

# **Use of Serious games in Treatment of Depression**

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| Abstract<br><br><p>The purpose of this study was to investigate the concept of gamification as an alternative treatment of Depression. The aim was to find out how serious games also known as Health games or Educational games are used in the treatment of depression globally.</p> <p>The study was implemented using a systematic literature review approach and eight selected articles were thematically analyzed. Sentences that answered the research question were highlighted then organized into themes.</p> <p>Two main themes deduced were Personalized patient support and self-help therapy. Under personalized patient support, the sub-themes included self-empowerment, Engagement and an adjunct to treatment of other illnesses. Self-help therapy entailed easy accessibility to treatment and privacy.</p> <p>The study established that serious games are a promising alternative to treatment of depression either solely or as an adjunct. The element of privacy in serious games can also be considered a solution to stigma associated with mental illnesses. However, more studies should be done in other parts of the world as well. So far, most of the studies have been done in Australia and New Zealand which is a very small portion to be fully relied on.</p> |  |  |
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## CONTENTS

|     |  |    |
|-----|--|----|
| 1   | Introduction.....  | 3  |
| 2   | Depression.....  | 4  |
| 2.1 | What is Depression? .....  | 4  |
| 2.2 | Diagnosis and Types of Depression .....                          | 5  |
| 2.3 | Interventions .....  | 6  |
| 3   | Gamification .....   | 9  |
| 3.1 | Games .....  | 9  |
| 3.2 | Serious games.....   | 10 |
| 4   | Purpose and Aims of the study .....                              | 12 |
| 5   | Implementation of the study .....                                | 13 |
| 5.1 | Literature review .....  | 13 |
| 5.2 | Scientific article selection process.....                        | 15 |
| 5.3 | Inclusion and Exclusion Criteria.....                            | 16 |
| 5.4 | Analysis of Data .....   | 17 |
| 6   | Results .....  | 19 |
| 6.1 | Serious games as Personal Support to the patient. ....           | 19 |
| 6.2 | Serious games as Self-help therapy.....                          | 22 |
| 7   | Discussion .....   | 23 |
| 7.1 | Reliability, Validity and Ethical Considerations. ....           | 23 |
| 7.2 | Implications to Nursing Practice and Healthcare .....            | 25 |
| 7.3 | Conclusions and Future Recommendations.....                      | 26 |
|     | REFERENCES .....   | 29 |
|     | Appendix 1. Summary of Chosen articles .....                     | 36 |
|     | Appendix 2: An example of Critically Appraise article .....      | 41 |
|     | Appendix 3. Summary of Critically Appraised articles scores..... | 42 |

## Table of Figures

|  |    |
|--|----|
| Figure 1. Functions of Serious games .....                           | 11 |
| Figure 2. Classification of Serious Games for Health by player ..... | 12 |
| Figure 3. The Literature review model.....                           | 14 |
| Figure 4. Selection Process .....                                    | 17 |
| Figure 5. Thematisation Process.....                                 | 19 |

## 1 INTRODUCTION

Depression is a global health concern and a leading cause of disability worldwide. According to WHO Europe, about 25% of the European population suffer from depression or anxiety annually. Neuropsychiatric disorders account for 19.5% and 26% of the burden of disease in the European Region, and European Union (EU) countries respectively. Depression account for up to 40% of years lived with disability and up to 50% of sick leaves are as a result of depression or anxiety. Inasmuch as depression is treatable, almost 50% of major depression are not treated and mood disorders and anxiety is costing the EU almost €170 billion annually. (WHO European Region, 2016). Depression can as well lead to other somatic illnesses such as hypertension, myocardial infarction stroke and even cancer. (ibid). ‘

Because of the burden of depression, a deliberate effort should be made to combat it. This means thinking outside the box and bringing new efficacious and safe treatment options to use. Self-help can be promoted by utilizing well evaluated internet based interventions such as cCBT. (ibid) The most important thing is to ensure that clients base their trust on the fact that they will be effectively and respectfully served. In CBT, the idea is that feelings are affected by thoughts and behaviors. And that, mental disorder causes unrealistic distorted thoughts which might eventually lead to unwanted behavior. The cognitive component of CBT helps one to identify and challenge unrealistic negative thoughts. MhGAP-IG recommends CBT as a treatment option for depression. (Mental Health Gap Action Programme, 2010).

Serious games are a form of cCBT which teaches the players new adaptive skills that they can apply from the game format to a real life experience. They may as well socialize, receive peer support and peer learning depending on the game. (Fitzgerald and Kirk, 2013). Research on gamification started just before 2010 and so far there are enough scientific studies on the efficacy of gamification. They found out that gamification can influence both psychological as well as physical outcomes. Some studies showed that the impact of gamification varied depending on the community, users and the product. Some studies with positive results also reported that the duration of this positive impact could not be ascertained (Cugelman, 2013).

The purpose of this study, therefore, was to find out how serious games are used in treatment of depression globally. The study took a literature review approach, eight scientific research articles were selected and results were then inductively analyzed.

## 2 DEPRESSION

### 2.1 What is Depression?

Depression is a common problem that affects almost 350 million people globally. It is characterized by low mood, loss of interest or pleasure, feelings of low self-worth, changes in appetite and sleep pattern. Recurrent depression gradually affects an individual's ability to perform at workplace, in school or even cope with daily activities. It can happen with all genders, ages, and different backgrounds. Effective treatments for depression include: - psychological treatments (behavioral activation and cognitive

behavioral therapy CBT), interpersonal psychotherapy IPT and antidepressant medications (selective serotonin reuptake inhibitors SSRI) (WHO 2015.)

## 2.2 Diagnosis and Types of Depression

In diagnosing depression, health practitioners in Finland use ICD 10 by WHO and DSM IV by American Psychiatric Association manuals (Mieli, 2016.) In 2013, APA (American Psychiatric Association) made some changes and updates to DSM and it is called DSM-5 (APA 2013.) ICD-10, 2016 classify depression into two major categories; - Depressive episode and Recurrent Depressive disorder. A *depressive episode* can either be mild, moderate or severe depending on severity of symptoms which are low mood and lesser activity. Reduced enjoyment, interest, and concentration may occur. Sleep is disturbed and loss of appetite. Low Self-esteem and self-confidence with some feeling of worthlessness is common.

