am deeply aware of how easy it is to fall prey to biases and pre-conceived notions that I already have of the Association that I will be researching. In order to avoid biases and to focus on truthfulness, I will make use of reflexivity throughout the process of the research. For a researcher to be reflexive, one should try to avoid "obvious, conscious and systematic biases and be as neutral as possible" (Ormston, Spencer, Bernard, and Snape, 2003, p.22). In order to do this, it is important for a researcher to reflect about the practices applied and any sources of partiality and biases (Ormston et al., 2003).

Despite the fact that I will make use of a rigorous and systematic approach to ensure that the data presented is trustworthy, I am still aware of the subjective biases that led me to embark on this research journey, and that have led me to develop this research project in the way I did. I believe that it is these essential subjective views that give a unique and insightful perspective to this study.

Hence, as a researcher, I will be adopting an objective viewpoint which proposes an integration of subjectivity and objectivity. This view recognizes that subjectivity and subjective means and processes such as perception, observation and logical inferences have an important role in objective research (Ratner, 2002).

3.4 Case Study Approach

Cohen et al., (2007) define case studies as being "Instances in Action" (p. 253). Case studies take particular organisational or institutional contexts and use them to establish a wide-ranging theory or principle (Cohen et al., 2007). A case study can investigate the realities of different individuals, groups, and even communities and present these realities to the readers. These realities are used to illustrate conceptual and abstract theories to the readers, making it easier to comprehend the point the researcher is trying to make. It gives context to an otherwise ambiguous concept (Cohen et al., 2007, p.253).

This lack of ambiguity is one of the major benefits of case studies. Case studies can also portray distinctive realities that are essential in understanding a situation and that no other large-scale study can expose (Cohen et al., 2007, p.256). This does not mean that case studies do not come with their downsides as well. Cohen et al., (2007) continue to highlight several drawbacks that case studies might present. Observers' bias is mentioned as being one of most noticeable weaknesses in case studies, as they can easily be shrouded in personal biases and subjectivity. This subjectivity often arises from the fact that it is often difficult to replicate the results of a case study, as each context is different and thus yields different results. Furthermore, each researcher will interpret realities in a different manner. While this subjectivity might seem to be problematic when conducting research, Ratner (2002) provides several reasons why subjectivity plays an important role in educational research and why it cannot be eliminated completely. The very fact that a researcher chooses one research topic over

another, is subjective. This is why a researcher is encouraged to reflect critically about the values they adopt within the research study. This critical reflection should also be adopted by other researchers who come into contact with that particular research. Ratner (2002), suggests adopting the objectivists' point of view, which proposes an integration of subjectivity and objectivity. This view recognizes that subjectivity and subjective means and processes such as perception, observation and logical inferences have an important role in objective research (Ratner, 2002).

When taking into consideration both the benefits and weaknesses of case studies, it was decided that the best course of action to answer the research questions was to adopt a case study approach. The in-depth and unique perspectives that such an approach could provide were the key factors in selecting this method. Through this approach, it would be possible to explore and probe in a more reflective and insightful manner, thus answering the questions posed in this study thoroughly.

This research project took the form of a case study. The context of the case study was a STEM Programme within a Ranger Guides group to map the experiences of Ranger Guides throughout the implemented programme. In the case study, a STEM programme was designed and delivered to a group of six Ranger Guides (aged between 13-15) within the Malta Girl Guide Association, in which the researcher is also a leader.

The research study is made up of four main stages: (1) an initial focus group which determined the Ranger Guides' initial ideas about STEM Careers and helped in the development of a badge curriculum; (2) the development of a badge curriculum with the aim of encouraging participants towards STEM careers; (3) the implementation of the programme; and (4) the evaluation phase which also took the form of a focus group.

The badge curriculum was developed using the format of the Malta Girl Guides badge curricula involving a number of group tasks as well as, individual tasks (Refer to Appendix 2). The STEM Badge Curriculum programme was implemented within a workshop carried out over the course of a day. The badge curriculum was made up of a number of group activities, together with individual reflective tasks which the girls completed on their own. Through this badge curriculum, the participants had the opportunity to get to know female scientists from at least three different fields of science stipulated within the badge curriculum. The areas of science chosen were: engineering, information technology, medical science and research. After they met the scientist, the girls then participated in a number of hands-on activities related to the different areas of STEM careers mentioned above. The individual tasks were a set of reflective written tasks that the Guides completed after each session. These written tasks were combined to form a reflective diary which helped in evaluating the programme, together with the final focus group (Refer to Appendix 3). Within the final focus group, participants shared their experiences and perspectives on the STEM badge programme. Finally, they evaluated the programme and provided suggestions for improvement.

3.4.1 The Use of Focus Groups.

Cohen et al., (2007), define focus groups as "a form of group interview" (p. 376), through which the role of the researcher is not to ask questions and expect an answer, but rather to facilitate the discussion and interaction between the participants. Because of this kind of interaction, the researcher within this kind of research technique is often referred to as a moderator or a facilitator (Gill, Stewart, Treasure, and Chadwick, 2008). The role of the researcher in a focus group is not to ask questions directly to each participant but to enable the participants to discuss together, question each other, exchange ideas and share opinions. This kind of communication would reveal not just the participants' views, but also their underlying reasoning (Kitzinger, 1995). The discussion that ensues during a focus group interview makes it easier for participants to

articulate their feelings and attitudes, since within this setting they would be able to share and discuss opinions. This is because a discussion can easily bring out the differences and similarities amongst participants and thus provide an excellent opportunity for differences to be discussed (Lewis, 2003). These opportunities for a deeper discussion arise from what Finch and Lewis (2003) refer to as a "stronger social context" (p.171) leading to a greater sense of spontaneity, that in turn bids participants to divulge more about the subject under discussion. Furthermore, a focus group allows for a more creative outlook which provides the perfect backdrop to furnish solutions or strategies (Lewis, 2003). Kitzinger (1995) highlights major drawbacks of focus groups. Kitzinger (1995) points out that the presence of other people in the focus group leads to lack of confidentiality. It is therefore, described as inappropriate to make use of focus groups when discussing sensitive topics. Kitzinger (1995) also asserts that the group dynamics, may make it difficult for participants who are in a minority or who disagree with the rest of the group to share their ideas. Kitzinger (1995) suggests groupwork as an effective way of enabling participants who might feel threatened by the topics being discussed. Through groupwork, the withdrawn participant is more likely to feel a certain sense of support and acceptance from other participants when voicing feelings or thoughts that are considered conventional as these participants might share the same beliefs. Groupwork also initiates different forms of communication that are used in everyday life interaction such as tales and banter. These methods of communication can tell the researcher as much as a structured answer to a direct question or even more (Kitzinger, 1995). This kind of interaction, often leads to a more relaxed and comfortable environment through which more diverse and wide-ranging data emerges (MacDonald and Headlam, 2009). This laid-back environment is also effective in making adolescent participants, feel more at ease to share their ideas and perspectives. Focus groups were chosen as the main form of data collection within this study for the reasons mentioned above.

3.4.1.1. Designing the Focus group

When planning to use focus groups as part of a research study, one has to take several aspects into consideration. The composition and the size of the group has to be thought through, before decisions are made. The group can be made up of either *naturally-occurring* participants or *pre-existing* groups of people. A naturally-occurring group is one which gets together for the purpose of the research, whereas, a pre-existing group is one in which the participants already know each other. Having participants who already know each other poses several advantages as they are in-turn more likely to interact and challenge each other. However, having a naturally-occurring group may also lead to more diverse views and experiences since they would bring different insights and cultures into the focus group discussion (Kitzinger, 1995). Gill et. al., (2008) discuss that there is no perfect arrangement for a focus group and that whatever the group composition is, the outcomes will be different. The authors emphasize the importance of having a good group mix and to take into consideration the group composition when interpreting data. Within this study, the participants of the focus group where recruited from 2 different Units within the Malta Girl Guides. This meant, that although some participants knew each other, thus aiding the interaction, they were also able to bring to the discussion a sense of diversity. Despite the fact that the participants were not all familiar with each other, they had a lot in common since they all form part of the same Association which provides its members with shared experiences and values. Having this sense of familiarity and shared values, enabled and assisted the discussion (Gill et. al.,2008).

Another important consideration when planning the focus group was the number of participants taking part. Gill et. al., (2008) suggest that it is always beneficial to enrol more participants than required for a focus group, than risking having fewer participants or having to cancel the focus group session. It is estimated that for each focus group there will always be two participants who fail to attend. The suggested number of participants in a focus group is six to eight (Gill et. al., 2008). In the recruitment process for this research study, nine participants were initially recruited. The number of attending

participants eventually dropped to six participants. This happened mainly because of participants' other commitments.

Designing a good focus group is epitome to a great discussion, and Gill et.al., 2008) suggest that although there should be no rigid structure to a focus group, it is necessary when planning the questions, that the facilitator should start with the most general questions, then move on to more detailed ones. The facilitator should also discuss the topics and explain its significance in relation to the theme of the research questions. Making use of groupwork activities is also a common technique used in focus group settings, to enable participants to discuss and interact rather than to give a direct answer to the facilitator (Kitzinger, 1995). Groupwork activities were used within this research study to help initiate discussion. In conjunction with groupwork activities, other questioning techniques and reflective tasks were used to elicit participants' authentic thoughts. These reflective tasks provided the participants space and time for more in-depth answers, rather than providing single word answers (Refer to Appendix 4 & 5).

3.4.1.2 Facilitating the Focus Group

Facilitating a focus groups is not an easy task and requires skills and presence of mind on behalf of the facilitator/researcher. The role of the researcher is to enable a smooth discussion amongst the participants, keep the participants on track without leading their replies and, ensuring that each participant is given the opportunity for their opinions to be heard without judgment. (Gill et. al., 2008). Finch and Lewis, (2003) stress that while it would be unlikely that all participants will contribute in equal parts to the discussion, making certain that the environment being created is conducive to such an aim, is essential. In certain cases, it is necessary for the interviewer to intervene and address the situation accordingly, e.g. if a particular participant is dominating the discussion or always being the first to answer, other participants may feel that they have nothing more

to contribute, or they might end up feeling less confident to share their differing ideas out of fear that this might be played down or over-powered. Cases like these require the facilitator to proceed with caution to divert attention from the dominating participant and towards equally empowering focus group members. It is only suggested to take up a more "direct approach" (p.183) if nothing else works (Finch and Lewis, 2003). On the other hand, it is essential to encourage and motivate more reserved and quiet participants. It is first essential to understand the reasons behind this reticent behaviour. Finch and Lewis, (2003) suggest various reasons why a particular participant might be holding back, ranging from a lack of self-confidence, a naturally withdrawn person or even a feeling of anxiety because of different ideologies. It is the facilitator's role to reassure and encourage these participants by making them feel safe and valued (Finch and Lewis, 2003).

Gill et. al., (2008) suggest some important points that the facilitator of a focus group has to keep in mind to ensure a respectful relationship between themselves and participants; and to ensure participants feel safe and valued. These suggestions are listed below:

1. An interviewer should react in a positive and respectful manner. The ideas of participants should be valued to encourage further discussion.
2. A researcher should refrain from participating within the discussion as this may influence the participants' answers in one way or another. Furthermore, this may discourage participants who disagree with the researcher, from sharing their views.
3. The main interviewer should be prepared for responses which oppose the objectives of the research.
4. Not all researchers are suitable to facilitate any kind of focus group.
5. It is essential that the researcher is comfortable in the role of facilitator, which in turn would make participants feel more comfortable.

These suggestions were kept in mind throughout the implementation of the focus group sessions and workshop, which helped the researcher build a relationship

of trust with the participants thus enabling them to feel comfortable in expressing their views, throughout the entire process.

3.4.1.3 The Focus Group Process

The Focus Group process in this study was based on a model provided by Tuckman and Jenson (1977), which was cited by Finch and Lewis, (2003). This model which was founded on a number of small group interactions that the former observed, identifies five different stages within a focus group. In this section I will be exploring these five stages and describing how these were incorporated in the focus groups held with the Ranger Guides.

Stage 1: Setting the scene and ground rules.

At the start of a session, while all the participants gathered, the atmosphere in the room was somewhat tense, while participants settled down. At this stage, it was the role of the facilitator to make the participants feel at ease by giving them a warm welcome and engaging in friendly conversation. At this initial part of the session, the research topic was avoided until everyone arrived and the formal part of the session could begin. Once everyone settled down, the facilitator ensured that everyone was ready to begin. The facilitator commenced with a personal introduction and provided information about the research and instructions for the session (Finch and Lewis, 2003). The aims and purposes of the research, the process involved and how data would be recorded and used, was also mentioned. The Ranger Guides were reminded of their rights and the importance of confidentiality and respect towards all participants was emphasised. This process was for the second focus group.

Stage 2: Individual Introductions.

Once the session started to be recorded, participants were asked to take it in turns to introduce themselves. Some opinions emerged during introductions although participants were still wary. Finch and Lewis, (2003), claim that at this initial stage of the focus group, some individuals already come out stronger than others, at times creating an atmosphere of tension. Next, the Ranger Guides were asked to participate in an ice breaker to acquaint themselves with one another. Through this ice breaker, the theme of the discussion was incorporated briefly. This allowed the facilitator to assess where the participants stood on the matter. In the second focus group session, the ice breaker was much shorter and the participants were asked to express their opinion about the workshop sessions they would later evaluate, based on instructions and topic presented thus far.

Stage 3: The Opening Topic.

In the first workshop, once individual introductions were over, the discussion about different STEM careers, was initiated through groupwork activity. In this part of the discussion, the ground rules were practised and some similarities and differences were evident. Already, it was observed, that participants seemed more comfortable sharing their views and opinions. The discussion topic was purposely left broad so as to allow participants to freely express their ideas and opinions as suggested by Finch and Lewis (2003). In the second workshop, the distinction between this stage and the latter was not as evident, since participants already knew each other.

Stage 4: The Discussion.

The following phase of the focus group is the Performing Phase or the Discussion. Participants work cooperatively and communicate about the research topic directly led by the facilitator, who ensured that topics being discussed were within the remit of this study (Finch and Lewis, 2003). At this stage, it was noted that participants became more focussed and engaged with the topics being

discussed. In the first focus group, the discussion dealt with a variety of preconceived notions about women in STEM and how these views can affect girls and women when deciding whether or not to pursue a STEM career. In the second focus group, participants were also asked to evaluate the workshop sessions which were carried out as part of the research process.

Stage 5: Ending the Discussion.

In the final section of the focus group, or the *adjourning* phase, participants were provided with time to share their concluding thoughts. The facilitator asked for suggestions and solutions to improve female take-up of STEM subjects and careers. Finch and Lewis (2003) advise that concluding in an optimistic and constructive tone is best. In both focus groups, participants were asked to provide suggestions about the badge and workshop created to promote interest in STEM. Suggestions from the first focus group were used to further develop the badge curriculum.

Finch and Lewis (2003) suggest that although the model suggested by Tuckman and Jenson (1977), is very structured and may seem rigid, a focus group does not have to follow the same exact structure as long as it is still beneficial to the process and it contains the most important aspects. The authors perceive these stages as "a normal part of the group process" (p.176), which should be allowed to happen, to ensure a fruitful and well-balanced discussion.

3.4.2 The Use of Reflective Diaries.

Reflection allows the person to value attributes and assess distortion through personal contemplation and thought (Pool, 2018). The use of the reflective diary in ethnographic research adds value to the analytical and individual perspective drawn (Duke, 2012).

While it is not suggested for reflective diaries to be used in isolation, a work diary can help enhance the data collected when used in conjunction with other qualitative data collection techniques (Duke, 2012). These diaries also allow the researcher to collect data of interactions and experiences that they cannot witness and observe. In this way, data can be gathered from different people simultaneously in a situation which is otherwise impossible for the researcher to do so (Duke, 2012).

In this research study, the reflective diaries were used to provide deeper insights on the thoughts of the participants about the badge curriculum and also to enable the researcher to gather observations about the workshop which could not be readily observed while also leading the workshop. Furthermore, the work diary is often used in educational research as it perceives the participants as observers themselves, thus putting their voice under the spotlight (Duke, 2012). One of the aims of the research study was to provide hindsight about the experience of the participants during the workshop and since the vast majority of the diaries were completed throughout the workshop, these diaries provided instinctive and spontaneous reflections of the participants' experience of the workshop. The possibility of assessing the attitudes towards a setting or event in its' natural context is highlighted as a key advantage of the use of diary methods by Bolger, Davis and Rafaeli (2003). Adding to this, diaries also indicate the level of importance participants attribute to specific situations (Jacelon and Imperio, 2005). When making good use of these characteristics, diaries may also increase the validity and reliability of a study (Cohen et al., 2007).

While there is no existing evidence about the effects the completion of a diary might have on the participants themselves, Bolger, Davis and Rafaeli (2003) suggest a number of possible positive effects ranging from: increased familiarization, involvedness and more readiness to change behaviour or attitudes. Despite the fact that research about the personal effects of writing

reflective notes may have on the participants is lacking, the same could not be said about the effects of the participants on the research process. Several researchers highlight the fact that the involvement of participants in the data collection process can pose several disadvantages as well. Marelli, (2007) identifies lack of motivation of participants to complete the diary as one of the challenges a researcher might face. Another issue that might also pose a problem for a researcher who is planning to collect data through diaries, is that in order to be able to complete the assigned tasks, the participants also require a diverse set of skills which they may not all possess (Jacelon and Imperio, 2005). Jacelon and Imperio also highlight the fact that this kind of data collection method also requires a lot of participant commitment and dedication for it to provide reliable and trustworthy data. In order to counteract these challenges, Duke (2012) suggests that a diary template which is simple, straightforward and effective in collecting the necessary data, should be developed. To ensure that participants find it easier to complete the reflective tasks during the workshop, in this research study, a diary template was developed. The participants were able to complete the diary on the template itself and were provided with enough space to write meaningful reflections. Some parts of the template provided, also allowed for flexibility, allowing the participants to choose which questions to tackle and which to leave out. The participants were also provided with clear expectations to ensure that the necessary data is collected. A section of the template was left blank for participants to express their own reflections where they felt the need to do so. Jacelon and Imperio, (2005) also suggests that before deciding upon using diaries as a method of data collection, the researcher must first ensure that the participants have the necessary skills. In the case of this research study, I opted for written diaries since I was already aware that the participants involved had the level of competency required to complete such a task. I was also aware that they have the level of motivation and initiative required to complete the reflective diaries. This level of commitment is necessary for the data obtained to be reliable and valid (Bolger, Davis and Rafaeli, 2003). The template was developed in such a way that it would take the participants only a few minutes to complete. Although this might limit the amount of data

gathered, it would ensure that the data obtained was truthful and meaningful (Bolger, Davis and Rafaeli, 2003).

3.5. The Badge Curriculum

3.5.1 Participants Expectations of the STEM Career Badge Curriculum.

A common practice within the senior sections of Girl Guiding Associations is for the Ranger Guides to choose the badges they want to work on. Thus, obtaining the participants opinion about badges and what they generally look for in the related curriculum, before choosing a badge, was deemed important prior to designing the badge curriculum.

3.5.1.1 Ideas about Badge Curricula

The participants of this research study were asked to give their views about what makes a good badge and what should a badge aimed at promoting STEM careers entail. An idea that prevailed amongst all participants was that an effective badge should include a number of hands-on activities. Emily explained how she prefers working on badge tasks which require hands-on involvement rather than activities which involve a great amount of theory. She feels that through hands-on activities Rangers would, "have the opportunity to try out new things and learn from these experiences."

The participants agree that they do not find badges which require research work or involve a lot of theory as effective and tend to find them tedious. When choosing a badge, they opt for those that involve the completion of hands-on tasks, rather than theoretical work. They also enjoy working on badges which involve discussions. Berta explains how she feels that such discussions help her

think about certain issues from a different perspective, and at times make her think about themes that she never really thought about. She states that:

> *Or maybe discussions. If we couldn't do hands-on, they would be great too. At least they make you think more than research and it's challenging. We've had some very good discussions that made me see things differently.*

Groupwork is another aspect that the participants also like about guiding badges. Sara explains that through groupwork, she feels more empowered, because she knows that she would be able to be successful at tasks that she would not have managed on her own. Sara enjoys group work because, as she says:

> *It's not like when you are working alone. You feel more lost alone. And most tasks are too difficult to do alone, so you would never manage. Together it's more like an experience. It makes much more sense.*

The participants also feel that through groupwork, they would be facing challenges together and this makes the experience of a badge more meaningful.

When choosing a badge, Maria goes for badges that make her, "feel empowered" and comfortable working on. She mentioned her experience with a particular badge which she felt made her feel really frustrated and useless because she was not good at the skills that this badge involved. Maria states that if given free choice, she would not go for such a badge again.

The other participants felt that in reality all skills are important and eliminating a badge because one does not feel confident working on a particular skill would be unfair on other participants. Berta suggests that a good idea would be to ensure that a badge involves a larger variety of skills, so that everyone would feel empowered. The participants agree that while a theme or topic might interest one person, it might feel meaningless for another person. The participants also

stressed the importance of having a choice when choosing a badge and the activities within a badge. Francesca feels that choosing on which badge to work and the activities they participate in gives them "control" over their own learning and makes them more involved in the process, thus the results are often more positive. Some participants argued that in some cases, because of logistical reasons, they are not allowed to decide which badge to work on. This makes them feel less motivated.

Having badge criteria that are manageable is also a factor that encourages the Ranger Guides to choose one badge over another. The participants pointed out that during their weekly meetings they do not always manage to finish the badges because they are also working on other programmes within the Ranger programme.

3.5.1.2 Expectations from a STEM Career Badge

Through the badge curriculum, the participants were eager to get an answer to several questions and concerns they had about STEM. It seemed that for them the main objective of the badge curriculum was to familiarize themselves with STEM subjects and careers as quickly as possible. When asked to share their expectations, the participants mentioned that through the badge, they expected to gain enough information to be able to make wise and informed decisions about their career choices. Apart from gathering information that would help them make more considerate decisions about their careers, the participants also wanted to better understand the role of women in STEM careers. They wanted to get to know what it feels like being in a STEM career, from the perspective of women who are already doing so.

When asked to discuss how the aims of the badge could be reached through a badge curriculum, the Ranger Guides suggested activities through which they

could meet people who work in different careers. Meeting different STEM professionals would give these members a point of reference when they are thinking about their careers and through interviewing the persons they meet, they would have someone to look up to. For them, what seems to be important is to get an authentic portrayal of other people's journeys. Sara explains how meeting females who work in different STEM careers would help her:

> *Understand better what their jobs are. I don't know a lot about these jobs and workplaces. And it helps me get a clearer picture.*

Participants felt that hands-on activities related to different STEM careers would also contribute to the authenticity of the badge experience. Through these activities the Ranger Guides felt that these activities would give them a good representation of what different STEM careers entail.

