

The Use of The ARCS Motivation Model on Special Needs Patients through Serious Games for Rehabilitation: A Systematic Review

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Abstract

Motivation is one of the vital keys for special needs patients to feel sustain with their performances during rehabilitation therapies. As technology grows, serious games have become one of the assistive technology tools that used in rehabilitation field to help special needs patients to undergo their exercise. In this regard, the adaptation of special needs patients in using serious games for rehabilitation have attracted scholars to conduct number of relevant studies. Accordingly, a systematic review was conducted to identify the motivation attributes that influence special needs patients while playing serious games for rehabilitation. After the identification and screening processes, the use of the ARCS motivation model is to classify the motivation attributes into four main factors: attention, relevance, confidence, and satisfaction. A total number of 29 motivation attributes have been found from the previous studies that vigorously important in determine the rehabilitation performance of special needs patients. Each motivation attribute which repeatedly used in the recent studies from the year of 2011 to 2019 has been grouped as one. As results, the mostly used attribute in the previous research is motivation. The essential of motivation in ensuring confidence level and satisfaction among special needs patients while undergoing rehabilitation therapies is very important and has been successfully proven on the results. In other words, the previous studies have shown a positive experience of special needs patients in gaining and sustaining their motivation through serious games for rehabilitation by using the ARCS model.

Keywords: Serious Games, Special Needs, Motivation, Rehabilitation

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1. INTRODUCTION

Rehabilitation is a one of the important services provided for people with disabilities. The special needs patients undergo rehabilitation as one of the ways to keep their performances on track and to stay healthy. For the past few years, technology has become vulnerable to everyone including the health care sector. The equipment used in the hospitals and other health care departments has taken the advantages by capitalizing the use of technology for treating special needs patients. Assistive technology is one of the equipment provided for special needs patients. Despite experiencing one to one monitoring session by using traditional treatment for rehabilitation, assistive technology is providing a better environment with immersive life experience to the special needs patients (Georgiou & Demiris, 2017; Tageldeen et al., 2017).

Assistive technology is embedded into the rehabilitation field as an attempt to increase the quality of recovery (Ahmad et al., 2019). This technology is an adjunct treatment in electrical or

mechanical movement for special needs to undergo exercises specifically in rehabilitation (Hughes et al., 2014). The use of assistive technology in maintaining and sustaining functional capabilities will help special needs patients to experience their rehabilitation in comfortable ways. Interestingly, the invention of assistive technology is embedded to increase the quality of recovery on the special needs patients (Rego et al., 2017). Throughout rehabilitation therapies and sessions, assistive technology function in improving and maintaining capabilities on special needs patients. In addition, assistive technology creates different experiences from traditional rehabilitation (De O. Andrade et al., 2013; Velasco et al., 2017).

Serious games are the example of assistive technology tools that provide cheerful environment and bring more satisfaction to special needs patients for going through the treatment comfortably (Bond et al., 2019; Garrido et al., 2013). These games are one of the preferable assistive technology tools for special needs patients to undergo rehabilitation. The interactive and attractive serious games led to a better interaction between special needs patients with technology while doing the exercises (Fernandez-Cervantes & Stroutia, 2019; Van Greunen, 2019). Moreover, serious games promote an excitement and enjoyment for special needs patients though they are doing the tedious and repetitive exercises every day (Baur et al., 2018; Ling et al., 2017). In advance, though serious games are developed and deployed as an adjunct to nonrecreational purposes, yet it still give huge impacts in assisting the special needs patients and offer them a new experience to perform their rehabilitation therapies and exercises (Li et al., 2018; Merilampi et al., 2018).

Serious games for rehabilitation is combining the digital gaming and physical exercise which gives special needs patients an experience on self-monitoring while doing the exercises (D'Ornellas et al., 2014; Santoso et al., 2017). Despite being originally designed for entertainment, serious games are increasingly used for health promotion and the popularity of serious games for rehabilitation has rose for special needs patients (Li et al., 2018). Serious games help in building the interaction between the special needs patients with computer (HCI) and robotics (HRI) (Chen et al., 2013). Hence, serious games provide a realistic environment through the imitation of systems that can be used for rehabilitation process (Cordella et al., 2012). The immersive type of serious games help user to feel the real-life scenarios while undergoing the exercises (Chen et al., 2013). The two mediums implemented in HCI and HRI are focusing on physical, cognitive, psychological well-being of player (Baur et al., 2018; Jerčić et al., 2018).

