An investigation of the benefit of using IT in the context of university students with ADHD

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Abstract: Attention deficit hyperactivity disorder (ADHD) is estimated to affect approximately 11% of the university populations which make it the second most prevalent disorder among North American university populations. This disorder impacts such students when it comes to keeping up with academic loads, study skills, and social life. Technology has the capability to improve mental health services. In the last decade, Australia has become one of the leading countries in providing e-mental health services and so a study has been designed to investigate possibilities in this country. The study design outlined in this paper proffers a possibility for applying information communication technology (ICT) solution to facilitate the current treatment/management of ADHD in university students.

Keywords: attention deficit hyperactivity disorder; ADHD; IT; e-mental health; university students; neurofeedback; CBT; grounded theory.

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1 Introduction

Rapid developments in internet and mobile technologies during the last two decades have enabled healthcare providers/services worldwide to adapt these technologies in order to facilitate better service delivery. In the field of healthcare, mental health services is an area which could greatly benefit from implementing such technologies. In recent years, Australia has become one of the leading countries in providing e-mental health services (Christensen and Petrie, 2013). Technology has the promise to improve mental health services especially by enabling early intervention and treatment for many people (Christensen et al., 2002), especially young adult with mental disorders such as attention deficit hyperactivity disorder (ADHD).

Between 4% and 11% of students at university level have symptoms of ADHD (Dipeolu, 2010). These symptoms usually have a negative impact on academic performance (Heiligenstein et al., 1999) and usually affect such students in terms of keeping up with their academic load and various aspects of social life (Quinn, 2001; Barkley, 1998). Typically, individuals with ADHD are deficit in executive functions, such as working memory (WM) (Barkley, 1997b) which is related to academic performance (Gropper and Tannock, 2009). ADHD often co-occurs with learning disabilities (LD) such as difficulty in organising time, poor reading, writing, or spelling skills, or completing tasks abilities (Mayes et al., 2000). The most effective treatments of ADHD include medication, education, therapy, and coaching (CADDRA, 2011; Department of Human Services Victoria, n.d.).

The emphasis of this research will be on the non-pharmaceutical treatment. Specifically, it investigates the use of IT in current treatments and the possibility of introducing IT into the traditional treatment context. In this research design four case studies will be selected, each case study concentrates one treatment and a role for IT in the context of each treatment will be examined.

2 Background

In this section, a brief background of the use of IT in healthcare in general is provided, followed by a definition of e-health and the use of technology in mental health services in

general, and ADHD in particular. The last part of this section will point out the relevance of ADHD in university students and what current non-medication treatments are used to treat and manage ADHD.

2.1   Technology for mental health and ADHD

Technology in healthcare has the potential to assist developed and developing countries to solve many issues they are facing (Wickramasinghe et al., 2005a), such as easy access to information and services, coping with changing in population health patterns and satisfaction and safety of stake holders. Healthcare is becoming technology-driven with the possibility of successful adoption of e-business in the form of e-health (Wickramasinghe et al., 2005a; Moumtzoglou, 2011). There is a wide range of e-health services (Eysenbach, 2001; Wickramasinghe et al., 2005b) and e-mental health is one of them.

Even though, the use of technologies in mental healthcare is relatively new, there are positive feelings in using technologies among different age groups, for different mental illness preventions, treatments, and management (Whittaker et al., 2012). Technology has the potential to improve efficiency, accessibility and the opportunities for early intervention and treatment of for young adults (Anthony et al., 2010; Christensen et al., 2002), especially in treating young adults with ADHD (Beck et al., 2010).

Technological tools and methods, such as internet-based interventions and mobile-based application or short message services (SMS) therapy are used for the treatment of people with mental illness like depression and anxiety (Whittaker et al., 2012). They also can target young adults seeking mental health attention (Christensen et al., 2002).

ADHD in young adults causes attention difficulties, and emotional instability which affects their life outcomes and results in underachievement (Wallace et al., 1999). They are in greater risk of developing anxiety, depression (Heiligenstein and Keeling, 1995), LD (Wender et al., 2001) and deficits in executive functions, such as WM, and planning (Barkley, 1997a). ADHD is estimated to affect approximately 11% of the university populations in North America and the majority of these students will face academic difficulties and perhaps will not complete their degree (Dipeolu, 2010; Grenwald-Mayes, 2001). Gropper and Tannock (2009) argue that there is a relationship between WM and academic performance in university students with ADHD too.

