Introducing Middle School children to compulsory D&T: Does It Influence Their Choice of Subject Later On? A Case Study of Maltese State Secondary Schools.

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ABSTRACT

In 2005, Design and Technology (D&T) was introduced in Maltese Secondary schools and it has been offered as an optional subject till the present situation. In 2014, D&T has been introduced as a compulsory subject during the first and second year of middle secondary schools yet there was no study indicating its' impact on student's perception linked to gender. Issues have surged where low gender representation from females were noticed within schools. Diekman, Weisgram, and Belanger (2015) argue that women in STEM fields of occupation are generally underrepresented, D&T included. Sonja Niiranen (2018), states that despite the work developed on gender equality, technology education appears to have issues related to gender. The number of women in technical careers in EU countries has not increased. This might be due to how childhood experiences set future interactions within technology education. This research investigates the relationship between students' perceptions of D&T with respect to gender during their compulsory exposure to the subject in Maltese middle schools. Questionnaires were used to build a quantitative case study for exploring the criteria used by students to decide whether to opt for or drop D&T after middle school. Results indicate that students' perception concerning D&T is generally positive for both genders and the female population has progressively increased, although it is still considered low. The students enjoy D&T in class and value it as a life enhancing subject however, they do not wish to continue studying it further than middle school. Results also indicate that exposure at school had minimal effect on students' decisions to continue their studies in D&T. The prime variables influencing and ultimately driving students' decisions seem to be sociocultural factors and future career aspirations. The research concludes that the creation of future employments for D&T graduates and the recognition of D&T courses and qualifications by employers will probably be the most influential factor governing the uptake of the study of D&T at the level of secondary school.

Keywords: Design and Technology, gender, subject choice, career aspiration

INTRODUCTION

The development of Design and Technology, D&T as a subject in Maltese Secondary schools, has been subject to debate for the past fourteen years. The subject is facing different challenges provoked by how it has been introduced in the Maltese Secondary schools (Navarro & Pulé, 2015). Trade schools in Malta, back to 1972 were labelled for disobedient and low-achieving students, such that it has contributed to a negative perception of D&T (Sultana, 1995). Purchase (2005) argues that having been introduced in 2005 as an optional subject, it is a relatively new subject within the Maltese Educational system and society. In 2012, D&T has been introduced as compulsory subject in all State Secondary Middle schools. During these two years students gain ground knowledge in Resistant materials, Electronics and Graphical Communication. At the end of the scholastic year in Form2/ Year 8 students are offered the option of choosing D&T as an optional subject through their senior secondary years.

The following research questions where central to the study:

1. Does compulsory introduction to D&T at middle school influence choice of subject later on?
2. Are there issues of gender stereotype patterns in how student base their decision regarding choosing or dropping the subject?

LITERATURE REVIEW

The European Commission of 2013 identified gender as a socio-cultural factor that shapes behaviours and attitudes (European Commission, 2013). It explains how both gender behaviour and attitudes are learned and not fixed. Gender norms are constantly in flux. Stets and Burke (2000) argue how members of society decide how male and female roles are defined. Males are associated with masculinity while females are associated with femininity. Technology education is usually perceived as a masculine discipline and it is deemed as an essential part of the upbringing and connection to masculinity from early socialization (Holth & Mellström, 2019). Salminen-Karlsson (2007) states that girls are not interested as much as boys in technology as they do not acquire the same experiences during early childhood. As they grow up, boys experience technology as their domain and usually leave girls out from technical activities and discussions. Such consequences attribute technology to masculinity and isolate girls from the subject (Salminen-Karlsson, 2007).

Van der Vleuten, Jaspers, Maas and Van der Lippe (2016) argue how gender ideology can imply on educational choices by influencing three main factors. It effects how students evaluate their competence within the subject, what occupational values are perceived as important for future occupation and their preferred current subject in school. Gender ideology shapes boys' occupational and subject preferences while contrary for girls, it shapes their competence beliefs. This shows that the more students have internalized traditional gender ideology, the more they shall make educational choices respective to masculine and feminine

norms (Van der Vleuten, Jaspers, Maas, & Van der Lippe, 2016). Stereotypes of what is masculine and feminine are pervasive throughout society and impact beliefs about ones' strength and shortcomings. Wang and Degol (2017) state that it is ideal to maximize career options for women and emphasize the ideal of hard work and talent. This would act to remove masculine stereotypes and misinformation of STEM and STEM careers.

