Now I know what ICT can do for me!

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Abstract. The under-representation of women entering into information and communication technology (ICT) programmes is a long-standing problem. While ICT continues to be increasingly accepted and integrated into everyday life, gender stereotypes prevail in ICT turning female students away from ICT as an occupation. Based on existing literature on factors influencing girls’ career choices and on an empirical qualitative study in three schools in Australia, a conceptualisation of the influence of middle-school experiences on girls’ ICT study and career choices is presented. This conceptualisation is used as a guide to evaluate a recent intervention programme aimed at promoting ICT study and work opportunities to middle-school girls. A number of recommendations for future programmes are provided, highlighting the need to study how subcultures that support ICT career choices develop and are supported in Australian schools.

Keywords: School, Communication technologies, Gender, Careers

INTRODUCTION

The under-representation of women entering into information and communication technology (ICT) programmes is a long-standing problem. While ICT continues to be increasingly accepted and integrated into everyday life and school students have had technology topics integrated in their schooling since their pre-school years, students are still rejecting tertiary ICT programmes. Recent research shows that gender stereotypes prevail in ICT (Clayton, von Hellens & Nielsen, 2009), turning female students further away from ICT as an occupation. As a result, Australian universities are battling with low ICT programme enrolments and the ICT industry is experiencing a chronic shortage of qualified professionals and lack of diversity that is essential for innovation.

This paper uses a model built on existing literature, including the model by Adya & Kaiser (2005), and on a substantial empirical qualitative study in three Australian schools (Clayton, 2007), which conceptualises the factors that influence middle-school girls’ ICT study and career choices. The view taken in this paper on gender and career choices may be summarised as taking a middle ground between social construction and essentialism and has similarities to the theory of individual differences proposed by Trauth (e.g. Trauth, 2002,
Trauth, Quesenberry & Huang, 2009). This view is consistent with the traditional view within the field of career psychology where individuals act as ‘active agents in creating themselves and shaping their own destiny’ (Gottfredson, 2002, p. 87). While there are genetic heritage and environmental factors (including culture) that may influence our life path, their complex interaction is also influenced by other individual factors related to the way that the individual interprets their discrete mix of environment, genetic heritage and experiences.

Clayton’s (2007) research found that a large variety of factors influence ICT career choices and confirms that individuals react to and perceive these factors in different ways. A premise for undertaking interventions is that personal contact between ICT professionals and educators and girls who are facing career and study decisions may moderate the influence of social factors and support individual choice.

The design and implementation of the *Technology Takes You Anywhere* (TTYA) intervention programme promoting ICT study and career opportunities to schoolgirls is evaluated in this paper. Specifically, we consider how the programme took into account the influencing factors in Figure 1 and whether these factors were in any way modified for individual participants. This is not to argue that substantive change has taken place as a result of this programme; however, it is always a challenge to measure the success of a programme of this type (Craig, 2008), particularly one run without a central organisational base and by volunteer organisers. Limited sponsorship also meant that funds to conduct a full-scale evaluation of the event were unavailable; however, every attempt is made to gather consistent and relevant data from participants to compare results.

This paper is concerned with participants’ perceptions, attitudes and beliefs in relation to how these factors may have been modified by attendance at these interventions. We can thus reflect on what we as researchers learned from examining the intervention as well as what the participants stated that they learned from the experience.

The paper is structured as follows. The intervention at the centre of this paper is introduced in the next section, followed by the method of research for this paper. Then, Clayton’s (2007) model provides a conceptualisation of the influence of middle-school experiences on girls’ ICT study and career choices. This conceptualisation is used as a guide to evaluate a recent intervention programme aimed at promoting ICT study and work opportunities to middle-school girls. This intervention is called TTYA. Finally, a number of recommendations for future programmes are provided, aimed at introducing girls to opportunities within ICT education and occupations.

**THE INTERVENTION**

Within Australia, there have been a number of ICT interventions aimed specifically at encouraging middle-school girls into ICT study and careers. TTYA is an annual event held in Brisbane, Australia, attended by schoolgirls from up to 30 schools in South-East Queensland. It aims to inform schoolgirls and their teachers and parents, about ICT study and career options and increase the girls’ confidence and interest in an ICT career. The event, run on a scant budget (only a few thousand dollars), is managed and delivered by a volunteer committee of
industry, government and educational representatives and relies on volunteer presenters, sponsorship by local ICT organisations and higher education providers, donated prizes and promotional items. The onus this places on a small community of interested persons and sponsors has curtailed the expansion of the event.