Department of Human Services Victoria (n.d.) and the CADDRA (2011) state that to better treat ADHD is to include different types of methods. These include medication, therapy, education, and coaching. The therapy methods include: cognitive behavioural therapy (CBT) (Safren et al., 2005), neurofeedback therapy (Lansbergen et al., 2011), and working memory training (WMT) (Westerberg et al., 2007). Coaching and education are affective for adults with ADHD to improve their study and social skills for example (Tuckman, 2009).

The aim of this study is to investigate the use of IT in the treatment/prevention of ADHD in university students as well as introducing a framework that might facilitate IT involvement in non-pharmaceutical therapy. This research will use a collective case study approach with semi-structured interviews as the data. To analysis the data within-case and cross-case analysis will be applied. The frame of analysis will be based on grounded theory methodology.

3   Literature review

The Australian Government is investing heavily in e-mental health services because technology can assist in overcome issues that are preventing young people from seeing mental health services/providers and creating barriers to treatment. Problems include; lack of access of mental health services due to location, time or perhaps financial matters (Booth et al., 2004); stigma incurred by seeing a therapist (Burns et al., 2010; Christensen and Hickie, 2010) and therapist time and efficacy (Jorm et al., 2007). Reynolds et al. (2011) argue that there are two types of e-mental health programmes in Australia:

1   Information, support and assessment websites: this includes informative website, diagnostics tools and screening methods.

2   Symptom prevention and management programmes: these programmes are designed to treat or manage specific mental illness such as depression and anxiety.

The Australian Government has invested $70.4 million to date in developing and funding e-mental health services and telephone crisis assistance, also the Australian Government (2012) will invest a further $110.4 million in the next four years. This investment is targeting young people in Australia using internet technologies. An estimate conducted between 2012 to 2013 showed that 96.5% of 15 to 24-year olds use the internet in Australia (Australian Bureau of Statistics, 2014) By reviewing the list of the online or telephone services that were provided in the E-Mental Health Strategy for Australia documents (Australian Government, 2012), the majority of e-mental health programmes are targeting depression, anxiety and suicidal thoughts illness. Even though between 5% and 10% of young Australians suffer from ADHD (The Royal Australian College of Physicians, 2009). This commitment to adoption of technology in Australia makes the country a potentially rich site in which to consider possibilities.

3.1   ADHD

ADHD is one of the most common childhood behavioural disorders and can continue through adolescence and adulthood (Fischer et al., 1990), with between 5% and 10% of the childhood population having ADHD (The Royal Australian College of Physicians, 2009) Barkley (1998) argues that the symptoms of children with ADHD are usually hyperactivity, inattention, daydreaming, and impulsiveness. Some of these symptoms will vary from one child to another (Barkley, 1998).

3.1.1   University students with ADHD

Studies have indicated that there is a relationship between ADHD symptoms and university students' academic underperformance (Heiligenstein et al., 1999). Fewer of ADHD students complete their degree than non-ADHD students (Barkley et al., 2008; Barkley, 2006). There are issues that university students with ADHD face during their studies (Quinn et al., 2003) such as finding university academic style and social life overwhelming and hard to adjust to which may result in dropping out (Barkley, 1998). Often university students with ADHD are lower in function on a number of academic variables comparing to their peers (Heiligenstein et al., 1999) (Table 1).

Table 1   Academic variables

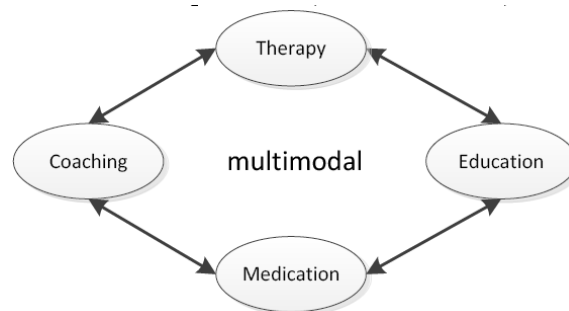| Academic variables	References
Study skills – note taking, summarising, organising	Mannuzza et al. (1998)
Anxiety, depression and motivation	Meaux et al. (2009)

Therefore, they usually have some common academic pattern behaviours which are listed in Table 2.