Gender in Design and Technology

As described in the Maltese D&T curriculum of 2015, the subject is multidisciplinary with constantly changing academic disciplines (Education, 2015). Opportunities for students are given where they can cultivate creative problem-solving skills which are essential to the 21st century education (Education, 2015). Bell, Hughes, & Owen-Jackson (2013), mention how researchers (Kimbell et. al. 1991; Murphy, 2006) found how in D&T tasks, both genders have different ways how to respond and work. Boys favour tasks which are short with instant reward style whereas girls tend to take longer and prefer to develop planning while refining work. Although both have different approaches the department for education and skills in UK (2007), published data stating girls do better than boys in D&T even among subject areas widespread with boys.

Jan Harding (2002) argues how girls perform with confidence and have the capability of completing reflective tasks such as identifying a need or evaluation of the project in D&T. However, looking at the technical aspect, Harding reports that girls had low performance in making use of tools. Further, Webber and Custer (2005), identified how girls prefer designing rather than utilizing. This is consonant with the results found by the APU, showing that girls do not feel confident in making use of tools and machines (Kimbell, Stables, & Green, 1996; Kimbell R. A., 1991). Contrary to girls, in terms of boys' performance during D&T, Harding (1997) states how boys focus more on right or wrong answers. Boys are better able than girls to master capability aspects when they are engaged in development of solutions (Spendlove, 2002).

STEM, Gender Research and Influential Factors

Girls are underrepresented in science, engineering, technology and mathematics (STEM) (Gjersoe, 2018). Women not opting for STEM studies and careers provoke questions of whether these are influenced from innate talents or sociocultural factors within society. Pisa study in 2015 found little difference between gender performance across Organisation for Economic Co-operation and Development (OECD) countries. This indicates that difference in performance by gender does not stem from innate talents but rather from influential factors such as parents, teachers, policies and politics (Gurría, 2018). Sociocultural factors may also be the reason why women are not equally represented in certain occupations (Darmanin, 1992). It could also be a reason that has shaped the number of students opting to choose D&T in Malta in these last years.

The influence can arise from different issues such as background of education and occupations of parents/guardians. Tyler & Osborne (2012) state that the inheritance of cultural capital has restrictions upon the student's pathways as parents/guardians and family can impose issues where support is not granted to them in pursuing academic studies in STEM subjects. There is also a strong belief that students who opt for a subject in science, engineering and technology are partially influenced by the teachers in different ways. Motivation seems to be one factor (Faitar & Faitar, 2013).

METHODOLOGY

This study is based on 271 questionnaires distributed among students at Forms 1 and 2/ Year 7 and 8, at the age of 11 to 13 years old. To reach the desired response rate of 250 questionnaires, 300 questionnaires were distributed between three middle schools having different catchment areas. The sample size of 271 participants provides a margin of error of 5.58% (assuming 95% confidence interval). The sample consists of 51.7% females and 48.3% males, indicating that more females participated in this study

