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THE WICKED PROBLEM OF LOW FEMALE PARTICIPATION IN IT: A COLLABORA-TIVE WORKSHOP APPROACH (10)

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Abstract

The decreasing number of young women undertaking IT-related degree programmes and careers has been a worrying trend for the past twenty years. Given that IT has never been more pervasive and accessible, decreasing female participation in the discipline (and the variety of reported causes) presents a 'wick-ed problem' for IT educators and professionals. In this research study, we suggest that the 'wicked problem' of low female participation in IT requires a practical, collaborative solution. To make sense of the low take-up of IT careers, we undertook a qualitative, exploratory study of female-only schools in Ireland using a tailored, collaborative workshop approach (#MakeITWork). Study findings indicate that while attitudes towards IT careers are largely outdated, these views can be swiftly changed through a collaborative workshop approach. Overall, this study highlights the need for (i) greater stakeholder collaboration and (ii) better quality information available via novel formats if the entrenched, negative (and often erroneous) perceptions of the IT industry are to be dispelled.

Keywords: Education, Awareness, Diversity, Information Technology (IT) and Knowledge Exchange (KX)

1.0 Introduction

The diminishing interest among young women in IT courses and associated careers continues to be prevalent (Fisher et al., 2015). Given that IT is far more pervasive now than it was twenty years ago, the decline seems counter-intuitive. Why should IT be less attractive as an area of study and career to young women who have always lived in a world where the Internet is available? This has a detrimental knock-on effect from an organisational perspective. As a consequence, the need for a more balanced representation of men and women has been reprioritised for those organisations that recognise that they cannot afford to under-utilise half of the population if they are to be competitive (Badal & Harter, 2014). Global business continues to invest in diversity management as a means of recruiting a more diverse and representative workforce (Rezvani, 2015). Subsequently in order to meet the expectations of the professions, educators pursue positive approaches to student recruitment to the area of IT, particularly amongst minority groups (Natale & Doran, 2012).

With this in mind, the objective of this study is to investigate the extent to which young women understand the nature of IT-related undergraduate degree programmes and the opportunities afforded to graduate students who have skills in IT-related areas. Using an exploratory, qualitative analysis approach, we undertook a phased strategy to further examine this phenomenon. This paper is structured as follows: the next section presents a review of relevant literature relating to young women's engagement with formal IT education as a means of investigating those factors that impact the trend of females opting for alternative courses and career paths. The motivation for the study is presented and the research approach adopted by the researchers is explained. Then the results from the brainstorming exercise are recounted and the survey results are considered. Data analysis, discussion and implications for both research and practice are presented.

2.0 Factors influencing the selection of IT Degrees and IT Careers among Young Women

Academics and practitioners continue to search for new ways to attract greater numbers of females to IT degrees and subsequently to IT-related careers. In an increasingly consumerist higher education market (Maringe, 2006), it has never been more important for educators to pursue a responsible and ethical approach to support students' choice of undergraduate degree (Natale & Doran, 2012). This is particularly true with respect to IT-related programmes as the field already struggles with a perception problem on the part of young women. Existing research has considered the perceived barriers or disincentives associated with choosing IT (Ahuja, 2002; Anderson et al., 2008; Fisher et al., 2015). A sig-

nificant number of females are disinterested in computers, or find the idea of working with computers boring (Anderson et al., 2008). Empirical evidence indicates that this number remains in sharp decline on an annual basis (Eurostat, 2014) despite the proliferation of media campaigns and female-only training for young software developers e.g. digital divas (Fisher et al., 2015). However, the protestation that "computers are boring" is (Anderson et al., 2008) unconvincing when technology-spend and recreational technology usage by females, challenges that of their male counterparts (Drabowicz, 2014). Given practitioner investment in promoting the diversified workforce in businesses highly dependent on IT and IT related skills and the diverse nature of new IT roles and career paths, there is a great impetus for higher educators/recruiters to not only engage in promotional/informational activities with potential students but to also identify ways in which the preconceived ideas around IT education and careers can be dispelled. Educators need a way to open student's minds to the possibility of IT without imposing their own partial views. Striking this balance is not a simple task. It is clear that additional research is warranted to further understand the phenomenon.

The area of females and IT, places considerable emphasis on three factors; 1) gender stereotypes, 2) awareness and 3) ability, as integral to influencing the uptake of IT degrees and subsequently IT careers amongst young women as illustrated in Figure 1. Focusing on these three factors together will amount to a more holistic approach to engaging with the challenge of low female participation in IT, as indicated by the green circles highlighted in Figure 1. The disconnect between the positive representation of career opportunities in IT and female uptake in related university undergraduate programmes needs to be resolved (Ashcraft et al., 2012).