Table 2   Critical ADHD factors affecting university students

Factor	References
Higher rates of subject failure	Grenwald-Mayes (2001)
Lower grade point averages	Murphy et al. (2002)
Class attendance	Wolf (2001)

3.1.2 *Treatment and management of ADHD*

The recommended treatment/ managing ADHD symptoms in adults should contain combinations of coaching, education, therapy, and medication (Department of Human Services Victoria, n.d.; The Royal Australian College of Physicians, 2009; CADDRA, 2011). Such an approach is called Multimodal framework (Figure 1).

Figure 1   The multimodal framework

Source: Adapted from CADDRA (2011)

Therapies that have been seen useful for treating ADHD in adults include CBT (Ramsay, 2012), neurofeedback therapy (Gevensleben et al., 2009), and WMT (Klingberg et al., 2005).

"CBT refers to the pragmatic combination of concepts and techniques from cognitive and behaviour therapies common in clinical practice" (Kaltenthaler et al., 2006).

Neurofeedback therapy appears to be a promising alternative or additional treatment without reported adverse effects (Arns et al., 2008; Gevensleben et al., 2009). Neurofeedback training involves the self-regulation of on-going neuronal oscillations which is recorded by electroencephalography (EEG), in one or more frequency bands by visual or auditory feedback, aimed at normalising and/or self-regulating brain activity (Lansbergen et al., 2011).

WMT aims to improve an individual's WM. This includes algorithm, non-algorithm or both computerised programme that automatically adjust the training difficulties based on the individuals answers (Klingberg et al., 2005).

Education includes information on intervention related to educational accommodations, support, and school management (Wilens et al., 2008).

Coaching which includes improving time management, studies, and social skills at university (Swartz et al., 2005).

3.2 Exploring the use of technology in the multimodal framework

This research will look at each one of the treatment options: therapy, education, and coaching. This research in progress is designed to explorer and investigates the use of technology in the delivery of the treatment of ADHD in university students. The multimodal framework is adapted to see where IT is used or where it can be introduced.

3.2.1 Technologies currently used for treating/managing ADHD

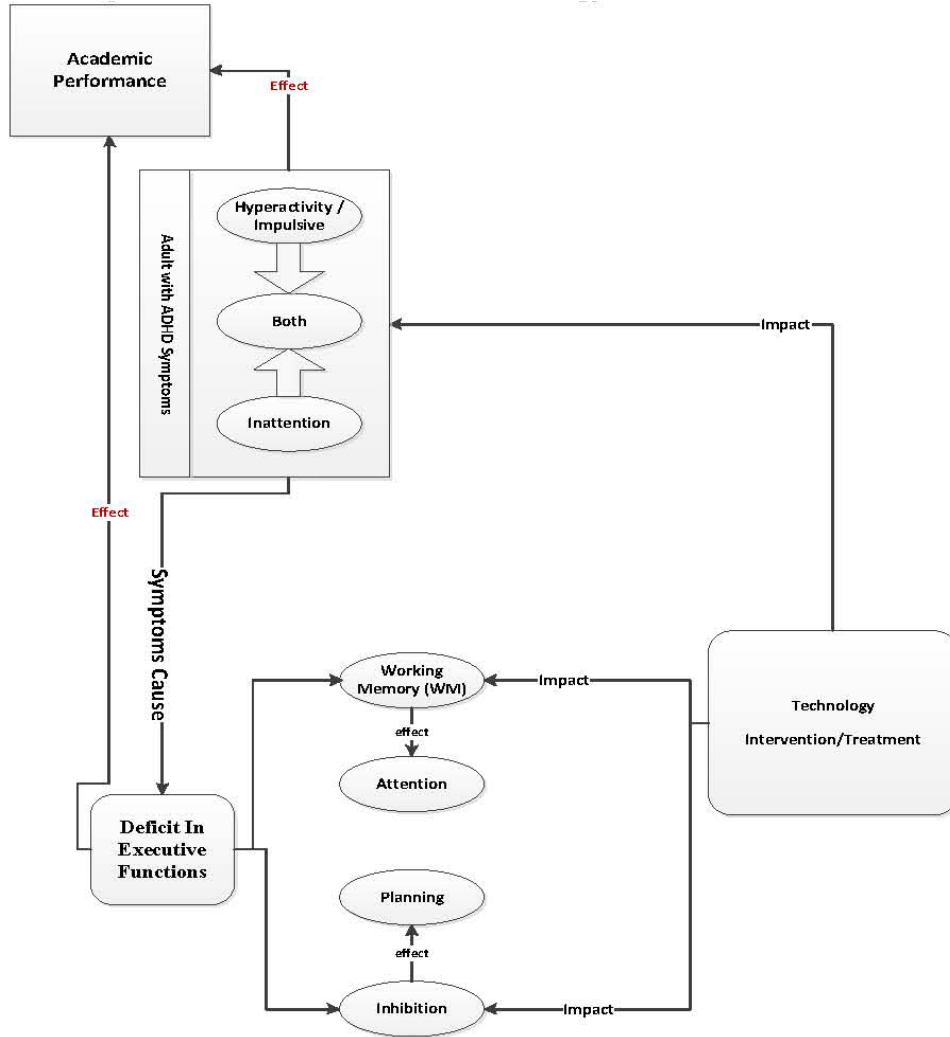Some of the technology tools that have been found in the literature and previous studies are listed in Table 3.