This discussion amongst participants indicates that the participants were willing to explore what goes on in STEM careers more in depth. This indicates that while the participants might feel distant from STEM careers, they are willing to explore them and find out more about them.

These views about badge curricula and effective STEM programmes formed the basis for the development of the badge curriculum within this study. The ideas of the Ranger Guides gathered during the first focus group were analysed before the badge curriculum was developed so that the curriculum developed would be one that was suited to the needs of the Ranger Guides.

3.5.2 Designing the Badge Curriculum.

The STEM badge curriculum was designed after the first focus group, keeping in mind the badge guidelines of the Malta Girl Guide Association and what research says about the development of STEM out-of-school programmes.

Whilst planning this badge curriculum, the three essential principles of the Guiding and Scouting method: a) learning by doing, b) progressive self-development; and c) the Patrol system were kept in mind. Other aspects that were taken into consideration were some limitations that Ranger Guiders might encounter whilst delivering the badge, such as the lack of funds to invest in specialised equipment and space restrictions. Hence, the badge is designed in such a way, that the activities can take place in a variety of settings, with resources that are inexpensive and easily accessible. The person monitoring or delivering the activities would be the Ranger Guider who may not herself have sufficient knowledge and confidence to pass on difficult scientific concepts. To deal with this, the activities planned require very little to no scientific knowledge and focus mainly on skills rather than on the acquisition of facts and information.

The Badge designed is made up of a number of hands-on activities in which girls interact through STEM concepts. The introductory activity of the badge curriculum is a compulsory activity in which participants have to think of three to four questions to ask a STEM professional about their career. In this activity the participants engage in groupwork to recruit female STEM professionals as speakers from varying fields and invite them to a Q and A session. The participants have the option to also ask the STEM professionals to join in on one of the optional activities in the badge. The aim of having the professionals engage in the hands-on activities is to provide a form of mentorship in which the participants have the opportunity to interact on an informal level with the professional and observe how these professionals perform in different tasks.

The badge curriculum includes four optional activities which are related to different aspects of STEM. The aspects chosen include: engineering, technology, health sciences, innovation and research. These aspects were chosen because they provide a general idea of what STEM entails. The area of Health was included in this badge, even though participation of women in this field is plentiful. This was done to provide a truthful view of all that STEM entails. Girls working on the

badge have to choose three out of four of the activities listed in the badge however, for the sake of this research study, the participants carried out all activities. The following is a short overview of what each activity entails.

3.5.2.1 Engineering - Build a Geodesic Dome

In this activity Ranger Guides build a 3D Geodesic Dome. The badge curriculum explains that a geodesic dome is a dome that is based on triangles to provide the support that such a structure requires. The Ranger Guides can make use of a variety of different materials ranging from popsicle sticks, newspaper, straws and toothpicks, glue guns, tape and glue tac. The participants also have the option to get creative and choose other materials that they deem suitable for the task.

3.5.2.2 Health - Bandaging Skills

This activity is a learning process directed by the Guider or any person competent to teach bandaging skills. In this activity the Ranger Guides have to learn how to carry out bandaging in different situations, and practice bandaging of fellow participants.

3.5.2.3 ICT - Coding Geometric Shapes

Coding (also called programming or developing) is a way of telling a computer, app, phone, or website what you want it to do (Blackwell, 2002). In this activity, the participants make use of coding to draw a geometric shape.

In the appendix section of the badge curriculum, the Ranger Guides will find a coding sequence to help them draw a Geometric Shape on an A3 sheet. The Rangers, also have the possibilities to take this activity a step further and create

and code their own Geometric designs, depending on how confident they feel carrying out the task.

3.5.2.4 Research - Measure the Height of a Building

The aim of this task is for Ranger Guides to device a method how to measure the height of a building using only measuring tape, mirror, pencil and paper. This activity may be carried out under timed conditions to increase the challenge of the task. The person delivering the session might also prompt participants or allow them to research ideas.

3.5.2.5 Concluding Activity

The concluding activity of the badge, which is also compulsory, takes a more reflective tone. In this activity, the Ranger Guides are required to think and reflect on the activities carried out in the badge. Through a number of reflective tasks, the Ranger Guides reflect on the skills they used in different aspects of the badge; they think about how different activities made them feel and about the different opportunities that exist.

3.5.3. Delivering the Badge Curriculum

For research purposes, the badge curriculum was implemented over the course of a day, in the form of a workshop session carried out at the Island Guides Headquarters in Floriana (Refer to Appendix 6). The day started with a brief introduction in which the researcher reminded the participants of their rights, and gave a brief description of the day's programme. The introductory session proceeded with two ice-breaker games which were necessary to make the participants feel at ease with each other. The participants were asked to divide into two smaller groups, as they wished, to mimic more closely the Patrol system, usually used by the Guiding association. The introductory, compulsory activity in

which the participants were asked to design questions to ask the STEM professionals was carried out, however, for this study, the STEM professionals were not sought by the participants of the study as is stipulated within the badge curriculum, but by the researcher delivering the sessions.

The interviews with the STEM professionals were spread out throughout the day. Immediately before every activity related to a particular field, a STEM professional working in that particular field, joined for an interview and stayed on to participate in the activity with the participants. Each activity was also followed by some time for the participants to complete their reflective diary, which was also linked to the concluding activity of the Badge. The implementation of the badge curriculum was followed by another focus group session.

3.6 Ethical Considerations

An ethical researcher considers the wellbeing of all participants within a research study, before, during and after the research process (Webster, Lewis and Brown, 2014). This involves much more than just following a prescribed set of rules, but rather, thinking things through and truly understanding the standpoint of the participants (Silverman, 2010).

Webster, Lewis and Brown, (2014) created a list of five principles that any research study should be based on. These five principles state that:

1. The research should be useful and should not put undue pressure on any of the participants.
2. Informed consent must be gained from all involved parties.
3. Participation must be voluntary and no one should be pressured to participate.
4. Any risks of harm should be avoided.

5. Confidentiality and anonymity must be respected.

The design and set up of this research project will be based on these ethical considerations. Together with personal reflection, these ensure the wellbeing of those who will be involved. In this section, I will explain how I proceeded, keeping in mind these five ethical principles.

3.6.1 The Research is Useful and does not Place Undue Pressure

Through this research the participants will be gaining information that they will find useful about various science careers and everyday life situations. Furthermore, the participating Association will be provided with the dissertation after its completion. This dissertation will come in useful for the Association to strengthen its educational programme.

At no point in time were subjects at risk of any harm by participating in this research. To ensure so, a fellow Guider will be asked to moderate my approach towards the participants and ensure no undue pressure is placed on them.

3.6.2 Informed Consent

One essential ethical consideration of any research is informed consent. Cohen, Manion and Morrisson (2007) defined informed consent as, "the procedures in which individuals choose whether to participate in an investigation after being informed of facts that would be likely to influence their decisions". This means that permission from the administrative body of the Malta Girl Guide Association was requested through the means of a formal letter asking permission to carry out the research study with its members (Refer to Appendix 7). Furthermore, all participants within the study were clearly informed that they could opt out of the research project at any time. The participants in this study research are still minors and this means that information letters, assent and consent forms are to be issued and collected both from the participants and the guardians of the

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participants. Full information about the research study and the implications of participating in this research was provided to all contributing parties before seeking their permission (Refer to Appendix 8 & 9). This information was provided in both Maltese and English, to ensure that the written correspondence was understood by all. Webster, Lewis and Brown (2014), give a detailed account of the kind of information which a researcher must provide to prospective participants, prior to them agreeing to participate. The information provided should include the rational and targets of the study, who is conducting the study, within which institution the research is being carried out; and what kind of involvement is required from the participants. It is also important to inform the participants that participation is voluntary and that they have the right to withdraw at any point within the research study (Webster, Lewis and Brown, 2014).

It is also important to note that asking and gaining consent once is not enough. Consent is to be sought continually throughout the research process (Webster, Lewis and Brown, 2014). At several stages consent was sought again, for example right before the start of the focus group, after instructions were repeated, and after data was collected. Since the workshop was not going to be recorded for research purposes, participants were also made aware which parts where going to be recorded and which sections were not.

3.6.3 Being an Insider

As a researcher who is also an insider of the Guiding community, having the role of a leader within the Association, I am greatly aware of the implications this might have on prospective participants. Due to this fact, the participants will be informed that they should not feel obliged to participate within this research and that they can withdraw at any point, without the need to provide a reason. To ensure that there is no conflict of interest before or while carrying out the research, another leader within the association will be asked to oversee the

process and to intervene should the need arise. This appointed person will also provide critical insights throughout the implementation of the programme.

To avoid conflict of interest, and to avoid putting undue pressure on the potential participants, the first approach with the participants was done through a "gatekeeper", who in this case was the Unit Guider (Refer to Appendix 10). Webster, Lewis and Brown, (2014), describe the gatekeeper as the person who initiates contact with the participants to provide information about the research and to seek consent. The aim of making initial contact through a gatekeeper is to ensure that the participants do not feel obliged to participate.

3.6.4 Confidentiality

The right to privacy allows an individual to take free decisions about when, with whom and to which degree they want to share their personal information and opinions (Cohen et al., 2007). One way to protect the privacy of the participants within a research study is through confidentiality. While the researcher knows who the person being interviewed is, and gets to access his personal information and opinions, through confidentiality, this information is not published and made public. Through the information provided it should not be possible to trace the identity of the participant (Cohen et al., 2007). Keeping confidentiality in mind, any personal information through which one could easily identify a participant, for example the name and the Unit, was deleted or changed. This was done to ensure confidentiality and with the full knowledge that this kind of data was not relevant to the study and was not going to impact the results and conclusions of the research.

Another important ethical consideration is to emphasise the importance of confidentiality to the participants. Unlike, other research methods, within focus groups, participants meet each other in person to share their ideas and points of

views, hence it is of utmost importance that participants abide by a set of confidentiality rules set and discussed at the start of each focus group or workshop (Power and Single, 1996). Apart from reminding the participants of the meaning and importance of confidentiality throughout the research process, I also included a clause in the assent form that stated that any information should not be divulged to anyone who was not present during the sessions. To further ensure the privacy of the participants, the work within the reflective diaries was not shared amongst other participants and any names or any direct reference to the participants was omitted. This will ensure that if participants did not feel comfortable sharing a particular opinion with the rest of the group, they had the opportunity to disclose it in writing. Power and Single (1996) also suggest that the moderator stays behind after the end of the focus group, just in case any of the participants want to share ideas they might not have felt comfortable communicating in front of others. This was done after every session in this research process.

3.7 Data Analysis Process

The focus group and reflective diary outcomes, were analysed using qualitative data analysis, through which the collected data is analysed and interpreted to elicit understanding and explanations of the data collected (Taylor and Gibbs, 2010). In qualitative research and data analysis, the researcher begins the data collection at an early stage in the research process with the aim of moving from straightforward descriptive data to a hypothesis or theory. Within this process the data collected has to be selected and grouped in order to provide an articulate and complete picture (Cohen et al., (2007). The main aim of qualitative data analysis is, to make sense of the data by observing and classifying the participants' perspectives of a given situation (Cohen et al., 2007).

3.7.1 Thematic Analysis.

The type of data analysis carried out within this study will be thematic analysis, through which the focus group transcripts and reflective diaries are coded. This kind of data analysis was based on the instruments used to collect data which in turn were determined by the kind of information required to answer the research question.

The starting point of the analytical process is the transcription of the audio recordings of the focus group interview and reading of the reflective diaries. This process is essential as it makes the researcher more familiar with the data collected, making it easier to develop codes. The transcribing process of the focus group interviews was carried out right after the interview itself so that important details such as non-verbal cues were easily recalled and hence included into the transcript. A word processer was used for the transcription process. The audio recordings were also listened to more than once "for a sense of a whole" (Hycner 1985, p. 281). Hycner (1985) states that by listening to the audio recording and reading the transcripts over and over again, the researcher will be able to see the interview as a whole and would be able to listen to accentuations, pauses and other non-verbal cues. After the transcription process was completed, a template analysis was carried out. A template analysis is defined by Cassell and Bishop (2018) as "a type of thematic analysis where the aim is to create an analytic template in which the data can be categorized" (p.4). This kind of approach is often used to analyse case study data (Cassell and Bishop 2018). The focus group interview transcripts, together with the reflective diaries, also typed, were coded according to the template analysis using the developer's tool in a word processor. Through the coding process, the researcher goes through the transcribed focus groups and diary data and gives specific themes to different sections of the text, to make it easier for the researcher to quickly retrieve data related to one particular theme (Taylor and Gibbs, 2010). Once these themes were identified, they were analysed and the researcher can begin to form an understanding of the situations observed and discussed (Taylor and Gibbs, 2010). The kind of analysis

carried out is called analytical induction and was introduced by Znaniecki (1968), as an alternative to other more numerical and rigid forms of data analysis (Cohen et al.,2007). In this kind of analysis, applied within the research study, the surfacing categories are scrutinized and encapsulated and the resulting outcomes are used to verify, strengthen or modify an already existing hypothesis.

Chapter 4

Results

4.1. Girls' views on STEM subjects

4.1.1. Defining STEM.

STEM is usually described as an approach to learning and development that integrates the areas of Science, Technology, Engineering and Mathematics (Department of Education, 2019). Hom (2014) describes STEM as an interdisciplinary approach which attempts to integrate these different disciplines into an applied learning experience based on real life applications. When asked to define STEM, the participants in the current study, simply explained what the acronym "STEM" stands for, that is "Science, Technology, Engineering and Mathematics". They did not offer any further explanations.

All the six participants did not have any perception of the basic philosophy behind STEM, that is the integration of the four disciplines and they discussed STEM in terms of the individual disciplines. Sara for example described her perception of the different STEM subjects individually:

> *It depends which science because like general science [is a no] but then when it comes to biology, then I get really interested. Technology, oh my god. Engineering, since, those that like engineering will speak to me and I'm like no, I cannot understand anything they are saying. And maths, it's just maths.*

Lara also talks about the STEM subjects separately:

Science, okay, most of it. Technology, not bad, Engineering, I also never had at school and Maths, very bad.

The same could be said of the other participants who also talked about STEM in a fragmented manner.

4.1.2. Deconstructing Stereotypes about Girls and STEM subjects.

The main aim of the current study was to develop a badge curriculum with the objective of engaging Ranger Guides with STEM concepts and motivate them to pursue STEM careers. Before actually designing the badge curriculum I was also interested in exploring the typical stereotypes that the girls had about STEM subjects and whether they considered STEM subjects to be more relevant for boys than for girls. The participants had differing views about gender-based interest in STEM subjects. Two of the participants – Lara and Sara – believed that girls are less interested in STEM subjects than boys. Lara explained that this could be due to the fact that:

In Malta there is still some stigma about STEM subjects and some things in STEM are more masculine than feminine.

Other three participants: Francesca, Bertha and Emily – disagreed with Lara and Sara since they believed that there are girls who are interested in STEM subjects. Emily for example pointed out that:

Girls are more interested than boys…and the girls who do eventually choose STEM careers are more motivated than the boys.

Francesca also agreed that girls are interested in STEM subjects, although in her view the major drawback that girls have regarding STEM subjects is that very often they are discouraged from taking up STEM subjects in the first place. She stated:

I take it that even if women are interested in these things, sometimes they stay back. So, they are still interested but they don't go for it.

The idea that males do better in STEM areas than females, was mentioned as another stereotype that is keeping females away from STEM subjects. The participants believed that different people have different abilities. They all agreed that each person, irrespective of their gender, have their strengths and weaknesses. Lara explained that females should not shy away from male-oriented careers because they feel that they might not be as good as a man. The participants explained how they know of boys who are not good in mathematics and science, but they know they are great at other things, and vice versa; they know of girls who are weak in arts and languages, but they make up for it in science and mathematics, making them the perfect candidates for different careers in STEM. As Maria argued:

I know boys, who are much worse in these subjects than some women. Because it's according to the person.

Therefore, according to participants in the current study, the main problem with girls in STEM subjects is the attitudes of individuals in Maltese society who still view STEM subjects as subjects for boys, thus girls who may be interested in STEM subjects, are at times discouraged from choosing them.

4.1.3. Girls' Attitudes towards STEM Subjects.

Girls' attitudes towards STEM subjects has an impact on their engagement in STEM and their motivation to follow a STEM career (Sinnes and Løken, 2012). The participants' views of STEM subjects varied greatly from one participant to another and for different aspects of STEM. The participants provided very mixed views when asked to describe how they felt about STEM subjects and as stated previously, they opted to talk about STEM subjects separately. This dissimilarity

between the likes and dislikes of the participants within the study, opened an opportunity to better understand what motivates teenage girls to pursue STEM subjects. Similarly, the notions that may hinder teenage girls from pursuing STEM subjects, may also be explored. Despite the fact that the participants have such mixed views about STEM subjects, the factors that influence these ideas and perceptions seem to be common.

4.1.3.1 Positive Attitudes towards Familiar STEM Subjects

The majority of the participants within this study, had more positive perceptions of STEM subjects which they were already familiar with. In fact, they commented positively about technology and science. The girls stated that they liked technology because it was something they used in their everyday life and they could easily relate to this aspect of STEM. Berta explained how through technology she felt that she had more access to science:

> *So, Science interests me a lot, technology as well, it's all right. I use it every day, sort of. Sometimes I also get interested and combine them together, to see science I use technology to explore new things.*

Science was also an area that participants had positive attitudes towards. They viewed science as something relevant for their everyday lives and therefore more important for them. Sara explained that she liked biology:

> *Because, like in biology I feel, it's part of our lives so I get interested. Even how humans' organs work, the [human] body, plants, I get more interested when compared to chemistry or physics. It's like part of life.*

When it came to engineering and mathematics, the girls in the study were not so positive, mainly because they were not familiar with engineering and because mathematics remains challenging for some students. Emily stated:

Science, not bad. Technology, okay, engineering, I never had so I don't know and maths, simply a disaster.

4.1.3.2 Impact of Academic Achievement

Another factor that had an impact on whether the participants liked a subject or not, was their academic achievement in the subject. They preferred subjects which they felt they excelled at, and disregarded those that they did badly in. In general, mathematics was not a very popular subject amongst the majority of participants, with five of the participants saying they did not like mathematics. The reason given for their dislike of mathematics was that the participants felt that their achievement in mathematics was low. Berta pointed this out very clearly:

Maths, nothing, sort of I was never good at it so I'm not keen to select it [as a subject to study].

Such findings are consistent with Ertl, Luttenberger and Paechter's (2017) study in which, "academic self-concept" (p.2) is regarded as a strong influence on the attitudes of students towards STEM.

4.1.3.3 Difficulty of STEM Subjects

Another recurring theme throughout the focus group interviews was the perception of STEM subjects as being too difficult. Emily, who did not study physics in secondary school, was afraid of the prospect of starting to study this subject later on in life. She believed that physics is a difficult subject and hence it would be hard for her to keep up with her peers. Even though she has never experienced this subject herself, and would like to pursue a career in architecture, she still felt that she would not be able to grasp the subject. She

formed her ideas about this subject through her peers, who she had often heard complaining about the subject. Emily stated:

I don't want to study physics because everyone says that it's really hard.

4.1.3.4 Influence of Role Models

Francesca was the only participant who mentioned the impact role models had on her interest towards STEM. She highlighted how her parents who both work in STEM careers have had a positive influence on her perception of STEM. She described how having her father talk to her about his career, helped her to develop an interest towards STEM subjects.

So, I like Science, Maths and Technology a lot, as in technology it's not like I'm good at programs and all that but I don't imagine myself going out without my phone or something like that, that I can use as technology. Engineering in reality, my father works as a mechanical engineer so although I don't know exactly about the subject, sometimes he explains to me and I know it interests me but I never went in [got into it].

Francesca claimed that the fact that her parents talked to her about their own careers, gave her a more positive outlook on STEM subjects, and because of this she also feels more, "confident" about such topics.

4.2. Girls and STEM Careers

Interest and beliefs towards STEM careers are shaped through a number of factors ranging from socialization, personal values and cultural norms (Wang and

Degol, 2013). This section will review the participants' knowledge and ideas of STEM careers, and their outlook on the participation of females in STEM.

4.2.1 Knowledge about Opportunities in STEM and STEM Careers.

During the first focus group sessions, the participants were asked to create a list of different STEM careers. When carrying out this task the participants were able to name a variety of STEM careers and their list was not restricted to any one particular field.

Their approach to the task was to name the four strands of STEM and list the jobs and careers that fit into each strand separately. (See Table 1)

The approach taken by the participants to name careers in separate areas of STEM highlights the fact that the participants were still finding it difficult to link the four strands of STEM together. It was through this activity that the participants realised that most careers cannot fit into a mould. Soon after they started working on this activity, the Ranger Guides realised that they were either listing the careers more than once under different headings, or finding it difficult to decide under which heading a career should fit, as it was related to more than one strand. An excerpt of a conversation amongst the Rangers illustrates this:

Lara: Architecture where would it fall?

Interviewer: Where do you think it fits?

Emily: All of them no? Because you need science, you need maths.

Emily: Just write STEM above.