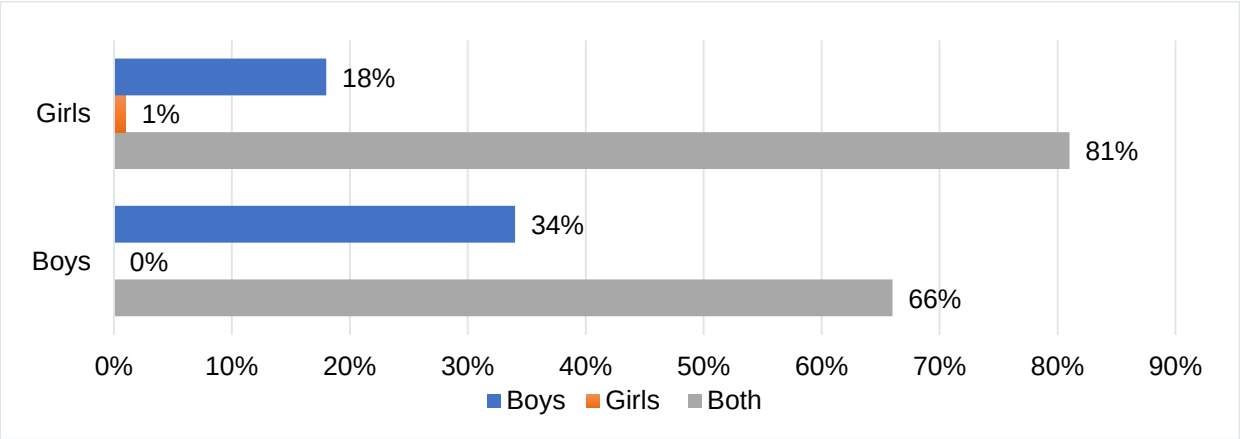
In this research, thematic analysis was applied; concepts were broken into various components that could be collected through the questions provided, producing quantifiable data. Fixed-choice questions were chosen as these are relatively easier to complete keeping in mind these were to be administered with eleven to thirteen-year-old adolescent students (Schutt, 2012, p. 257). When the data was examined, core themes were extracted such that coding could take place in relation to these themes (Bryman, 2008). Non-parametric test, Mann Whitney U test was used to compare between independent groups making use of Statistical Package for the Social Sciences, SPSS.

RESULTS

Design and Technology applies for both Gender

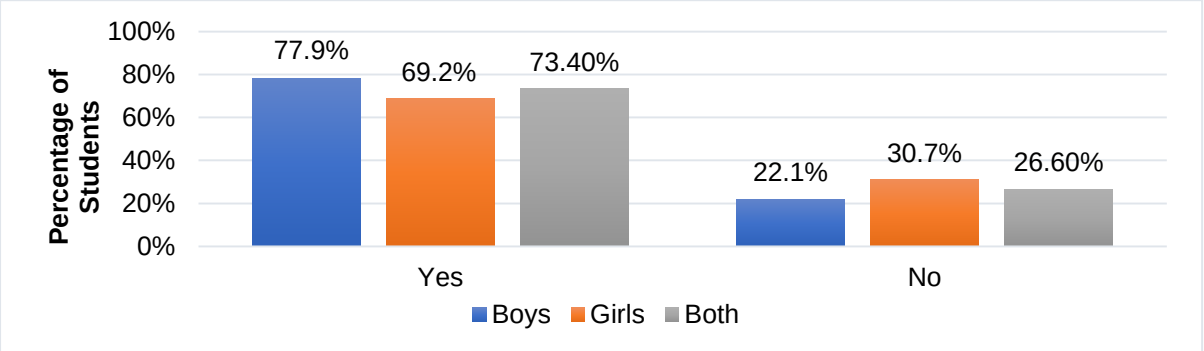
As part of the research, participants were asked to express their opinion on whether the subject is for both genders, or just for male or female (Figure 1). Results show that the majority believe the subject is for both genders. Gender association was further examined separately by female and male students of the sample. The majority of female students tend to believe that the subject is for both genders (81.4%), whereas 17.8% tend to believe that the subject is for boys and only 0.7% for girls. Similarly, the majority of male students believe that the subject is relevant for both genders (65.7%), though 34.3% believe that the subject is for boys rather than girls. None of the male students believe that the subject is for girls.

Figure 26: Is D&T for boys, for girls or both? Participants' response by gender.