Firstly, the gender factor is core to female participation in IT (Serenko and Turel, 2016; Trauth, 2013). Several research studies have revealed a gender imbalance in IT (Adya & Kaiser, 2005; Ahuja, 2002; Beise et al., 2003; Camp, 1997; Trauth et al., 2003; von Hellens et al., 2000). Career genderisation occurs early in an adolescent's life, possibly in middle school or the early years of high school (Adya & Kaiser, 2005). This genderisation is likely to grow, resulting in women's negative perceptions about their ability to succeed in more technical fields of study and work such as computer science and Information Systems (Beyer, 2002). Core to the discussion about gender and IT, Trauth (2006, p1154) suggests there are two main theories: first, essentialist theory presupposes the existence of relevant differentiators between men and women including their respective attitudes to IT. Essentially hypothesising that the female attitude toward IT differs compared to the male attitude. Based on this line of thinking, Trauth et al. (2004) contend that women are underrepresented in IT as a result of biology. The second theory focuses on social construction (Adya & Kaiser, 2005; Trauth, 2006). This theory considers the societal impact, characterising information technology as "men's work" places IT ca-

reers outside the domain of women" (Trauth, 2006, p1155). Thus supporting Margolis & Fisher's (2003) view that the societal perception of IT as a field of employment was 'male-gendered'. Furthermore, Papastergiou (2008) purports that the declining numbers of young women attracted to careers in IT may be attributed to gender bias in the home environment, thus supporting the contention that the family is one of the most influential factors when it comes to persuading career choices in young adolescents (Adya & Kaiser, 2005; Dryler, 1998; Serenko and Turel, 2016). Social (i.e. family, friends) and structural (i.e. school) influences are widely cited as determinants on career choices among young females (Ahuja, 2002; Adya & Kaiser, 2005; Fisher et al. 2015).

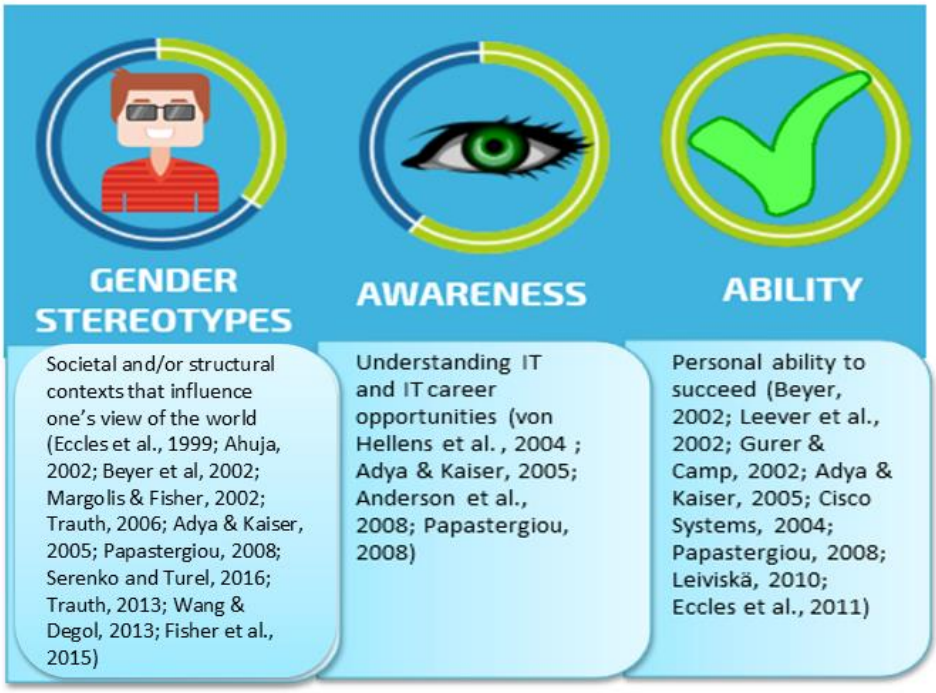

Figure 1. Factors influencing the uptake of IT Degrees/Careers among Young Females

In her more recent study, Trauth (2013) extends the two theories of essentialist and social construction to incorporate a third theory. From her synthesis of existing literature, Trauth (2013) suggests that gender theories *"fall into three broad categories: gender essentialism, social shaping of gender, and gender intersectionality*" (p.284). The third theory of gender intersectionality, focuses on the nuance or within group variability, e.g. studies about black women, these theories are typically utilised in feminist or critical race studies (Trauth, 2013). Adya and Kaiser's (2005) career choice paper is one example of an IS study where intersectionality is theorised based on their investigation of structural factors, social settings, ethnic culture and how these factors influence career choice with specific focus on IT.

Secondly, there remains a lack of awareness and general understanding about the variety and nature of IT careers (Adya & Kaiser, 2005). IT as an area of study and a prospective career is underpinned by computer information systems (CIS), management information systems (MIS), and computer science (CS) degrees (Adya & Kaiser, 2005). In their research on the nature of IT work, von Hellens et al. (2004) have uncovered a prevailing perception that the IT workplace is essentially masculine which can be unattractive and unappealing to women. Research also indicates that students are uncertain about the nature of IT work and the skills required to succeed in this field (Anderson et al., 2008). In their study, Anderson et al. (2008) revealed that IT is perceived as difficult, boring, and solitary in nature, requiring little interaction with fellow workers and customers. In fact, Adya & Kaiser (2005, p23) concluded that "the misperception of what IT professionals do and what skills they need to succeed can deter many college students from choosing an IT-related major, and therefore a career in that field". The need for greater awareness about opportunities in this career domain is acknowledged (Papastergiou, 2008). To achieve this, Adya and Kaiser (2005) recommend that teachers and career guidance counsellors play their part by disseminating the appropriate information and support to students, encouraging them to consider IT as a prospective career path.