Table 1 - List of STEM Careers compiled by Participants.			
Science		Technology	Engineering
Pharmacist	Nutritionist	ICT Teacher	Mechanical Engineer
Physician		Programmer	Electrical Engineer
Radiologist	Marine Biologist	Technician	Mechanical Supervisor
Nurse	Biologist	Gamer	Electricians
Physicist	Chemist	Installer	Manufacturers
Surgeon		Hacker	
Optician	Researcher		
Dentist	Dental	Mathematics	STEM
Physiotherapist	Technician	Mathematician	Architect
Teacher	Microbiologist	Accountant	STEM Teachers
Plant Scientist	Blood Scientist	Business Management	
Astronomer		Statistician	
Gynaecologist	Pediatrician	Tax Collectors	
	Astronaut		

Another perception that the participants held about STEM careers was the idea that in most STEM professions, the scientist worked alone and in a confined space, normally a laboratory. Lara, expressed the views of her peers in stating her opinion that working in a laboratory meant that one would have to sit and stare and this is a factor that would keep her away from entering certain STEM careers. She stated:

> *For me, sciences don't [interest me so much]. For example, work in a laboratory, it doesn't interest me at all. Because I hate being in that space and type of setting. I have to sit down and stare at something and I have to study it without a choice. No, it's not for me.*

This statement suggests that the participants still had a number of stereotypical views about STEM careers and highlights the need to develop initiatives to challenge stereotypes and provide more information about STEM careers

4.2.2. Choosing a STEM Career.

When it came to their career of choice, it was apparent that most of the participants were still not sure about the professional path that they wanted to pursue and their options were still open. All participants mentioned at least one STEM career that they would be interested in and four out of six participants opted for careers which in their opinion fell under the strand of science rather than those that involve technology, engineering and mathematics. As stated earlier, this shows that even though through the initial task; in which they had to list different STEM careers, the Rangers realised that most careers cannot fit neatly into a distinct strand. The idea of looking at STEM careers separately persisted. Later on, when asked to elaborate more about what they meant by careers in science and what careers in science they would consider, they

mentioned some careers that are interdisciplinary such as architecture, marine biology and even radiology, like so:

> *Berta: I like other things like radiologist, dentist. I imagine myself more in those sectors.*
>
> *Emily: I think the one that I've been liking the most recently is architect.... and marine biologist as well. I like it.*

While, the Ranger Guides were still deciding upon the different options available and thinking about which careers suited them, they identified a number of determining factors that would influence their career choices.

4.2.2.1 Personal Interests and familiarity with STEM subjects

When asked to explain what draws them to certain STEM careers, all the participants mentioned interest in that career as something that would motivate them to pursue it. The participants also seemed to prefer careers that are "useful" and "important for everyday life". Furthermore, when Berta was asked to explain why she would rather go for careers related to science, she indicated that she felt more confident and familiar with these careers as she studied the subjects related to these careers at school. This indicates that familiarity with STEM subjects can have an influence over career choice.

One of the reasons given by the participants as to why they were not willing to opt for careers in technology, engineering and mathematics was because they were not familiar with these subjects and they imagined that they would not find these subjects interesting or exciting, as opposed to other science careers.

Sara was willing to consider "science" related careers but would definitely not opt for technology, as she saw technology as, "a boring subject." This idea was echoed by Emily:

For me the least [interesting] one is technology, as I will find it very boring.

4.2.2.2 Subjects at school

Not choosing the right subjects earlier on in life also seemed to be a determining factor for the participants. As stated in the previous section, the participants were not willing to opt for careers in STEM that required the uptake of subjects they were not familiar with. Furthermore, the participants felt restricted by the subject choices they made in secondary school as they were aware that certain subjects are mandatory to pursue careers in certain fields.

Another reason, that was mentioned for not pursuing a career in STEM was not being good at a particular subject. Sara was considering a career as a physiotherapist, up till the point when she realized that she required physics to enter this career, which is a subject she was not willing to keep on studying. She mentions:

*"I wanted to be a physiotherapist. But then I realized that I needed physics *laughter* and physics and me *hum*."*

4.2.2.3 A career that Pays

Apart from being in a career that they enjoy, the participants also considered salary as being another factor they would consider when deciding upon their future profession. The girls associated STEM careers with a "good pay" and they

felt that such a career was perceived as having a better social standing. Francesca asserted that:

> *In the end, you do work both to have fun but also so you're paid, so I would consider a job in STEM.*

The Rangers felt that from a young age they had been told by their parents to work hard in order to get a job that pays and since they were aware that most STEM careers pay well, they considered this as a motivator to enter STEM careers. As Emily explains:

> *Plus our parents or guardians always tell us 'oh you need to find a place of work that generates a lot of money' and so on. Although they consider and tell you to do something you like, I think they mainly consider the money. In my perspective.*

The participants agreed that this idea shaped their perceptions of different careers and would eventually influence their career choice.

4.2.3. Girls' Views about Opportunities in STEM Careers.

The participants held very mixed views about whether females have the same opportunities within STEM as males. Some of the participants believed that females have the same opportunities to work in STEM as males and that the only inhibitors for women to enter STEM fields are innate and self-constructed. Lara argued that nowadays there are plenty of opportunities and that if one is truly determined and works hard for an aim, there is nothing that can stop that person from pursuing their dream. On the other hand, Sara felt that this is not true because in her view:

> *If the employer has a man and a woman in front of him, even if it could be that the woman has more qualification and more, you know... He could still*

> *choose the man for the very reason that he's a man. That's what I think.*
> *Unfortunately. I don't want it to be like this... but that's how it is.*

The rest of the participants seemed to agree with both Lara and Sara, even though they have opposing views. They seemed to value what both were saying, and felt that they were both putting forward valid responses. Francesca echoed what Lara was saying, but mentioned the fact that whenever she entered her father's workplace, she noticed that there were plenty of males and very few women.

Francesca questioned whether this was because women are simply not interested in STEM or because they feel that they do not have the same opportunities. Sara built on what Francesca was saying and explained that at times, although the opportunity might be there, there might be a lot of people who through their words and perceptions might be distancing women from these opportunities. Sara argued that:

> *Opportunities are always there. But then again, people themselves will tell*
> *you 'listen take that opportunity' or 'listen, don't take it'.*

This perception was common amongst other participants, with Maria stating that people still have the mentality that certain careers are for men while others for women and these perceptions were keeping females from entering certain STEM fields and careers. She explained that it was up to the individual to decide what her interests were and make sure to pursue those interests.

Francesca pointed out that it is people within a society that foster these mentalities and they are also part of the society, so it is also up to them to challenge these stereotypes and bring about change. She states:

I think it's more, like you said, the mentality. Mentality changes according to the persons. Because we're saying 'mentality, mentality' but we have the mentality so we must change it in this case.

4.2.4. Having a Successful STEM Career as a Woman.

The participants all shared the belief that both men and women can get to be successful if they work hard for what they want. However, they were aware that very often it might be more challenging for females to do so. They also felt that it was most often the women's decision to keep from progressing through her career. The participants attributed several reasons for this.

The reason that was mentioned and agreed upon unanimously, was that women tended to be more family-oriented and considered their families' needs more than men, when thinking about moving up the career ladder. Bertha explained that:

If a woman already has a family, has children, she finds it more difficult to get back to studying and finding her own time to study and do exams to keep on moving up the ladder even though she would like to.

The Rangers agreed that in nature women tended to be more thoughtful of their actions and this often resulted in females holding back from certain positions. One participant in particular also explained how she felt that our society expects a mother to take responsibility of her own family. She also explained how females who have high aspirations are often frowned upon and discouraged from progressing through their careers. Maria explains how:

A woman, because she's, it may sound bad, but because she takes care more of the family, maybe once she reaches a certain level and she stops and finds

work and then for example she already has a family, has children, she finds it more difficult to get back to studying and finding her own time to study and do exams to keep on moving up. She would like it, I don't think she'd think she'll have an opportunity in her life, unfortunately.

On the other hand, Sara challenged the idea that having women who choose not to progress through their careers as something negative. She stated that in reality different people might have different aspirations and what for one person might translate to being successful, for another it might not. Sara argued that:

success for me could be just for example walking up the steps *laughter* Success for her could be flying to the moon *laughter*. No, just speaking figuratively. So really for example to keep with this point, success for a woman could be not to have a high position but simply to get the job, could be a success for her.

Another idea that emerged was that the work of men is often appreciated more than that of women. Lara felt that the science women work on and are interested in, might not be given as much importance as fields that men are interested in and hence they are not given that much recognition for their work. This might result in having less female role models which can encourage other girls to pursue STEM careers. Lara explains that:

Certain awards and certain research, they are more prejudiced towards women, because they think that if there is someone who is a woman and she is doing research on Earth's crust and there is a man who's researching something about space, the work of the male is given much more importance than that of the women.

The participants also felt a sense of hope for the future. They were hopeful that things are now changing and that now that more women are starting to enter STEM, and proving themselves in this field, the stereotypes and ideas that used to keep women away from STEM, would fade into nothingness.

4.2.5 Final Reflections about the Choice of STEM Careers

The outlooks of the participants towards females in STEM and STEM careers, give an understanding of what the participants think about women in STEM and their awareness about issues that women in STEM experience. This in-depth understanding helped in the development of the badge curriculum, and in its delivery. When the badge curriculum was being designed, the ideas the participants held about women in STEM were taken into consideration and the activities within the badge were targeted to address these views.

4.3 Encouraging Ranger Guides to Choose STEM Subjects

The main aim of this research study was to design and implement a badge curriculum aimed at encouraging Ranger Guides to pursue STEM subjects and careers. This badge curriculum was designed with the needs of members within the Guiding Association in mind. The participants of this study, who are active members of this association, were thus consulted about the badge curriculum both prior to its development and after they carried out the badge curriculum. This section is an analysis of their feedback.

4.3.1 Motivating Girls and Young Women towards STEM.

Motivation plays an important role in the choice of girls to pursue STEM careers (Wang and Degol, 2013). However, it is not ideal to impose STEM careers on

people who clearly have no interest towards them. Thus, initiatives aimed at decreasing the gender gap in STEM should focus on instilling in girls the belief that there are no limits to jobs they can take on, and that it is possible to challenge stereotypical views of STEM careers (Wang and Degol, 2013).

These views were also echoed by the participants who agreed that each and every person has distinct interests and are drawn towards different careers. They believe that everyone has their path in life and that every person should be encouraged to pursue the path they wish for. It is for this reason that they felt that in most cases it might be futile to try to motivate individuals who are not inclined towards STEM to pursue careers in STEM. As Berta explains:

> *Not that there is nothing that you can do, I mean a good education for all students is like important, but I don't think that motivating someone is something you can easily do. I think it's something that the person is born with. The drive for science or a certain other subject.*

The Ranger Guides however acknowledged the fact that due to a number of pre-conceived notions and stereotypical ideas, a lot of girls and young women are moving away from STEM subjects and careers, without being given the opportunity to explore what STEM entails. Hence, they suggested STEM subjects amongst girls and young women. This idea is well explained by Lara when she says:

> *I think that when it comes to teaching another individual, there is always something you can do to make the individual more interested.*

4.3.1.1 A change in the approach to Teaching and Learning

The teachers' approach and methods of teaching was mentioned as being one of the main predictors in nurturing interest towards a subject. Emily mentioned that a change in the teaching methods often adopted at school should be applied and a more game-based approach adopted. She explains:

> *If you are teaching the student in a way that they, the student, are showing lack of interest, you have to change the way that you are teaching or for example insert a game related to the subject.*

Sara highlighted the importance of presenting a positive approach and a good feeling when teaching a subject. She explained that when a teacher is positive in her approach towards a subject, that enthusiasm is transferred to the students:

> *If you have a teacher that doesn't care about the students, you'll force the students to give up. Not like when you have a teacher who shows love for the subject. That makes a difference.*

4.3.1.2 Role Models

Sinnes and Løken (2012), consider female role models as an essential aspect to battle the existing gender gap in STEM careers and to motivate young women to pursue STEM professions. Having good role models was only mentioned by Lara and Francesca as a good way of encouraging young women and girls into STEM. Lara felt that people can leave a great impact in a person's life. She explains:

> *If for example you know someone who is studying STEM subjects, or is working in STEM and is encouraging you, of course you're going to be more interested in the subject.*

Francesca was the only participant who, once again made reference to her own experience and explained how having parents who work in STEM careers had a positive effect on her perception of STEM since she was exposed to STEM concepts from a young age and had positive role models.

4.3.1.3 STEM Initiatives

The participants also mentioned that initiatives within non-formal educational settings might also be beneficial in increasing interest towards STEM amongst girls. The participants in this research study, all participated in an initiative by the Malta Girl Guide Association aimed at promoting STEM subjects and careers with members of this association. Berta explained how through this initiative (iCan do Science camp) that took place a few years ago, the participants were given the opportunity to experience science in a different way. She states:

> *There are things that we can do. For example, when we had done that science camp, there were many things that we didn't know and we got interested in them.*

She felt that the informal methods and approaches used throughout this camp installed a sense of interest amongst participants. The other participants who had the same experience also agreed with this claim.

4.4 The Ranger Guides' View of the STEM Career Badge

4.4.1 The need for a STEM Careers Badge.

All the participants agreed on the need for a badge aimed at promoting STEM careers amongst members of the Malta Girl Guides. As indicated in the previous sections, the Ranger Guides felt that in today's day and age, there were still a number of stereotypes which are keeping girls and young women from thinking about and considering STEM careers. They felt that a badge would be a fitting approach to challenge these stereotypes and misconceptions. The girls also liked the idea of having a STEM badge because as stated by Sara, "*even unintentionally, you're empowering women's rights*." Berta agreed that even if the girls did not intend to pursue STEM careers or are "*not specifically interested in STEM*", such a badge would encourage girls' self-confidence. A report by the Girl Scouts of the USA. (2016), states that the informal aspect of such a programme also proves to be beneficial in developing leadership skills, and a stronger sense of self-worth.

4.4.2 Activities within the Badge Curriculum.

The badge curriculum, which was delivered to the Ranger Guides in a day workshop, was made up of a number of group activities that the Ranger Guides completed, together with individual tasks. The first group task the Guides worked on, required the girls to develop a set of questions they wanted to ask four different female scientists who they met during the workshop session. This task was followed by four separate sessions during which the Ranger Guides interviewed different STEM professionals. The girls were able to work on activities related to different areas of interest within STEM. The areas of STEM chosen were: engineering, information technology, medical science and research and innovation. The participating Ranger Guides had a number of ideas about

this badge curriculum, and even though they enjoyed the activities and gave very positive feedback, they provided a number of suggestions for improvement.

One of the main highlights within the badge curriculum were the interviews with the STEM professionals. A study carried out by Levine et al., (2015) highlights how meeting and interacting with female scientists and other STEM professionals in an informal manner could lead to a stronger STEM identity amongst girls. In the previous focus group interview, the Ranger Guides had indicated that they wanted to meet individuals who work in STEM careers, so this was an activity they aspired to be involved in. All the participants felt that through the interviews they managed to get a better insight of what different STEM careers entail and what it feels like to be a female in STEM. As Sara wrote in her reflective diary:

> *"Through the interviews I learned new things about STEM careers in a fun way. It was also interesting seeing different jobs from a women's perspective."*

The participants also liked the fact that they were allowed to develop their own questions for the interviews, as this provided them with an opportunity to get answers to questions they had. One suggestion made by a Ranger was to include male professionals as speakers. She felt that this would provide a different point of view and would allow them to better understand the experiences of men and women in STEM careers. This suggestion was made by Lara:

> *Maybe meeting a male scientist as well. It would help us understand better his point of view.*

The Ranger Guides also agreed that they enjoyed working on the different hands-on tasks that followed each interview and that were related to different areas of STEM. These activities included tasks related to different STEM careers, for example in one activity related to engineering, the participants had to construct a geodesic dome, made up of materials provided. In other activities related to health sciences and computer science respectively, the participants learned how to apply bandages and how to make use of coding to draw geometrical designs. The participants all agreed that they were able to link the activities they participated in with different lines of work. Berta also explained how in the 'Build a Dome' activity, the engineer helped them solve an issue they were experiencing by explaining how an engineer would go about solving the problem Francesca explained how in the 'Measure the Height of a Building' activity; in which they had to measure the height of a building using only a mirror and a small measuring tape, they were able to link the task to the work done by the scientist whose job is to "think up methods to solve problems". She explained how in this task they had to do the same. While the participants were aware that these activities were not an exact portrayal of the different STEM careers, they felt that the tasks still provided them with a good idea of the main aspects of every area of STEM.

An aspect that the girls pointed out was the fact that most activities were quite challenging at first glance. The Rangers explained how at first some tasks seemed impossible to complete. This sense of insecurity was evident while the participants were carrying out their tasks. In my research journal I pointed out that:

> *The Rangers seemed very unsure of this and they looked concerned and worried that they will not be able to do it. (Research Journal, 13/06/18)*

Lara explained how she thought it impossible to find a solution to the 'Measure the Height of a Building' activity, but tried to stay optimistic. She stated:

At first I said; 'No, how is it possible? Bring a measuring tape and we'll measure it.' But after you start thinking, then you start to say 'There really must be a solution.'

This concern was also echoed by other participants who also thought they did not have the necessary scientific knowledge to solve such a problem. Berta explained how she felt particularly disadvantaged as she did "*not study physics at school*". The participants explained how working in teams provided them with the opportunity to pool their knowledge, which made them successful. This success was beneficial to boost their confidence in the following tasks. The participating Rangers agreed that although having challenging tasks seemed daunting at first, once they managed to complete the tasks, they felt a greater sense of satisfaction and pride. As Francesca and Berta explain:

Francesca: In the beginning I was like 'okaaaaaaay' *doubtful tone* but then in the end 'okay!' *positive and cheerful*.

Berta: 'You managed!' You feel happy that you managed to do it.

Francesca: You feel successful.

The participants all agreed that they would have been able to work more successfully if they had more time to work on the different tasks. Lara pointed out that having more time for the dome building activity would have meant that they would have had a better opportunity to explore the task better and provide a better result, *"We could have decorated it a bit. But we needed much more time"*. The issue of time was also brought up when the Rangers were talking about the 'Coding' activity, in which one of the groups did not manage to complete this task successfully. All the team members agreed that had they had more time they would have managed to work more diligently and successfully. It seemed that during this task the group in question felt pressured for time, in fact I noted that:

> *...there were a few of the lines of the geometric shape that did not correspond and this made them hesitant. They seemed worried that they did not have enough time to complete the task successfully... (Research Journal, 13/06/18)*

The participants were also asked to complete a reflective diary as part of the badge curriculum. As suggested by Bolger, Davis and Rafaeli (2003), reflective writing ensures that the participants feel more engaged and involved in the process, resulting in a change in attitudes. All the participants agreed that this diary helped them understand the badge process more and think about the aims and values that the badge was targeted to foster. Lara states:

> *The diary helped me think more about what was going on. It was useful.*

They also felt that the time they spent working on the reflective diaries was a pleasant break from the stimulating activities of the day and that the tasks within the diary were quite straightforward and easy to complete.

A common idea that emerged throughout the evaluation of the badge curriculum was that although not all of the participating Ranger Guides considered themselves as scientifically inclined, they still enjoyed the tasks within the badge and felt comfortable and at ease while completing them. They felt that the different aspects that made up the badge and their overall experience in completing it, improved their sense of self-worth. Emily stated that she was not aware that she, *"could do some tasks. It made me more confident."* Lara explains that through the workshop she got to know more about different jobs she would *"like to consider,"* and Sara felt satisfied that she had *"contributed to the different activities".* These feelings were also shared by Berta and Francesca who expressed, as stated earlier, feeling a sense of accomplishment that they

completed the tasks successfully, even though they were doubtful that they could at the beginning.

4.4.3 Characteristics of the STEM Badge.

In order to develop a badge curriculum that ensures the right conditions for the objectives to be realized, I made use of a number of approaches and methods. These methods and their outcomes are discussed in depth in the section below.

4.4.3.1 The Use of Interviews to Develop Role Models

An important aspect of the badge were the interviews with the STEM professionals. The aim of these interviews was to enable girls to meet and discuss STEM careers with experts within different STEM fields, with the aim of them serving as role models and inspiration for the participants. Shin, Levy and London, (2016) found that exposure to role models, who are perceived as successful and hardworking, was effective in altering participants' ideas about STEM and their career aspirations. This was done by challenging stereotypes which often relate STEM careers to masculinity (Shin et al., 2016).

Through the feedback provided by the participants, it seems that the aim of using interviews with role models was reached and that a lot of beneficial elements emerged from these interviews. It seems that the highlight of the sessions for the girls was actually getting to know more women who are already working in STEM. In fact, when asked to think about what kind of information they would like to gain, they stated that they would like to get to meet more women in STEM and listen to their experiences and research the opportunities available within STEM. Lara explained that she wished to have:

> *Talks from professionals that are already in high positions and they say their story about how they were promoted and what opportunities they had and the disadvantages they found.*

Sara explained why she feels that meeting with STEM professionals gives a better portrayal of STEM careers. She states:

> *…because it would help us understand better what their jobs are. I don't know a lot about these jobs and work places. And it helps me get a clearer picture.*

All the participants felt that through the interviews, the professionals encouraged them to pursue STEM careers. This was not done directly, but through the way the interviewees were acting, their approach was encouraging to the participants. As Francesca and Lara explain:

> *Francesca: And you see them talk with such a passion on their job and it's like …*

> *Lara: They prompt you to like them [STEM careers]. Even if you were not inclined to them, they make you be more inclined to those sort of jobs.*

The participants also felt that although the professionals were trying to encourage them to pursue STEM careers, they were still honest in their portrayal of this field and they presented them with a truthful picture. The girls explained that apart from the positive aspects, the interviewees also mentioned that reaching their goals was not always easy, and they faced and were still facing some obstacles every now and again. As Berta explains:

> *They didn't hide the fact that it's going to be tough getting where they are but they seemed to embrace it.*

Lara pointed out how the interviewees did not try to portray a perfect view of their work, but:

> *they said it how they really is because you have some people who try to make the work look nicer so they attract you to it but they said how it really is.*

This view was also held by Francesca who explained how the interviewed professionals:

> *also mentioned the bad things about work.*

According to the girls, this honesty in the answers was key to change their perspectives about STEM. In general, the participants, all agreed that listening to other women's experiences in STEM would encourage them "*to pursue STEM careers*".

4.4.3.2 Mentoring

The STEM professionals who were invited to participate in the one-day workshop, were asked to mentor the girls in activities which were related to their fields. The girls felt that having the professionals working with them and mentoring them through the tasks was extremely beneficial. They felt that the mentors helped them form and develop their thinking skills, guided them through the tasks and gave them useful tips on how to proceed in a task. Berta explained how one of the professionals gave them "*a lot of useful tips on how to go about to build the dome*". One thing that really struck the participants was the fact that although the interviewees were professionals in their specific fields,

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they still had to think to reach a solution or an outcome; it did not come naturally to them. Maria mentioned how she had, "*expected them to know everything and find it easy*". This implies that the participants were under the initial impression that the professionals knew all there is to know in their particular field. The realisation that the STEM professionals still had to think in order to reach a solution, made them appear more approachable for the participants, because as indicated by Maria in her reflective diary when talking about one of the professionals, she says, *"she was like one of us, trying to help us out."*

This process of mentoring allowed the girls to look at the STEM professionals from a different perspective and made them realise that being an expert in a field did not mean that one should stop learning.