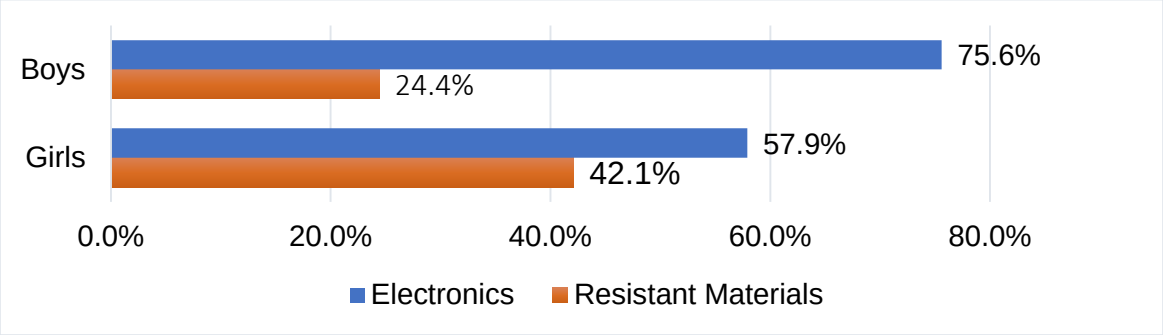
It is clear that both genders enjoy the subject. Figure 2 shows the positive feedback with relevance to how far students enjoy different areas of the subject. When asked if they enjoyed studying D&T 73.4% chose 'Yes' and 26.6% chose 'No'. Analyses by gender is also presented. One can observe that the majority of students who chose 'No' are mostly females (30.7%). It can be concluded that from the students who don't enjoy studying D&T, females strongly agreed more than boys by a bare difference of 8.6%.

Figure 27: Do students enjoy studying D&T? Participants' response by gender.



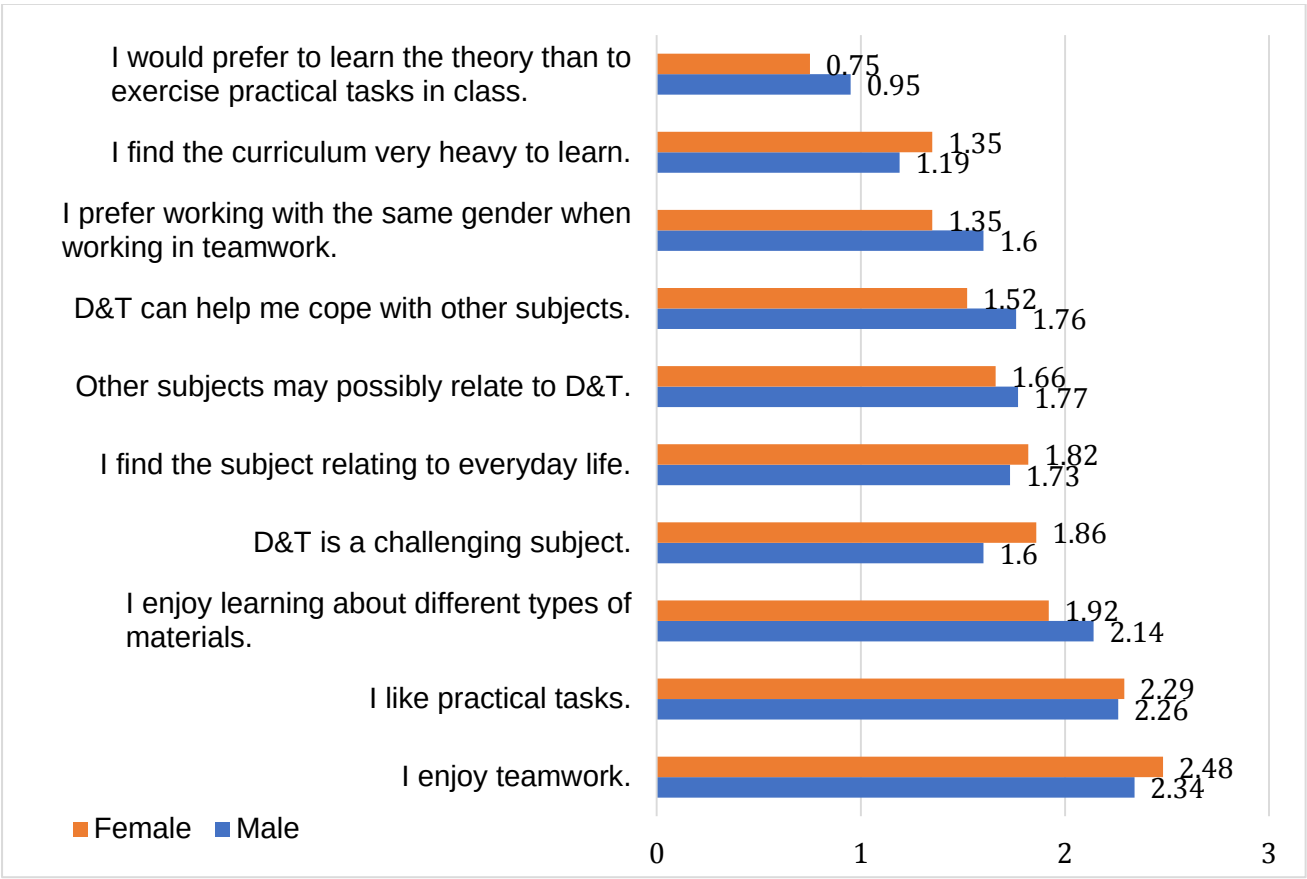
To differentiate between the domains of Electronics and Resistant Materials, all students were asked about those aspects of the D&T curriculum they find most interesting out of these two. As shown in Figure 3, the majority of the students (66.4%) like Electronics, while others enjoy Resistant Materials (33.6%). Figure 3 shows that the majority of female students, (57.9%) engage more into Electronics while (42.1%) prefer Resistant Materials. This is consonant with the literature that indicates that girls do not really like using tools or machinery. Electronics is more abstract and design oriented than resistant materials in the school curriculum. Boys strongly choose Electronics (75.6%) over Resistant Materials.