*Mild depressive episode* exhibits two or three of these symptoms. The patient is usually distressed but manages to carry on with most of the daily life activities. *Moderate depressive episode* has four or more symptoms which may hinder the patient's ability to continue with ordinary activities. *Severe depressive episode without psychotic symptoms* is exhibited by several symptoms which are loss of self-esteem and feeling of guilt. Suicidal attempts are present and some somatic symptoms. *Severe depressive episode with psychotic symptoms* present with hallucinations, delusions, psychomotor retardations that affect daily life activities (ICD-10, 2016).

*Recurrent depressive disorder* is characterized by repeated depressive episodes with no history of mania. It can be also be mild, moderate or severe with or without psychotic symptoms. (ICD-10, 2016). Depression can also be classified as primary or secondary. *Primary Depression* mood disorders problems are central while in *secondary depression* which emotional problems are secondary to other health issues such as neurological and brain diseases caused by medications' side effects. (Baker, 2009, 174)

Other types of depression are *dysthymia* with symptoms are mild and mood is regularly low that lasts for least two years, *Bipolar disorder* who may experience mood swings from excitement and elation to despair, *Seasonal affective disorder (SAD)* that may occur during autumn and winter and may be caused by lack of sunlight and shortened daylight and lastly, *Postnatal depression* that may occur between two weeks and two years after childbirth and may show problems on panic attack and sleeping (Bupa 2016.)

### 2.3 Interventions

Mental health nurses have a role in providing *psychosocial interventions* to patients. It is the key element in practice.

Psychosocial interventions are non-pharmacological therapeutic interventions that address psychological, social, personal, relational and vocational problems related to mental health disorders. Some treatments that use this intervention are cognitive behavioral therapy (CBT), Dialectical behavioral Therapy (DBT), supported employment, and peer support (Turton, 2014, 5-6). *Antidepressants*: - The role of nurses is to administer the prescribed medication and



monitor its effects. Nurses should also be aware of the recommended dosages, possible side-effects, duration of action and its therapeutic effect, contraindications and be able to answer common questions from client about reasons of prescribed medications (Barker, 2009, 176).

*Physical methods* of treating depression are electroconvulsive therapy and transcranial magnetic stimulation. Electroconvulsive therapy (ECT) involves the administration of a controlled current of electricity across the skull to induce seizure and it is done under anesthesia. Responsibilities of the nurse is similar with medication. The patient's queries and anxiety must be addressed and information process about the procedure must explain to patients (Ibid, 173.) The National Institute for Health and Clinical Excellence (2004) recommends that ECT can only be used if other treatment options have failed. Transcranial magnetic stimulation (TMS) is a treatment that involves controlled bursts of an electromagnetic field around the head of the patient. The procedure stimulates the activity of neurons and reduces depression (NICE 2007).

*Psychological therapies* include Cognitive Behavioral Therapy (CBT), Interpersonal therapy, Mindfulness-based cognitive therapy, positive psychology, psychotherapy and narrative therapy. (Black Dog Institute, 2013). *Cognitive behavior therapy* is used to show people how thinking affects mood and make patient think less in negative way about life and self. Nowadays, there are several online programs developed to give CBT to patients (Black Dog Institute 2013). *Interpersonal Therapy* (IPT) aims at helping the patients to understand how work, relationships, social roles

and personality can cause depression and avoid recurring again (Black Dog Institute 2013). *Mindfulness-based Cognitive Therapy* is a self-awareness training that makes the patient aware of what is happening in the present and not making judgements about whether it is good or bad and is used to prevent recurrence of depression as well. (Ibid. *Positive Psychology* is on the other hand is used to reinforce full functioning of patient to enhance their experiences of love, work, and play that serve as personal strength (ibid).

*Psychotherapy* is a long term treatment in which relationship between the therapist and patient. Therapist allows the patient explores past and how it caused depression while *Counselling* aims at helping the patient with problem solving regarding family and sudden problems (crisis counselling) (ibid) Finally, *Narrative Therapy* is a counselling which focuses on understanding patient's own description of life story that affects problem solving skills. It is also used to recognize individual's skills, beliefs and abilities in solving problems (ibid)

Nursing interventions comprising of medication administration and monitoring therapeutic and side effects of medication and providing nurse-patient relationship that makes patient develop skills on how experiences can be used as a strength. Also, nurses are equipped with theoretical and practical approaches to make nurse-patient relationship meaningful and focused with patient care (Barker, 2009.)

## 3 GAMIFICATION

### 3.1 Games

A game is “a physical or mental contest with a goal or objective, played according to a framework, or a set of rules, which determines what a player can and cannot do inside a game world” (Wattanasoontorn, Boada, Garcia & Sbert, 2013). As shown in figure 1 below, games have five major components. First is the rule/gameplay which creates the game pattern. Second is challenge which determine the reward system and interaction which is the way the player communicates with the game is third one. Finally comes the objective which can either be implicit or explicit and it refers to what one’s efforts tend to achieve. Computer games have only explicit objective while serious games possess both the explicit as well as implicit objectives.

Electronic games have become a prevalent entertainment technology. Electronic gaming is now a popular form of leisure available on most smart devices and virtual reality headsets unlike in the old days when it could only be accessed from higher institutions of learning. Interestingly, discussions on the impact of gaming on individuals and society are increasingly witnessed in popular, political as well as academic circles (Przybylski & Weinstein, 2016). For a long time, game developers have been having students as their number one target audience (53.79%) while healthcare professionals come sixth (23,81%) and healthcare

patients including mental health at number nine (7,94%). (Michael & Chen, 2005).

### 3.2 Serious games

Serious games are games which aim mainly at education rather than entertainment, that is, they do have a definite pre-conceived educational purpose. This, however, does not rule out the possibility for entertainment and fun in the game. ((Michael et al, 2005, 18-22). Serious games may also be defined as games that offer more than entertainment. They inherit basic concepts from entertainment but focus on the main objectives such as learning and training with the aim of applying the lessons learned in real-life. (Wattanasoontorn, et al, 2013).