Thirdly, lack of confidence in technical ability remains a challenge for females in both high school (Eccles, 2011; Fisher et al., 2015) and in the IT work place (Eccles, 2011). Often gender stereotyping commences around young women's ability to do maths compared with the skills of their male counterparts (Beyer, 2002). Confidence amongst young females in their mathematical, physical science (Leever et al., 2002; Leiviskä, 2010; Eccles et al., 2011) and IT ability is low (Adya & Kaiser, 2005; Eccles et al., 2011). What's more, existing research (Gurer & Camp, 2002; Cisco Systems, 2004) indicates that females are intimidated by their male counterparts when it comes to IT subjects. This finding is illustrated in previous studies where young women are characterised by displaying less experience and self-confidence in their own computing skills (Papastergiou, 2008).

Given the widely reported issues related to recruitment of females to the IT field, such as (i) the perceived genderisation of IT education and the IT industry, (ii) limited awareness of different career paths and opportunities; and (iii) lack of confidence in ability (more specifically mathematical and technical ability), it is critical that we explore these issues as they impact female choices for higher education and future careers.

3.0 Research Approach

An exploratory, qualitative approach in the form of a three-phased workshop approach, namely #MakeITWork programme, was conducted to gain a more intimate appreciation of the research phenomenon under consideration (Van Mannen, 1983). This programme was designed by three IS re-

searchers to investigate the issues associated with choosing IT. This approach to student recruitment is embodied by the #MakeITWork programme. The aim of #MakeITWork was to provide richer knowledge to a cohort of female high school students about the breadth of opportunities available, in Ireland and internationally, for creative, talented young people with IT skills. The programme included (i) brainstorming; (ii) a knowledge exchange (KX) session; and (iii) qualitative survey. These workshops were conducted with 109 sixteen-year-old high school students in three female only high schools located in Ireland, during Spring and Autumn 2014. Each workshop lasted two hours in duration and included three phases (see Table 1). They were designed to promote an environment where students were confident and comfortable enough to develop their views amongst their peers without undue influence from the researchers or teachers.

Workshop	Approach	Description	Rationale
Phase 1	Brainstorming/ Idea generation session	Edward de Bono's Six Thinking Hats (1985) used to identify the views and feelings of students for the concept of IT (White – facts, Green – ideas, Black- criticism, Yellow – benefits, Blue – organisation of information, Red – gut feeling)	Understand 'As-Is' - explore the views/perceptions of this cohort of students
Phase 2	Knowledge Exchange Sessions	Knowledge exchange providing an overview of the degree (i.e. Business and IT modules available), undergraduate placement opportunities (i.e. year 3 placement programme) and career opportunities	Intervention – provide a better/richer understanding of one IT-related degree programme and prospective career opportunities
Phase 3	Qualitative Survey	The ten questionnaire items (Table 2) represent the typical topics raised by school students with respect to IT undergraduate courses and careers. These questions were derived from fourteen years of school visits, open days and past presentations.	Gauge the impression of Phase 1 and Phase 2 among this cohort of students

Table 1. Overview of #MakeITWork Programme

Phase 1 involved a brainstorming session leveraging the Edward de Bono Six Hats methodology (1985), see Figure 1. Through a parallel thinking approach, this formal semi-structured discussion offered the opportunity to openly discuss the subject at hand. Using group interaction affords the researcher the opportunity to initiate "communication between research participants in order to generate data" (Kitzinger, 1995). Nonaka and Takeuchi (1995) support brainstorming as an enabler for new knowledge, advocating the need to step outside the normal way of thinking, in some cases leveraging external knowledge resources as a means of generating fresh ideas. The objective of the activity was to work through the six hats to elicit student ideas based on the proposition "What a career in IT means to me".

Figure 2. #MakeITWork Six Hats Methodology

The Six Hats approach is widely used by practitioners involved in leadership and creativity. The MakeITWork programme was an exciting test-bed to trial this approach in a higher education scenario. As part of Phase 1, students self-selected into groups of four and were provided with a Six Hats exercise pack (this included six coloured sheets of paper and a set of basic instructions). Each group was invited to assemble their hats from the pack in less than five minutes. Following this, we presented the rationale behind the Six Hats methodology for brainstorming and idea generation. Each hat was allocated eight minutes, to facilitate group discussion and note taking using the sequence of hats illustrated in Figure 1. De Bono (1985) recommends a pre-set sequence if the group is unfamiliar with the Six Hats method. Subsequently, we defined the sequence of hats, i.e. white/green/yellow/red/black/blue, providing the groups with an opportunity to focus on subject before offering criticisms (Black hat). During each eight-minute interval, students were supported to think in the same way at the same time i.e. green hat – idea generation and creativity. Once the blue hat was called, each group were asked to organise the output from the hats process and to nominate a speaker for the group to present the highlights of their findings. These findings were noted by the research team during the session and the notes made by each student team were collected at the end of the workshop.