In 2003, a small one-off grant was provided by the Queensland government to develop girls' interest in ICT. To roll the funds out across the state, action committees were established in eight locations throughout Queensland: Cairns, Townsville, Mt Isa, Gold Coast, Toowoomba, Ipswich, Sunshine Coast and Brisbane. The Brisbane event had the highest participation rate with approximately 150 people attending.

*Figure 1. Model of girls' ICT study and career choices (Clayton, 2007).*

From this modest beginning, these events expanded to involve up to 1500 girls per year from Years 4 to 12 (ages 8 to 17). Strong interest from the younger years has resulted in registrations filling within days of opening. In 2008 and 2009, the number of participants was significantly lower (522 and 502, respectively) due to limited funds, possibly as a result of the global financial crisis or a lack of interest in supporting the event.

While the first event only involved role model talks, software demonstrations and bags with ICT information and giveaways, subsequent events expanded to include hands-on robotics, gadgets and gismos, and game development activities and biomedical, forensic and cryptography workshops delivered by ICT and relate industry professionals. Other activities included role model talks and break-out sessions where the girls (Year 7 students aged 11–12 years and beyond) could mingle with role models, ICT professionals and tertiary institution representatives. The buzz of enthusiasm and excitement in this break-out area is tremendous. Similar events are run in other states; most notable is the biennial Victorian Go Girl: Go For IT! event.

During the TTYA event, the girls are asked to complete a short survey about their experiences on the day, with those agreeing to this request given a chance to win a prize. The accompanying teachers/parents are similarly surveyed. The event also provides the opportunity to observe student interactions with the role models and presenters and between their peers and their teachers. The collected data give some insight into individual girls’ opinions and beliefs about ICT study and careers, and their experiences at the event. One of the drawbacks of collecting data at these events is the limited time available for the participants to complete the surveys; however, the organisers feel it adequately captures their perceptions at the time of the event. The following section describes the theory that is used for the evaluation of the intervention. The data from the evaluation of the TTYA intervention are included in the discussion where appropriate.

Craig’s (2008) research argued that having a clear goal for the intervention makes it easier to evaluate its success; the goal of TTYA is to first expose the girls to positive experiences with technology, supporting this by giving them information about ICT studies and careers. Both of these goals are easily measured, the first by the many positive comments received from participants that they ‘wouldn’t change a thing’ about the event because ‘it was awesome!’ (TTYA, 2008). Information is given to girls and the teachers/parents in show bags at the event.

METHOD

Based on existing literature on factors influencing girls’ career choices and on an empirical qualitative study in three schools in Australia, a conceptualisation of the influence of middle-school experiences on girls’ ICT study and career choices is presented. This conceptualisation is used as a guide to evaluate a recent intervention programme aimed at promoting ICT study and work opportunities to middle-school girls.

The ongoing research on factors influencing female perceptions of ICT study and careers (von Hellens & Nielsen, 2001) has guided our research of designing and running interventions

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aimed at encouraging females at various developmental stages into ICT paths, including TTYA. The initiative evaluated in this paper is especially aimed at increasing the middle-school girls’ interest in ICT education and occupations. In Australia, the middle-school phase is an educational term describing the period between Years 4 and 9 (8 and 14 years) in primary and secondary schooling.

Second, the first author’s doctoral dissertation (Clayton, 2007), an interpretive study of the middle-school experience on girls’ ICT study and career choices, has guided this evaluation of TTYA. Figure 1 illustrates the conceptualisation of the affecting factors that was empirically tested and validated in the doctoral study. This doctoral study involved a government (free tuition) co-educational school, a private (tuition charged) female single-sex school and a private (tuition charged) co-educational school, providing a broad perspective to the classroom culture in Australian schools. The data collection was composed of 58 classroom visits involving observations and group interviews with 69 students. Individual semi-structured interviews of six teachers were also conducted to provide further contextual clarification for the student interviews and classroom observations.