Figure 28: Area of Interest within D&T by Gender



Students were asked to rate their references in response to given statements as shown in Figure 4. The Mann Whitney U non-parametric test was used to compare the mean rating scores for statements between two independent groups, males and females. Scoring shows males scored significantly higher than females in these statements: a) 'I enjoy learning about different types of materials,' b) 'D&T can help me cope with other subjects' and c) 'I prefer working with the same gender when working in teamwork'. In contrast, females score significantly higher than males in: a) 'I find the curriculum very heavy to learn' and b) 'D&T is a challenging subject'. Meanwhile, for the remaining statements there were no significant gender discrepancies (Figure 4).

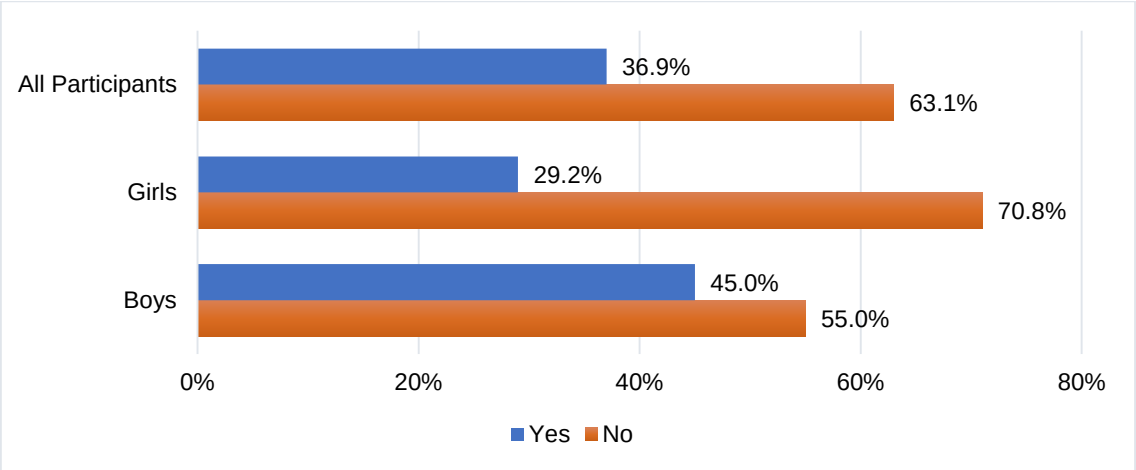
Figure 29: Mean Rating Score by Gender



Interest in opting subject and Influential Systems

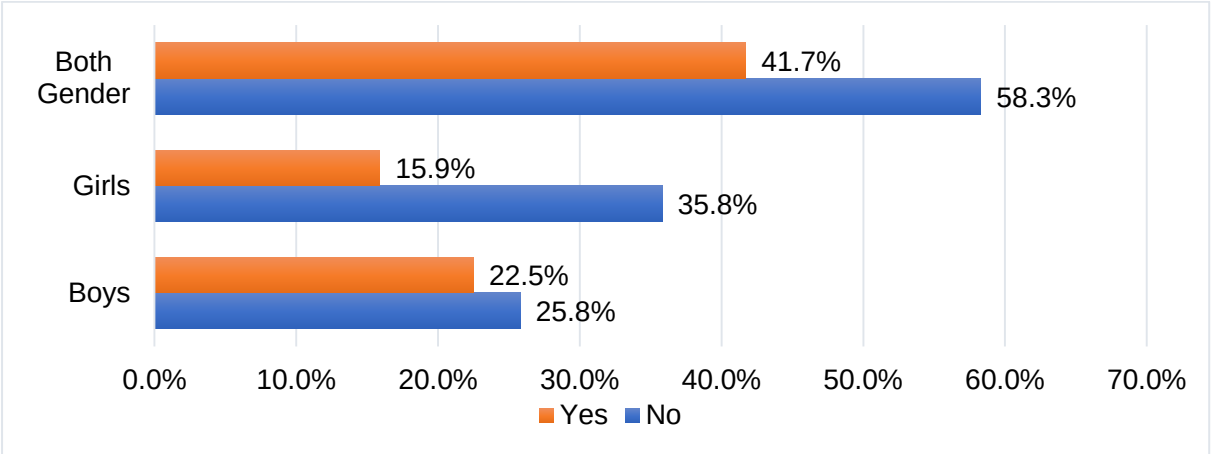