Simulator, robotic and virtual reality are the technology that embed serious games as tools for rehabilitation. The simulated car driving serious games are realistic imitation of controls that used for training process (Jonsdottir et al., 2018). Serious games in robotics shows the increment number of interactive robots in recent times such as The Tower of Hanoi (ToI) Serious Games and Smart Chair Ski-Jumping (Jerčić et al., 2018; Merilampi et al., 2019). As for virtual reality serious games, the aim is to overcome disabilities resulting memory impairment, attention deficit and unilateral visual neglect (Fernandez-Cervantes & Stroutia, 2019), it has the potential to improve the special needs patients in terms of emotion-based, behavior-based and attitude-based related according to (Ahmad et al., 2019). The example of serious games in virtual reality are Virtual-Gym Bubbles (Fernandez-Cervantes & Stroutia, 2019) and Heart Collection (Merilampi et al., 2018).

Serious games show a positive impact as the assistive technology tools for rehabilitation as the reinforcement is notable to be one of the methods for special needs patients to adapt with new environment and gain their motivation (Goršič et al., 2017). It helps in increasing the self-motivation of the special needs patients while playing the games (Georgiou & Demiris, 2017). Motivation becomes an essential determinant of rehabilitation outcome for special needs patients (Baur et al., 2018; Ling et al., 2017). The special needs patients experiences and perspectives on serious games are one of phenomenon that can be used to identify the diversity of the existing technology used for rehabilitation (Basri et al., 2017). The used concept of serious games for rehabilitation in assisting special needs patients has involved the user experience in motivation (Bond et al., 2019; Vugts et al., 2016).

User experience is a field of study that bring new perspective and phenomenon for special needs patients to identify and looking for different concept of treatment and education (Basri et al., 2017). Motivation is one of the user experience factor which plays an important roles in rehabilitation field as the responses of special needs patients which are resulting a real approach from the use of serious games (Dhawan et al., 2019; Tobler-Ammann et al., 2017). The quality of interaction between the special needs patients with computer and robotics can be described in terms of competitive, reward-based and motivation have brought satisfaction towards them (P. Rego et al., 2010). Hence, in terms of education John Keller has invented the ARCS motivation model to motivate learner and ensure the continuity of the motivation during the education and treatment purposes (J. Keller, 2000).

However, assistive technology infusions into learning environment which shows exponentially during the past decades (J. M. Keller, 2016). According to the ARCS motivation model, there are four keys to be expressed as attention, relevance, confidence, and satisfaction. The explanation of each factor is shown in the summary Table 1.

Table 1: The ARCS Motivation Model Summary

Factors	Explanation	Example
Attention	Engage with a deeper level of curiosity at the beginning of the lesson	Participation, Humour, Variability
Relevance	Curiosity aroused when there is the need for matching	Experience, Choice, Usefulness
Confidence	Positive expectancies for success through learning requirements	Self-confidence, Difficulty, Learning Requirement
Satisfaction	Sustain the motivation with positive outcomes	Unexpected rewards, positive and negative outcomes

Source: (J. Keller, 2000)

The ARCS motivation model by John Keller is an instructional model that important in motivate special needs patients and ensure the motivation continuity during the completion of tasks (J. Keller, 2000). In this regard, the ARCS motivation model is used to classify the motivation attributes into four different groups according to their four main factors. It helps in identifying special needs patients' preferences from different platforms in different environment while playing serious games for rehabilitation. The development of the ARCS motivation model is to ensure the positive outcomes in user experience has introduced serious games as the tools to undergo rehabilitation.