4.4.3.3 Hands-on Approach

A study carried out by Christensen, Knezek and Tyler-Wood (2015), implies that hands-on experiences which relate STEM to everyday life are effective in fostering a greater sense of interest towards STEM subjects and careers. All the participants within this study agreed that the hands-on approach adopted in the badge curriculum was beneficial for them to become more engaged in the badge. They considered the hands-on approach as one of the elements that distinguished the badge curriculum from the learning they did at school, where they spent most of their time sitting down, listening and writing. Berta stated that hands-on work "*is much better than sitting down and listening to someone telling you about something. Like in school.*" For them hands-on adds an element of excitement and fun. Sara explained that she enjoyed participating in hands-on activities and before each activity she was even eager to start working on the task:

> *"I feel that doing stuff and being hands-on is quite fun as well. Once you explained the task, of the popsicle sticks (Geodesic Dome), I was eager to start."*

The participants felt that the hands-on approach also created a different atmosphere and environment than what they had at school. Emily explained that such an approach also helped her consolidate her learning:

> *"It was a good idea. I prefer to try out things when I am learning about something. It makes me feel sure that I understood."*

4.4.3.4 Inquiry Based Approach

Krishnamurthi, Ballard and Noam (2014), identify the development of positive attitudes towards STEM as one of the main objectives of informal STEM after-school programs. In fact, the badge curriculum allowed the rangers to develop positive attitudes towards STEM, as they themselves stated the sessions allowed them to use their own creativity and were not too leading. At first the inquiry-based approach adopted within the badge made them feel nervous and insecure, however they soon realized that being able to work without strict and direct instructions, was challenging and this made them more involved in the task they were carrying out. In addition, they all agreed that this aspect of the badge gave them a greater sense of satisfaction once the task was completed. Francesca described how at first, she was very unsure and sceptical of the activity in which they had to measure the building. Francesca said:

> *"At first I didn't...if someone were to come and tell me, I would have said 'No, how is it possible?"*

However, as they started working and especially later, once they reached a conclusion, she felt really satisfied and proud of the result:

> *"But after you start thinking, then you start to say 'There really must be a solution' Because for example, you don't just have a mirror to have a mirror, you need to see how to place it. ….. You feel successful."*

Lara also expressed how happy she felt once she managed to complete the same task.

> " *'You managed!' You feel happy that you managed to do it."*

The participants' positive feelings when they felt challenged or were successful at completing tasks, played an important role in developing more positive outlooks towards STEM. This confirms the importance of developing positive attitudes towards STEM as outlined by Krishnamurti et. al. (2014).

4.4.3.5 Groupwork

A study carried out by Dare and Roehrig, (2016), found that girls perceived collaborative learning as a beneficial aspect of their learning process and highlights how because of this, the use of group work within STEM programmes targeting girls can help in challenging the stereotype of STEM careers as being "cold and isolated" (p.8). The Rangers within this study indicated groupwork as one of the badge characteristics that they felt made the badge curriculum more effective. Apart from improving their teamwork skills, the participants pointed out that groupwork allowed them to come up with solutions and to improve their outcomes. Francesca pointed out that through their group effort when working on the dome, they: "*managed to create a much better result*". They felt that through the groupwork activities they also got to know each other better and

respect each other more. Maria pointed out that although they had disagreements, they "*managed to discuss, find solutions and seek the best approach to solve problems*".

Most participants agreed that within the group they had a lot to contribute, even though they were not confident in all tasks. Emily felt that she was able to contribute more in some activities and not in others, mainly because she was already familiar with some aspects of the badge such as bandaging. She stated:

> *"I felt I contributed in the bandaging because since I knew beforehand, I had an idea of what I had to do. I felt that I could put more effort into it."*

While most of the participants agreed that groupwork was beneficial, Maria noted that in a particular activity she was feeling rather frustrated by the fact that she was working within a group, mainly because she felt that she would have been able to solve the challenge on her own, but the rest of the group were "*going around in circles… literally*".

4.4.4. Changing Attitudes towards STEM.

Throughout the second focus group and also within the reflective diaries, the participants were asked to reflect about what they had gained throughout the workshop sessions. This was done to enable myself, as the researcher, to identify whether the objectives of the badge curriculum were reached. The STEM badge curriculum had the aim of encouraging more girls and young women to pursue STEM subjects and careers. In order to reach this aim, through the badge curriculum I sought to:

- Initiate a greater interest in STEM
- Develop STEM skills

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- Change outlooks about women in STEM.

Within this section, I will be analysing what impact the badge curriculum developed within this study had on these three areas of development.

4.4.4.1 Initiate a greater interest in STEM

After listening to the experiences of STEM professionals and coming into contact with STEM through the Badge activities, the majority of the girls agree that they were willing to get to know more about STEM subjects and careers, even though they "*might not go for a STEM career*".

All participants agreed that through the interviews they formed new ideas about what STEM careers entail. Before they used to perceive STEM and STEM related careers as repetitive and boring. Sara stated that now that she had listened to the experiences of the STEM professionals, she was more open minded about STEM careers. This sense of increased interest was formed through the passion the professionals showed when talking about their own careers. Sara stated:

> *"But then through these interviews, I really started to get interested. I started to learn things that I didn't know like for example, the engineer; what she was telling us, she left me speechless. She loves what she does. It's like before, I was more removed from them but now I feel more open-minded towards STEM careers."*

Lara explained that through the badge curriculum, she changed the way she looked at STEM and the sessions made her realize that *"STEM involves many different things around us."* Berta explained how the activities made her realize that STEM can be more interesting than she had ever imagined:

"I learned about new jobs and [that] many people don't realise they are more interesting than they think."

These positive changes in the way the participants perceive STEM indicate that the badge curriculum played an important part in challenging stereotypical beliefs that often keep girls and women away from STEM. These changes also lead to greater interest in STEM careers and a more positive STEM identity.

4.4.4.2 Develop STEM Skills

When planning the sessions for the badge curriculum, it was made sure that through the activities the participants would have the opportunity to use and develop a number of skills. By the end of the workshop, i.e. in the final focus group, the participants were able to identify some of the skills that they had used and developed throughout the workshop.

Apart from the obvious and direct skills that they gained through the hands-on activities, such as bandaging an arm, and building a dome, they also mentioned other soft skills that the Rangers felt they would find useful in other aspects of their lives. As an example, Lara talked about the "skill of researching and gathering information", and explained how she thought it was a skill that might be useful in their everyday lives. Lara explained how:

Even if you're in a school or a class, it would come useful. Whatever the situation, everyone would need to do research and gather information. Having good research skills is a good idea.

The participants also stated that through the workshop, they were allowed to develop and express their opinions with others. The girls reported that working in groups, apart from allowing them to familiarize themselves with each other also improved their group and leadership skills. Maria mentioned how she felt that she managed to gain more patience and understanding of the task at hand, since they were not spoon fed. The process of having to think critically was found to be challenging and intimidating at first, but at the end she realized that through the process she felt more involved and motivated. Maria stated:

I'm not going to lie. I like to be spoon-fed. But then when I am not, I think that this experience has helped me to have more patience to understand and reach a conclusion on my own, so I think this will help in the future because not everyone [has it]. Even to find a job for example.

The skills mentioned above are identified by Lawless et al., (2016) as STEM skills. The development of such skills, apart from having a significant effect on STEM identity and are important for anyone who wants to take up a career in STEM, are also necessary skills in everyday life situations (Lawless et al., 2016).

All the participants agreed that these skills can be useful in several situations in life and could be transferrable to different situations. As Francesca explained:

They are related to everything, because you even if you don't work on your own, first you have to search information on the internet or you get the information from your friends or something as in it's not just for STEM careers but for everything.

4.4.4.3 Changed outlooks about women in STEM

On several occasions, the participants reported how through the activities carried out as part of the badge curriculum, their outlooks on several ideas about STEM and females in STEM changed. These changes in perceptions were mostly positive.

The girls stated that the interviews made them reflect more on the prejudice that still exists within STEM careers and how this is still affecting females in STEM. This made them realise that in order to achieve one's goal, that person has to work hard and strive to achieve the aspirations. Emily states that she learned that

> *"it doesn't really matter if you're a female because if you really want something, you should fight for it."*

Francesca also talked about how the badge curriculum made them realize that they must work hard for whatever they would like to achieve:

> *Something that I learned is that you really need to work hard to reach your goal but if you really want it, it will be worth the hard work in the end.*

Lara explained that the interviews made her realise that while in some sectors there is gender balance between both sexes, and that there is no prejudice, there are still a number of STEM fields which are still not inclusive and in which females find it difficult to flourish. Lara says:

> *"It made me reflect that although there are many talks and such on that we need to change, the difference between genders and sexes in the workplace is still there, in interviews you see the difference between them.*

There are those that are balanced and there are instances where a woman is on her own and they won't let her advance. It made me reflect on how it's still there."

Becoming aware of these inequalities made the Rangers more willing to work hard for what they wanted, and be able to prove these inequalities wrong. It seems that being aware of injustices and identifying stereotypes, instilled in them a motivation to challenge these ideas. Francesca explains that the badge curriculum made her aware of inequalities within STEM careers, and the need to challenge discrimination:

It made me think on the inequality and difference between the sexes, like she said and in STEM careers - that they still exist and I feel it is important that we work hard to destroy these differences so there is equal pay and equal opportunity like she said, because she said that we don't have as much opportunities as others.

Sara stated that she was willing to speak up if she is ever faced with injustice in her workplace.

...now I feel that if I am faced with these injustices in the future, I'm not going to let them go. So, I will speak up and if I really want to stay working in that field, I will fight and see that I have the same opportunities as the others.

The interviews were also beneficial in changing the perspective of the participants towards women in STEM. The participants reported that the experiences of the professionals made them aware of the importance of having more females working in STEM careers. The girls mentioned parts of their interviews with the STEM Professionals, to support this idea. Sara referred to

how the employer of one of the professionals was at first reluctant to employ her because she was the first female employed by the company, later to realise that she brought a different perspective to the work place. Sara explains:

> *And even when the engineer said they were working and to the men they said they needed to start working like the women, that encouraged us more. Like look, the women, although an engineer and that we usually we associate that with men, she was doing it better than him.*

This idea that emerged through some of the interviews with the STEM professionals was echoed by other participants. Lara explained that women could bring in more empathy to a workplace:

> *Even the fact that for example it made me realize that every job, whether you like it or not there needs to be a woman because it won't have the same outcome as when there is just men. Because I feel that even just having a woman, it's more friendly. Maybe even empathy.*

Maria felt that a woman is more likely to think long term and Berta referred to the interview with one of the professionals who explained that when designing a car, while a male engineer would think mostly about the appearance of a car, a female engineer would think more about other practical issues. Maria illustrated:

> *"I feel that women, they don't only see short-term but they see the future. I think all of us are thinking about our future."*

Berta realised:

> *"Like the engineer said. Like a car, it's not just about building a car and making it look nice. A woman would think of how to put in a baby with a pram inside the car and such."*

The Rangers felt that these characteristics which are often associated with females, would improve the quality of the work done and add a different perspective to the work place. These ideas that emerged through the interviews with the professionals show that these interviews apart from providing the participants with a number of role models, were also beneficial in shaping the participants' ideas about females in STEM and helped them better comprehend why having females participating in STEM is beneficial

4.4.5 General Views about the STEM Badge Curriculum.

The participants who took part in this study all expressed positive feelings towards the day workshop, in which the badge curriculum was implemented. The participants stated that they felt glad that they had the opportunity to work on the badge curriculum. In fact, in her reflective diary Maria points out the she felt, "*satisfied and glad I took part in this activity*"; while Berta writes that she felt, "*very happy that I took part in this study as it taught me new things.*" All the participants also expressed the view that the badge curriculum helped them think more about their future careers and what profession they would like to pursue. As Sara and Francesca stated the workshop made them think further, "*about the career we want to have*". Lara also wrote about her experience of the badge curriculum in very positive terms and she explained how it made her more persistent to follow her aspirations. She complemented this by saying:

> *"I decided to always follow my dreams and never give up without a fight.*

These realisations and thoughts that the participants developed throughout the sessions, coupled with the ideas expressed throughout the focus group session, indicate that this workshop was a meaningful and constructive experience for all of them.

Chapter 5

Discussion

5.1 Understanding Perceptions about STEM Subjects and Careers

This research study included the design of an effective badge curriculum aimed at encouraging girls and young women towards choosing STEM subjects and careers. However, as stated in Chapters 3 and 4, it would have been futile to develop such a badge curriculum without first analysing and making sense of the Rangers Guides' identities and ideas *vis a vis* STEM subjects and careers. Thus, a considerable portion of this research study was dedicated towards providing an understanding of the participants' views about STEM subjects and careers.

5.1.1 Participants' Definition of STEM.

As outlined in section 4.1.1 it was evident that the participants had heard of the term STEM before the start of the study, and knew what the acronym stood for. However, they found it difficult to talk about STEM subjects in an integrated manner. This shows that while they were introduced to STEM as a concept, they were unsure of the common factors and skills that bind this strand of subjects together. One possible reason for this fragmented view of STEM is the lack of integration between the sciences that is still prevalent in Maltese schools when it comes to teaching STEM subjects where, science is still taught as the separate subjects Biology, Chemistry and Physics in the upper forms (years) of secondary school and a combination of these three subjects (Integrated Science) in the lower forms (years) of secondary school. Very little emphasis is placed on the integration of science subjects with Engineering and Mathematics. This approach is similar to what is described by Osborne and Dillon (2008), who suggest that

current approaches to teaching STEM subjects, places too much weight on the academic curriculum which is applied out of context and with little significance to everyday life, leading to a lack of integration between STEM subjects, and making them appear disjointed.

5.1.2 Participants' perceptions about STEM Subjects.

One of the most striking observations made in the current study as shown in section 4.1.3, is the fact that the Rangers had very different views about STEM subjects. Despite differences in likes and dislikes, the factors that determined the participants' perceptions of STEM subjects were common. One factor that the participants felt held an influence on their motivation towards a particular field, were the relevance of the subject to everyday life. The majority of participants agreed that they liked subjects they encounter in everyday life. Another participant mentioned that she likes technology because it plays an important role in her life. The participants also felt drawn towards subjects that are familiar, in fact another participant stated she enjoys biology as she finds that she can relate real-life aspects to different biological concepts she learns at school.

These motivating factors are very similar to what has been reported in the international literature. As outlined in section 2.1.2.6, Holmegaard et al (2012), support the idea that students who perceive STEM subjects as relevant to their everyday life, are more likely to develop a positive STEM identity. They move on to discuss how presenting STEM in a more approachable and relevant manner within STEM programmes, would lead to a stronger STEM identity amongst participants.

Another factor that seemed to have an effect on the participants' perception of STEM subjects was their academic achievement. As discussed in section 4.1.3.2, most of the participants agreed that not doing well in a particular STEM subject had a negative effect on their outlook towards that subject. One particular Ranger also held the perception that certain STEM subjects are very difficult, and this made her distance herself from these STEM subjects. In fact, Wang and Degol

(2013), link students' accomplishments in STEM subjects to the possibility to them pursuing a career in STEM.

Within this study, it was noted that peers and parents also played an important role in shaping the participants' views on particular subjects. A participant who held a positive STEM identity, attributed her positive attitude towards STEM to her parents, who are both STEM professionals. A study conducted by Dasgupta and Stout (2014), found that parents play an important role in the early socialization process of children and this is when children's academic interests start developing. In fact, youth whose parents are in a STEM careers, are more likely to pursue STEM careers themselves, since parents often act as role models (Austin and Sax, 1996).

In contrast, a participant who held a negative view towards STEM, attributed this to her peers. As explained in Chapter 4 Section 4.1.3.2 her attitude towards a particular STEM subject was formed when her peers passed on the perception that this subject is difficult. Robnett (2015), identified a relationship between a stronger STEM identity and having a strong network of supportive STEM peers. This study illustrates that girls who do not have friends who support them in STEM, are less likely to show interest and motivation towards STEM themselves. As stated in Chapter 2 Section 2.1.2.6 , Crosnoe et al., (2008), also link this idea to academic achievement and explains that if peers are not faring well in STEM subjects, they would be more likely to influence their peers through their perceived lack of interest.

5.1.3 Participants' Views about STEM Careers.

5.1.3.1 Career Opportunities within STEM.

Despite the fact that the participants' views of STEM were quite narrow, the participants were able to list a great number of STEM careers and they moved away from the obvious choice of careers, as shown in the table in Chapter 4 Section 4.2.1. This shows that the participants are well aware of the opportunities

that are available and have already thought about these opportunities. They were, in fact, able to identify some STEM careers they would like to consider for their own future careers (see Chapter 4, Section 4.2.2).

The participants feel that while the opportunities are there, women face a number of obstacles in order to follow these opportunities. The Ranger Guides mentioned a number of restrictions and limitations which females might face along their career paths. The most predominant restriction the participants noted was discrimination in the workplace as mentioned in Chapter 4 Section 4.2.3. The participants feel that the work of females is not appreciated as much as that of males, because of stereotypical ideas that still exist. This idea is supported by Hill et al., (2010), who, as mentioned in Chapter 2 Section 2.1.2.1, identify discrimination against women as a reason why females are finding it more difficult to enter and progress through STEM careers.

Another challenge the participants identified were the issues women face in trying to balance their personal and professional lives. This issue is discussed within the literature review (Chapter 2, Section 2.1.2.1) in which Sonnert (1999), contradicts this idea and asserts that while family matters might have an influence on a women's choice of career or decision to progress, this is not a determining factor.

As discussed in Chapter 4 Section 4.2.4, the participants are positive that over time, through gender equality and a more optimistic outlook, these challenges will diminish. In the meantime, awareness of the challenges which women in STEM face, and a lack of role models, might push more females away from STEM careers, leading to a vicious circle which makes it trickier for the situation to change (Hill et al., 2010).

5.1.3.2 Participants' Interest towards STEM Careers.

With regards to STEM careers, the participants identify personal interests and familiarity with a particular STEM strand as a major motivator for choosing a career in STEM (Chapter 4, Section 4.2.2.1). Similar to their perceptions held towards STEM subjects (Chapter 5, Section 5.1.2), the participants were more attracted towards careers or areas within STEM that they are more acquainted with and which they liked. As outlined in Chapter 4 Section 4.2.2.1, some participants indicated that they would opt for STEM careers that they are familiar with, and find relevant to everyday life. This relationship between the career choice and being interested and familiar with the subject is outlined in Chapter 2 Section 2.2.1, in which Smyth and Darmody (2009), assert that students choose particular careers based on their familiarity and liking of a particular subject or strand; relevance; and usefulness to their career prospects. As shown in Chapter 4 Section 4.2.2.3, participants also discussed being in a career that pays well. They associate STEM careers with a good wage, and hence, some participants agreed that this would be a motivating factor in opting to pursue a STEM career. The idea that STEM careers are an opportunity to earn a good wage is not prevalent in literature, however, Fox, Sonnert and Nikiforova (2011), talk about the prestige and importance which is often associated with STEM areas. It is most likely that unclear perceptions of STEM subjects, contributed to this belief amongst participants. Another element that plays a role in determining which career the participants would opt for, is their choice of subjects at school. They feel that this would be a hinderance, since if they did not choose to undertake certain subjects at school, they would not be able to pursue a career which is directly related to that subject (Chapter 4 section 4.2.2.2), later on in life.

5.2 Motivating Girls into STEM Careers

5.2.1 Characteristics of the Badge Curriculum

Through the badge curriculum developed as part of this study, I sought to better understand which aspects could lead to a more effective programme aimed at fostering a greater sense of interest towards STEM careers. Within this section I analysed the different characteristics which make up this badge, and their impact on the participating Ranger Guides' perceptions of STEM.

5.2.1.1 Meeting Role Models through Interviews.

The lack of female role models in STEM is a significant contributing factor to the gender gap in STEM careers (Weber, 2012). Within this study, the participants came into contact with positive, professional STEM role models via interviews. As stated in Chapter 4, Section, 4.4.3.1, through the interviews with STEM professionals, the Rangers did not only expand their knowledge and understanding of STEM careers and what they entail, but also clarified their perspectives of STEM and women in STEM. The interviews led the girls to think more about gender equality and the sexist attitudes that persist in certain STEM areas. The participants relate these thoughts to an increased interest towards STEM careers. In fact, as outlined in Chapter 4 Section, 4.4.4.3, one participant explained how after being made aware of the gender inequalities, she feels more inclined to challenge stereotypes leading to these inequalities and is motivated to take up a STEM career. This relation between learning about gender inequality and motivation towards STEM is highlighted in Chapter 2 Section 2.4.1.3 by Leaper et.al., (2011), who established that girls who were exposed to, or learnt about gender equality and sexism were more likely to display a greater

motivation towards non-traditional fields such as STEM. Given the large number of references they made about the interviewed professionals during the proceeding focus groups and reflective diaries, it became clear that these interviews left an imprint on the participants' mindset, mainly because of the attitudes of the interviewees towards their own careers. The participants valued the authenticity in the interviewees' experiences, and the enthusiasm with which they talked made them eager to probe further and discover more about STEM careers (Chapter 4, Section 4.4.3.1).

5.2.1.2 An Experience of Mentoring.

As stated in Chapter 2 Section 2.2.4.1, Tyler-Wood et al. (2011) highlights the important role mentoring has in increasing the exposure of STEM amongst girls. The role of the professionals as mentors during the implementation of the badge curriculum strengthened the ideas that the Rangers had developed over the interviews. Esprivalo-Harrell, Walker, Hildreth-Combes, Tyler-Wood (2004) define a mentors' role as that of creating "a social context that fosters interest, participation, and self-concept related to science by encouraging the mentee to think reflectively, question effectively, and develop personal responsibility for her own learning." (p.367-368). Within this study, the participants reported that apart from them strengthening their relationship with other participants, the mentors also provided an environment in which the participants felt comfortable and supported in the completion of their tasks (Chapter 4, Section 4.4.3.2). This was achieved by helping them use several STEM skills. Thus, in conclusion, the mentors were effective in fulfilling their role as mentors as described by Esprivalo-Harrell et al., (2004).

5.2.1.3 Exploring STEM Careers through a Hands-on Approach.

The hands-on approach which in Chapter 2 Section 2.3.4.3 is identified as an important aspect of the Guiding and Scouting method (World Association of Girl

Guides and Girl Scouts, 2014), was beneficial in developing a greater sense of interest towards STEM amongst the participants. Levine et al., (2015) identifies hands-on experiences as an important aspect within STEM programmes that distinguishes these programmes from more formal educational settings, which provide a less tactile and more mundane experience than that of less formal STEM programmes (chapter 2, section 2.2.4.3). In fact, as evident in Chapter 4 Section 4.4.3.3, the Rangers refer to the hands-on approach often as this seems to be one of the major sources of enjoyment within the sessions, mainly because it is different to what is done at school. The fact that the participants had to carry out the tasks themselves, helped them become more engaged with the badge programme and resulted in a greater sense of self accomplishment. This increased interest in STEM is mentioned in Section 2.1.4.3 of the literature review, in which it is recognised by Burkam et al., (1997), as another benefit of hands-on activities which allow girls to engage more with STEM areas.