When participants were asked if they would consider choosing the subject as an optional subject, most of the participants (63%) stated that they would NOT choose it, as shown in Figure 5. More than half of the female students (70.8%) stated they would not choose the subject. For males the percentage for not choosing the subject was at 55%. This shows that both gender score considerably high for NOT opting for the subject. This result urged further investigation as to what could be the influential factors involved in such a decision.

Figure 30: Students' Consideration in opting for D&T or not opting for D&T



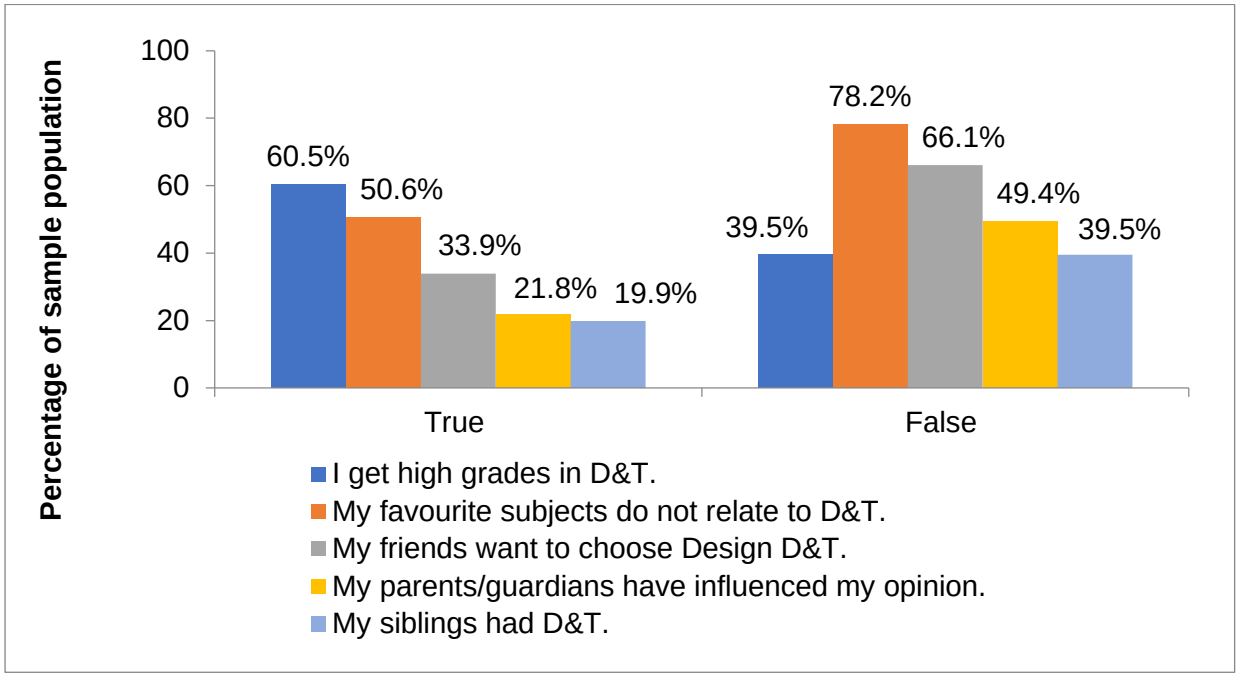
Participants were asked if exposure of the subject makes them more interested in choosing the subject. Figure 6 shows that the majority of females (35.8%) chose 'No'. Similarly, the majority of the male students stated 'No' (25.8%). Over-all results show that the majority of the students (58.3%) chose 'No'. It can be concluded that exposure to the subject is not influencing students' interest in choosing it for further study.