Our third research task for this paper is the evaluation of an intervention aimed at increasing the middle-school girls’ interest in ICT education and occupations. Craig (2008) proposed an evaluation framework for evaluation intervention programmes such as TTYA. She argued that the evaluation framework ‘empowers the program members to be able to conduct useful evaluation when limited resources do not stretch to employing the services of an evaluation expert’ (p. 213).

The data used in this study was collected at three sessions/events in 2008 and 2009. The data are reported in a publicly accessible evaluation report. In 2008, the event was split into two sessions. The morning session was attended by girls from Years 5 to 7. The afternoon session was attended by girls from Years 8 to 10. Eighteen teacher and 522 student evaluation surveys were collected from the two sessions. The following chart illustrates the percentage of attending students (TTYA, 2008).

In 2009, TTYA was open to girls from Years 4 to 9. It was decided to focus the event on the most interested age group in 2008. Nineteen teacher and 502 student evaluation surveys were returned from the 575 students attending. Due to the event falling on a private school holiday, the total attendance was from public schools.

The data were collected during the event. The same survey is used each year and given out in the final session of the day. Each girl was asked 13 questions about her use of technology (e.g. what for, how often, where) as well as her experiences at the event that day (e.g. enjoyment, positive feelings). They were also asked about their favourite event of the day and about their perceptions of working in the technology industry after attending the event. The students were also asked to agree/disagree with a number of statements about technology. Although desired, it was not possible to follow up with the students due to difficulties related to privacy restrictions and minors in Australia. A mix of qualitative and quantitative data was collected. The results of the survey are published in an evaluation report each year, which is publicly available on the event Web site. All quotes and data in this paper come from the 2008 and 2009 evaluation reports.
THE MODEL OF GIRLS’ ICT STUDY AND CAREER CHOICES

Clayton’s (2007) dissertation explored the ICT attitudes and perceptions of metropolitan Brisbane middle-school students, their ICT experiences and the influence that these perceptions, attitudes and experiences have on their ICT study and career choices. Based on a search of relevant literature and an empirical study, a model of Girls’ ICT Study and Career Choices (see Figure 1) was developed. The model captures the many factors that influence Australian girls’ ICT study and career choices and uses similar groupings to those suggested in Adya and Kaiser’s (2006) seminal paper. However, Clayton’s research indicated other influential factors that were not included in the early determinants of Adya and Kaiser, such as socio-economic status involving family and ICT access issues. Individual attributes also required conceptualisation at a more detailed level because factors such as interpretations of experience, personality and aptitude, goals and self-schemata and subjective task value appeared to be highly influential. All of these factors and the study and career choices take place in an environment affected by the students’ cultural context. Socio-economic factors further shape some of the social and structural factors, including home and school ICT access, curriculum and teaching and ICT-related resources. All of these influences should not be regarded as being equal in origin or effect; they depend on the context and on the individual’s interpretation of events. The outcome is also not absolute and can be changed if a particular influence is greater than the cumulative effect of other influences.

Clayton’s (2007) research found that ICT subjects are regarded as being synonymous with computer literacy, and low-level skills are taught in these classes. Individual attributes, such as personality, aptitude and attitudes, goals, subjective task value and interpretations of experience, were identified as being influential. The girls were enthusiastic and confident users of ICT but expressed an ‘I can, but I don’t want to’ attitude towards ICT study and careers. In contrast to the boys, the girls did not explore the computer, concentrated on completing their work and were generally compliant with rules.

This paper applies concepts previously presented to evaluate interventions to encourage Australian girls to consider ICT study and career pathways. The comprehensive discussion of all factors can be found in Clayton (2007). This paper focuses only on the factors that are specifically associated with the programme. We also discuss how the intervention programme took into account these factors in the design and conduct and how these factors have been modified.

EVALUATION OF THE PROGRAMME

Social factors

The current generation of school students are often referred to as the ‘Net Generation’ (Oblinger & Oblinger, 2005). Many of them were introduced to ICT as toddlers, or during early childhood education, and have been ‘socialised to use computers and the Internet from an
early age’ (Durndell & Miller, 2006, p. 696). Consequently, they are confident and competent users of computers, mobile phones, the internet, email and instant messaging.