As part of Phase 2 (illustrated in Table 1), the researchers (lecturers and administrative staff of an Information Systems department) conducted an hour long knowledge exchange (KX) session at each of the three high schools. These sessions provided the opportunity to inform the students' understanding of the IT field and IT related careers. During this KX, rich insights were provided based on an IT-related degree programme offering undergraduate students a mix of business and technology skills.

Using freely available presentation software, a thirty minute overview of an IT undergraduate degree was considered including information on first year subjects, placement programme opportunities and potential career opportunities in a variety of business sectors. The presentation was followed by an interactive questions and answers session, where the facilitators and students engaged on questions, comments and feedback that arose from both Phase 1 and the presentation.

Phase 3 of this study required that students completed an exploratory questionnaire. This data collection tool was designed to investigate the three factors illustrated in Figure 1, namely; 1) gender stereotypes, 2) awareness and 3) ability. Using 5 point Likert scales (Table 2) this data collection instrument provided a richer picture of the students' knowledge about IT-related college courses and career opportunities in IT following the KX session. Students were instructed to: tick "1" if you strongly agree, "2" if you agree, "3" if you neither agree nor disagree; "4" if you disagree and "5" if you strongly disagree. Tick "NA" if the statement is not applicable to you. In addition to the ten statements listed in Table 2, a final optional question afforded students the opportunity to provide clarifying comments for their responses to the first ten statements.

ID	Question
1	I have a good understanding of information technology (IT) college courses.
2	I am interested in undertaking an IT qualification after college.
3	I think girls are interested in IT.
4	I believe IT courses are geared towards male students.
5	I have an appreciation for the career possibilities available to someone with an IT qualification.
6	I am aware how much an IT Graduate is paid.
7	I believe that I need to be good at maths to be good at IT.
8	I believe that all IT college graduates become programmers.
9	I have sufficient access to IT course information.
10	I believe that an IT course would be too challenging for me.

Table 2. Questionnaire

The questionnaire was piloted with a small sample of sixteen-year-old female students to ensure that it was unambiguous for the intended respondents (Remenyi & Williams, 1995) and measured the intended items accurately. Over the course of three workshops, 109 completed and valid paper-based questionnaires were collected and used for analysis. Once the data was obtained, it was manually inputted to MS Excel to facilitate data analysis.

Data collected during Phase 1 (the Six Hats brainstorming session) was analysed on a hat-by-hat basis triangulating the sentiment of the hats with the group responses. Further to this, the questionnaire data (Phase 3) was collated and analysed using descriptive statistics. While qualitative forms of analysis are

more labour intensive than quantitative schemes, they offer a greater degree of explanatory power when a researcher is investigating the meaning behind a user's actions (DeSanctis & Poole, 1994), which is an advantage when conducting this type of exploratory research study. The following section presents the results of this study.

4.0 Results

4.1 Pre-presentation

At the start of the workshop, the Six Thinking Hats exercise and the theme (female students' understanding of the field of IT) were explained to the classes. Students were then divided into groups of four participants and provided with materials in order to construct each hat. After the hats were constructed, each student group wore each coloured hat for four minutes and recorded responses (Table 3 displays sample responses). First, students wore the blue hat to clarify the objective of the exercise and capture initial reactions to the idea of pursuing a career in the IT field. In general, responses were predominantly focused on technology, career prospects, financial rewards and the perception of the field as "boring". Second, students wore the white hat and recorded known facts on the topic. Responses indicate that the students recognised the pervasiveness of IT in everyday life and the buoyancy of the job market. For instance, students identified "plentiful job opportunities" and the dependence that most companies have on IT. Overall, the white hat responses were promising and positive.

White Hat (Facts)	**Green Hat (Ideas)**	**Yellow Hat (Positivity)**
" we need computers to work"; "lots of job opportunities"; "you have to know computers"; "make loads of money"; "used in every job"; "in demand"; "rapidly evolving"; "websites, games, advertising use computers".	"phones"; "creating new technology"; "using computers to make software"; "fixing computers"; "website design"; "programming"; "game design"; "software development"; "making software"; "advertising".	"good money"; "success"; "interesting job"; "an enjoyable job"; "not many women in technology"; "job opportunities"; "lots of job opportunities"; "good pay"; "up-to-date on latest technology"; "large and growing demand"; "used in every job"; "travel".
Red Hat (Emotions)	**Black Hat (Criticisms)**	**Blue Hat (Organisation and Prioritisation of ideas)**
"boring"; "repetitive"; "numbers"; "maths"; "interesting"; "uneducated about it"; "for boys career-wise"; nervous"; "lost"; "uneducated"; "insecure"; "nice option"; "smart"; "not interested"; "confused"; "inadequate"; "men"; "technical"; "nerd"; "sitting in front of a computer".	"stressful"; "boring"; "does not sound that fun"; "hard"; "confused"; "challenging"; "not a lot of girls do it"; "people may excel more than you"; "unhealthy"; "inside all the time"; "unfulfilling"; "stuck on computer"; "less able to enjoy technology at home"; "no human interaction".	"boring"; "money"; "computers"; "there are jobs"; "Information technology".