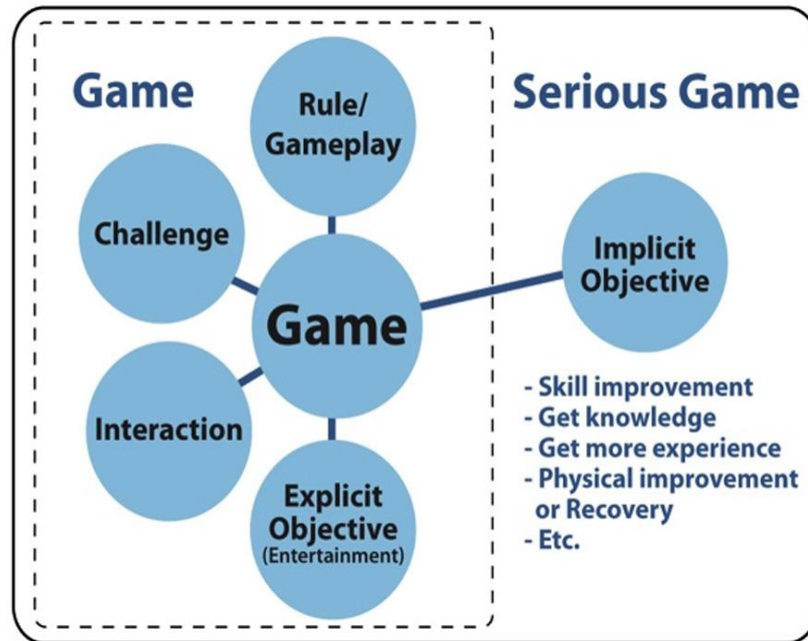


Figure 1. Functions of Serious games

(Adapted from Wattanasoontorn et al, 2013, 232)

Use of serious games as a therapeutic intervention is based on Constructivist theory which states that “we learn by connecting a new experience with an old one”. Players learn and apply new adaptive skills from the game format to a real life experience. Furthermore, they are able to socialize, receive peer support as well as peer learning. (Fitzgerald et al 2013)

They use artistic medium of games to deliver a message, teach a lesson and provide an experience (Michael et al, 2005, 23).

Education through entertainment (edutainment) was used in the late twentieth century and referred to educational video game which targeted preschoolers and new readers. Games can teach and train different age-groups in different situations because they are motivating and efficiently communicate the concepts and facts. (ibid, 26). Serious games also allow students to assume realistic roles, face problems, formulate strategies, make decisions and get fast feedback on the consequences of their actions without the cost

of real-world consequences or errors. The main objective of serious games is to get the players to learn something and have fun at the same time if possible (ibid, 26). Since today's generation have grown up playing video games, they are more likely to play and learn from video games. Therefore, effectiveness of serious games is becoming more and more evident as time goes by. Serious games can be classified among other classifications as either patient or non-patient depending on the target player as shown in Fig. 2 below.

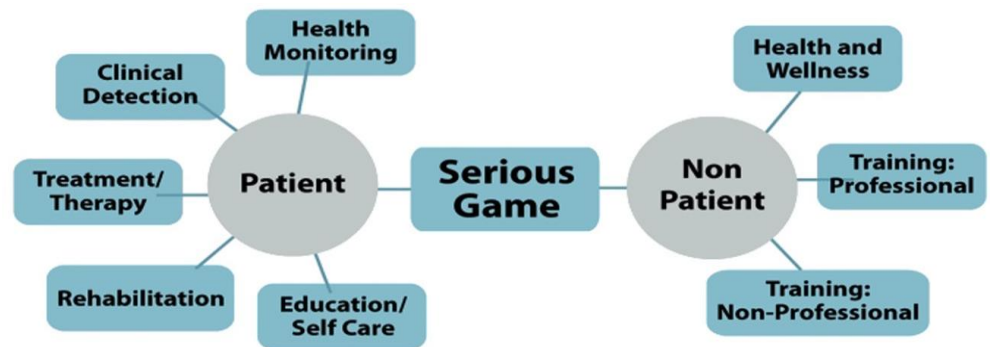


Figure 2. Classification of Serious Games for Health by player

(Adapted from Wattanasoontorn et al, 2013, 237)

#### 4 PURPOSE AND AIMS OF THE STUDY

The purpose of this study is to investigate the concept of gamification as an alternative to treatment of Depression. The aim of this study is to find out how serious games also known as Health games or Educational games are used in the treatment of depression among different age groups.

*Research Question:*

How are serious games used in the treatment of depression among different age groups globally?

## 5 IMPLEMENTATION OF THE STUDY

### 5.1 Literature review

Literature review is a written work that systematically and accurately identify, appraise and synthesize existing original scholarly and research studies in a reproducible manner with the conclusions based on the original work or scholars and researchers (Fink 2005, 3). It brings an understanding to the current state of awareness about a topic of study in order to answer the research question (Machi, McEvoy, 2009, 4)