Table 3 Tools used in the multimodal framework

Treatment	Tools	References
Coaching	• Smartphone/SMS reminder	Prevatt et al. (2011)
	• Alarm/computerised reminders	
	• E-mail coaching/time management	
Therapy	• Neurofeedback therapy	Arns et al. (2009), Wilens et al. (1999), Klingberg et al. (2005)
	• CBT	
	• WM	
Education	• Informative website and social media	CADDRA (2011)

4 Proposed framework

As mentioned earlier that ADHD symptoms affect academic performance of university students and impact the executive functions, WM and planning. The proposed framework is to guide the investigation in using information communication technology (ICT) in treating and managing ADHD symptoms in university students, and to seek whether ICT tools have a positive impact on the academic performance of university students with ADHD. The framework is trying to show where ICT treatment or management will focus. Essentially, the research is going to look two areas, one area is how ICT can assist with ADHD symptoms and the other area is how ICT can assist with deficit executive functions (Figure 2).

Figure 2   Proposed framework of the use of technology in ADHD (see online version for colours)

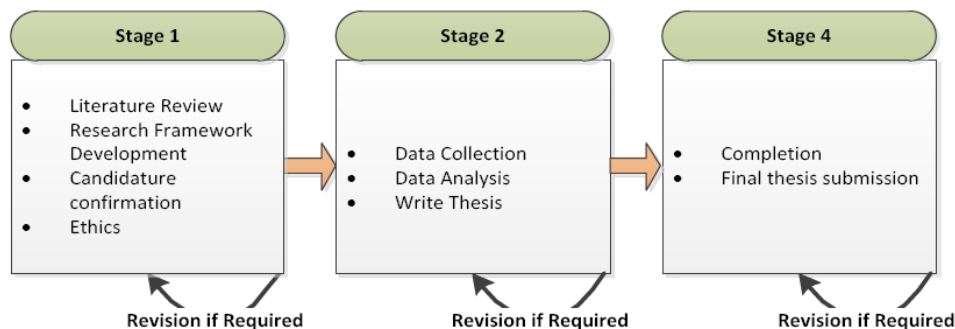## 5   Research design and methodology

Choosing the suitable research method can be sometimes a challenge for academic researchers (Yin, 2008). Because this area of study has not been explored before and the research questions do not have defined characteristics, a qualitative research method is the most suitable method and case studies and grounded theory are used as the framework for data collection and analysis.

5.1   Research stages

This research project will be developed in three stages (Figure 3) as follow:

- Stage 1 will include literatures review, developing the research framework, candidature confirmation and ethic approval.

- Stage 2 includes collecting and analysing data and writing up the thesis.

- Stage 3 finalising the research outcomes and submitting the complete thesis.

Figure 3   Research stages (see online version for colours)

5.2   Methodologies

This research design will use multiple case studies and grounded theory methodologies. In this section an overview of case study approach and grounded theory methodology will be introduced.

5.2.1   Case study

Case studies are a tool of investigation found in numerous fields, especially evaluation, in which the researcher develops an in-depth analysis of a case (Creswell, 2013). According to Stake (1995), there are three types of case study research; intrinsic, instrumental, and collective case studies. To gain more insight and knowledge into this research topic, collective case studies have been chosen.

They are also called multiple-case design (Yin, 2008). Collective studies are studying in depth more than one case in one overall research study and are usually designed for the purpose of comparison (Yin, 2008). Soy (1997) mentions that when multiple cases are adopted in the research, each case should be treated as a single case and then each case's conclusions could be then used as data contribution to the whole study. Lapan et al. (2011) argue that all the case studies conducted in the research should share the common characteristics. Case studies typically combine data collection methods such as, interviews, focus group (Eisenhardt, 1989).