Table 3. De Bono's Thinking Hat Sample Responses

However, when students were asked to wear the third hat (red) and provide their "gut reactions", the responses became very negative. Groups identified the IT field as boring, technical, repetitive, requiring high mathematical competency and being male dominated. The red hat also uncovered individual concerns such as feelings of inadequacy, ill-preparedness, nervousness and the idea that practitioners sat in front a computer all day. Similar responses were recorded when groups used the black hat to identify risks associated with pursuing an undergraduate programme and career in IT. In general, responses were focused on the perceived difficulty, tediousness, lack of human interactions and contribution to an unhealthy lifestyle. The perception that IT is male dominated also emerged as a common theme when students were asked to identify risks.

With the fifth hat (yellow), groups were asked to identify benefits with undertaking an undergraduate degree in the IT field. Overall, students had a good idea of the potential benefits citing excellent job opportunities, high salaries, ability to work in different countries without retraining and a stimulating work environment. With the final green hat, students were asked to identify opportunities afforded by the IT field. As with the previous yellow hat, students demonstrated a good grasp of the creative possibilities identifying game design, website development, developing new technology and cultivating

an expert knowledge of IT. At the end of the exercise, responses for each hat were collected from student groups. Collectively, the six hats illustrated that while female students have a good understanding of the importance of the field for individuals and for the greater community (white, green and yellow hats), they have difficulty picturing themselves studying, working and thriving in the IT field (red and black hats).

Post-presentation questionnaire administered to students

The post-presentation questionnaire questions are presented in Table 2. Answers for all questions were captured using five-point Likert scales (1-Strongly Agree, 2-Agree, 3-Neutral, 4-Disagree, 5-Strongly Disagree). The questionnaire consisted of ten questions (Q1-Q10) and a final question to allow respondents the option to comment and expand on their answers to Q1-Q10.

ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Mean	2.6	3.0	2.7	2.9	3.1	3.5	2.8	3.2	3.1	3.2
StDev	1.24	1.11	1.04	1.33	1.08	1.24	1.08	1.01	1.12	1.07

Table 4. Mean and Standard Deviation for Survey Questions

The questionnaire was administered to students in a classroom setting directly after the presentation. In total, there were 109 completed questionnaires. Descriptive statistics for Q1-Q10 are presented in Table 4 and the overall distribution of answers obtained for Q1-Q10 is presented in Table 5. On the basis of the mean scores (Table 4), while students appear to feel that they have a good understanding of undergraduate IT offerings (Q1) and that girls are interested in IT (Q3), they also agree that undergraduate IT programmes are geared towards males (Q4) and that a person undertaking an IT programme must be good at maths (Q7). Students felt they did not know enough about IT graduate salaries (Q6). However, they disagreed with the statements that all IT graduates became programmers (Q8) and that an IT programme would be too challenging for them personally (Q10). The standard deviations reported for each question suggest that there is high agreement amongst respondents, with Q4 showing the highest deviation of 1.33.

ID	% of respondents per scale				
	5 (St. Disagree)	4 (Disagree)	3 (Neutral)	2 (Agree)	1 (St. Agree)
Q1	9.2%	11.9%	29.4%	25.7%	23.9%
Q 2	12.8%	16.5%	38.5%	24.8%	7.3%
Q 3	3.7%	20.2%	35.8%	27.5%	12.8%
Q 4	15.6%	19.3%	17.4%	32.1%	15.6%
Q 5	8.3%	32.1%	27.5%	25.7%	6.4%
Q 6	25.7%	29.4%	22.9%	13.8%	8.3%
Q 7	10.1%	13.8%	33.0%	35.8%	7.3%
Q 8	10.1%	26.6%	36.7%	22.9%	3.7%
Q 9	11.0%	22.9%	33.9%	23.9%	8.3%

Q 10	10.1%	32.1%	30.3%	22.0%	5.5%

Table 5. Percentages of post-presentation attitudes on the ordinal scale (5-strongly disagree, 4-disagree, 3-neutral, 2-agree, 1-strongly agree).

Students were asked post-presentation if they were interested in pursuing an IT qualification (Q2). On average, respondents were neutral when it came to the prospect of an undergraduate IT qualification (mean score: 3.0). Over a third of respondents (38.5%) were ambivalent, while nearly a further 30% (32 respondents) were opposed or strongly opposed to undertaking an IT college course. Less than a third of the sample expressed interest in an IT qualification (Table 5).

4.2 Awareness

Several questions within the post-presentation questionnaire were focused on awareness of IT qualifications and careers. Results indicate that nearly 50% of respondents had good awareness of undergraduate IT qualifications (Q1), while 21% reported poor awareness of undergraduate options. While a mean score of 2.6 suggests that there is awareness of IT courses, 32 students (29.4%) reported a neutral attitude to awareness which is a significant figure. Several respondents suggested measures that would increase awareness of IT qualifications, such as increased promotions. A popular suggestion was to increase the teaching of IT at primary and secondary levels so that students grow up accustomed to the field. One student commented that "*computer classes should become more common in all girl schools and have us grow up being comfortable with technology*".

In relation to IT industry salaries, results indicate that students do not feel that they possess enough information (Q6). Only 22.1% (strongly agree and agree) felt they had been provided with sufficient salary data. By contrast, 55.1% of surveyed students (strongly disagree: 25.7%; disagree: 29.4%) were not satisfied with salary information. One student recommended that we should "*say more about the salary and show videos about the jobs that you could possibly do*".