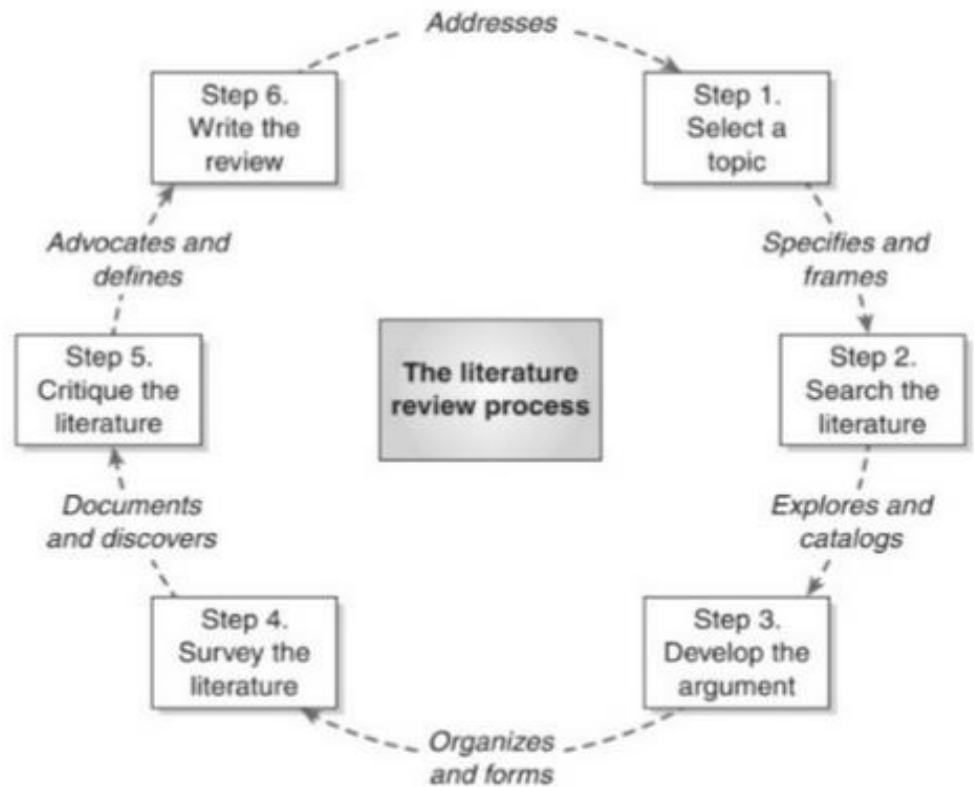


Figure 3. The Literature review model

(Adapted from Machi et al, 2009, 5)

Step one involves selecting a topic based on the author's interest in a practical problem which is eventually translated to a researchable topic. Literature search follows in order to resolve the information to be reviewed and only data that strongly support the thesis are selected. Step three involves logically forming and presenting the case in a way that explains what is already known about the topic followed by assembling, synthesizing and analyzing the data to form an argument about the current knowledge on the topic. The literature is then appraised to interpret the current understanding of the topic, that is, how the available knowledge answers the research question. Finally, the work is audited and edited so that it can be understood by the target audience. (Figure 3 Machi et al, 2009, 4-6).



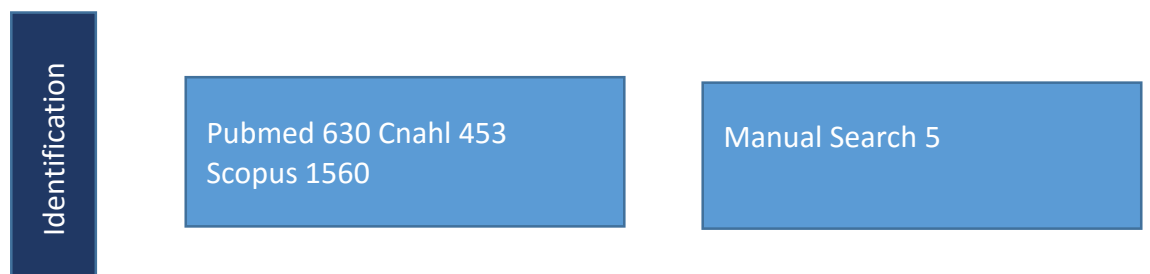
## 5.2 Scientific article selection process

It is important to carry out an extensive and systematic search because study will only be as genuine as the thoroughness of the search as well as its ability to identify all the relevant studies (Bettany-Saltikov 2012, 66). The quality of the literature acquired will in the long run determine the quality of the conclusion arrived at (ibid 67). A preliminary test search will be conducted to refine key words and to ensure that there are relevant data for answering the thesis questions and relevant data. Relevant studies will be extracted from printed scientific journals from the following databases; - CINAHL, Elsevier ScienceDirect, Journals@Ovid, PubMed as well as SCOPUS via JAMK University of Jyväskylä library Websites. The search words will include Health games, serious games, mental health games, Depression, Gamification, emotional skills and use of games, computer games. Boolean logic will be used to come up with search queries for the databases. Key words will be combined using Boolean operators AND, OR and NOT (Fink, 2005, 28; Machi et al, 2009, 41). An appraisal tool by Hawker and colleagues (2002) will be used to filter quality research articles. The tool provides the score from 1 "poor" to 4 "good" for every element based from study, like introduction, aims, method, sample, data analysis. The total score determines quality of the article, ranging from 10 "very poor" to 36 "good". Researches will use a cut point of 50% of the total score and scored in two different individual appraisals which will be analyzed if there were huge difference. The process also treats ethics and bias as two separate and dissimilar components (Hawker et al, 2002, 1292).

### 5.3 Inclusion and Exclusion Criteria

| Inclusion Criteria             | Exclusion Criteria                           |
|--------------------------------|--|
| Publications in English        | Systemic Literature review articles          |
| Published from 2006 to date    | Literature review articles                   |
| Original research publications | Other mental illnesses other than depression |
| Serious games                  |  |
| Answers research questions     |  |