Participants at TTYA report using ICT for five main activities: assignments, email, games, chatting and internet surfing. However, this often does not translate into young people wishing to study ICT or take it up as a career. Therefore, the events aim to broaden their perceptions of ICT by building upon their own personal experiences and introducing them to topics such as programming, robotics and interactive design. Hands-on activities are crucial to the event, attempting to make a connection between using and building ICT.

Family

Family is an important influence on study and career choices during childhood and into adolescence (Barker & Aspray, 2006), and family expectations contribute towards girls’ decisions to enter ICT study or career pathways (Lang & McKay, 2006). Children are keen observers and notice the role that their parents take in everyday life (Margolis & Fisher, 2002, p. 21), including ICT use at home and in the workplace. In Australia, as reported by Downes (2002, p. 188), ‘the resident computer expert in the home is usually male (father or older brother) and the least involved in the family is usually female (mother or younger sister)’. As such, the ICT attitude of their parent potentially provides inspiration for some, or despair for others, especially females, due to the absence of strong tech-savvy female ICT role models in the home (Moorman & Johnson, 2003).

According to Adya & Kaiser (2006), early parental involvement in a child’s career planning has been found to have a clear positive bearing on the choice of ICT as a career. Furthermore, Dryler (1998) stated that children often make vocational and occupational choices in the same area as their parents and that highly educated parents promoted gender-atypical occupations more than less educated, or working-class, parents. Parents whose daughters attend TTYA sometimes recognise their own ignorance of ICT careers and the need for access to better information. As one parent commented, parents do not realise ‘where and how girls can go to achieve a great career in IT’. A strategy for overcoming such nescience is the distribution of the book Tech Girls Are Chic, Not Just Geek! (Beekhuyzen & Dorries, 2008) to each attending girl. It is hoped that parents will also use this book to educate themselves about ICT careers.

Peers

Peers exert a powerful influence on a child’s beliefs and behavioural choices (Henslin, 1999; Barker & Aspray, 2006). They influence beliefs about the value of education, gender roles and academic choices, and throughout the teenage years, there is an increased need to conform to the qualities that their peers feel are acceptable (Barker & Aspray, 2006). Males and females are likely to engage in different activities and acquire different competencies, patterns of expectations, values and long-term goals if their peers reinforce traditional gender role behaviours and values (Eccles et al., 1999). Peers also play a role in student course selection decisions (Margolis & Fisher, 2002). In order to avoid negative attention from their peers,
students are more likely to choose subjects that are locally considered to be appropriate for their gender role (Barker & Aspray, 2006).

However, the TTYA intervention shows that girls are able to resist peer pressure and/or are part of a peer group that resists gender stereotyping (discussed later). For example, in the TTYA sessions that focused on robotics, programming and computer hardware, the girls showed a strong level of competitiveness. Reflecting on their school ICT classes where they were significantly outnumbered by boys, they commented: ‘you get to shame out the boys because they think that they know everything’, and it was great ‘being the only girl in the class and beating all of the boys’. Another girl added, ‘I’m one of five girls in a class of 20 and I’m the top of the class’.

Media

Mass media, such as television, movies and magazines, play a large role in influencing perceptions of ICT (Gürer & Camp, 2002) and reinforce cultural expectations of gender stereotypes (Henslin, 1999). Furthermore, mass media images of ICT carry implicit and significant messages about gender roles; frequently, computer programmers and developers are men, while the users are female (Barker & Aspray, 2006). It is also problematic that there is a distinct lack of both fictional and real-world role models within mass media, and where they do exist, they frequently reinforce unflattering and negative stereotypes and spread misinformation about the use of ICT in real-world situations (Multimedia Victoria, 2001).

Accordingly, teachers/parents of girls attending TTYA cited ICT stereotypes in the media as influential: ‘IT seems to be a lonely, difficult and demanding job as it is portrayed on TV’. Teachers also said that by attending TTYA, they gained a better understanding about ICT careers, and with this understanding, in almost all instances, the teachers now encourage students to pursue an ICT career.