Figure 31: Participants' Response if Exposure is Influencing interest in choosing D&T



The characteristics which could influence participants' choice in opting for the subject were presented in statements with respective 'True' or 'False' options. Figure 7 shows what influential factors could be at play and impacting on the students' decisions. The majority agreed with 'I get high grades' (60.5%), followed by 'My favourite subjects do not relate to D&T' (50.6%) and 'My friends want to choose D&T' (33.6%). Here it can be concluded that students do get high grades in D&T, their favourite subjects do not relate to D&T and their friends do not want to choose D&T. All these could be influential factors which determine if students opt to continue studying D&T.

Figure 32: Influential Factors (True or False)



The types of occupation the students were aspiring to were collected in Table 1. Occupations such as industrial and manufacturing are likely to be chosen by male students is seen in Table 1. On the other hand, female students are more likely to choose hair and beauty, health work and welfare and teaching and training as presented in Table 1.

Students' career aspiration was tested against Gender using the chi-square test for association (Table 1). The null and alternative hypotheses are as follows:

H_0: There is no association between students' career aspiration and gender
H_1: There is an association between students' career aspiration and gender

The resulting p-value=0.001 is less than 0.05 level of significance, therefore the alternative hypothesis was accepted. This implies that there exists a significant association between students' career aspiration and gender. The strength of association between the two variables indicates that there is a moderate strength of relationship.

Table 1: Students' Career Aspiration by Gender

			What is your gender?		Total
			Male	Female	
What profession would you like to pursue when you grow up?	Professional	Count	14	22	36
		%	38.9%	61.1%	100.0%
	Clerical/ Office Work/ Manager	Count	8	20	28
		%	28.6%	71.4%	100.0%
	Health Work and Welfare	Count	3	11	14
		%	21.4%	78.6%	100.0%
	Industrial and Manufacturing	Count	53	14	67
		%	79.1%	20.9%	100.0%
	Teaching and Training	Count	8	23	31
		%	25.8%	74.2%	100.0%
	Humanities and Arts	Count	3	3	6
		%	50.0%	50.0%	100.0%
	Agriculture and Veterinary	Count	0	8	8
		%	0.0%	100.0%	100.0%
	Civil Work	Count	8	2	10
		%	80.0%	20.0%	100.0%
	Hair and Beauty	Count	0	18	18
		%	0.0%	100.0%	100.0%
	Catering	Count	4	2	6
		%	66.7%	33.3%	100.0%
	Do not Know	Count	30	17	47
		%	63.8%	36.2%	100.0%
Total		Count	131	140	271
		%	48.3%	51.7%	100.0%

DISCUSSION & CONCLUSION

This study challenges stereotypical assumptions where females do not opt for D&T due to practical tasks and using tools. Issues relating to favourite subjects and career aspiration have been found. The focus of gender research appertaining to the research questions was engaged. Due to circumstances being unaware of key issues within the context of this paper, for future reference it can be recommended to explore the impact of external socio-economic factors or gender-neutral projects.

Student's perception segregated by gender

Findings regarding perceptions were analysed according to gender making use of different statements. Statements such as: a) 'enjoy learning about different materials' and b) 'D&T can help to cope in other subjects' were predominantly marked by males. Suggestions such as: c) 'finding the curriculum very heavy to learn' and d) 'considering it as a challenging subject' were pointed out mostly by females. Weber and Custer's (2005) assumption that curriculum content might lean more towards males' interest can be true. Ashworth and Evans (2001) state that teacher's gender affects female students too. In fact, Thomas S. Dee (2006) found that teacher's gender has impact over student test performance, teacher's perception of students and student's engagement towards academic material.