Table 1. Inclusion and Exclusion Criteria



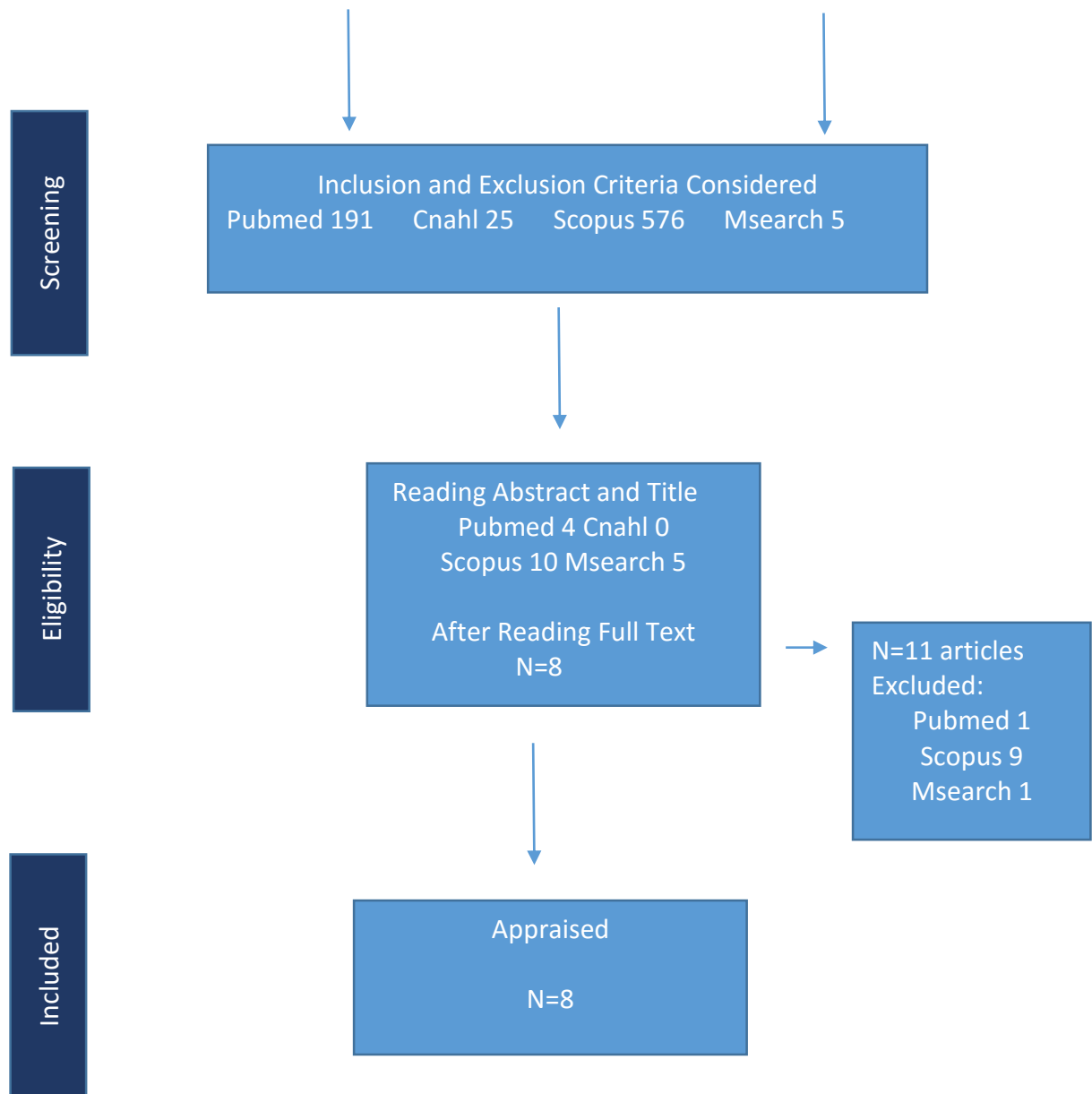


Figure 4. Selection Process

## 5.4 Analysis of Data

Inductive approach was used with analysis data to form a condensed data into a summary format. The aim of inductive analysis is to find the main point of a certain raw data based on material (Thomas D. 2006). Data are thematised into a main theme and methods are identifying, analyzing and reporting themes within data. Also, according to Braun & Clarke (2006), the process organizes and describes data which answers research question.

Researchers read articles through again to familiarize how it answers research question and not to miss any relevant information (Braun & Clarke 2006.) On the first stage of analysis, 24 themes were drawn up from familiarization of articles and mainly based on result. After consideration of duplicates and same thought regrouping, 5 subthemes which are self-empowerment, to engagement in treatments, as an adjunct to treatment of other illnesses, accessible treatment and providing privacy. And lastly 2 main themes made of personalized patient support and self-help therapy answered researchers' question.

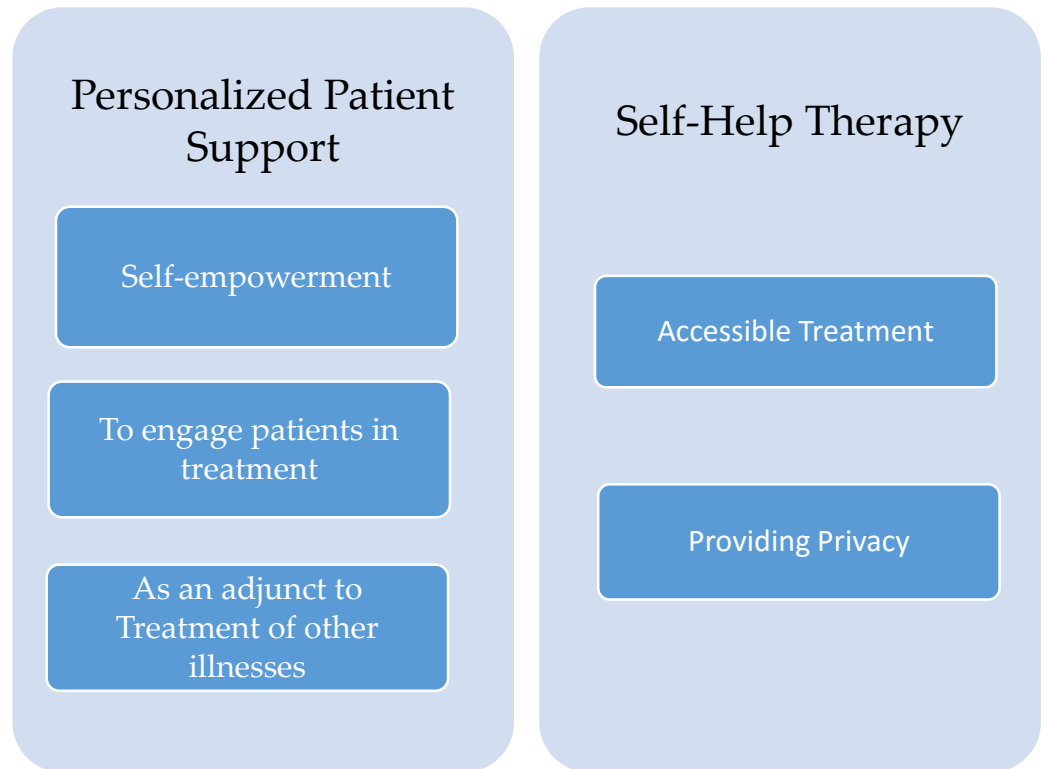


Figure 5. Thematisation Process

## 6 RESULTS

### 6.1 Serious games as Personal Support to the patient.

#### **Self-empowerment**

SPARX is a third-person fantasy-based game for the PC platform incorporating 3D. The user is able to customize and use an avatar. Avatar's mission is to get out from the world of gloom and negativity brought about by GNATs (gloomy negative automatic thoughts) and bring back 'balance' in the virtual world. SPARX has challenges, puzzles and psycho-education about mood