There are advantages of using collective case studies as comparative type of studies can be conducted in which a number of cases are compared for similarities and differences. However, the depth of the analysis will have to be sacrificed due to the breadth of analysis (Johnson and Christensen, 2008).

This research in progress design uses the eight steps recommended by Eisenhardt (1989) as follow:

- getting started

- selecting cases

- crafting instruments and protocols

- entering the field

- analysing data

- shaping hypotheses

- enfolding literature

- reaching closure/recommendation.

5.2.2   Grounded theory methodology

Grounded theory has been used in health informatics since the start of the health informatics and grounded theory has been found effective in pointing out and describing the impact of Health information systems and their associated devices where area has not been studied or is not easily describe by quantitative approaches (Cummings and Borycki, 2011). In addition, Cummings and Borycki (2011) cite that grounded theory has been seen a powerful tool when it comes to a development of health informatics' frameworks and/or applications.

   Grounded theory, like other forms of qualitative research methods, has key concepts which differentiate this methodology from others. The research will follow the systematic design in grounded theory focuses on the use of data analysis steps of open, axial and selective coding suggested by Corbin and Strauss (1990).

- Open code also known as initial coding open coding is the first step of data analysis which is identifying important words or groups of words in the data collected and then labelling them accordingly. Open coding is a process of reducing the data to a small set of themes that appear to describe the phenomenon under investigation:

- Axial coding this process facilitates building connections within categories.

- Selective coding: The process of selecting and identifying the core category and systematically relating it to other categories.

- Memos: "The writing of theoretical memos is the core stage in the process of generating grounded theory. If the researcher skips this stage by going directly to sorting or writing up, after coding, she is not doing grounded theory" (Glaser, 1978).

5.3   Research design

This research will follow steps and process that have been developed using the combination of multiple case studies steps and grounded theory data analysis steps. Four case studies will be selected with each representing an element of the multimodal frame or more. The case studies will be reviewed and notes and comments will be stored in the memos process. The case studies are representing one or more treatments and tools that are found in the literature (Table 4). These case studies are shown in Table 4.

Table 4   Four selected case studies

Case study	Treatments	Brief	References
1	Coaching/education	Face2face coaching and education techniques to manage a university student's ADHD symptoms in the UK.	Swartz et al. (2005)
2	WMT	examine WM in children and adolescents with ADHD to how affective WMT is.	Puffenberger (2011)
3	CBT	used traditional CBT on one of the his penitent to help him reduce his ADHD symptoms.	Ramsay (2012)
4	Neurofeedback therapy	Unpublished case from a Melbourne, Australia, clinic, they have used neurofeedback therapy in the treatment of ADHD in a university student.	De-identified patient data

5.3.1   Writing memos

Memos are written records of thoughts and idea during the process of undertaking the grounded theory studies (Glaser, 1978); they differ in intensity, coherence, subject, theoretical content and usefulness to the finished product. It is highly recommended that the memo be kept until the end of the research and never thrown away (Corbin and Strauss, 1990). In this research, writing memo is an important process that overlaps and affects every single step and element of this research. It will start from developing the research questions to enclosing the literature review.

5.3.2   Data collection

Both case studies and grounded theory share the same concept of data collection and analysis over lap and research can go back and forth until the main theory emerge.

5.3.2.1   Crafting instruments and protocols

For this research, between eight and 12 registered psychologists will be recruited to participate. The targeted participants will be divided in four groups equally. Each group will be allocated to a case study. The participants will be selected based on four dimensions: educational level, years of experience, specialised in ADHD and offering internet technology as a treatment tool.

The participants, registered psychologists, will be selected based on four dimensions: educational level, years of experience, specialised in ADHD and offering internet technology as a treatment tool.

Thus, registered psychologists who are:

- specialised in treating/preventing adults with ADHD

- have a minimum of 10 years of experience

- offer at least one of internet technologies to deliver his/her services. i.e., Skype, mail, SMS

- and have at least used one of the of the following tools which it will identify which case they will fall into:
  1 coaching/education
  2 WMT
  3 CBT
  3 neurofeedback therapy.

The participants will be reached via e-mail, or mail requesting participation in the research. In addition, a brief introduction of the purpose of the research as well as its scope and objectives will be enclosed. Individual semi-structured interviews: The participants will be requested to take part in the study only after they provide their consent. This can be delivered to the researcher in two ways either e-mailing back a signed form, or replying via e-mail to an invitation to participate by stating in the message that "The consent form was read and agreed to" (Meho, 2006).