2. PROBLEM STATEMENT

Rehabilitation is a field which provides important services to citizen especially the special needs patients to gain motivation and comfort. There are lot of equipment in this field which help the special needs patients to have undergo rehabilitation and recover through exercises in daily life activities. The therapies and exercises are still conducted in traditional ways by using the repeated exercises and lessons by the same methods without introducing the technology together (Bowker et al., 2006). Hence, this has led the special need patients to have less interest in rehabilitation as it involves repetitive and tedious exercises (Bond et al., 2019; De O. Andrade et al., 2013). Motivation is vital in delivering impacts for special needs patients to undergo rehabilitation as it indicates high motivation level and sense of usefulness (Merilampi et al., 2017).

However, by doing the tiring and constant exercises in traditional ways has given the special needs patients less interest and low self-esteem thus it causing less improvement in endurance (Merilampi et al., 2019). Less interest and low self-esteem in special needs patients has led to low motivation level and declining performances (Rego et al., 2017). Though these can triggered the self-management of special needs patients in daily life activities, it is hard to have the immersive and real

scenarios of life without implementing serious games and having a sustain feeling of motivation (Akinwuntan et al., 2012; Chen et al., 2013).

Motivation of special needs patients can be measured from their rehabilitation performances. However without enforcing and identifying the main factors to keep sustain in doing the exercises, it is difficult to increase their motivation level (Cordella et al., 2012; Lumsden et al., 2016). The gaps that should be emphasized and found from the previous studies are the assessment of motivation level in special needs patients and the equipment used for rehabilitation is affecting the sustainability of motivation (Ahmad et al., 2019). Hence, this research is exploring the motivation attributes through the ARCS motivation model in serious games for rehabilitation on special needs patients. Figure 2 below shows the gaps and the impact on the special needs patients while using serious games for rehabilitation.

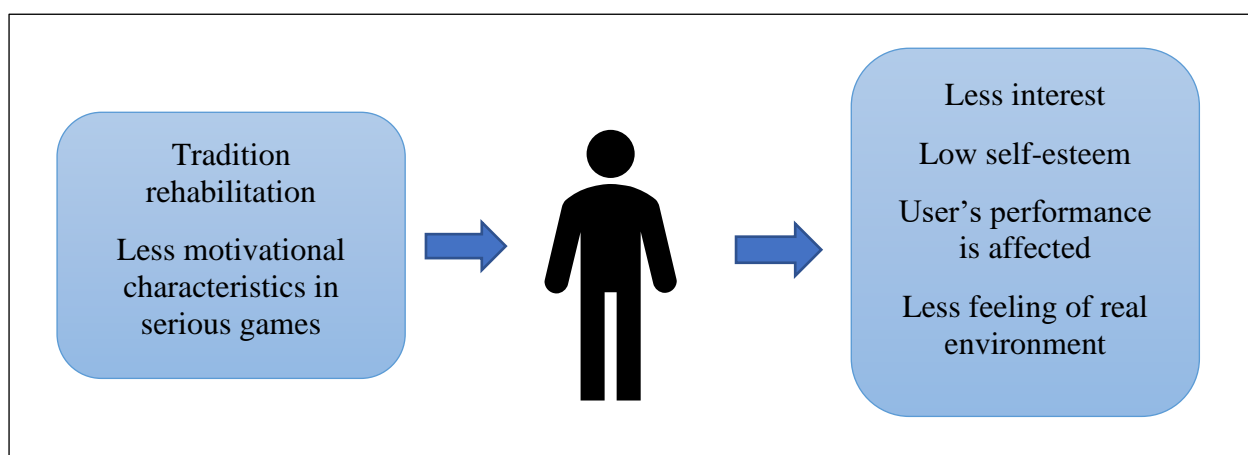


Figure 2: The gaps and impacts of serious games for rehabilitation

3. OBJECTIVES

The objectives as follows are clearly stated to overcome and solve the problems in this research:

- i. To identify the motivation attributes that influence special needs patients in serious games for rehabilitation.
- ii. To classify the motivation attributes in serious games for rehabilitation using the ARCS motivation model.
- iii. To recognize the most influence motivation attributes that affect special needs patients in serious games for rehabilitation.