management (Bobier et al 2013, 287.) In addition, SPARX is used as computerized cognitive behavioral therapy program, used in learning about depression, handling negative thoughts, problem solving, activity rescheduling and relaxation, and focusing on positive thoughts (Bobier et al. 2013, 290-291). Another version of SPARX is self-help Rainbow SPARX, a new version of computerized cognitive behavioral/ therapy for lesbian, gay and bisexual adolescents that allowed self-expression on customization of characters with any clothes and accessories that encourage positive based views of self. (Lucassen et al, 2013, 28-29.) Another study has been done about mobile phone application that can reduce symptoms of depression. For assessing significant depression, Epidemiological Studies Depression questionnaire (CES-D) was used and super better application was used for treatment process. Super Better is a game mechanics to increase users' drive to accomplish challenging goals and to build social support through online discussion forums and Facebook integration. It is also a program that can be used and downloaded with smartphones (iPhone IOS). The study concluded that super better can be used in reducing anxiety, depression and improves life satisfaction, self-efficacy and social support (Roepke et al., 2015, 236,243).

### **To engage patients in treatment**

Adolescents from twelve to nineteen years old who had received SPARX cCBT believed that the treatment would appeal to teenagers and would recommend it to friends (Merry et al. 2012, 6). Results from the study suggested that the SPARX programme is engaging

and effective in reducing depressive symptoms in adolescents (Fleming et al, 2011, 538.) Adolescents in New Zealand used SPARX (Smart, Positive, Active, Realistic, X-factor thoughts) as computerized cognitive behavior therapy. Some features of the program are having a chance to choose avatar's gender and different characters that provided an element of socialization and "life" of the game which supported the youth in access of SPARX and its acceptability. (Cheek et al, 2014, 7-8.) Rainbow SPARX emerged in adapting with lesbian, gay and bisexual adolescents who are often isolated because of stigma of being mentally ill. New version of self-help Rainbow SPARX program promotes own choice of characters or avatars that can be customized in any clothes and accessories desired and this made them suggested and assured that Rainbow SPARX is appealing to them (Lucassen et al, 2013, 29-30.) Promising feedbacks using SPARX made users engage more in using the program and increase adherence of treatment regimen.

### **An adjunct to treatment of other illnesses and disorders**

Patients in Korea who suffered stroke and with symptoms of depression tried to use virtual reality game called Xbox Kinect as treatment. Compared with usual MOTOMed ergometer bicycle training rehabilitative device, result using Xbox Kinect made a significant improvement than MOTOMed in treating depression and physical rehabilitation (Song & Park, 2015, 2059-2060.) Anxiety disorder is one the psychological problems among adolescents and makes it more difficult to treat if it is accompanied with depression. In United States, Game-based biofeedback was used in relaxation

training, facilitate learning of deep breathing and imagery. Research resulted a significant decrease of anxiety and depression symptoms (Knox, et al, 2011, 199). Xbox and Game-based biofeedback was used in treatment of patients with underlying illnesses, disorders. Games mentioned are indeed according to the result, help reducing depression.

## 6.2 Serious games as Self-help therapy

### **Accessible treatment**

Accessibility was the most appealing feature according to SPARX users. Adolescents responded well using SPARX for the treatment of depression in own pace and normal activity without a presence of healthcare practitioner as a self-help therapy (Bobier et al, 2013, 290-291; Merry et al, 2012, 6.) A female player commented that it helped bring back normality, "it felt normal playing using a computer" (Bobier et al, 2013, 290). SPARX is effective in treatment for person with symptoms of depression. It is cheaper and easy to access (Merry et al, 2012, 8). Another program is super better that have proved accessible and easy to adapt to any mobile format. Also treatment barriers such as cost, location, long waiting lists were avoided (Roepke et al, 2015, 243).



## Providing Privacy to the patient

Adolescents in New Zealand considered an online therapy providing help without telling anyone and physically seeing a person. Also, computerized cognitive behavioral therapy allowed patients to get help without divulging feelings to others that provided privacy and easy access. Participants identified that using computers when they were feeling down is really helpful and reported that they use SPARX in privacy of their own home (Cheek et al, 2014, 8) Some patients preferred to have treatment in private thus allowing users freedom to choose ways of receiving treatment.

## 7 DISCUSSION

### 7.1 Reliability, Validity and Ethical Considerations.

Reliability and Validity are ethical principles that aim at displaying how thorough a research has been done and how trustworthy the results presented are. A *reliable study* means that the tests, procedures and tools used are able to produce similar results in different settings if all the factors remained constant- main focus is on stability. *Validity* on the other hand demonstrates how close the researcher's intention is to what is actually measured. It can also be referred to as a focus on accuracy. (Roberts et al, 2006, 41; Houser, J. 2008). The authors followed guidance from Jamk's Information seeking specialist in order to ensure that literature

search was rigorous enough to avail reliable and valid results. Being two authors was also an advantage in that it was possible to review and critic each other's work.

*Plagiarism* refers to taking credit for another person's work. It occurs when an individual uses or presents another person's work without proper referencing and presenting it as their own. (Price 2014, 46). *Fabrication* involves improvising data or results and recording or reporting them. (Horner et al, 2011, 348). In as much as fabrication is not typical in nursing research, its occurrence and detection raises great alarm (Fierz et al, 2014, 273). *Falsification* is defined by the office of research integrity (ORI) as "manipulation of research materials, equipment, or processes, or changing or omitting data or results such that the research is not accurately represented in the research record"

### *Risk of bias*

Bias in research may not be completely eliminated, however, the awareness of which enables the researcher to implement strategies throughout the research process that will minimize the risk of bias as much as possible hence better reliability and validity of research findings. (Malone, Nicholl and Tracy, 2014, 279). In order to minimize risk of bias, a rigorous literature search will be done as transparently as possible and properly documented to enhance evaluation and reproducibility. A decision has to be made concerning literature search, that is, where and how. This may unfortunately introduce unintentional *Publication Bias* to this study. For instance, among the selection criteria, only publications accessible to the students will be used because the study isn't

funded and the researchers cannot afford to pay the cost of accessing the studies that have not yet been published in peer reviewed journals. *Language Bias* may be inevitable because this study clearly states in the inclusion criteria that only studies available in English will be selected.