Respondents were similarly dissatisfied with IT career path information (Q5). Only 6.4% of respondents were of the opinion that they well versed in IT career opportunities. By comparison, 40.4% (44 students) were unhappy with their knowledge of diverse IT roles in industry. Taken together, it appears that secondary level students do not know enough about IT careers and salaries. This is a finding supported by student comments, with one respondent noting that "*I was very interested in the IT course but I still don't really know what the people actually do*" while another asked for presenters to "*explain about jobs that don't involve sitting at a computer*". An interesting point raised by one student was that teachers tended to focus on careers other than IT.

Respondents were uncertain when it came to IT graduate roles involving programming (Q8). Survey data illustrates the uncertainty that students experience on this matter, with 40 respondents (36.7%) unsure of this point (mean score: 3.2). Only 10.1% were sure that IT careers offered more than just traditional coding positions. Overall, only 36.7% of students indicated that they knew coding roles were not the only career paths.

With respect to relevant information (Q9), only 32.2% of respondents felt that they had sufficient access. Over a third of students were not happy with their current access to IT course and career information (33.9%). A further 37 students (33.9%) were noncommittal with respect to information access which might suggest that students do not have access to the right sort of information (results relating to salaries and career paths lend support to this view).

4.3 Gender

Two questions in the post-presentation questionnaire were related to gender (Q3, Q4). First, students were asked whether they thought girls were interested in IT. Over a third of students were of the view that girls are interested in IT (40.3%), with only 23.9% expressing the opposing view that girls are not interested in the area. However, with 35.8% of respondents unsure, the engagement of young women in IT is a live issue. Second, students were asked whether they felt IT courses were geared towards male students. Nearly half of respondents think IT courses are focused towards males (47.7%). The results from these two questions suggest that while female students think girls are interested in IT courses, they perceive IT courses as catering specifically to male students. This perspective is supported by several respondent comments such as "*why do people think men are the only ones good at IT?*"; "*I definitely feel like IT is geared towards male students. There is an unfair stigma against girls and IT. Many people assume girls are incapable of succeeding in such an area*" and "*females should be shown that IT is not a man's career*".

4.4 Ability

Students were also asked two questions focusing on ability (Q7, Q10). Students were asked whether they thought they needed to be good at mathematics in order to pursue an undergraduate IT qualification and IT career. Again, a significant number of respondents (47) viewed mathematical ability as critical to undertaking further education and a career in IT (43.1%). A third of respondents were unsure as to whether mathematical ability was a necessity (33%). Only 23.9% of respondents did not think mathematics was a key requirement for undertaking an IT programme.

Students were also asked whether they thought an IT course would be too challenging (Q10). Only 27.5% of respondents considered an IT course too much of a challenge. By comparison, 42.2% did not

perceive an IT course as being too difficult for their skillset. Again, almost a third of respondents (30.3%) were unsure. This could be indicative of some students not possessing sufficient information in order to make an informed choice. Several students commented on the limited exposure to technology at secondary level and the need to introduce coding courses into the local community.

5.0 Conclusions

This study contributes to the cumulative body of research on female engagement in IT. The purpose of the #MakeITWork programme was to pursue an approach to investigate young women's understanding of the nature of IT-related undergraduate degree programmes and the opportunities afforded to graduates with these skills. Our research provides insights for both educators and researchers.

As with any empirical study, this paper has several limitations that should be considered when interpreting the findings. The study uses three schools in the south of Ireland and a total of 109 student participants. As illustrated in Figure 1, this study focuses on three specific issues (i) awareness; (ii) gender and (iii) ability. These issues do not represent an exhaustive list with respect to female engagement in IT. There are likely other issues that contribute to the issues surrounding the decreasing number of female students undertaking IT programmes. In addition, the study has not (to date) been piloted in boys-only or mixed high schools. In order to illuminate the entire landscape through the use of focus groups, there is an opportunity to explore how boys and mixed schools experience the issues of awareness, gender and ability in relation to further supporting diversity in IT. Further to this, we recognise that attention must be given to the secondary school based IT educators. While there is no formal examinable IT subject offered as part of the high school diploma or Leaving Certificate examination in Ireland, increasingly teacher(s) are assigned (or are taking) responsibility for IT education in their respective schools. Understanding the awareness of teachers would offer valuable insight particularly in terms of further appreciating the implications of assumptions or misconceptions held by this cohort about women in IT and the effect that this may be having on students.

There are a number of key recommendations for educators/recruiters and the IT industry. The diversity of roles in the IT field needs to be communicated to female students. The message that while mathematical ability is important; lower competency does not preclude someone from succeeding in the IT field. In order to properly address the first two implications, we need to tailor marketing material and customise presentations so that they properly convey the positive message and dispel old-fashioned views of the IT field. Educators, starting as early as elementary school, need to collaborate in order to deliver an effective, positive and consistent message to students. We need to encourage a more accurate, inspirational, varied representation of women in IT in mainstream media so that young women begin to identify themselves with the IT field.