4. METHODOLOGY

In this section, systematic literature review is employed. Resources, systematic review for selected articles and data analysis are three main sub-sections used.

4.1 Resources

The present studies review considerable number of serious games and assistive technology in rehabilitation for special needs patients. There are more than five (5) databases used for this research as suggested by (Younger, 2010). The databases are vigorous and cover more than 300 fields of studies. Accordingly, the researchers have conducted the searching process using more databases to increase the probability of getting similar articles. Though the two main databases for this research are using SCOPUS and ScienceDirect, therefore the searching efforts on published articles and

journals such as IEEE Xplore, JMIR Serious Games, and JSTOR Rehabilitation are reliable to rehabilitation, serious games, special needs, and user experience.

4.2 Systematic Literature Review (SLR)

4.2.1 Identification

In this subsection shows the selection of relevant articles consist of specific keywords that are used in this research. The first step in process of identification starts with keyword searching using Boolean Operations in all databases. The relevant main keywords are shown in Table 2. The second step requires keywords to be search for related similar terms in thesaurus, dictionaries, and through the past research. After the manual searching in all stated databases using the keywords, a total of more than thousand articles managed to be found and the current research are successfully grouped and retrieved are 500 articles.

Table 2: Database String Searching

Database	Data String
SCOPUS and ScienceDirect	TITLE-ABS-KEY (("serious games* OR exergames") AND ("ARCS model*") AND ("motivation*") AND ("user experience* OR user performance* OR user preference*") AND ("rehabilitation*"))

4.2.2 Screening

The main objective of screening is to remove the duplicate articles. For this research, the total of 17 duplicated articles are removed in the identification stage while the balance of 483 articles were screened based on several inclusion and exclusion criteria determined by the researchers. The first criterion included in this research is the keywords in abstract from the past works which have mentioned on the specific keywords for the whole studies. The second included criterion is the literature type in which journals and articles were the only decided research papers to be selected, hence other than that were excluded.

The language used in each journal and article is using English as medium and publication like conference proceedings and chapters in books are excluded and must be in the full-text article. This screening phase is focusing on recent publication from 2011 to 2019. Hence, the recent studies are not more than 10 years period. Overall, a total of 68 articles are included based on the criteria mentioned in Table 3.

Table 3: The Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Keywords	Serious games, ARCS model, Motivation, Rehabilitation, User Experience, User Acceptance	Other than the keywords mentioned
Literature Type	Journal and Article	Conference proceeding, chapters in book, book series, systematic review
Document Type	Full-type article	Half-text
Language	English	Non-English
Publication Year	2011-2019	Below than 2010

4.2.3 Eligibility

Figure 1 shows the flowchart of systematic literature review for this research. A total 65 articles were prepared for this stage where the important notes, titles, abstract and main contents were examined thoroughly. The eligibility is used to make sure each article and journal is fulfilled all the requirements without duplicating and fit to be selected as present study for this research. Consequently, number of 40 articles have been excluded as and there is no results and discussion focusing on motivation. The end of this stage, total of 28 selected articles are ready to be analysed.