The participants will be interviewed individually on face-to-face basis as primary tool of data collection; the secondary tool will be using online video conference, Skype for example, if the location of the participant is outside Melbourne. Other data collection tools option will be considered such as e-mail or phone interviews.

The individual semi-structured interview's protocol will be developed, which mainly will be focused on their perspective of the non-medication therapy that was introduced in the case studies and IT involvement in the multimodal Figure 2. The interview also will include the participants' profession, years of experiences, number of patients with ADHD, and educational level.

5.3.3   Coding and analysis of data

Coding is the process of naming or labelling things, categories, and properties (Cummings and Borycki, 2011). In coding analysis, the researcher moves back and forth from data collection and coding and analysis, this process will continue until a main theory starts to shape. The data is analysed by within-case analysis and later cross-case analysis.

5.3.3.1   Open coding

The data collected will be divided into segments and then examined for common aspects that reflect categories or themes. After categorising the data, extra examination of properties that will develop subcategories and based on common character has to be conducted (Corbin and Strauss, 1990). For instance, the important words or group of words data collected will be divided into categories which later with more depth analysis sub categories will be created accordingly. From these categories and their subs, the axial coding will be initiated.

5.3.3.2   Axial coding

Identifying and improving relationships between the open coding's categories and sub-categories (Corbin and Strauss, 1990). A core category will start to develop or shape.

5.3.3.3 Selective coding

Selecting and identifying the core category and systematically relating it to other categories will occur in this level (Corbin and Strauss, 1990). The relationship will be validated and the categories will be refined. Most likely in this stage, all the findings which will help in shaping the theory.

5.3.4 Enfolding literature

In this level, the findings will be compared with similar and conflicting literatures.

5.3.5 Recommendation

Based on the outcomes of the data analysis and findings and the literature, a recommendation will be created.

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6 Discussion

This research in progress has served to investigate the possibilities for incorporating ICT into the treatment and management of ADHD in university students and assist such student in their studies. In particular, it suggests that such technology solutions can enable ADHD students to enjoy better outcomes at university and also better manage their ADHD. It aims to discover how mental health professionals think of the use of ICT in treating/managing ADHD in university students and how these professionals will use such ICT in their routine treatments or managements. The outcomes will contribute to Australian e-mental health services vision.

Recent studies estimate that between 18 to 32% of young adults with mental illness access mental health services and receive treatments (Kavanagh et al., 2014). This is because of barriers mentioned earlier, such as, stigma, services location or financial situations. E-mental health services popularity is rapidly increasing among young Australia adults who are not using or accessing the traditional mental health services (Kavanagh et al., 2014). This is because using ICT in mental health delivery provides services with low or no cost, better user privacy, anonymity, and accessibility at any time of day and anywhere.

People with mental disorders decrease their work productivity and attendance roughly 20% which an equal to $AU5.9 billion annual loss (Hilton et al., 2010). By providing affordable and accessible treatments for university with ADHD using ICT will not only increase these students productivity and prepare them to be more productive and successful for the world of work, but also it will assist them with their general happiness, mental health and wellbeing and sense of achievement. Students with ADHD might utterly feel better self-worth of improvement when they see technology helps them to improve their study skills and their ADHD symptoms.

However, this research will be limited to Australia and the participants will be asked only about the use of technology in treating ADHD in university students. The risks to completing the research are the location of participants. Locations of the participant

might affect the collection of data if he/she lives outside Melbourne and does not have video conference tools. Interview over the phone might be considered if this risk occurs.

Australia aims to develop a mature e-mental healthcare system by 2016; therefore, this research will contribute to the development, which will help to cover broad area in mental disorders and services and provide high quality outcomes that will assist both university students with ADHD and mental health providers.

7   Conclusions

This research in progress has served to investigate the possibilities for incorporating ICT into the treatment and management of ADHD in university students and assist such student in their studies. In particular, it suggests that such technology solutions can enable ADHD students to enjoy better outcomes at university and also better manage their ADHD.

Given the increasing costs solutions of healthcare and tertiary education that aim to support successful outcomes at universities as well as better healthcare outcomes are prudent and should be further investigate. We believe our study will serve to fill this need and close by calling from research in this area. This research will also contribute to e-mental health practice in Australia as well as theory regarding e-health and e-mental health.

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