Role models

A role model is a person who possesses the skills, values, attitude and appearance admired by another and serves as a source of inspiration for another person to emulate (Lagesen, 2006). Role models can be parents, older siblings and teachers, whose beliefs about appropriate educational interests, social norms and gendered behaviour are communicated both explicitly and implicitly (Barker & Aspray, 2006). According to Barker & Aspray (2006), teachers are one of the most common role models for students because of the amount of time they spend together and the authority relationship that is in place. Without positive female role models in non-traditional fields, girls may ‘self-select themselves towards careers in which they observe other women, thus further intensifying the gender-based stereotyping of professionals’ (Ahuja, 2002, p. 25).

The opportunity to speak to and listen to role models at the TTYA events is highly regarded by both the teachers/parents and students. Each year, more than 85% of participants report the usefulness of role models participating in the event’s activities. The accompanying teachers and parents also found the role models to be of significant value to the girls. One parent
commented that it was useful for ‘showing my daughter the many options available, especially as she wants to be a teacher in primary school, and she now sees the value in ICT’. One 15-year-old girl commented, ‘[the session] showed us that IT isn’t just about boring repetitive business, but is really versatile’; another 15-year-old commented, ‘my favourite session was the [role model] forum as it provided great insight into the IT world’.

Interestingly, the percentage of girls who stated that they already had a role model increased from 6% in 2004 to 49% in 2005. This could be seen as a positive sign of a change and demonstrating the significance and impact of previous TTYA events. These role models were primarily from within the family, second, teachers, and third, their friends, all three groups being equally important to the girls participating in events.

Stereotypes

Gender roles and stereotypes are learned in the home, at school and through the media, and they are a primary reason for the rejection of certain occupations (Trusty et al., 2000). Eccles (1994, p. 604) found ‘that parents and teachers distort their perceptions of the competencies of particular girls and boys in various domains in a gender role stereotypic fashion’, and this was strongly supported in Clayton’s (2007) study where despite teacher support, students ‘bowed to peer pressure to make themselves appear less knowledgeable’ (p. 205). Some teachers/parents attending TTYA commented that girls ‘think it [ICT] is too hard and are afraid to take the leap’ or that there is ‘a lack of belief in girls’ ability to enter the area’.

Teachers’ beliefs and attitudes about appropriate behaviours and roles for boys and girls, combined with their attitudes and beliefs about technology, can subtly influence girls not to study ICT (Barker & Aspray, 2006, p. 20). Furthermore, the masculinisation of the ICT field discourages many people from choosing ICT as a career (Byrne & Lyons, 2001; von Hellens et al., 2003). Some parents of girls attending TTYA understand the problem of stereotyping; one commented that ICT is ‘not seen as a “girl” career – girls [are] not encouraged to do IT or to see themselves as successful in IT’.

One of the major inhibitors to increasing the uptake of ICT in education, or as an occupation, is the widespread stereotyping of the characteristics of people involved in the ICT industry. ICT jobs are often stereotyped as being highly technical rather than creative (Multimedia Victoria, 2001), and this was confirmed by parents involved in TTYA who said that there is the ‘belief that it is all about programming and the technical aspects of computers’. Moreover, ‘there is very little awareness of the breadth and depth of the industry, the career options that are available, the jobs available to individuals and the day-to-day activities one would undertake’ (Hinds & Croft, 2006, p. 23). One of the most common reasons for the lack of girls’ interest in ICT cited by the teachers/parents attending TTYA is the lack of available information about ICT careers. Furthermore, they called for this information to be given to girls early in their education. Responses spoke about the ‘misconception of what IT actually is’, that ‘girls don’t know enough about what it is about’ and ‘I don’t think girls realise the diversity of positions available in IT’, thus the decision to target the events at girls as young as eight.
It is not clear if the aforementioned would stop girls from considering ICT studies or jobs. One teacher commented during TTYA, ‘don’t downplay the role of PROGRAMMING and MATHS too much! – some of us women get a buzz from this! – and the girls who have no experience yet of programming may be put off despite the fact that this may be something that would suit them well’. Comments from the girls about the types of ICT activities that they enjoyed backed this teacher comment. There are many responses indicating an interest in programming, software engineering, artificial intelligence, building robots and tinkering with computers as well as an interest in the creative and social aspects of ICT. What is required is the early exposure of girls to these ICT domains to inform them about what is available.