A feature within the hands-on activities that the participants brought up was the link that existed between the hands-on activities and the respective STEM careers (Chapter 4, Section 4.4.3.3). The Rangers reported that the hands-on activities were closely linked to different STEM careers, and that this allowed them to familiarise themselves with STEM careers. Exposure to STEM careers through hands-on activities can change the participants' views of STEM by challenging specific stereotypes and providing the participants with the opportunity to view themselves in different STEM careers (Dare and Roehrig, 2016).

5.2.1.4 Inquiry Based Approach – Teaching Perseverance and Confidence.

Another aspect that helped foster a greater interest towards both STEM and STEM skills, was the inquiry-based approach (See Chapter 4, Section 4.4.3.4). In Chapter 2 Section 2.2.4.6, Hill et al., (2010), identify the development of these skills, which are gained through exploration and inquiry, with a stronger STEM identity and with increased interest in STEM. While, as noted in Chapter 4 Section

4.4.3.4, the participants felt a slight unease with not being given detailed directions on how to carry out a task. They eventually reported that this method allowed for a greater sense of creativity and innovative thinking. Gaining a greater sense of satisfaction once a task was completed, was also identified by the participants as another benefit of this approach, making them feel more empowered and hence strengthening their own STEM identity (Chapter 4, Section 4.4.3.4). This finding is supported in Chapter 2 Section 2.1.4.6 in which Hill et al., (2010) explain how the exposure of girls to challenges and hard work, can lead to a stronger sense of confidence in STEM subjects amongst girls and young women. A lack of confidence in STEM subjects, is identified as a leading factor keeping females away from STEM (Hill et al., 2010).

5.2.1.5 A Collaborative Approach through the Patrol System.

The activities, as intended in the badge curriculum, were implemented in a group setting. As indicated in Chapter 2 Section 2.3.4.3 this approach to learning is also an integral part of the Guiding and Scouting method, in which members work in groups known as patrols (World Association of Girl Guides and Girl Scouts, 2014). Lansiquot (2016), identifies collaborative learning as a STEM skill which any person would need to make decisions both at a personal and professional level. As indicated in Chapter 4 Section 4.4.4.2 working in groups provided the ideal setting for the participants to develop several team skills. The participants reported how group work allowed them to use argumentation and critical thinking skills to put forward their ideas and arrive at the best conclusions (Chapter 4 section 4.4.3.5). As pointed out by a particular participant, the Patrol System provided the participants with the confidence they required to carry out challenging STEM tasks which they might not have been able to solve had they been working alone. This finding was consistent with those identified by Dare and Roehrig, (2016), who noted that girls found "strength in numbers" (p.7) and valued groupwork as an opportunity to share ideas (Chapter 2.2.4.4). As established in Chapter 4 Section 4.4.3.5, most participants felt that working in groups was something they found beneficial and which helped them build better

relationships with the rest of the group. Developing positive relationships and experiences when working on STEM tasks might lead to a greater sense of interest towards STEM. Stake and Nickens (2005) found that the development of positive relationships amongst participants of enrichment programmes, provides girls, in particular, with a sense of belongingness that helps strengthen their STEM identity and increases the likelihood to express interest in becoming a STEM professional.

5.2.2 Objectives of the Badge Curriculum.

It is unrealistic to expect to be able to document the success of a programme aimed at promoting STEM careers in terms of the number of participants who actually pursue STEM careers, mainly due to the fact, that such an outcome would take a number of years to materialise (Krishnamurthi et al., 2014). It is for this reason that Krishnamurthi et al., (2014) identify more measurable objectives of informal STEM programmes. As stated in Chapter 2 Section 2.2.3, Krishnamurthi et al., (2014) state that informal STEM initiatives should aim to:

- Initiate a greater interest in STEM
- Foster STEM skills
- Foster positive outlooks towards STEM.

While these objectives might not be directly correlated to the core aim of the badge curriculum – that of encouraging more girls and young women towards STEM areas – they should be the yard stick to determine the effectiveness of the badge curriculum developed for this research study since its various aspects play an important role in developing a stronger STEM identity. A lack of STEM identity is identified by Castillo, Grazzi, and Tacsir (2014), as being one of the main reasons for having less women opting for STEM subjects and careers. Within this section, I plan to evaluate the Ranger Guides' experience of the badge, in terms of these objectives.

5.2.2.1 Initiate a Greater Interest in STEM.

The participants explained how through the badge curriculum they have gained a greater interest towards STEM and STEM careers (see Chapter 4, Section 4.4.5). As discussed in Chapter 2 Section 2.2.4.3, an effective method to foster a greater sense of interest in STEM is through hands-on experience, which is deemed not only effective in fostering interest, but also in allowing participants of such activities to imagine themselves in STEM careers (Watermeyer, 2012). In fact, within this study, the participants enjoyed the hands-on activities within the badge curriculum because they felt these helped them better comprehend what working in a STEM career must be like. As a result, this sense of enjoyment made the Ranger Guides feel more drawn towards STEM (Chapter 4 Section 4.4.4.1). The participants also reported how the enthusiasm displayed by the STEM professionals during the interviews, ignited in them a sense of curiosity towards STEM and STEM careers which made them think more about opportunities in STEM. Within a study carried out by, Hughes, Nzekwe and Molyneaux (2013), also mentioned in Chapter 2 Section 2.1.4.2, similar findings were reported in which girls who were exposed to female role models developed a greater interest towards STEM as a career.

5.2.2.2 Fostering STEM Skills amongst Participants.

Lawless, et al., (2016), as quoted in Chapter 2 Section 2.3.4.4, highlights the importance of having a scientifically literate population who is able to engage in matters that would affect them as citizens. Scientific literacy does not refer only to the accumulation of knowledge, but can be developed through STEM skills (also known as twenty-first century skills) such as collaboration, communication and problem solving (Lawless et al., 2016). The participants within this study were able to identify a number of skills that they felt were fostered through the Badge activities. As described in Chapter 4 Section 4.4.4.2, the Rangers explained how they had to use several soft skills such as critical thinking, problem solving,

group and leadership skills through the activities they participated in. They also had the opportunity to carry out research and be innovative. These skills were gained both directly and indirectly through the hands-on activities that were carried out as part of the badge curriculum. All participants agreed that such skills would be beneficial in their everyday lives, even if they do not pursue STEM careers (Chapter 4, Section 4.4.4.3). This idea is echoed by Lawless et al., (2016), who states that the development of STEM skills should be widespread and not limited only to STEM professionals, because these skills involve abilities which can be transferrable to different situations and instances (Lawless et al., 2016).

5.2.2.3 Foster Positive Outlooks towards STEM.

Challenging the mindsets and outlooks of young women towards STEM is one way to provide support for girls' STEM identity (Reinking and Martin, 2018) (Chapter 2, section 2.1.2). The interviews with STEM professionals were deemed fruitful and effective in changing and challenging the views participants held about STEM before the start of this study. One such change identified in Chapter 4 Section 4.4.4.3, is in the way the participants now view women in STEM. The participants explained how through the interviews, they were able to understand why it is essential to have more females in STEM and how females in STEM add a different dimension to STEM professions. In Chapter 4 Section 4.4.4.3, it becomes evident that the workshop sessions were also effective in helping the participant to create a better understanding of what STEM entails and how STEM careers could be an exciting option for those willing to pursue them.

5.3 Concluding Remarks

The implementation of the badge curriculum with the Ranger Guides seemed to have the desired effect on their motivation and interest towards STEM. As reported within Chapter 4, the participants felt that through the workshop, they

gained a number of skills, and the activities were effective in triggering thoughts about their attitudes towards STEM careers. Nonetheless, as stated by a number of participants, a change in attitude towards a particular subject or career cannot be forced on anyone. The aim of such initiatives should be that of highlighting opportunities, options and instilling the belief that when one wishes, there are no restrictions to achieve dreams (Wang and Degol, 2013).

Chapter 6

Recomendations and Conclusions

This final chapter reflects on the factors that motivate girls to choosing STEM careers and provides suggestions on how a badge curriculum within the Malta Girl Guides can be used to encourage the uptake of STEM subjects and careers amongst its members. These conclusions will shed more light on how initiatives aimed at reducing the gender gap in STEM can be implemented within Girl Guiding and Scouting Associations and in other non-formal educational settings.

6.1 Factors Influencing Girls and Young Women into Choosing STEM Careers

In this research study, I attempted to understand how a badge curriculum for Ranger Guides within the Malta Girl Guides can be used to encourage girls to take up STEM careers. Before doing this, I wanted to better understand what factors motivate girls to choose STEM related careers.

One of the main predictors for interest towards STEM careers was the perceived relevance that the girls attributed to STEM subjects and careers. It became evident, through interaction with participants of the study, that they were more inclined towards subjects and careers they were familiar with and careers they considered relevant. The participants disregarded subjects which they were not familiar with. This lack of familiarity with certain subjects resulted from lack of knowledge of the subjects; a number of stereotypical beliefs the participants encountered throughout their life; and lack of exposure to different STEM careers. This is why exposure to different STEM subjects and careers is an essential element which could lead to a stronger STEM identity, and in turn a greater interest towards STEM careers.

The kind of exposure girls had of STEM subjects also resulted in a great influence on their perceptions of these subjects and careers. Negative experiences of STEM subjects such as low academic achievement and lessons which were not motivating, pushed the participants away from STEM subjects. Although these negative experiences had no direct effect on the participants' perceptions of STEM careers, the participants felt that the failure to take up certain STEM subjects at school, would make it more difficult for them to pursue STEM careers. On the other hand, the participants held more positive views of STEM subjects they enjoy at school, and towards careers related to these subjects. Elements that the girls felt would enhance their experience in STEM, were the hands-on approach and strong links between the topic and everyday life.

The support and encouragement girls get from peers and parents was also mentioned as a contributing factor in developing positive attitudes towards STEM subjects and careers, and in challenging stereotypes related to women in STEM. In this study, it became evident that girls can be easily influenced by their peers and parents when it comes to developing their ideas about STEM subjects and careers. This is why the role of peers within initiatives aimed at reducing the gender gap is valuable for participants to affirm and nurture their interest in STEM. Furthermore, effective STEM programmes and initiatives may also benefit from the participation of parents who are interested in supporting their daughters in the pursuit of their careers.

While this list of factors motivating girls into STEM subjects and careers is not conclusive, it provided me with a better understanding of how to design and develop the badge curriculum. Keeping these factors in mind throughout the development and implementation of the badge curriculum, helped me ensure that the needs of the participants were being met.

6.2 A Badge Curriculum Aimed at Encouraging Girl Guides to Pursue STEM

Through the implemented badge curriculum and through its evaluation, I managed to identify the aspects within the badge that made it effective in encouraging more girls and young women towards STEM careers. The characteristics that made this badge curriculum successful in reaching its' aims and objectives were:

- **The use of role models** – Increases participants' interest towards STEM careers, and their awareness of the challanges women in STEM professions face in pursuing their careers.

- **Mentorship –** Having mentors who can lead the girls through their educational journey proved to be benefical in fostering a greater sense of STEM identity. Furthermore, a collaborative approach between girls and adults, which is identified by WAGGGS as part of the Girl Guiding and Scouting method, can also be deemed beneficial in empowering the Guides and help them in their decision making process while carrying out the badge activities.

- **Hands on experiences** – or as reffered to within the Guiding and Scouting Method, *Learning by Doing*, involves the girls in the learning process making them feel that they have contributed to the outcomes. This sense of involvement, apart from making learning more interesting and fun, helped the girls engage in the STEM programme, and develop a greater sense of self accomplishemnt.

- **A collaborative approach through the Patrol system** – Apart from improving team skills, developing positive relationships and experiences through the use of group work and collaboration, it provides girls, in

particular, with a greater sense of belongingness that can increase interest in STEM.

- ***An inquiry based approach*** – It allows participants the freedom to take risks and make mistakes, leading to an enhanced learning experience. Through this approach, girls develop a greater sense of satisfaction, feel more empowered and strengthen their STEM identity.

- ***Activities which are relevant*** – Providing activties which are meaningful and directly linked to different STEM careers was an aspect that made this badge curriculum more effective in reaching its aims. Exposure to different STEM careers through STEM activities which are related to STEM careers, provides the girls with the opportunity to better familiarize themselves with these careers. It also allows the girls to understand the importance of different STEM careers in our society and the world in general.

The use of the different factors and characteristics listed above all proved to be beneficial in one way or another to reach the objectives of the badge curriculum, which were [1] initiating a greater interest in STEM, [2] fostering STEM skills and [3] changing outlooks towards STEM, amongst participants within this study. While these objectives were important in determining the effectiveness of the badge curriculum and in understanding the effects the badge had on the participants, the most important point that emerged through the implementation of the badge curriculum, is the belief that girls should be provided with the opportunity to make informed and meaningful decisions about their career choices and be encouraged to follow their dreams. This study has shown that this badge curriculum was effective in fulfilling the purposes of STEM initiates aimed at reducing the gender gap in STEM. However, it is important to note that to ensure that the attitudinal changes identified lead to more long-term results, a

badge curriculum can not be used in isolation, and should be supported by other initiatives aimed at empowering girls and young women to pursue STEM subjects and careers.

6.3 Limitations of the Study

As in any other study, through the course of the research, I encountered a number of limitations, mostly due to logistical issues. Before the start of the implementation process, I found that due to the nature of the study, time constraints and the small population size of the Malta Girl Guide Association, the organisation I based my research on, the amount of participants within this study was rather small and involved only one specific age group. The issue with smaller sample sizes is that this would not provide a good representation of the whole population (Denscombe, 2010). The limited number of participants within this study might have had an impact on the badge design and the activities within the badge. The badge was designed to suit the needs and interests of the participants within my study, whose interests I identified from the first focus group. Therefore, the badge curriculum used for this research study was designed to following suggestions from the participating Ranger Guides, whose views and needs might vary from those of other Ranger Guides. While I was aware of this limitation and its implications, having a smaller sample size allowed me, as the researcher, to better understand the participants and produce a more accurate account of their experiences during implementation, which is one of the most distinguishing characteristics of qualitative research (Cohen et al., 2007).

Another limitation I encountered throughout the research process was time restrictions. In order to avoid putting undue pressure on any of the participants, the workshop was carried out over the course of one single day. This was very convenient for the participants as it meant that they only had to commit for three seperate occasions, once for the workshop, and twice for the focus group interviews. However, under normal circumstances a badge curriculum is often implemented during a number of shorter weekly meetings. This meant that the

girls had to work and complete the badge in a single day. Although the day workshop equated to the same amount of time had it been implemented over a number of weekly meetings, this meant that the participants might have felt slightly overwhelmed during the course of the workshop. This might also have resulted in less time for them to think about the badge process and engage with it. In fact, when evaluating the badge curriculum the participants felt that they would have preferred having more time to complete the task.

Another limitation of this study was the fact that the research was carried out over a number of weeks. This meant that this study was able to identify only the short term benefits of the badge curriculum, as the long term outcomes would become evident over a longer number of months or years.

Furthermore, the fact that the badge curriculum designed and implemented within this study, was carried out within the Malta Girl Guides Assocation, this means that the research findings within this study are influenced and imbued by the contextual realities of the association within which the reasearch was carried out. The design of the badge curriculum and its implimentation, were influenced by the principles of the Guiding and Scouting Methods, the practices adopted by the Malta Girl Guides Assocation and by my own personal experiences as a leader within the Association.

Despite the implications and limitations of this study, the experiences of the participating Ranger Guides could still provide a trustworthy understanding of the factors that make up STEM programmes and how these could be improved. This study's findings provide an understanding of the goings within the context studied, but also the common factors that make STEM initiatives effective within different settings. In conjunction with findings from other studies, the factors and recomendations identified within this study could serve as a basis for understanding and improving STEM initiatives within other organisations or educational contexts. Such an understanding is important for providers of STEM initiatives to engage in the matters that arise in the development and implementation of STEM programmes, which are effective in challenging the bounderies keeping females away from STEM careers.

6.4 Recommendations for the Development of STEM Badges and Initiatives within the Girl Guiding and Scouting Movement

As established in earlier sections, WAGGGS and its member association Malta Girl Guides, through its Guiding and Scouting method, can greatly contribute to issues of gender equity within STEM fields. I believe that Girl Guiding and Scouting Associations, can embark on further projects and initiatives aimed at reducing the existing Gender Gap within STEM fields and empower more girls to pursue their dreams. This could be done by:

6.4.1 Embracing the Guiding and Scouting Method in the Development of STEM Badge Curricula.

The Guiding and Scouting Method, is what distinguishes Girl Guiding and Scouting organisations from other educational settings. For a number of years, this method proved fruitful in targeting different issues which were affecting girls and women around the world. Within this study, it became evident that the five main pillars of the Guiding and Scouting method (World Association of Girl Guides and Girl Scouts, 2014), played an important role in the badge curriculum and led to it's effectiveness. This was done through:

- **The Patrol System** is essential in providing a setting in which girls can develop stronger peer-to-peer support systems and become more successful in completing STEM related tasks, making them feel more confident in STEM.

- **Progressive Self Development** offering girls the opportunity to challenge their perceived limits. This results in an increased sense of confidence

amongst girls, which is important for the successful development of a stronger STEM identity.

- ***Learning by doing*** which actively involved girls in STEM activities. This was an effective way for girls to enjoy STEM subjects. Apart from increased enjoyment, learning by doing can also improve girls' confidence in STEM.

- ***Active cooperation between young people and adults*** through interactions with the STEM professionals. Through their capacity as role models and mentors, STEM professional, can provide a supportive and encouraging environment for Guides to learn about and increase their engagement with STEM.

- ***Connecting to my world***, in other words, activities targeting the gender gap in STEM should also be related to their everyday life, emphasise the relevence of different STEM careers and subjects, and help Guides to connect with their surrounding world.

This shows that embracing the Guiding and Scouting method in targeting the gender gap in STEM can lead to initiatives which are effective in developing a stronger STEM identiy and encouraging more girls to opt for STEM careers.

6.4.2 Providing More Timely Intervention.

The badge curriculum developed within this study was targeted at one of the older sections of the Malta Girl Guides. This particular age group was chosen in view of the fact, that participants of the chosen age group would have been thinking of their furture careers. However, ideas about gender roles and stereotypes related to STEM careers, which would eventually influence the

choice of career, are often acquired much earlier, within the early years of childhood development (Reinking and Martin, 2018). This is why early intervention is essential in ensuring that initiatives aimed at reducing the Gender gap in STEM are more effective. The Malta Girl Guide Association starts to enroll members from the age of five, and members have the option to remain within this organization throughout their lifetime. Hence, in developing initiatives directed at younger members and aimed at different age groups, the association would be ensuring that gendered ideas and stereotypes about STEM could be targeted from a younger age, resulting in more effective and consistent outcomes.

6.4.3 Recognizing the Importance of Role Models in Shaping Views about STEM.

When looking back at my research, it becomes clear that the Ranger Guides' attitudes were deeply influenced by the different STEM professionals who they met through the interviews and through the mentoring process. The purpose of meeting STEM professionals was to provide the participants with role models with whom to interact. Stout, Dasgupta, Hunsinger and McManus (2011), emphasize the importance of role models in challenging stereotypes leading to the gender gap and in motivating girls and females to pursue STEM careers. This proves that the use of Role Models within initiaitves developed by Guiding and Scouting associations could prove beneficial in shaping girls' STEM identities. Reinking and Martin (2018), suggest a number of ways to feature role models within STEM initiatives, ranging from story-telling, research, meeting with STEM professionals or even working in STEM environments. Within Guiding and Scouting settings, role models can be incorporated by inviting different STEM professionals to interact with members through interviews and actively participate in STEM activities with participants. The active participation of these STEM professionals, as mentors, in different STEM activities can create a context in which girls, do not only strengthen their confidence in STEM, but are also guided to develop different coping strategies and problem-solving skills through their interactions with their mentors. When choosing STEM professionals as role

models, it is also beneficial to ensure that women engaged are coming from different walks of life and different fields of STEM, thus proving to participants that there are no restrictions as to who can pursue STEM careers. It is also important for Guiding and Scouting associations to recognize the potential their leaders have as role models, and make use of existing human resources in order to reap the benefits of Guiders (leaders) whose life experiences could set an example to members of these organisations.

6.4.4 Respecting the Individuality of Every Participant.

While the aim of STEM badges and initiaitves is most commonly that of encouraging more girls and young women to pursue STEM careers, the individuality of each girl should be respected. It is important to understand that every person has different interests and this is why the aim of STEM initiaitives should not be that of forcefully imposing STEM careers on participants, but to encouraging members to think about the different careers options available. As suggested by Wang and Degol, (2013) STEM initiatives should aim at eliminating barriers which are keeping women away from STEM careers. In doing so, the Guiding and Scouting association would be challanging stereotypes amongst its participants who in turn are also empowered to share their beliefs with the wider society.

6.5 Recomendations for Further Research

Within my research I attempted to better understand girls' experiences within STEM programmes, in an out of the school context, and determine the factors that make up an effective out-of-school programme aimed at encouraging more girls to take up STEM careers. It was through my study that I became aware of a number of factors and characteristics within effective STEM initiatives which although I have discussed and analyzed within my study, would require further research which is specifically targeted at each individual characteristic. In fact,

Dorsen et al., (2006), discuss that while there are several factors within non-formal and informal educational settings that lead to a stronger STEM identity amongst girls and young women, the links between the two are not always easy to identify. Studying more in-depth individual STEM programmes would help us understand these links better (Dorsen et al., 2006).

While this study focussed exclusively on a badge curriculum developed for the Malta Girl Guides, it would be interesting to understand how initiatives aimed at motivating more girls to take up STEM careers, are and could be implemented within other organisations and different settings, thus providing a wider view of the factors leading to effective STEM programmes. Further research also needs to be carried out in order to investigate the implementation and the effectiveness of STEM initiatives pursued by smaller age groups, and by mixed sex groups.

As stated earlier within this chapter, one limitation of the study is the lack of possibility of analyzing the long term effects the badge curriculum would have on participants. This is one of the restrictions researchers face in evaluating STEM programmes within non-formal and informal educational settings (Krishnamurthi et al., 2014). It would thus be beneficial to carry out follow up studies which provide an understanding of the benefits or lack of these programmes, in the long run.