This study supports existing research (Anderson et al., 2008; Papastergiou, 2008; Fisher et al. 2015), which posits that female students perceive the IT field as: (i) being geared towards males (Whitney et al., 2013); (ii) requiring high levels of mathematical aptitude (Anderson et al., 2008; Leever et al., 2002; Leiviskä, 2010) and (iii) anti-social or un-dynamic (von Hellens et al., 2000; Margolis & Fisher, 2002; Teague & Clarke, 1993). In addition, this study upholds the view that female students are not receiving the right message from educators and the IT industry (Kahle & Schmidt, 2004). Most notably, this study proposes, trials, and assesses a novel workshop approach to a "wicked" problem supporting diversity management, in the form of the #MakeITWork programme for addressing the key misconceptions held by female students in relation to the field of IT. The workshop approach outlined allows us to interact with teenagers in a meaningful, informal way that facilitates a natural, non-pressurised environment wherein students felt comfortable expressing their often deeply-held views on women and IT.

With respect to our workshop approach, we found the three phases of activity to be a particularly effective way of uncovering the issues by providing female students with the environment to explore perceptions around IT undergraduate degrees and IT careers, targeting our knowledge exchange sessions and immediately assessing the impact of the presentation. The approach also minimised the impact of the personal (albeit positive) biases held by the workshop facilitators. Essentially, the participating students were able to set the agenda for the workshop via the Six Thinking Hats exercise. Survey findings suggest that we need to further refine our presentation to address the issues of (i) career path awareness; (ii) male dominated industry and (iii) mathematical ability as a limitation to entering the IT field. Since the initial workshop pilots in spring 2014, we have redesigned the school presentation, developed a short animation video on our degree programme which has been very positively received, and are in the process of designing short videos highlighting unique career paths in IT (business analysts, designers etc.). We will roll out a new, improved workshop with tailored animated videos in 2017. It is imperative to assess the longer term implications of a programme such as this one (Fisher et al. 2105). Subsequently, the updated workshop will be conducted with students in schools previously visited. Those students will be surveyed again to evaluate the longer term impact of the #MakeITWork programme.

Research findings illustrate that the misconceptions about the IT field are deeply entrenched with female students. While female students can see the benefits of engaging in the field, it is from a position of theory rather than intended practice. They do not see themselves in the IT field. We need to change this mind-set. This is a problem of perception that has crept up on us steadily over the past twenty years. The bigger question is what has caused this change in perception? It was not there in the 1990s (for example, there was a 50/50 split between men and women in the authors graduating classes).

What makes female perception of IT more negative in 2017 than 1996? We need to answer this question. For one thing, the field is growing and having a large part of the world's population unwilling or deterred from entering the IT industry due to (in large part) misconceptions, is untenable (Chhabra, 2014; Lev-Ram, 2014).

6.0 References

Adya, M. & Kaiser, K. M. (2005). Early determinants of women in the IT workforce: a model of girls' career choices. *Information Technology & People*, *18*(3), 230-259.

Ahuja, A. (2002). "Women in the information technology profession: a literature review, synthesis and research agenda." *European Journal of Information Systems, 11*, 20-34.

Ahuja, M. K. & Thatcher, J. B. (2005). "Moving Beyond Intentions and Toward the Theory of Trying: Effects of Work Environment and Gender on Post-Adoption Information Technology Use," *MIS Quarterly*, (29: 3).

Anderson, N., Lankshear, C., Timms, C., & Courtney, L. (2008). 'Because it's boring, irrelevant and I don't like computers': Why high school girls avoid professionally-oriented ICT subjects. *Computers & Education*, *50*(4), 1304-1318.

Ashcraft, C, Eger, E, and Friend, M. (2012). *Girls in IT: The Facts*. USA: National Center for Women in Information Technology (NCWIT).

Badal, S. & Harter, J.K. (2014) *"Gender Diversity, Business-Unit Engagement, and Performance"*, Journal of Leadership & Organizational Studies, Vol. 21(4) pp. 354 -365.

Beise, C., Myers, M., VanBrackle, L. & Chevli-Saroq, N. (2003). "An examination of age, race and sex as predictors of success in the first programming course", *Journal of Informatics Education Research*, Vol. 5 No. 1, pp. 51-64.

Beyer, S., Rynes, K., Perrault, J., Hay, K. and Haller, S. (2002), "Gender differences in computer science students", *Association for Computing Machinery SIGCSE Technical Symposium on Computer Science Education, Cincinnati*, OH, pp. 49-53.

Camp, T. (1997). "The incredible shrinking pipeline", *Communications of the ACM*, Vol. 40 No.10, pp. 103-10.

Chhabra, E. (2014). Code Debugs The Gender Gap In Tech. Forbes Magazine. http://www.forbes.com/sites/eshachhabra/2014/10/30/code-debugs-the-gender-gap-in-tech/. Last accessed Nov 27th, 2014.

Cisco Systems (2004). Gender Diversity Initiative. http://certmag.com/women-in-it-ciscos-gender-diversity-initiative/ Last visited Nov27th 2014

DeBono, E. (1985) Six Thinking Hats, Little Brown and Company.

DeSanctis, G. & Poole, M. S. (1994). Capturing the Complexity in Advanced Technology Use: Adaptive Structuration Theory. *Organization science, 5*, 121-147.

Drabowicz, T. (2014). Gender and digital usage inequality among adolescents: a comparative study of 39 countries. Computers & Education, 74, 98–111.