Overall, the feedback on the event regularly shows a positive shift in opinion about studying ICT subjects at school. Comments from the girls included ‘I didn’t realise I liked it until about a month ago’, ‘I wasn’t really interested in it, but now I am interested in doing IT as a subject’ and ‘I plan on being a barrister though after the games seminar I am a little tempted’.

**Structural factors**

Teachers, the ICT curriculum and the way it is taught along with the quality, availability and maintenance of ICT-related resources (including computers and other ICT devices, internet access and furniture/environment to use the computers and devices) can have a powerful influence on how ICT is perceived by students and people who influence them. This influence can range on the spectrum from being extremely positive to strongly negative.

The school environment influences ICT access and the curriculum in that a lack of resources and technical support affects the amount of access available and the activities and skills taught in the classroom. Many schools do not have the technical expertise or budgets to keep the ICT in the classrooms performing at an optimal level, and in some cases, a teacher also doubles as a technician (Soloway & Norris, 1999). Furthermore, according to Cleary *et al.* (2006), the amount and quality of school ICT resources and internet access that are available are important if the student does not have home access.

Considerable evidence points to the content and delivery of the secondary ICT curriculum being an important factor in interesting students, especially girls, to continue in ICT pathways (Newmarch *et al.*, 2000). Many students report negative opinions of ICT-specific subjects and general dissatisfaction with the ICT curriculum (Carey, 2001; Multimedia Victoria, 2001). They found secondary school ICT classes boring because the classes had lost the element of fun and creativity, and there was little difference between what is taught at the primary and secondary school levels (Pau *et al.*, 2005). According to Goode *et al.* (2006, p. 91), ‘even at schools that are “heavily wired,” computer science is too often interpreted as “computer literacy” and only low-level user skills are taught’. The students are obtaining a skewed view of the ICT field because of the focus on mastering software packages and the perception of ICT being simply word processing (Newmarch *et al.*, 2000; Downes, 2004). Other common impediments to pursuing ICT education and careers cited by the students attending TTYA included timetable clashes, prioritisation of subjects and the unavailability of ICT subjects.
Many of the teachers/parents involved in TTYA called for teacher education to show them that ‘computers extend outside of word processing/spreadsheets and database’ and assistance to show them how to promote ICT to girls. There was a call for more female ICT teachers, changes to the syllabus and increased government funding to progress ICT promotion and support female teachers in ICT subjects. Others recognised the role of the parent in promoting ICT to the girls and called for parents to be educated.

Individual attributes

Trauth (2002) pointed out that individuals experience societal influences in different ways and vary in their response to gender group biases. Ham, Junankar & Wells (2009) confirmed that personality has a significant effect on occupational choice outcomes, in particular for females. Trauth et al. (2009) proposed a number of constructs that enable theorising of within-gender variation. These constitute the major constructs of individual identity (personal demographics and career items), individual influences (personal characteristics and personal influences) and environmental influences (cultural, economic, policy and infrastructure). Trauth et al. (2009) focused on women who are in the information technology workforce, but they may apply with some modification to younger female subjects. Many of these factors are represented in aspects of the model shown in Figure 1.

Although it is not feasible to report on the variations in such a large group of girls, it may be inferred that all the girls participating in the intervention showed their individualism by attending an event for a non-traditional career choice. Their remarks reported earlier represent their ability to respond to social influences in non-stereotypical fashion, as mentioned earlier, ‘Being the only girl in the class and beating all of the boys’.

Cultural context

As mentioned earlier, the conceptualisation of influential factors is viewed within the wider cultural context. Australia is recognised as a young, culturally diverse country, whose population includes people from diverse national and ethnic background. Young (2002) affirmed the influence of national culture and families in relation to girls and ICT in Australia, and Harris & Wilkinson (2004) suggested that this influences the potential entrants to the ICT field. Several studies have identified significant differences in perceptions of ICT study and work between different national cultures (e.g. Nielsen, von Hellens, Pringle & Greenhill, 1999; Adya, 2008). Furthermore, Clayton’s (2007) study showed that there is very little in the school environment, which supports a strong ICT culture. Currently, we can not compare this with the development of other vocational subcultures as there has been very little investigation in this field.