6.5 Concluding Remarks

The findings of this study have provided valuable insights and information for educators and non-formal educational organisations, such as the Malta Girl Guides and other Guiding and Scouting associations worldwide, about the development of programmes and initiatives aimed at reducing the gender gap in STEM. In this study, it became evident that while having a greater understanding of the factors pushing girls away from STEM careers, is the first step towards designing effective STEM programmes, there are a number of programme characteristics which can be deemed effective in changing attitudes towards STEM and in encouraging young women to pursue STEM careers.

It is trusted that such findings will encourage the Malta Girl Guides and other non-formal educational organisations to embark on new ventures aimed at reducing the gender gap in STEM and strengthen existing initiatives.

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Appendix 1: Structure of the Malta Girl Guides

Malta Girl Guides Structure

Council	National Board
Governing body of the Association. Chaired by the President of the Association	Administrative body of the Association. Chaired by the Chief Commissioner of the Association.

South District	Central District	North District
Administered by the South District Commissioner.	Administered by the Central District Commissioner.	Administered by the North District Commissioner.

Units in different localities spread out across the three districts.

Structure within the Unit.

Dolphins (5 – 7 years)

Brownies (7 – 10 years)

Guides (10 – 13 years)

Rangers (13 - 16 years)

Senior Rangers (16 – 22)

Adult Volunteers (18+)

Warranted Guiders (18+)
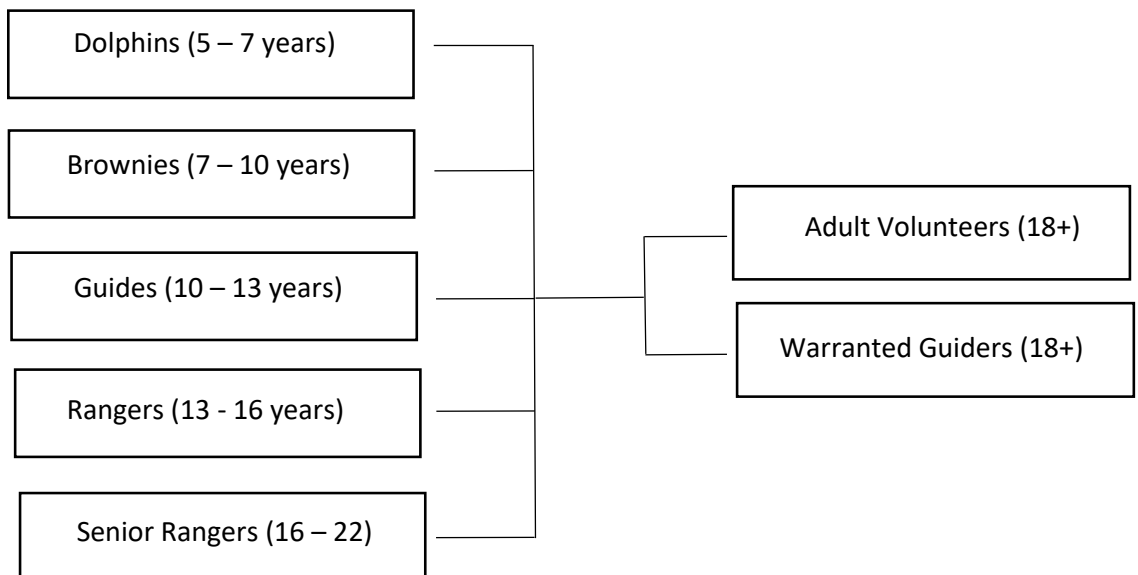
Appendix 2: Badge Curriculum

STEM Careers Badge

AIM: Recognize the need for more females in STEM Careers.

OBJECTIVES: 1. Identify different STEM Careers.

2. Ask questions about STEM Careers.

3. Engage in various STEM related task.

4. Use STEM skills to carry out tasks.

5. Relate STEM skills to different STEM Careers and other Careers.

INDIVIDUAL TASKS

- Create a list of expectations that you have about this badge.
- Think about questions you have about STEM Careers.
- Write a letter to your future self.

COMPULSORY TASK

Find 3 women who work in different STEM fields. Ideally the women have different levels of education and are coming from different educational institutions. Create a list of career related questions that you would like to ask these STEM professionals and invite them to your meeting place for an interview session using the questions you have created.

You might also like to ask these STEM professionals to join you in the rest of the activities you will be doing to gain this badge.

OPTIONAL TASKS (Choose 3 Tasks)

1. Engineering: Build a Geodesic Dome.

A Dome is an architectural structure that has the shape of a half sphere, normally forming the roof of a building. A dome exerts forces all around its' perimeter, without the need to use any supporting columns. One of the most modern dome structures is the Geodesic Dome which was invented by Buckminster Fuller in the 1940s. The Geodesic Dome is created by a series of triangles that make the dome withstand very heavy loads.

Design and build a Geodesic dome model which is not smaller than 50 cm in diameter. Look at pictures in the resource section to look at some examples of Geodesic Domes. You can use a variety of materials ranging from popsicle sticks, newspaper, straws and toothpicks, glue guns, tape and glue tac.

2. Health: Bandaging and other Skills.

Bandaging is a skill used by several health care professionals for several purposes:

1. To create pressure over an area.
2. To immobilize a part of the body.
3. To support and protect wound from contamination.
4. To reduce bleeding.
5. To secure a dressing.

Learn when to use and practice how to do the following bandaging techniques:

- Figure of Eight Bandage for sprained ankle.
- Figure of Eight Bandage for sprained wrist.
- Circular and Reverse Spiral Bandage.
- Recurrent Head Wrap.

- Arm Sling.
- Elevation Sling.

3. ICT Activity: Coding Geometric Designs

Coding (also called programming or developing) is telling a computer, app, phone or website what you want it to do. In this case, you will use coding to draw a geometric shape.

Use the coding sequence in the Resource Section to draw a Geometric Shape on an A3 sheet. Take 1 step to be 1mm on your paper. By the end of the task ask your Guider to show you the geometric shape you should have created and compare to your creation.

Once you have experienced creating geometric shapes using codes, create your own shape and write down the code so that other people could draw the same geometric shape. You may find the different commands in your resource pack.

4. Research and Innovation Activity: Measure the Height of a Building.

The job of a scientist is to answer scientific questions. To do so, scientists have to device methods to help them answer their questions.

Your task is to explore ways to measure an unreachable height in a building. The only materials that are provided are a 2-meter measuring tape and a mirror. By the end of your task, ask your Guider for the correct measurement and solution.

CONCLUSION

Make a list of the different skills that you think have made use in these activities. Discuss where do you think you can use these skills in your everyday life.

RESOURCES – ACTIVITY 1

Geodesic Dome

Coding Sequence

Pen Down

Repeat **10**

Repeat **4**

Move **10** Steps

Turn ⤴ **90** Degrees

Turn ⤴ **36** Degrees
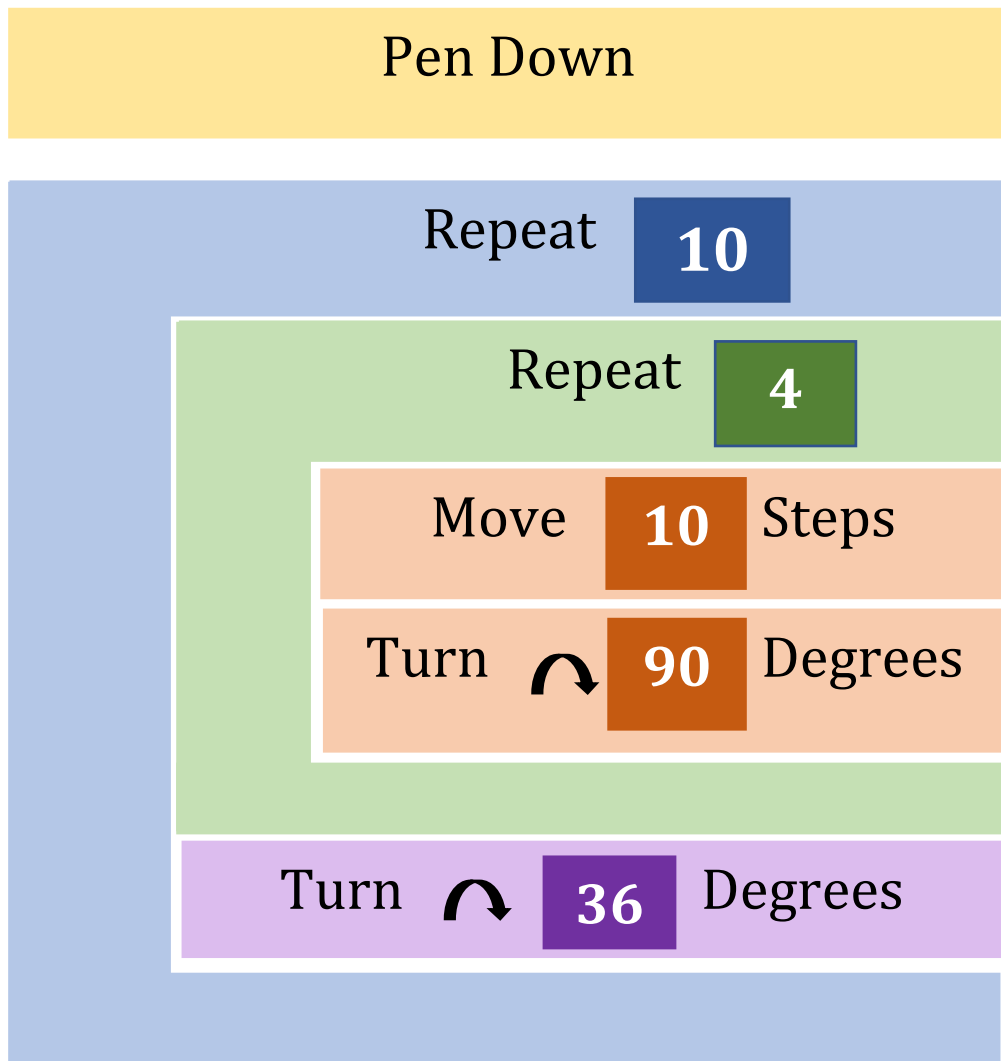
Geometric Shape
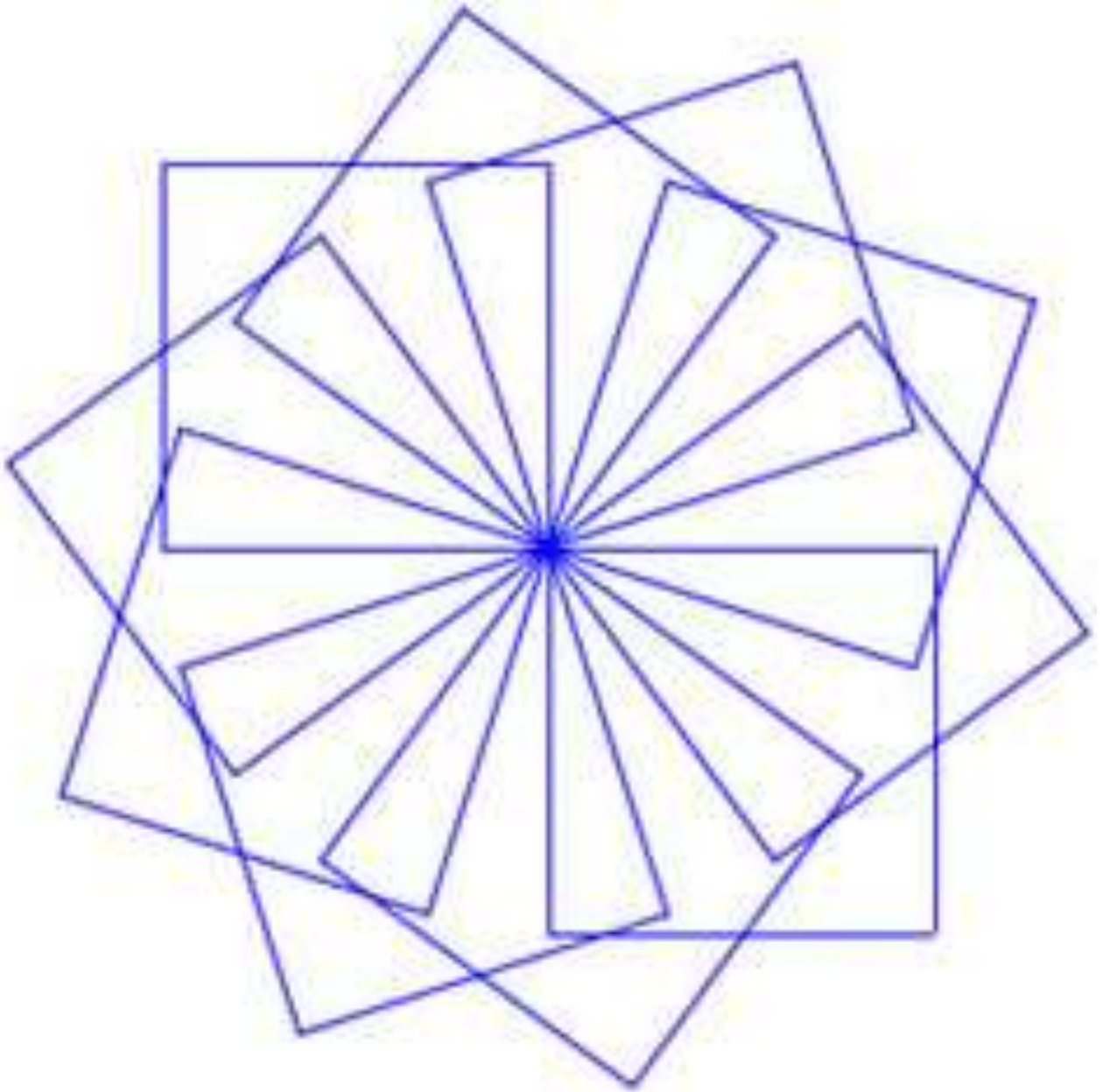
RESOURCES – ACTIVITY 3

Codes

Go Forward
Turn Left
Turn Right
Turn Clockwise _ Degrees
Turn Anticlockwise _ Degrees
Repeat _ times
For _ Steps
End
Set Y to _
Set X to _
Pen Down

Solution

1. Pick a tall object a flag pole or utility pole, for instance.
2. Place the mirror the ground a few meters from the tall object.
3. Move around until you can see the image of the top of the pole reflected in the mirror.
4. Measure the distance from the bowl to your feet (d) , the distance from the bowl to the base of the light pole (D), and record them in your data table.
5. Measure the vertical distance from the bowl to your eye (h).
6. Move the mirror to another distance from the pole, and repeat your measurements until you are satisfied that you have enough data.

   Use similar triangles (as shown below) to calculate the height of your tall object for each trial.

For Similar Triangles
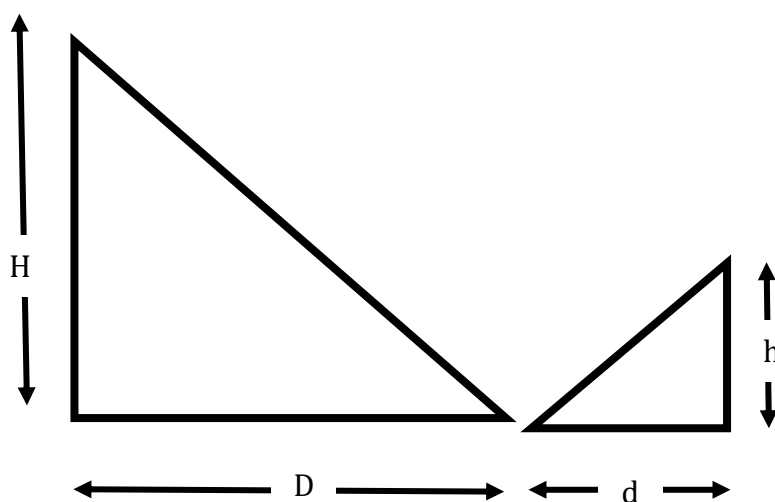
$$\frac{H}{D} = \frac{h}{d}$$

$$\text{so} \quad H = \frac{hD}{d}$$

Appendix 3: Reflective Diary

Reflective DiarY

STEM Careers Workshop

16th June 2018

The following reflective tasks are part of the data collection process. May I remind you that you may also refrain from answering any questions without providing a reason and without any prejudice.

What are your expectations for today's workshop?

What questions do you have about STEM Careers that you would like to answer through this workshop?

Activity 1: _____

Which of the following STEM Skills did you make use of during this activity? (Tick where appropriate)

- o   Problem Solving
- o   Creativity and Innovation
- o   Interpreting Data
- o   Discussing
- o   Flexibility
- o   Ask Questions

Others (Please Specify) _____

What where your strengths in this activity?	What where your weaknesses in this activity?
_____ _____ _____ _____	_____ _____ _____ _____

What challenges did you encounter?	This activity made me realize that …..
_____ _____ _____ _____ _____	_____ _____ _____ _____ _____

Activity 2: _____

Which of the following STEM Skills did you make use of during this activity? (Tick where appropriate)

- o Problem Solving
- o Creativity and Innovation
- o Interpreting Data
- o Discussing
- o Flexibility
- o Ask Questions

Others (Please Specify) _____

What where your strengths in this activity?	What where your weaknesses in this activity?
_____ _____ _____ _____	_____ _____ _____ _____

What challenges did you encounter?	This activity made me realize that …..
_____ _____ _____ _____ _____	_____ _____ _____ _____ _____

Activity 3: _____

Which of the following STEM Skills did you make use of during this activity? (Tick where appropriate)

- o Problem Solving
- o Creativity and Innovation
- o Interpreting Data
- o Discussing
- o Flexibility
- o Ask Questions

Others (Please Specify) _____

What where your strengths in this activity?	What where your weaknesses in this activity?
_____ _____ _____ _____	_____ _____ _____ _____

What challenges did you encounter?	This activity made me realize that …..
_____ _____ _____ _____ _____	_____ _____ _____ _____ _____

Activity 4: _____

Which of the following STEM Skills did you make use of during this activity? (Tick where appropriate)

o   Problem Solving

o   Creativity and Innovation

o   Interpreting Data

o   Discussing

o   Flexibility

o   Ask Questions

Others (Please Specify) _____

What where your strengths in this activity?	What where your weaknesses in this activity?
_____ _____ _____ _____	_____ _____ _____ _____

What challenges did you encounter?	This activity made me realize that .....
_____ _____ _____ _____ _____	_____ _____ _____ _____ _____

Write a letter to your Future Self.

_____

_____

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Appendix 4: Focus Group 1 Schedule

Focus Group 1 Schedule

Briefing

Good morning/afternoon,

I am Chiara Attard and I am currently reading for a master's degree in science education. As part of my studies, I am doing a dissertation about the promotion of STEM careers within the Guiding Association.

The purpose of this study is to create and implement a STEM badge curriculum programme for Maltese Ranger Guides (aged 13-15). The aim of this focus group is to determine your initial ideas about STEM Careers. These insights and ideas are useful in the development of a badge curriculum according to your needs.

Whilst thank you for your participation, I would like to remind you that participation in this study is voluntary and that you can withdraw from this study at any point. You may also refrain from answering any questions without providing a reason and without any prejudice.

May I also remind you that anything that is said or done during this focus group interview is confidential and is not to be shared with anyone who is not present.

There are no correct or incorrect answers.

Section 1: Profiles

Each participant will have five minutes alone to answer the following questions on a sheet of paper.

After these 5 minutes, we will share the answers with the rest of the group.

1. Name:*
2. Age:
3. Personal Interests and Hobbies:
4. When I was young, my aspirations were ……
5. Something special I can do is……
6. I joined Girl Guiding because …….

Section 2: STEM Subjects: Our Reactions

The word STEM is the abbreviation of Science, Technology, Engineering and Mathematics.

I am now going to write down these subjects in the middle of the chart in front of us.

How do these subjects make you feel?

Write down or draw the feeling/s on a sticky note. We will be sharing this feeling together as well.

1. What makes you feel this way about these subjects?
2. Would you like to share your experiences of the subject with us?

Section 3: Brainstorming STEM Careers

Work together to list as many stem careers that they can think of on this blank sheet of paper.

1. Are there any of the careers listed on this sheet of paper that interest you or that you would consider for your future career?
2. Which STEM Careers would you consider for your future?
3. Why do some of the careers seem more attractive than others?
4. Why do some of the careers seem less attractive than others?
5. What would motivate you to enter any of the careers listed?
6. What would stop you from entering any of the careers listed?

Section 4: Truth or Myth Discussion

Do you think that the following sentences are the truth or a myth? Explain why for each sentence.

1. Most girls are less interested in STEM than boys are.
2. Bias against girls in STEM is something of the past.
3. There is nothing we can do to make girls more interested in science.

4. Women are just born at a disadvantage when it comes to STEM subject. Their brains are more suited for arts and languages.
5. There are very little opportunities for women to enter STEM Careers.
6. Women in STEM careers can never be as successful as men.

Section 5: Guiding Badges Expectations

1. What do you look for when choosing a badge to complete?
2. What kind of guiding badge activities do you prefer?
3. Can you describe these activities?
4. Do you feel that a badge with the aim of promoting STEM Careers amongst women is important? Why?
5. What would you expect from a STEM badge with the aim of promoting STEM Careers?

*this information will not be disclosed in any part of the dissertation.

<u>Skema tal-ewwel *Focus Group*</u>

Bonġu / Il-waranofsinhar it-tajjeb,

Jiena Chiara Attard u bħalissa qiegħda nistudja għal *Masters Degree* fl-Edukazzjoni tax-Xjenza. Bħala parti mill-istudji tiegħi qiegħda nagħmel teżi fuq il-promozzjoni ta' karrieri fix-xjenza, it-teknoloġija, l-inġinerija u l-matematika mal-assoċjazzjoni tal-*Malta Girl Guides.*

L-għan ta' dan l-istudju hu li noħloq u nimplimenta kurrikulu ta' *badge* fuq ix-xjenza, it-teknoloġija, l-inġinerija u l-matematika għal *Ranger Guides* Maltin. L-għan ta' dan il-*Focus Group* hu li niddetermina l-ideat inizjali tagħkom fuq karrieri fix-xjenza, it-teknoloġija, l-inġinerija u l-matematika.

Filwaqt li nirringrazzjakom għall-parteċipazzjoni tagħkom, nixtieq infakkarkom illi l-parteċipazzjoni tagħkom għandha tkun waħda volontarja, u li tistgħu twaqqfu l-parteċipazzjoni tagħkom f'dan l-istudju fi kwalunkwe stadju tal-istudju.