Perceptions generated through gender could be a result of students' level of confidence and interest (Dee, 2006). Analysing whether there is a relationship between gender and area of interest in D&T, both gender marked 'electronics' as their favourite area, boys ranking higher by 17.7% than girls. Goodness of fit through SPSS suggests there is evidence of a relationship between gender and area of interest, although the strength is weak. Gender ideology shapes girls' beliefs on their competence. Teachers' own mindset and goals about learning can be a powerful tool to influence and change students' mindset (Van der Vleuten, Jaspers, Maas, & Van der Lippe, 2016; Wang & Degol, 2017). To appeal to females and minorities, teachers should have opportunities to design the curriculum to address the needs of such groups in a systematic way (Childress, 2006).

Gender and Career Aspiration

The findings of this study showed that students perceive D&T as a subject for both genders and eliminated the perception of gender association towards the subject (Figure 1). When students were asked if they consider opting for further study of D&T, 63.1% stated No. This is marginally equal in both genders (Figure 5). The study showed that for 58% from the sample population, exposure of the subject did not influence them in choosing D&T later on in their school years. The number of female participants who claimed having been influenced in their choice of the subject because of the compulsory exposure is relatively low (15.9%). Male results show there is minimal difference between those stating that exposure influenced them and those that were not. (Figure 6). Discussion delves in connection to what Wang and Degol (2017) tackle with regards to the ideology that as children grow up, they start to create realistic connections between their interest and future career choices which hence influence subject choice. Considering the sample population of this study, 50.6% state that their favourite

subject does not relate to D&T, whereas 63% of the population does not consider choosing D&T. A significance between the two variables shows that the majority of the sample population does not consider opting for the subject because it does not fit within their preferred subjects. This implies how gender ideology has consequences on educational choices which effects how students evaluate their preferred subject and what is perceived important for future career (Van der Vleuten, Jaspers, Maas, & Van der Lippe, 2016).

Results showed that career aspirations by the students was a detrimental factor in their choice of D&T. Data showed that there is a significant relationship between career aspiration and gender, having a moderate strength of contingency coefficient (0.466). Occupations which are perceived to be related to physical strength such as industrial and manufacturing, civil work and catering are highly represented by males. Meanwhile, teaching and training, professional occupations, clerical/office work and hair and beauty are female dominated. Information by the European Commission (2012) also lists teaching and training as jobs most sought after by females. This situation can be associated to women codes that are generated by the dominant group who establish their needs (Buckley, 1989). Characteristics such as gentle, beautiful, emotionally expressive and sensitive also fit to the occupations highly scored by females (Galdas, 2010). Thus, females being under-represented in STEM subjects, is probably more a result of sociocultural factors and not innate talent as restrictions are created over gender differences (Booy, Jansen, Joukes, & Van Schaik, 2012). Females do not constrain themselves from opting for D&T due to innate talents, but more due to career aspirations. Wang and Degol (2017) argue how women refrain from aspiring STEM related career choices due to lifestyle priorities which can shift to a family-centred goal. Females believe that once they build a family, they would find it difficult to allocate time necessary to keep efficient with current innovations and compete within STEM fields.

Dasgupta and Stout (2014) clearly discuss how stereotypes related to STEM are inaccurate. The ideology regards to such related stereotypes and feminine gender role expectations creates constraints for girls and women to engage in STEM areas. Females are self-guided towards communal concerns while men pursue self-focused goals (Putrevu, Gentry, & Fischer, 2001). Technology education involves real life problems that help both people and society, thus females are probably unaware of the communal values inherent in STEM occupations (Dasgupta & Stout, 2014).

In Malta, a dire need for the dissemination of information about a coherent philosophy of D&T and the potential impact which such study may have on society is being felt at all levels. It would be especially important in the employability sector to invest in the creation of gender-neutral jobs related to D&T so that young students can form their career aspirations towards such jobs. Within the academic sector, it would be important to ensure that appropriate research is conducted relating gender to the uptake and content of technology courses and eventual employment opportunities for both genders.

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