The cultural diversity represented at TTYA makes it difficult to assess the influence of specific national cultures or indeed multiculturalism, which is strongly supported by Australian educational policy. Educational researchers also propose that the culture of a learning community not only involves the educational institutions (teachers, students and administrators)
but also parents and community organisations involved in school life (Cavanagh & Dellar, 2001). To study the contextual influences and processes by which career choices are developed, we propose that for vocational education (such as ICT), the involvement of professional organisations and the industry also needs to be considered. This has been demonstrated by reflection on TTYA; in interventions such as these, industry mentors, academics and university students are actively involved in transmitting ideas and values to school students, supplementing, reinforcing and in some instances contradicting the ideas and values that are transmitted through formal education.

There has been almost no research carried out into the development of subcultures in schools in relation to career aspirations, apart from a recent study by Tsolidis (2006, 2008). As well as discussing the development of subcultures based on national or ethnic background, this paper identified other school subcultures as ‘the popular kids’, ‘the nerds’, ‘the musos’ and ‘the jocks’. Some students showed great resilience in rejecting the need to belong to a subculture, but most students enjoyed the support that similar-minded students provided or found it difficult to ‘go it alone’. These subcultures especially helped students determine their future options (or limit them, in the case of ‘the jock’ subculture).

However, research in Australia has focused on student subcultures associated with ethnocultural identity. Our evaluation of this programme suggests the need to study how subcultures that support particular career choices develop and are supported in Australian schools.

**CONCLUSIONS AND RECOMMENDATIONS**

According to our experience, programmes such as TTYA go a long way towards breaking down stereotypes and dispelling fears associated with tinkering with computer hardware and software, demonstrating the opportunities provided by ICT and helping girls to know what ICT can do for them.

Craig’s (2008) research contributed to the gap in the literature by investigating how these types of intervention programmes should be evaluated. She asked, ‘what effect have all these initiatives and strategies (like TTYA) had’? She argued that it could be interpreted that with the continuing low number of women in computing education and the profession that these strategies have had limited or no success at all. However, she offered an alternative view of measuring the successfulness of these programmes, that the percentage of women in the discipline may have been worse still if these strategies and the intervention programmes associated had not been conducted. This paper agrees with the latter statement.

Several issues created problems. Historically, TTYA had a significantly greater number of participants from private schools or public schools in more affluent suburbs. Transportation costs and costs associated with releasing teachers to supervise the students may have caused lower participation rates from less affluent schools, indicating that in-school programmes may be easier to organise for lower socio-economic schools. Furthermore, teacher interest was crucial and the programme depended on teacher involvement and enthusiasm.

A limitation of this study is, as pointed out earlier in the method section, that the three sets of research tasks for this paper overlapped. There was the urgent need for effective interven-
tion programmes, as the female numbers in ICT education did not improve and actually declined. The scope of data available in the evaluation forms from TTYA was limited as we were constrained by how much we could ask in the time.

Despite these issues and limitations, this analysis of the TTYA event gives support for the argument presented in Craig’s doctoral dissertation, ‘Attracting Women to Computing’ (2008), which found that most intervention programmes are conducted by volunteers with limited resources at their disposal. Generally, the women organising and participating in these events are passionate about the need for more females in computing and are prepared to devote large amounts of their own time to make a difference. Also, in line with Craig’s findings, the organisers of TTYA are practitioners, not qualified evaluators, and are more concerned about the implementation of the programme than its evaluation; the main evaluation concern comes from the researcher. Each year, the organisers consider that TTYA has been successful.

**Learning from the intervention**

The theoretical finding of this paper is to provide further validation of the model of Girls’ ICT Study and Career Choices illustrated in Figure 1. We discovered that the socio-economic factors were less influential, and the individual attributes were shown to be more significant.

Our research showed that there is very little in the school environment that supports a strong ICT culture. Currently, we can not compare this with the development of other vocational subcultures as there has been very little investigation in this field. There has been almost no research, apart from Tsoloidis (2006, 2008), carried out into the development of subcultures in schools in relation to career aspirations. The intervention discussed in this paper shows early signs of the development of a subculture of young women interested in ICT education and careers.