Tajjeb li żżommu f'moħħkom ukoll illi dak kollu li jingħad jew isir huwa kunfidenzjali, u m'għandu jiġi diskuss ma' ħadd li mhux preżenti.

M'hemmx risposti li huma tajbin jew ħżiena.

<u>Sezzjoni 1: Profil</u>

Kull parteċipanta ħa jkollha ħames minuti waħedha sabiex twieġeb il-mistoqijiet li ġejjin fuq karta.

Wara dawn il-ħames minuti ħa naqsmu t-tweġibiet tagħna flimkien.

1. Isem*
2. Età
3. Interessi personali u passatempi:
4. Meta kont zgħira, l-aspirazzjoni tiegħi kienet li …
5. Xi ħaġa specjali li naf nagħmel hi …
6. Jiena sirt Girl Guide għaliex …

<u>Sezzjoni 2:</u>

L-akronomu "*STEM*" huwa l-frażi mqassra għal xjenza, teknoloġija, inġinerija u matematika.

Issa ħa nikteb dawn is-suġġetti fin-nofs tal-kartonċina ta' quddiemna.

Kif iġegħluk tħossok dawn is-suġġetti?

Ikteb l-emozzjonijiet tiegħek fuq dawn is-suġġetti fuq l-*isticky note*. Ħa naqsmu dak li ħa tiktbu flimkien.

1. Xi jġiegħlek tħossok hekk fuq dawn is-suġġetti?
2. Tixtieq taqsam l-esperjenzi tiegħek ta' dawn is-suġġetti?

Sezzjoni 3:

Aħdmu flimkien sabiex toħolqu lista ta' karrieri fix-xjenza, it-teknoloġija, l-inġinerija u l-matematika.

1. Hemm xi karrieri minn dawk li niżżiltu fil-lista li huma ta' interess għalikom, jew li tikkunsidraw bħala l-karriera futura tagħkom?
2. Liema minn dawn il-karrieri tikkunsidraw għall-karriera futura tagħkom?
3. Għaliex xi karrieri jidhru iktar attraenti minn oħrajn?
4. Għaliex xi karrieri jidhru inqas attraenti minn oħrajn?
5. X'jimmotivakom tagħżlu waħda mill-karrieri msemmija?
6. Xi jwaqqafkom milli tagħżlu waħda mill-karrieri msemmija?

Sezzjoni 4: Realtà jew Qlajja; Diskussjoni

Taħseb illi s-sentenzi li ġejjin huma realtà jew qlajja? Spjega għal kull sentenza.

1. Ħafna bniet huma inqas interessati fix-xjenza, it-teknoloġija, l-inġinerija u l-matematika mis-subien.
2. Il-preġudizzju kontra l-bniet fix-xjenza hu xi ħaġa tal-passat?
3. Xejn ma nistgħu nagħmlu biex ninteressaw 'il-bniet iktar fix-xjenza.
4. In-nisa jitwieldu fi żvantaġġ meta jiġu għas-suġġetti tax-xjenza, it-teknoloġija, l-inġinerija u l-matematika. Moħħhom huwa iktar addattat għall-arti u l-lingwi.
5. Ma hemmx ħafna opportunitajiet għan-nisa sabiex jidħlu f'karrieri marbuta max-xjenza, it-teknoloġija, l-inġinerija u l-matematika.
6. In-nisa fix-xjenza, it-teknoloġija, l-inġinerija u l-matematika qatt ma jistgħu jkunu ta' suċċess daqs l-irġiel.

Sezzjoni 5:

6. Fuq liema kriterji tagħżel *badge*?

7. X'tip ta' attivitajiet tippreferi f'*Guiding Badge*?

8. Tista' tiddiskrivi dawn l-attivitajiet?

9. X'tistenna minn *badge* fuq karrieri fix-xjenza, it-teknoloġija, l-inġinerija u l-matematika?

Appendix 5: Focus Group 2 Schedule

Focus Group 2 Schedule

Good morning/afternoon,

I would like to thank you for attending for the last focus group of this research study. The aim of this focus group is for you to evaluate the badge programme and provide suggestions for improvement.

Before proceeding with the focus group interview, I would like to remind you that participation in this study is voluntary and that you can withdraw from this study at any point. You may also refrain from answering any questions without providing a reason and without any prejudice.

May I also remind you that anything that is said or done during this focus group interview is confidential and is not to be shared with anyone who is not present.

There are no correct or incorrect answers.

Learning Outcomes

Each participant gets four post it notes.

Write

1. Something that you learnt.
2. Something that you would like to get to know more about.
3. A skill that you gained.
4. Something that made you reflect.

Stick these post its on the wall in four separate columns.

Explain to your mates what you have written.

Additional Questions:

a. What do you mean when you said …?
b. What made you gain interest in …..?
c. Can you give me an example of….?

Interviews with STEM Professionals

Rate the following statements by ticking the appropriate response. After you answer you questions individually we will discuss your answers.

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The Interviews with the STEM Professionals were useful in forming my ideas about STEM Careers.					
2. I feel that through the interviews with the STEM Professionals I learned something new.					
3. I feel that through these interviews my view of STEM careers has changed.					
4. I feel that the STEM professionals encouraged us to pursue STEM Careers.					
5. I feel that the STEM professionals were presenting a realistic picture of what STEM careers entail.					
6. Listening to other women's experiences					

in STEM will encourage me to pursue STEM careers.					

Further questions to support participants when discussing their replies:

1. Do you think the interviews with the STEM Professionals were beneficial? In what ways?
2. Do you feel that you prepared well for these interviews?
3. Do you feel that you have questions that remained unanswered during the interview? What questions?
4. Do you feel that these interviews changed your perspective on STEM Careers and females in STEM Careers?

Badge Activity Timeline

As a group create a timeline of the different stages of the badge. Go into as much detail as can be.

Color each activity within your timeline in green, yellow, orange and red, depending how effective you feel they were; with green being the most effective and the red being the least effective.

Explain the timeline you have created. For each section explain how you felt during that section, name something that you liked and what you would change.

Brainstorming

Which aspects of the badge will help you make a better and wiser decisions about your future careers?

Which aspects of the badge did nothing to help you make a better and wiser decision about your future career?

Write each aspect on the whiteboard.

Conclusion – Card Charades

On the set of cards in front of us, there are parts of sentences that I would like you to complete. Each participant is to draw a card from the pile and one by one you will complete the sentence written on that card. The game will go on until all cards are read.

Sentences.

1. The easiest thing for me was…..
2. The hardest thing for me…..
3. If I had a camera…..
4. If I had to do it again I would…..
5. I felt motivated when…..
6. What surprised me was….
7. I'm really pleased I …..
8. I appreciated …..
9. I felt unmotivated when …..
10. I feel I contributed in …..
11. I wish we had….
12. I' d like to say that ……

<u>Skema tat-tieni *Focus Group*</u>

Bonġu / Il-waranofsinhar it-tajjeb,

Nixtieq nirringrazzjakom talli attendejtu għall-aħħar *focus group* ta' din ir-riċerka. L-għan ta dan il-*focus group* hu li intom tevalwaw il-programm tal-*badge* u tipprovdu suġġerimenti għal titjib.

Qabel ma nipproċedu bil-*focus group* nixtieq infakkarkom illi l-parteċipazzjoni tagħkom f'dan l-istudju hi volontarja, u li intom tistgħu twaqqfu l-parteċipazzjoni tagħkom f'dan l-istudju fi kwalunkwe stadju.

Tajjeb li żżommu f'moħħkom ukoll illi dak kollu li jingħad jew isir huwa kunfidenzjali u m'għandu jiġi diskuss ma' ħadd li mhux preżenti.

M'hemmx risposti li huma tajbin jew ħżiena.

<u>Riżultati tat-tagħlim</u>

Kull parteċipanta ħa tingħata erba' *Post it notes.*

Ikteb:

1. Xi ħaġa li tgħallimt.
2. Xi ħaġa li tixtieq tkun taf iktar dwarha.
3. Ħila li ksibt.
4. Xi ħaga li gegħlitek tirrifletti.

Waħħal dawn il-*post it notes* mal-ħajt f'erba' kolonni differenti.

Spjega lil sħabek dak illi ktibt.

<u>Mistoqsijiet addizzjonali:</u>

a. X'ridt tfisser meta għedt …?
b. X'ġiegħlek trabbi interess f'…?
c. Tista' tagħtini eżempju ta'…?

Kronoloġija tal-attivitajiet

Bħala grupp oħolqu kronoloġija tal-istadji differenti tal-*badge*. Idħlu kemm jista'
jkun fid-dettall.

Agħtu l-kulur lil kull attività fil-kronoloġija tagħkom bil-kuluri aħdar, isfar,
oranġjo u aħmar, skont kemm l-attività kienet effettiva; bl-aħdar ikunu dawk li
kienu l-iktar effettivi u bl-aħmar l-inqas effettivi.

Spjegaw il-kronoloġija li ħloqtu. Għal kull sezzjoni spjegaw kif ħassejtukom u
semmu xi ħaġa li għoġbitkom u xi ħaġa li kontu tibdlu.

Brainstorming

Liema Aspetti tal-*badge* ħa jgħinukom tieħdu deċiżjoni aħjar u iktar għaqlija dwar
il-karriera futura tagħkom?

Liema aspetti tal-*badge* ma għenukomx tieħdu deċiżjoni aħjar u iktar għaqlija
dwar il-karriera futura tagħkom?

Iktbu kull aspett fuq il-*whiteboard*.

Konklużjoni – *Card Charades*

Fuq is-sett ta' karti quddiemna nsibu partijiet ta' sentenza li nixtieqkom tkomplu.
Kull parteċipanta ħa tieħu karta mill-mazz u waħda waħda ħa tkomplu s-sentenzi
li għandkom miktubin fuq il-karti. Il-logħba tispiċċa meta jispiċċaw il-karti kollha.

Sentenzi

1. L-iktar ħaġa faċli għalija kienet …
2. L-iktar ħaġa diffiċli għalija kienet …
3. Kieku kelli kamera …
4. Kieku kelli nerġa' nagħmilha, kont …
5. Ħassejtni motivata meta …
6. Kont sorpriża b' …
7. Ninsab kuntenta li jien …

8. Apprezzajt li ...

9. Ħassejtni dimotivata meta ...

10. Ħassejt li kkontribwixxejt f' ...

11. Xtaqt li kellna ...

12. Nixtieq ngħid li ...

Appendix 6: Workshop Schedule

STEM Badge Workshop Programme

Date: 16th June 2018

Time: 8.30am – 4.00 pm

Venue: Malta Girl Guides IHQ, Triq il-Kapuccini, Floriana.

Aim of Badge:	Recognize the need for more females in STEM Careers.	
Objectives of Badge:	The participants will be able to: 1. Identify different STEM Careers. 2. Engage in various STEM related tasks. 3. Use STEM skills to carry out tasks. 4. Relate STEM skills to different STEM Careers and other Careers.	
Time	**Description**	**Resources**
8.30am - 8.40am	**Welcome by Researcher** *Good Morning!* *I would like to thank you for attending for this day workshop. The aim of this workshop is for you to experience the badge curriculum programme so that eventually you will be able to provide suggestions for improvement. Through this workshop you will also be getting a better insight of different STEM career paths that you might be interested in pursuing in the future.* *Before proceeding with the workshop, I would like to remind you that participation in this study is voluntary and that you can withdraw from this study at any point. You may also refrain from*	

	answering any questions without providing a reason and without any prejudice. *May I also remind you that anything that is said or done during this workshop is confidential and is not to be shared with anyone who is not present.* **Give a brief overview of the programme.**	
8.40am – 9.00 am	**2 Ice breaker Challenges** **Ice breaker 1 – 3D Puzzle (10 minutes)** Present participants with the 3D Puzzle pictured below. The participants are to dismantle the puzzle and build it up again. **Ice breaker 2 – Helium Stick (10 minutes)** 1. Line up participants in two rows which face each other. Introduce the Helium Stick- a long, thin, lightweight rod. 2. Ask participants to point their index fingers and hold their arms out. 3. Lay the Helium Stick down on their fingers. Get the group to adjust their finger heights until the Helium Stick is horizontal and everyone's index fingers are touching the stick. 4. Explain that the challenge is to lower the Helium Stick to the ground. 5. Each person's fingers must be in contact with the Helium Stick at all times. Pinching or grabbing the pole in not allowed - it must rest on top of fingers.	

	If anyone's finger is caught not touching the Helium Stick, the task will be restarted.	
9.00am – 9.15am	Reflective Journal Task 1 and 2 Task 1: What are your expectations for today's workshop? Task 2: What questions do you have about STEM Careers that you would like to answer through this workshop?	Reflective Journals 1&2. Pencils.
9.15am – 9.45am	Planning the Interviews. *Today you will get to meet different women who have pursued STEM Careers. Create a list of career related questions that you would like to ask these women who have STEM careers. The women you will get to meet work in 4 different areas of STEM:* • *Engineering* • *Health* • *ICT* • *Research and Innovation* *Read out their profiles to help you develop interesting questions for each and every scientist.*	Scientist Profiles. Rough Paper Pencils.
9.45am – 10.05am	**Interview with Engineer** Everyone sits in a circle.	Questions to ask to Engineer.

	Introduce Engineer to Rangers. Allow Rangers to ask questions and discuss.	
10.05am – 10.50am	**Engineering Activity: Build a Geodesic Dome** *A Dome is an Architectural Structure that has the shape of a half sphere, normally forming the roof of a building. A dome exerts forces all around it's perimeter, without the need to use any supporting columns. One of the most modern dome structures is the Geodesic Dome which was invented by Buckminster Fuller in the 1940s. The Geodesic Dome is created by a series of triangles that make the dome withstand very heavy loads.* *Design and build a Geodesic dome model which is not smaller than 50 cm in diameter. Look at pictures in the resource section to look at some examples of Geodesic Domes. You can use a variety of materials ranging from popsicle sticks, newspaper, straws and toothpicks, glue guns, tape and glue tac.*	Pictures of Geodesic Dome Popsicle Sticks Glue Gun Newspaper Straws Toothpicks Tape Glue Tac. Measuring Tape A3 papers
10.50am – 11.00am	**Reflective Journal Task 3** 1. Which of the following STEM Skills did you make use of during this activity? (Tick where appropriate) ○ Problem Solving ○ Creativity and Innovation ○ Interpreting Data	Reflective Journal 3 Pencil

	o Discussing
	o Flexibility
	o Ask Questions
	Others (Please Specify) _____
	
	2. What where your strengths in this activity?
	3. What where your weaknesses in this activity?
	4. What challenges did you encounter?
	5. This activity made me realize that …..
	
	Complete one of the following sentences for each interview.
	
	   1. A lesson I learned during this interview is:
	   2. What impressed me during this interview is
	   3. A question that came to mind during the interview was:
	   4. Something I will remember about this interview is:	

11.00am – 11.20am	**Interview with Health Care Professional** Everyone sits in a circle. Introduce Health Care Professional to Rangers. Allow Rangers to ask questions and discuss.	Questions to ask to Health Care professional

11.20am – 12.10pm	**Health Activity: Bandaging and other Skills.**
	
	Bandaging is a skill used by several health care professionals for several purposes:
	   1. To create pressure over an area.
	   2. To immobilize a part of the body.
		Bandages. Triangular Slings.

	3. To support and protect wound from contamination. *4. To reduce bleeding.* *5. To secure a dressing.* *Learn when to use and practice how to do* *the following bandaging techniques:* • *Figure of Eight Bandage for sprained ankle.* • *Figure of Eight Bandage for sprained wrist.* • *Circular and Reverse Spiral Bandage.* • *Recurrent Head Wrap.* • *Arm Sling.* • *Elevation Sling.*	
12.10pm – 12.30pm	**Reflective Journal Task 4** 1. Which of the following STEM Skills did you make use of during this activity? (Tick where appropriate) o Problem Solving o Creativity and Innovation o Interpreting Data o Discussing o Flexibility o Ask Questions Others (Please Specify) _____ 2. What where your strengths in this activity? 3. What where your weaknesses in this activity? 4. What challenges did you encounter? 5. This activity made me realize that ….. **Complete one of the following** **sentences for each interview.** 1. A lesson I learned during this interview is: 2. What impressed me during this interview is: 3. A question that came to mind during the interview was:	Reflective Journal task 4 Pencil

	4. Something I will remember about this interview is:	
12.30pm – 01.15pm	**Break**	
01.15pm – 01.35pm	**Interview with ICT Specialist** Everyone sits in a circle. Introduce ICT Specialist to Rangers. Allow Rangers to ask questions and discuss.	Questions to ask to ICT Specialist
01.35pm – 02.20pm	**ICT Activity: Coding Geometric Designs** *Coding (also called programming or developing) is telling a computer, app, phone or website what you want it to do. In this case, you will use coding to draw a geometric shape.* *Use the coding sequence in the Resource Section to draw a Geometric Shape on an A3 sheet. Take 1 step to be 1mm on your paper. By the end of the task ask your Guider to show you the geometric shape you should have created and compare to your creation.* Allow time for the Rangers to draw the shape using coding. *Now that you have experienced creating geometric shapes using codes, create your*	Coding Sequence from resource Pack. Coding Commands from resource pack. A3 sheets of paper. Ruler. Protractor. Pencil.

	own shape and write down the code so that other people could draw the same geometric shape. You may find the different commands in your resource pack.	
02.20pm – 02.30pm	**Reflective Journal 5**	Reflective Journal 5
		Pencils.
	1. Which of the following STEM Skills did you make use of during this activity? (Tick where appropriate)	
	o Problem Solving	
	o Creativity and Innovation	
	o Interpreting Data	
	o Discussing	
	o Flexibility	
	o Ask Questions	
	Others (Please Specify) _____	
	2. What where your strengths in this activity?	
	3. What where your weaknesses in this activity?	
	4. What challenges did you encounter?	
	5. This activity made me realize that	
	Complete one of the following sentences for each interview.	
	1. A lesson I learned during this interview is:	
	2. What impressed me during this interview is	
	3. A question that came to mind during the interview was:	
	4. Something I will remember about this interview is:	
02.30pm – 02.50pm	**Interview with Scientist.**	Questions to ask to Scientist.
	Everyone sits in a circle.	

	Introduce Scientist to Rangers. Allow Rangers to ask questions and discuss.	
02.50pm – 03.30pm	**Research and Innovation Activity – Measure the Height of a Building.** *The job of a scientist is to answer scientific questions. To do so, scientists have to device methods to help them answer their questions.* *Your task is to explore ways to measure an unreachable height in a building. The only materials that are provided are a 2-meter measuring tape and a mirror. By the end of your task, ask your Guider for the correct measurement and solution.*	Rough Paper. Pencil Mirror 2 meter measuring tape.
03.30pm – 03.50pm	**Reflective Journal Tasks 6** 1. Which of the following STEM Skills did you make use of during this activity? (Tick where appropriate) o Problem Solving o Creativity and Innovation o Interpreting Data o Discussing o Flexibility o Ask Questions Others (Please Specify) _____ 2. What where your strengths in this activity? 3. What where your weaknesses in this activity? 4. What challenges did you encounter? 5. This activity made me realize that	Reflective Journal tasks 6&7. Pencils.

	Complete one of the following sentences for each interview.
	
	1. A lesson I learned during this interview is:
	2. What impressed me during this interview is
	3. A question that came to mind during the interview was:
	4. Something I will remember about this interview is:
	
	Reflective Journal Task 7
	
	10 Minute Day Overview
	
	Today I,
	   o Felt:
	   o Enjoyed:
	   o Appreciated:
	   o Worked on:
	   o Thought about:
	   o Decided to:	

03.50pm – 04.00pm	**Explain that participants who wish to do so can work out Reflective Task 8 and submit it during the second focus group interview.** **Thank You and Dismissal**	

Appendix 7: Letter to the Chief Commissioner

Letter for Chief Commisioner.

Dear Chief Commissioner,

I am currently reading for a Master's Degree in Science Education within the University of Malta and as part of my studies, I am required to carry out a dissertation. As a member of the Malta Girl Guides, who has close to heart the values of Guiding, I would like to carry out my dissertation within this Association. My Dissertation Supervisor is Prof. Deborah Chetcuti.

The purpose of this study is to create and implement a STEM badge curriculum programme for Maltese Ranger Guides (aged 13-15). The Ranger Guides who will be asked to participate in the study, will have just sat for the SEC examinations and about to make decisions related to their future careers. The STEM badge curriculum will provide the Ranger Guides with the opportunity to explore the various possibilities of a career in the STEM areas.   This study also has the objective to evaluate the implemented badge curriculum programme and provide suggestions for improvement. The ultimate aim is to develop an initiative within the Maltese Girl Guides Association that will help girls make better informed decisions and choices; and be encouraged to embark in STEM related careers.

I am writing this letter to ask for permission to carry out this research project within the Association which you are responsible for. The Malta Girl Guides will be used as a context In the case study, I will be designing and delivering a STEM programme to a group of 6-8 Ranger Guides (aged between 13-15) within the Association. The research study will compromise of four main stages; (1) an initial focus group to determine their initial ideas about STEM Careers and to help in the development of a badge curriculum according to their needs, (2) the development of a badge curriculum with the aim of encouraging participants into STEM Careers, (3) the implementation of the programme and (4) the evaluation phase which will also take the form of a focus group.

The participants in this research study are still minors and this means that information letters and consent forms will be issued and collected both from the participants and their parents.. Full information about the research study and the

implications of participating in this research will be provided to all contributing parties before seeking their permission. Furthermore, all participants within the study are to be able to opt in or out of the research project based on the information provided. Confidentiality of all participating members will be ensured and the ethical guidelines issued by the University Research Ethics Committee of the University of Malta will be followed throughout the course of the research. Also, in order to ensure that all ethical processes are adhered to during the research, I will ask a critical friend to accompany when implementing the badge curriculum.

The results of this dissertation will be shared with the association once the course I am following is completed. Should you have any queries or would like to know more about this research projects, do not hesitate to contact me using the information found below.

Thank you for your attention and consideration.

Best Regards,

_____

Chiara Attard

Contact Details:

Researcher: Ms. Chiara Attard

Supervisor: Prof. Deborah Chetcuti.

Appendix 8: Letter of Information and Assent form for

Participants.

Letter of Information for Participant

Dear Ranger Guide,

I am currently reading for a Master's Degree in Science Education within the University of Malta and as part of my studies, I am carrying out a dissertation titled "Unlocking Imaginary Boundaries: Promoting STEM careers in the Girl Guides' Association". My dissertation supervisor is Prof. Deborah Chetcuti.