### **Credibility, Integrity and Objectivity**

Any research should be conducted appropriately and with integrity in order to accord it credibility and public trust. (Fierz and colleagues, 2014, 271). Research misconduct is the deviation from the principle of integrity and it entails Fabrication, Falsification or plagiarism suggesting, executing, analyzing research or in reporting research findings. (Fierz et al, 2014, 271; Horner et al, 2011, 348) Universities should avail, like Jamk has done, a clear and logical guidance on what constitute plagiarism and other ethical principles to the students. (Price 2014, 46) This study will therefore follow the Jamk's ethical principles to avoid any of these malpractices.

## **7.2 Implications to Nursing Practice and Healthcare**

Serious games are self-care and self- management interventions with the focus on encouraging players to practice behavior change while improving their knowledge of the illness. (Wantland, Portillo, Holzemer, Slaughter and McGhee, 2004). Gamification improves healthcare delivery process, because it does not only

educate but also help in sharing knowledge (Wantland et al, 2004). Merry et al (2012) suggested that compared to traditional treatment methods SPARX could be a cheaper treatment alternative. This is because SPARX is a self-help resource, the patients met the clinician just one at the beginning of the treatment followed by an on phone consultation just once in a month and adherence was pretty good all the same (ibid, 6). Non-compliance to treatment has negative impact on the clinical outcomes and is financially costly to the society because of urgent care visits, hospitalizations as well as higher treatment costs. Healthcare institutions are therefore obliged to find ways of minimizing non-compliance by understanding the factors that lead to non-compliance. (Jin, Sklar, Sen Oh & Li, 2008). Therefore, if the use computerised CBT such as SPARX is more appealing to the patient and improves adherence, then why not? Furthermore, most healthcare systems are overstretched with lack of sufficient staff to attend to patients. It is our opinion that the use of serious games could help in reducing the impact of staff shortage within the healthcare settings.

### 7.3 Conclusions and Future Recommendations

The aim of this study was find out how health games are used in the treatment of depression among different age groups. Inductive approach was used in analyzing data from eight appraised scientific studies. Based on the results, the study achieved its aims. In the eight studies included in the review two categories were identified which are personalized patient support and self-help therapy. Personalized patient support included self-empowerment, engagement to treatment and an adjunct to treatment of other

illnesses. Many health games are available and have been used for treatment of depression. SPARX, rainbow SPARX, xbox kinect, super better and game based biofeedback showed significant results in reducing depression. SPARX, rainbow SPARX and super better have been used in providing self-empowerment. SPARX has challenges, puzzles and psycho-education about mood management (Bobier et al 2013, 287.) New version of SPARX which is rainbow SPARX designed for LGB patients used as computerized cognitive allowed self-expression (Lucassen et al, 2013, 28-29). Super Better's mechanism is used to increase users' drive to accomplish challenging goals (Roepke et al 2015, 236,243). Engaging in treatment helps the patient adhere to the treatment plan. SPARX users believed that it would appeal to teenagers and one participant said " I would recommend it to friends" (Merry et al, 2012, 6). Because rainbow SPARX program promotes own choice of characters, participants suggested and assured that rainbow SPARX is appealing and can engage users (Lucassen et al, 2013, 29-30.) In other various conditions such as post-stroke and anxiety, health games made positive result in evaluation of care. Xbox Kinect made a significant improvement on post-stroke patients than MOTOMed (ergometer device) in physical rehabilitation and treating depression (Song et al, 2015, 2059-2060) Game based biofeedback (relaxation training) also successfully made a decrease of anxiety and depression symptoms to patients. (Knox et al 2011, 199)

The last main theme is *self-help therapy*. Health games are used as self-help therapy and it features accessibility to treatment and provides privacy. SPARX can be used as an individual's own pace

and normal activity without a presence of health professionals (Bobier et al 2013, 290-291; Merry et al, 2012, 6). In addition, Super better is accessible and easy to adapt to mobile format and can be downloaded anytime and treatment barriers such as cost, location, long waiting lists were precluded (Roepke et al 2015, 243). A unique feature of using health games is that it can provide privacy on receiving treatment without telling anyone and some patients reported preference in using the program in private (Cheek et al, 2014, 8.)

Previous research in Hongkong used virtual reality game in reducing anxiety and depression in children 8-16 years of age who had cancer. The game improved children's coping skills, decreased stress and developed self-control (HC Li, et al 2011.) Similar literature reviews also mentioned that health games used as psycho-educational computer program that enhances real life skills and generalized that adherence of treatment using health games is also promising. (Fleming, 2014.) Researchers believed that limitation of this study is that the concept is still new which made it difficult to access relevant studies. Therefore, more literature reviews should be accessed in the future. Also, the review has different target groups, support types, depression symptoms. Heterogeneity of studies made researches differentiate studies but interpreted it carefully.

It can be concluded based on this study that serious games are a promising alternative to treatment of depression either solely or as an adjunct. Furthermore, serious games and gamification have an element of privacy which can be tapped into to combat stigma associated

with depression and other mental disorders. However, more studies should be done in other parts of the world. So far, most of the studies have been done in Australia and New Zealand which is a very small portion to be fully relied on.

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## Appendix 1. Summary of Chosen articles

| Author(s), year & Country   | Purpose and Aims of the Study  | Research Methods or Instruments   | Sample (n=) | Main Results  | Critical Appraisal Score (9-36)<br>Hawker et al 2002. |
|---|--|---|-------------|---|---|
| Cheek, C.,<br>Bridgman, H.,<br>Fleming, T.,<br>Cummings, E.,<br>Ellis, L.,<br>Lucassen, M. FG.,<br>Shepherd, M. &<br>Skinner, H.<br>2014<br>New Zealand | Explore the acceptability of SPARX by youth in rural Australia<br><br>Explore whether and how young people would wish to access such a program | Focus groups and semi-structured interviews, inductive data-driven approach | 16          | Sparx a computerized therapy supports privacy and choice to personalize an avatar.<br><br>Personalised avatar playing cCBT<br>SPARX allowed players to get help even without divulging feelings.<br><br>Accessibility of treatment has improved for rural youth | 33  |
| Lucassen, M. F. G., Hatcher, S.,  | To explore what alterations, if any, might be needed to make   | general inductive approach, Questionnaire                                   | 10          | Users of rainbow SPARX taught about how to manage unsupportive  | 35  |