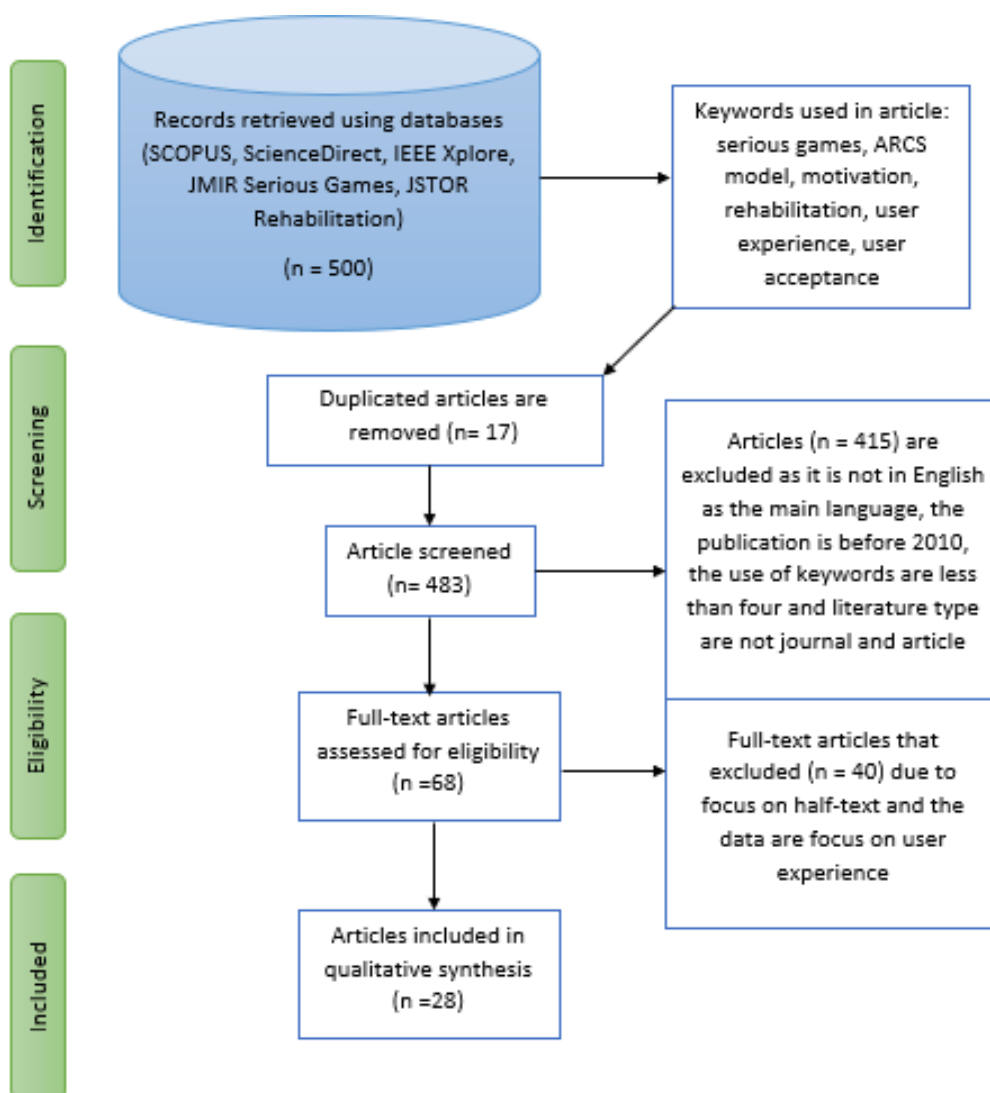


Figure 1: Flowchart of Systematic Review

5. FINDINGS

In this section, the researchers will be answered the objectives by showing the results of research in the tabulate data. Serious games and motivation are two main focuses for this research. The researchers aimed to identify the motivation attributes which has influence the special needs patients in serious games for rehabilitation (RO1) meanwhile the next objective (RO2) is to classify the

motivation attributes found in RO1 using the ARCS motivation model. Ironically, the method of collecting and analysing are done by using the systematic literature review in the previous section. From the SLR method, the findings on objectives RO1 and RO2 are as follows. Table 4 shows all the motivation attributes found in past studies on special needs patients which influence in serious games for rehabilitation.