Recommendations for practice reinforce findings from an earlier study (Beekhuyzen, Clayton & von Hellens, 2006):

1. adequate and realistic funding to run these projects;
2. a coordinator to build and maintain good relationships and networks;
3. increasing use of evolving technologies for mentor/student communication;
4. integration of mentoring projects into the school curriculum; and
5. a project champion with power and status to overcome bureaucratic difficulties.

It is difficult to carry out evaluations of these interventions while allowing the participants to focus on their interests. Time is limited, and events do not always unfold as planned. It is also difficult to recruit girls who are at the stage of making final decisions about where and what to study as they are often focussed on intensive study to achieve the highest possible university entry scores. Recruiting younger girls is easier, and it is important to continue to contact them before they have started to firm up their career choices. The contacts need to be maintained so that their early interest is not undermined by negative influences as discussed earlier. This is especially important as there is no strong ICT-oriented subculture in schools.
CONCLUSION

While the enthusiasm of the girls, teachers and parents attending these events was extremely positive, we did consider that these programmes might be ‘preaching to the converted’ and not reaching those whose attitudes we wish to change. That is, an unknown number of the girls and teachers who attended these events may already have a keen interest in ICT. For example, the 2004 TTYA event was held outside school hours and it would have required the sacrifice of a significant amount of time for the teachers, parents and students to attend, especially those who travelled a considerable distance. However, the tremendous response during the 2005 TTYA event that was held within school hours does not totally support this idea. There also was a heartening increase in students studying ICT at school (47.5% to 59%) and those intending to pursue ICT study or career options (36.1% to 46%). Perhaps most importantly, the girls who participated have become better informed to make choices. As one student commented in the feedback on TTYA, ‘now I know what ICT can do for me’.

The issues discussed in this paper are not just relevant to Australian girls; they are equally applicable to most Western nations. Therefore, this study, presented within Australian context, has applicability and implications to a much wider audience.

REFERENCES


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**Biographies**

**Jenine Beekhuizen** recently completed her doctoral studies examining how information systems support unauthorised file-sharing activities within an underground online community. Her critical ethnography of the digital music world conducted at Griffith University in Brisbane, Australia, contributes to the gap in the information systems knowledge on file sharing and online communities (http://www.iiiet.net.au/~beek/phil.pdf). In addition to her completed doctorate, Jenine has a Bachelor of Information Technology with First Class Honours, a Graduate Certificate in Research Management, and a Diploma of Business. Jenine is also part of the Women in Information Technology (http://www.winitproject.com) project, a longitudinal study exploring the under-representation of females in IT education and work. In 2007, she accepted an invitation as a visiting scholar to Hanover, Germany. Jenine is also an NVivo software trainer and consultant in qualitative research design and analysis and is active in the Information Systems community. Jenine’s not-for-profit book *Tech Girls Are Chic, Not Just Geek* aims to inspire young girls to a career in information technology (http://www.techgirlsarechic.org).

**Kaylene Clayton** has a diverse academic and professional background having worked in the health, maritime and IT fields. Kaylene has completed an IT degree with honours, winning the degree and university medals for academic excellence. Her honours research project explored information and communication technology (ICT) perceptions and experiences of Years 9 and 12 students and their teachers. Kaylene followed up on this research with her 2007 PhD, which investigated the influence of middle-school ICT experiences on girls’ ICT study and career choices. The Australian Council of Professors and Heads of Information Systems unanimously selected her thesis as the best Australian information systems PhD thesis of 2008/2009. In 2007, her achievements were also recognised when she won the Queensland Government’s ICT postgraduate student Smart Women – Smart State award. Kaylene continues to be part of the WinIT Project (http://www.winitproject.com), a longitudinal study exploring the under-representation of females in IT education and work.

**Sue Nielsen** is currently adjunct Senior Research Fellow at the Institute for Integrated and Intelligent Systems at Griffith University, Australia, and has more than 40 years experience as a practitioner and academic in the fields of Library Science and Information Systems. She is co-founder with Professor Lisa von Hellens of the WinIT project (http://www.winitproject.com), and more recently, established the Seek and Sign project to develop mobile technologies to improve the communication environment for young deaf children. Sue has a master’s degree in Communication and Linguistics, a PhD in Information Systems and consults in qualitative research methods across a number of disciplines.