Dryler, H. (1998), "Parental role models, gender, and educational choice", *British Journal of Sociology*, Vol. 49 No. 3, pp. 375-98.

Eccles, J. (2011). Gendered educational and occupational choices: Applying the Eccles et al. model of achievement-related choices. *International Journal of Behavioral Development*, *35*(3), 195-201.

Eurostat (2014). Education Statistics - Share of women among tertiary students (science, maths and computing) http://epp.eurostat.ec.europa.eu/tgm/refreshTableAction.do?tab=table&pcode=tps00063&language=en Last accessed Nov 27th 2014.

Fisher, J., Lang, C., Craig, A. and Forgasz, H. (2015) *"If Girls Aren't Interested in Computers Can We Change Their Minds?*", European Conference on Information Systems, Completed Research Papers, Munster, Germany

Gürer, D. & Camp, T. (2002). An ACM-W literature review on women in computing. *ACM SIGCSE Bulletin*, *34*(2), 121-127.

Kahle, J. & Schmidt, G. (2004) Reasons women pursue a computer science career: Perspectives from women from a mid-sized institution. Journal of Computer Science in Colleges, 19 (4) (2004), pp. 78–89.

Kitzinger, J. (1995). Qualitative research: introducing focus groups. *Bmj*, *311*(7000), 299-302.

Leever, S., Dunigan, M. & Turner, M. (2002). The Power to Change is in our Hands. JCSC, 18, 2 December, 169-179.

Lev-Ram, M. (2014). The Global Talent Crunch. Fortune Magazine. http://fortune.com/2014/09/04/the-global-talent-crunch/. Last accessed Nov 27th, 2014.

Leiviskä, K. (2010). Attitudes of Sixth Form Female Students Toward the IT Field. ACM SIGCAS Computers and Society, 40 (1), 34-49.

Margolis, J. & Fisher, A. (2003). Unlocking the clubhouse: women in computing. Cambridge, MA: Massachusetts Institute of Technology Press.

Maringe, F. (2006). University and course choice: Implications for positioning, recruitment and marketing. *International Journal of Educational Management*, *20*(6), 466-479.

Millar, J. & Jagger, N. (2001). Women in ITEC courses and careers.

Natale, S. M. and C. Doran (2012). "Marketization of Education: An Ethical Dilemma." Journal of Business Ethics 105(2): 187-196.

Nonaka, I. & Takeuchi, H. (1995) *The Knowledge-Creating Company*. Oxford University Press, New York, NY.

Papastergiou, M. (2008). Are computer science and information technology still masculine fields? High school students' perceptions and career choices. *Computers & Education*, *51*(2), 594-608.

Remenyi, D. & Williams, B. (1995). Some aspects of methodology for research in information systems. *Journal of Information Technology (Routledge, Ltd.)*, *10*, 191.

Rezvani, S. (2015). Five Trends Driving Workplace Diversity In 2015. Retrieved November 11, 2016, from http://www.forbes.com/sites/work-in-progress/2015/02/03/20768/#37c4f9c634c9

renko, A., & Turel, O. (2016). Why are Women Underrepresented in IT? The Role of Implicit and Explicit Gender Identity, 22ND Americas Conference on Information Systems,

Teague, G. J. & Clarke, V. A. (1993). Attracting women to tertiary computing courses: Two programs directed at secondary level. ACM SIGCSE Bulletin, 25(1), 208-212.

Trauth, E. M. (2013). The role of theory in gender and information systems research. *Information and Organization*, *23*(4), 277-293.

Trauth, E. M. (2006). Theorizing gender and information technology research. *Encyclopedia of gender and information technology*, *2*, 1154-1159.Trauth, E.M., Nielsen, S.H. and von Hellens, L.A. (2003), "Explaining the IT gender gap:

Australian stories for the new millennium", *Journal of Research and Practice in Information Technology*, Vol. 35 No. 1, pp. 7-20.

Venkatesh, V. & Morris, M. G. (2000). Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior. *MIS quarterly*, 115-139.

Von Hellens, L., Nielsen, S. & Beekhuyzen, J. (2004). An exploration of dualisms in female perceptions of IT work. *Journal of Information Technology Education: Research*, *3*(1), 103-116.

Von Hellens, L.A., Pringle, R., Nielsen, S.H. & Greenhill, A. (2000), "People, business, and IT skills: the perspective of women in the IT industry", in Nance, W. (Ed.), *Proceedings of the ACM SIGCPR Special Interest Group on Computer Personnel Research*, Association for Computing Machinery, Chicago, IL, pp. 152-7.

Whitney, T., Gammal, D., Gee, B., Mahoney, J. & Simard, C., "Priming the Pipeline: Addressing Gender-Based Barriers in Computing," Computer, vol.46, no.3, pp.30, 36, March 2013.

Van Mannen, J. (1983) "Reclaiming qualitative methods for organisational research", in *Qualitative Methodology*, J. Van Maanen, ed., London: Sage Publications, pp. 520-526.

Victorian Curriculum and Assessment Authority (2009). VCE Studies Retrieved July 1, 2009, from http://www.vcaa.vic.edu.au/vce/studies/index.html.