|   |   |                               |           |  |           |
|---|---|-------------------------------|-----------|--|-----------|
| <p>Stasiak, K.,<br/>Fleming, T.,<br/>Shepherd, M. &amp;<br/>Merry, S. N.,<br/>2013<br/>New Zealand</p>            | <p>SPARX acceptable and relevant to LGB youth. Research question not outlined</p>   |                               |           | <p>environments and depression. User (24 years old) thought that having a fantasy role-play program like SPARX can deliver cCBT skills and LGB's positive strength based regarding oneself gained. Computerised cognitive behavioural therapy has successfully given therapy to users.</p> |           |
| <p>Bobier, C.,<br/>Stasiak, K.,<br/>Mountford, H.,<br/>Merry, S. &amp;<br/>Moor, S.,<br/>2013<br/>New Zealand</p> | <p>Examine the feasibility and acceptability of offering SPARX an inpatient setting to adolescent patients who typically experience a greater severity of mental illness than in previous trials of computerized therapy.</p> | <p>Random, Questionnaires</p> | <p>20</p> | <p>Adolescents learned how to use positive thoughts and deal with negative thoughts, problem solving skills, activity rescheduling and relaxation. SPARX compatible with individual's computer learning things independently and is accessible to users.</p>                               | <p>33</p> |

|  |  |  |     |  |    |
|--|--|--|-----|--|----|
| Merry, S. N.,<br>Stasiak, K.,<br>Shepherd, M.,<br>Frampton, C.,<br>Fleming, T. &<br>Lucassen, M. FG<br>2012<br>New Zealand | To evaluate whether a new computerized cognitive behavioral therapy intervention (SPARX) could reduce depressive symptoms in help seeking adolescents as much or more than treatment as usual. | Multicenter randomized controlled non-inferiority trial.       | 187 | SPARX can be an alternative regime for treatment adherence problem. Adolescents believed that the games would appeal to teenager and they would recommend the treatment to their friends. SPARX was defined as a self-help cCBT and reduce depression. | 36 |
| Fleming, T.,<br>Dixon, R.,<br>Frampton, C. &<br>Merry, S.<br>2011<br>New Zealand   | To test the efficacy of the SPARX cCBT programme for symptoms of depression among adolescents in programmes for students excluded or alienated from mainstream education                       | immediate vs. delayed intervention randomized controlled trial | 32  | SPARX reduced symptoms of depression and serves as alternative treatment for students who have problems engaging with other traditional treatment plans.   | 35 |
| Song G. B &<br>Park E.C.<br>2015.  | to determine the effects of training using virtual reality games on balance, gait as well  |  | 40  | Use of wii virtual reality is effective in improving balance, gait abilities. Also motivation and interpersonal skills were improved using virtual reality   | 25 |



|   |  |                             |     |   |    |
|---|--|-----------------------------|-----|---|----|
| South Korea   | as psychological characteristics of stroke patients', such as depression and interpersonal relationships                                   |                             |     | game. Wii engaged patient to actively participate with treatment.   |    |
| Knox, M.<br>Lentini, J.<br>Cummings, T.S.<br>McGrady, A.<br>Whearty, K.<br>Sancrant, L.<br>2011 | To examine changes in anxiety and depression in a sample of children and youths referred for treatment for anxiety<br>Stated but not clear | statistical methods         | 24  | Game-based biofeedback can be used in reducing anxiety and depressive symptoms. The game was used for relaxation training for anxious and depressed children and provide psychoeducation about anxiety and depression.  | 29 |
| Roepke, M. A.<br>Jaffee, S. R.<br>Riffle, O. M.<br>McGonigal, J.<br>Broome, R.                  | To evaluate an intervention called SuperBetter (SB) but not clear  | Randomized Controlled Trial | 283 | Super better has positive effect on treatment of depression. Result showed improvements on life satisfaction, self-efficacy, and social support. Moreover, online program made it accessible to users and is a self-help resource reducing depressive symptoms. | 33 |

|                     |  |  |  |  |  |
|---------------------|--|--|--|--|--|
| Maxwell, B.<br>2015 |  |  |  |  |  |
|---------------------|--|--|--|--|--|

## Appendix 2: An example of Critically Appraise article

|                                      |  |                  |    |
|--------------------------------------|--|------------------|----|
| Author(s)                            | Merry, S. N., Stasiak, K., Shepherd, M.,<br>Chris Frampton, C., Fleming, T. & Lucassen,<br>M. FG   | SCOR<br>E<br>J D |    |
| Abstract and<br>Title                | The effectiveness of SPARX, a computerized<br>self-help intervention for adolescents seeking<br>help for depression: randomized controlled<br>non-inferiority trial  | 4                | 4  |
| Introduction and<br>Aims             | To evaluate whether a new computerized<br>cognitive behavioral therapy intervention<br>(SPARX) could reduce depressive symptoms in<br>help seeking adolescents as much or more than<br>treatment as usual. | 4                | 4  |
|                                      | Multicenter randomized controlled non-<br>inferiority trial.   | 4                | 4  |
| Sampling                             | N=187. Response rate as well as reasons for not<br>participating given.  | 4                | 4  |
| Data Analysis                        | Detailed description, sufficiently rigorous  | 4                | 4  |
| Ethics and Bias                      | Ethical issues addressed well. Bias reflected  | 4                | 4  |
| Results/Findings                     | Explicit and correspond to the aims of the<br>study  | 4                | 4  |
| Transferability/G<br>eneralizability | Sufficient and compared to other context   | 4                | 4  |
| Implications and<br>usefulness       | Contributes something new, suggest ideas and<br>questions for further research.  | 4                | 4  |
|                                      |  | 36               | 36 |

## Appendix 3. Summary of Critically Appraised articles scores

| Article      | Jonell's Score | Dianah's Score |
|--------------|----------------|----------------|
| Literature 1 | 33             | 32             |
| Literature 2 | 34             | 35             |
| Literature 3 | 33             | 32             |
| Literature 4 | 36             | 36             |
| Literature 5 | 34             | 36             |
| Literature 6 | 25             | 25             |
| Literature 7 | 28             | 29             |
| Literature 8 | 35             | 31             |