In this study I want to create and carry out a STEM badge curriculum programme for Maltese Ranger Guides (aged 13-15). The STEM badge curriculum will provide Ranger Guides with the opportunity to explore the various possibilities of a career in Science, Technology, Engineering and Mathamatics. In this study I will also be evaluating the implemented badge curriculum programme and provide suggestions for improvement. The main aim is to develop an initiative which will help girls make better informed decisions and choices; and be encouraged to embark in STEM related careers.

I would like to ask for your participation in this study. You are being asked to participate because you are a Ranger Guide who is about to sit for your SEC examinations and hence you are about to make decisions related to your future career choices.

Should you agree to participate in this research project, you will be asked to participate in two focus group interviews together with other Ranger Guides, one at the start and another at the end of the research project. You will also have the opportunity to participate in a set of activities as part of a STEM badge and a reflective journal. This badge will be delivered by myself as the researcher, with the help of different female scientists. The sessions will be carried out at the Island Head Quarters of the Malta Girl Guides on 3 different Saturdays. One of the Saturdays will be a long day workshop, while the focus group interviews will take about one hour.

The focus group interviews will be audio recorded and reflective journals will be used to extract data. Both forms of documentation will be stored safely throughout the course of the research study and will be destroyed once the

dissertation is complete. Names will not be disclosed in any part of the dissertation, however, anonymous quotations may be used in the dissertation with your assent and your guardian's consent.

Your participation is not obligatory and you may choose to withdraw from the research at any point in the research.

I would like to assure you that the ethical guidelines issued by the University Research Ethics Committee of the University of Malta will be followed throughout the course of the research. Should you have any queries or would like to know more about this research projects, do not hesitate to contact me using the contact details found below.

If you decide to participate in this research project, kindly carefully read and fill in the attached consent form attached below. Sign the document at the bottom to show your understanding of your role in this study.

Thank you for your attention and consideration.

Best Regards,

_____

Chiara Attard

Contact Details:

Researcher: Ms. Chiara Attard

Supervisor: Prof. Deborah Chetcuti.

Assent Form for Participants

I have read and understood the information letter presented to me by the researcher, Chiara Attard about her research "Unlocking Imaginary Boundaries: Promoting STEM careers in the Girl Guides' Association." which she is conducting as part of her Masters of Education in Science Education. Based on this information and the answers of any questions I asked, I agree to participate in this research project. I declare that:

- I am aware that focus group interviews will be audio recorded to ensure that the responses are recorded accurately.

- I am also aware that excerpts from my interview and my reflective journals will be used anonymously within the dissertation, with my approval.

- I was informed that I may withdraw my participation at any point during the research process without having to provide any reason and without penalty or prejudice.

- I am agreeing to participate in this research without being forced or intimidated to participate and out of my free will.

- I am aware that I may refuse to answer any questions within the focus group interviews without having to justify me decision and without any prejudice.

- I am aware that what is said during the focus group interviews is confidential and that I should not disclose any information to anyone who is not present.

Name of Participant _____

Signature of Participant   Signature of Researchers   Signature of Supervisor

_____   _____   _____

Ittra ta' Informazzjoni lill-Parteċipanta

Għażiża Ranger Guide,

Jiena ninsab nistudja l-Masters degree fl-Edukazzjoni tax-Xjenza fl-Università ta'
Malta, u bħala parti mill-istudji tiegħi qed nagħmel teżi bit-titlu "Unlocking
Imaginary Boundaries: Promoting STEM careers in the Girl Guides' Association".
Is-superviżur tat-teżi tiegħi hija Profs. Deborah Chetcuti.

F'dan l-istudju se nkun qiegħda noħloq u nimplimenta kurrikulu ta' programm
marbut mas-suġġetti STEM għar-Ranger Guides Maltin (ta' bejn it-13 u l-15-il
sena). Dan il-kurrikulu tal-*badge* se jipprovdi lir-Ranger Guides b'opportunità li
jesploraw il-possibilitajiet varji ta' karriera fix-xjenza, fit-teknoloġija, fl-inġinerija
u fil-matematika. Dan l-istudju għandu wkoll l-għan li jevalwa l-kurrikulu tal-
badge implimentata, u jipprovdi suġġerimenti sabiex jitjieb. L-għan ewlieni hu li
tiġi żviluppata inizjattiva sabiex tgħin tfajliet jieħdu deċiżjonijiet u jagħmlu
għażliet iktar għaqlin; u biex ikunu mħeġġa jagħżlu karrieri relatati max-xjenza,
mat-teknoloġija, mal-inġinerija u mal-matematika.

Jiena nixtieq nistiednek sabiex tipparteċipa f'dan l-istudju. Inti qed tintalab
tipparteċipa għaliex fi ftit tax-xhur oħra ħa tpoġġi għall-eżamijiet taċ-ĊES, u
għalhekk ħa tkun qed tieħu deċiżjonijiet relatati mal-karriera futura tiegħek.

Jekk inti taqbel li tipparteċipa f'dan il-proġett, inti se tintalab tipparteċipa f'żewġ
focus groups flimkien ma' Ranger Guides oħra; wieħed li se jsir fil-bidu u l-ieħor
li se jsir fl-aħħar tal-proġett tar-riċerka. Inti tiġi mitluba wkoll tieħu sehem f'sett
ta' attivitajiet kif ukoll fi djarju riflessiv bħala parti mill-*badge* relatata max-
xjenza, mat-teknoloġija, mal-inġinerija u mal-matematika. Din il-*badge* ħa tiġi
mwassla minni bħala riċerkatriċi, flimkien ma' xjentisti li ħa jgħinu fl-
implimentazzjoni tal-*badge*. Is-sessjonijiet ħa jsijru fil-kwartieri tal-Malta Girl

Guides matul tliet Sibtijiet differenti. F'wieħed mis-Sibtijiet il-*workshop* ħa jtul ġurnata sħiħa, filwaqt illi l-*focus groups* ħa jieħdu madwar siegħa l-wieħed.

Il-*focus groups* ħa jiġu rrekordjati permezz ta' *audio recorder* u l-ġurnali riflessivi ħa jintużaw biex minnhom tittieħed l-informazzjoni. Iż-żewġ metodi ta' dokumentazzjoni ħa jinżammu b'mod sikur tul iż-żmien kollu tar-riċerka, u ħa jinqerdu hekk kif it-teżi titlesta. Fl-ebda parti tat-teżi mhuma se jiġu żvelati ismijiet, bil-kwotazzjonijiet anonimi possibilment jintużaw fit-teżi bil-kunsens tiegħek u tal-ġenituri tiegħek.

Il-parteċipazzjoni tiegħek mhix obbligatorja u inti tista' tagħżel li tieqaf milli tipparteċipa fi kwalunkwe stadju tar-riċerka.

Jiena nassigurak li matul il-proċess kollu se nkun qed nimxi mal-gwidi etiċi maħruġa mill-Kumitat tal-Etika tar-Riċerka tal-Università ta' Malta. F'każ li għandek xi mistoqsijiet jew tixtieq tkun taf iktar fuq dan il-proġett, tiddejjaqx tikkuntattjani. Id-dettalji jinsabu hawn taħt.

Jekk tiddeċiedi li tipparteċipa f'dan il-proġett ta' riċerka, inti mitluba taqra b'mod kawtiel u timla l-formola ta' kunsens mehmuża hawn taħt. Iffirma d-dokument sabiex turi li tifhem is-sehem tiegħek fl-istudju.

Grazzi tal-attenzjoni u l-konsiderazzjoni tiegħek.

Saħħiet,

_____

Chiara Attard

Dettalji għall-kuntatt:

Riċerkatriċi: Is-Sa Chiara Attard

Numru tal-Mobile: 79287984

Indirizz elettroniku: chiara.attard.11@um.edu.mt

Superviżur: Profs. Deborah Chetcuti.

Indirizz elettroniku: deborah.chetcuti@um.edu.mt

Formola ta' Kunsens għall-Parteċipanta

Jien qrajt u fhimt l-ittra ta' informazzjoni ppreżentata lili mir-riċerkatriċi Chiara Attard dwar ir-riċerka tagħha *Unlocking Imaginary Bounderies: Promoting STEM Careers in the Girl Guides Association*, li hi qed tagħmel bħala parti mill-Masters degree. Niddikjara li:

- Jiena naqbel li nipparteċipa f'din ir-riċerka abbażi ta' din l-informazzjoni.

- Jiena konxja li l-*focus group interviews* ħa jiġu rrekordjati permezz ta' *audio recorder* sabiex ikun aċċertat li r-risposti jkunu korretti.

- Jiena konxja illi biċċiet mill-intervista u mill-ġurnali riflessivi se jintużaw b'mod anonimu fit-teżi bl-approvazzjoni tiegħi.

- Jiena infurmata li nista' nwaqqaf il-parteċipazzjoni tiegħi fi kwalunkwe stadju tal-proċess tar-riċerka mingħajr ma nipprovdi raġuni u mingħajr konsegwenzi u preġudizzju.

- Jiena naqbel li ħa nipparteċipa f'din ir-riċerka mingħajr ma ġejt sfurzata jew intimidata.

- Jiena konxja li nista' nirrifjuta li nwieġeb mistoqsijiet waqt il-*focus group* mingħajr ma niġġustifika d-deċiżjoni tiegħi u mingħajr preġudizzju.

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- Jiena konxja li dak li jingħad waqt il-*focus group* hu kunfidenzjali u li ma nista'
  nipprovdi l-ebda informazzjoni lil persuni mhux preżenti.

Isem il-Parteċipanta _____

Firma tal-Parteċipanta   Firma tar-riċerkatriċi   Firma tas-superviżur

_____   _____   _____

Appendix 9: Information Letter and Consent Form for

Parents.

Letter of Information for Parents/Guardians.

Dear Parent/ Guardian,

I am currently reading for a Masters Degree in Science Education within the University of Malta and as part of my studies, I am required to carry out a dissertation. My dissertation will be entitled " Unlocking Imaginary Boundaries: Promoting STEM careers in the Girl Guides' Association." My dissertation supervisor is Prof. Deborah Chetcuti.

The purpose of this study is to create and implement a STEM badge curriculum programme for Maltese Ranger Guides (aged 13-15). The STEM badge curriculum will provide Ranger Guides with the opportunity to explore the various possibilities of a career in the STEM areas. This study also has the objective to evaluate the implemented badge curriculum programme and provide suggestions for improvement. The ultimate aim is to develop an initiative within the Maltese Girl Guides Association that will help girls make better informed decisions and choices; and be encouraged to embark in STEM related careers.

I would like to inquire whether it is possible to ask for your approval of your daughter's participation in this study. She is being asked to participate because she is a Ranger Guide who is about to sit for her SEC examinations and hence she is about to make decisions related to her future career choices.

Should you agree to allow your daughter participate in this research project, she will participate in two focus group interviews together with other Ranger Guides, one at the start and another at the end of the research project. She will also carry out a set of activities and a reflective journal as part of a STEM badge which will be delivered by myself as the researcher, with the help of scientists who will help in the delivery of the badges. The sessions will be carried out at the Island Head Quarters of the Malta Girl Guides on 3 different Saturdays. One of the Saturdays will be a long day workshop, while the focus group interviews will take about one hour

The focus group interviews will be audio recorded and reflective journals will be used to extract data. Both forms of documentation will be stored safely throughout the course of the research study and will be destroyed once the dissertation is complete. Names will not be disclosed in any part of the dissertation, however, anonymous quotations may be used in the dissertation with your consent and her assent.

Your daughter's participation is not obligatory and she may choose to withdraw from the research at any point in the research.

I would like to assure you that the ethical guidelines issued by the University Research Ethics Committee of the University of Malta will be followed throughout the course of the research. Should you have any queries or would like to know more about this research project, do not hesitate to contact me using the contact details found below.

If you decide to allow your daughter to participate in this research project, kindly carefully read and fill in the attached consent form attached below. Sign the document at the bottom to show your understanding of her role in this study.

Thank you for your attention and consideration.

Best Regards,

_____

Chiara Attard

Contact Details:

Researcher: Ms. Chiara Attard

Supervisor: Prof. Deborah Chetcuti.

Consent Form for Parents/Guardian

I have read and understood the information letter presented to me by the researcher, Chiara Attard about her research "Unlocking Imaginary Boundaries: Promoting STEM careers in the Girl Guides' Association." which she is conducting as part of her Masters of Education in Science Education. Based on this information and the answers of any questions I asked, I agree to participate in this research project. I declare that:

- I am aware that focus group interviews will be audio recorded to ensure that the responses are recorded accurately.

- I am also aware that excerpts from my interview and my reflective journals will be used anonymously within the dissertation, with my approval.

- I was informed that my daughter may withdraw her participation at any point during the research process without having to provide any reason and without penalty or prejudice.

- I am agreeing to allow my daughter to participate in this research without being forced or intimidated to allow her to participate and out of my free will.

- I am aware that she may refuse to answer any questions within the focus group interviews without having to justify her decision and without any prejudice.

- I am aware that what is said during the focus group interviews is confidential and that my daughter should not disclose any information to anyone who is not present.

Name of Participant   _____

Name of Parent/Guardian _____

Signature of Parent/Guardian   Signature of Researchers   Signature of Supervisor

_____   _____   _____

Ittra ta' Informazzjoni għall-Ġenituri

Għażiż Ġenitur,

Jiena ninsab nistudja għal Masters degree fl-edukazzjoni tax-xjenza ġewwa l-Università ta' Malta, u bħala parti mill-istudji tiegħi meħtieġa nagħmel teżi. It-teżi tiegħi jisimha "Unlocking Imaginary Boundaries: Promoting STEM careers in the Girl Guides' Association." Is-superviżur tat-teżi tiegħi hija Profs. Deborah Chetcuti.

L-għan ta dan l-istudju hu li jinħoloq u jiġi implimentat kurrikulu ta' programm marbut mas-suġġetti STEM għar-Ranger Guides Maltin (ta' bejn it-13 u l-15-il sena). Dan il-kurrikulu tal-*badge* ħa jipprovdi lir-Ranger Guides b'opportunità li jesploraw il-possibilitajiet varji ta' karriera fix-xjenza, fit-teknoloġija, fl-inġinerija u fil-matematika. Dan l-istudju għandu wkoll l-għan li jevalwa l-kurrikulu tal-*badge* implimentata u jipprovdi suġġerimenti għal titjib. L-għan ewlieni hu li tiġi żviluppata inizjattiva fi ħdan il-Malta Girl Guides sabiex tgħin tfajliet jieħdu deċiżjonijiet u jagħmlu għażliet iktar infurmati; u sabiex b'hekk ikunu mħeġġin jagħżlu karrieri relatati max-xjenza, mat-teknoloġija, mal-inġinerija u mal-matematika.

Jiena nixtieq nistaqsi għall-approvazzjoni tiegħek sabiex it-tifla tiegħek tipparteċipa f'dan l-istudju. Hi qiegħda tintalab tipparteċipa għaliex hi Ranger Guide li fi ftit tax-xhur oħra se tkun qiegħda tpoġġi għall-eżamijiet taċ-Ċes, u għalhekk hija mistennija tieħu deċizjonijiet relatati mal-karriera futura tagħha.

Jekk inti taqbel mal-parteċipazzjoni ta' bintek f'dan il-progett, hi se tkun qiegħda tipparteċipa f'żewġ *Focus Group Interviews* flimkien ma' Ranger Guides oħra; wieħed fil-bidu u l-ieħor fl-aħħar tal-proġett ta' riċerka. Hi se tintalab tieħu sehem ukoll f'sett ta' attivitajiet u fi djarju riflessiv, bħala parti mill-*badge* relatata max-xjenza, mat-teknoloġija, mal-inġinerija u mal-matematika. Din il-*badge* se tiġi mwassla minni bħala riċerkatriċi, flimkien ma' xjentisti li ħa jgħinu fl-implimentazzjoni tal-*badge*. Is-sessjonijiet ħa jsiru fil-kwartieri tal-Malta Girl Guides matul tliet Sibtijiet differenti. F'wieħed mis-Sibtijiet il-*workshop* mistenni jtul ġurnata sħiħa, filwaqt illi l-*Focus Groups* se jkunu qiegħdin jieħdu madwar siegħa l-wieħed.

Il-*Focus Group Interview* ħa jiġi rrekordjat permezz ta' *audio recorder,* waqt li l-gurnali riflessivi ħa jkunu qegħdin jintużaw sabiex minnhom tittieħed l-informazzjoni. Iż-żewġ metodi ta' dokumentazzjoni ħa jiġu miżmuma b'mod sikur tul iż-żmien kollu tar-riċerka, u se jinqerdu hekk kif it-teżi tkun kompluta. L-ismijiet fl-ebda parti tat-teżi mhuma se jkunu żvelati, waqt li l-kwotazzjonijiet anonimi jistgħu jintużaw fit-teżi bil-kunsens tiegħek u ta' bintek.

Il-parteċipazzjoni tat-tifla tiegħek mhix obbligatorja u hi tista' tagħżel li tieqaf milli tipparteċipa f'kull stadju tar-riċerka.

Jiena nixtieq nassigurak li matul il-proċess kollu se nkun qiegħda nimxi mal-gwidi etiċi maħruġa mill-Kumitat tal-Etika tar-Riċerka tal-Università ta' Malta. Jekk għandek xi mistoqsijiet jew tixtieq tkun taf iktar fuq dan il-progett, tiddejjaqx tikkuntattjani.

Jekk tiddeċiedi li tippermetti lil bintek tipparteċipa f'dan il-proġett ta' riċerka, inti mitlub/a taqra b' mod kawtiel u timla l-formola ta' kunsens mehmuża hawn taħt. Iffirma d-dokument sabiex turi li tifhem is-sehem tagħha fl-istudju.

Grazzi tal-attenzjoni u l-konsiderazzjoni tiegħek.

Saħħiet,

_____

Chiara Attard

Dettalji għall-kuntatt:

Riċerkatriċi: Is-Sa Chiara Attard

Numru tal-Mobile: 79287984

Indirizz elettroniku: chiara.attard.11@um.edu.mt

Superviżur: Profs. Deborah Chetcuti.

Indirizz elettroniku: deborah.chetcuti@um.edu.mt

Formola ta' Kunsens għall-Ġenituri

Jien qrajt u fhimt l-ittra ta' informazzjoni ppreżentata lili mir-ricerkatriċi Chiara Attard dwar ir-riċerka tagħha *Unlocking Imaginary Bounderies: Promoting STEM Careers in the Girl Guides Association*, li hi qed tagħmel bħala parti mill-Masters degree. Jien nagħti l-permess lil binti tipparteċipa f'din ir-riċerka. Abbażi ta' din l-informazzjoni, jien niddikjara li:

- Jiena konxju/a li l-*focus group interviews* ħa jiġu rrekordjati permezz ta' *audio recorder* biex ikun aċċertat li r-risposti jkunu korretti.

- Jiena wkoll konxju/a li biċċiet mill-intervista u mill-ġurnali riflessivi ħa jintużaw b'mod anonimu fit-teżi bl-approvazzjoni tiegħi.

- Jiena infurmat/a li binti tista' twaqqaf il-parteċipazzjoni tagħha f'kull stadju tal-proċess tar-riċerka mingħajr ma' tagħti ġustifikazzjoni u mingħajr konzegwenzi u preġudizzju.

- Jiena naqbel li nħalli lil binti tipparteċipa f'din ir-riċerka mingħajr ma ġejt sfurzat/a jew intimidat/a.

- Jiena konxju/a li hi tista' tirrifjuta li twieġeb mistoqsijiet waqt il-*focus group interview* mingħajr ma tiġġustifika d-deċiżjoni tagħha u mingħajr preġudizzju.

- Jiena konxju/a li dak li jingħad waqt il-*focus group interview* hu kunfidenzjali u li binti ma tista' tipprovdi l-ebda informazzjoni lil persuni mhux preżenti.

Isem il-Parteċipanta _____

Isem il-ġenitur _____

Firma tal-ġenitur   Firma tar-riċerkatriċi   Firma tas-superviżur

_____   _____   _____

Appendix 10: Information Letter for Ranger Guider

Information Letter for Ranger Guiders.

Dear Ranger Guider,

I am currently reading for a Master's Degree in Science Education within the University of Malta and as part of my studies, I am required to carry out a dissertation. My dissertation will be entitled " Unlocking Imaginary Boundaries: Promoting STEM careers in the Girl Guides' Association." My Dissertation Supervisor is Prof. Deborah Chetcuti.

The purpose of this study is to create and implement a STEM badge curriculum programme for Maltese Ranger Guides (aged 13-15). The Ranger Guides who will be asked to participate in the study, will have just sat for the SEC examinations and about to make decisions related to their future careers. The STEM badge curriculum will provide the Ranger Guides with the opportunity to explore the various possibilities of a career in the STEM areas. This study also has the objective to evaluate the implemented badge curriculum programme and provide suggestions for improvement. The ultimate aim is to develop an initiative within the Maltese Girl Guides Association that will help girls make better informed decisions and choices; and be encouraged to embark in STEM related careers.

I am writing this letter to ask for permission to carry out this research project within the unit which you are responsible for. This research project is being conducted with the permission of the Chief Commisioner. The Malta Girl Guides will be used as a context in the case study. I will be designing and delivering a STEM programme to a group of 6-8 Ranger Guides (aged between 13-15) within the Association. The research study will compromise of four main stages; (1) an initial focus group to determine their initial ideas about STEM Careers and to help in the development of a badge curriculum according to their needs, (2) the development of a badge curriculum with the aim of encouraging participants into STEM Careers, (3) the implementation of the programme and (4) the evaluation phase which will also take the form of a focus group.

The participants in this research study are still minors and this means that information letters and consent forms will be issued and collected both from the

participants and their parents.. Full information about the research study and the implications of participating in this research will be provided to all contributing parties before seeking their permission. Furthermore, all participants within the study are to be able to opt in or out of the research project based on the information provided. Confidentiality of all participating members will be ensured and the ethical guidelines issued by the University Research Ethics Committee of the University of Malta will be followed throughout the course of the research. Also in order to ensure that all ethical processes are adhered to during the research, I will ask a critical friend to accompany when implementing the badge curriculum.

The results of this dissertation will be shared with the association once the course I am following is completed. Should you have any queries or would like to know more about this research projects, do not hesitate to contact me using the information found below.

Thank you for your attention and consideration.

Best Regards,

_____

Chiara Attard

Contact Details:

Researcher: Ms. Chiara Attard

Supervisor: Prof. Deborah Chetcuti.