Table 4: Motivation Attributes based on Previous Research

No	Attributes	Authors	Repetition
1	Enjoyable	(Baur et al., 2018; Ling et al., 2017; Merilampi et al., 2017)	3
2	Interesting	(Merilampi, 2018, 2019)	1
3	Attractive, Challenging	(Idriss et al., 2017)	1
4	Experienced, Attention	(Georgiou & Demiris, 2017)	1
5	Focus	(Brox et al., 2017; Ling et al., 2017)	2
6	Physiological	(Dhawan et al., 2019; Jerčić et al., 2018; Merilampi et al., 2017)	3
7	Reliable, Presence	(Jerčić et al., 2018)	1
8	Cooperative	(Baur et al., 2018; Rego et al., 2017)	2
9	Motivation/Motivating	(Baur et al., 2018; Brox et al., 2017; Chen et al., 2013; Dhawan et al., 2019; Goršič et al., 2017; Idriss et al., 2017; Jonsdottir et al., 2018; Ling et al., 2017; Merilampi et al., 2017, 2019; Mubin et al., 2019; Pramana et al., 2018; Rego et al., 2017; Vugts et al., 2016)	13
10	Exercise Intensity	(Goršič et al., 2017)	1
11	Conceived	(Jonsdottir et al., 2018)	1
12	Mobility	(Jonsdottir et al., 2018; Merilampi et al., 2018)	2
13	Satisfaction	(Hughes et al., 2014; Merilampi et al., 2017; Tobler-Ammann et al., 2017)	3
14	Meaningful	(Merilampi et al., 2018)	1
15	Feasibility	(Vugts et al., 2016)	1
16	Self-assessment	(Tan & Zary, 2019)	1
17	e-Learning	(Chen et al., 2013; Merilampi et al., 2017; Tan & Zary, 2019)	3
18	Balance	(Hoogland et al., 2019)	1
19	Immersive	(Chen et al., 2013; Ling et al., 2017; Mubin et al., 2019)	3
20	Competitive	(P. A. Rego et al., 2017)	1
21	Suitable, Exciting	(Merilampi et al., 2017)	1
22	Reward-based	(Dhawan et al., 2019; Merilampi et al., 2017; Pramana et al., 2018)	3
23	Reduce anxiety	(Pramana et al., 2018)	1
24	In detail	(Brox et al., 2017)	1
25	Simple/Simplicity	(Fernandez-Cervantes & Stroutia, 2019; Ling et al., 2017; Merilampi et al., 2018)	2

Table 4 shows the result on motivation attributes identification that affects the special needs patients while they undergoing rehabilitation using serious games. The data tabulation has fulfilled the RO1 and a total of 29 motivation attributes were found and used in the previous studies. The evidence from this study shows there are eleven (11) attributes have been mentioned repeatedly by the previous scholars in their studies such as motivation, satisfaction, immersive, and simple. The researchers managed to determine eighteen (18) attributes which have been mentioned at least once in the past research meanwhile the repeated attributes have at least been highlighted twice and three times.

On the other hand, the motivation attribute has been mentioned the most in thirteen (13) different previous studies from different scholars. The researchers have managed to identify the word as the most highlighted attribute in serious games which can assist the special needs patients who

undergo rehabilitation thoroughly. Hence, the evidence from this study intimates that motivation is the crucial and vital element to be put as one of the characteristics in serious games for rehabilitation.

Table 5 shows the data tabulation on motivation attributes in serious games for rehabilitation which have been classified into four main factors: attention, relevance, confidence, and satisfaction using the ARCS motivation model.

Table 5: Motivation Attributes based on The ARCS Motivation Model

Factors	Motivation Attributes
Attention	Focus, conceived, meaningful, reward-based, in detail, balance, immersive, attention
Relevance	Reliable, presence, exercise intensity, physiological, challenging, suitable, competitive
Confidence	Experienced, cooperative, motivation, simple, feasibility, self-assessment, e-Learning, exciting
Satisfaction	Enjoyable, interesting, attractive, mobility, satisfaction, reduce anxiety

Motivation is the most influence attribute in the previous studies that prove that serious games can bring satisfaction to special needs patients while doing the therapies. The result shown in Table 5 has completed the R02 for this research. The motivation attributes are grouped into four main factors in the ARCS motivation model based on their modes. Attention, relevance, confidence, and satisfaction are the factors which bring difference experiences in special needs patients while using serious games for rehabilitation. The motivation attributes from the previous table 4 is in the group of confidence factor. This shows that motivation is important in build up the confidence level of special needs patients in performing rehabilitation.

Figure 3 shows the relationship of confidence factor and the motivation attribute in working together to help special needs patients to experience rehabilitation using serious games as the assistive technology tools.

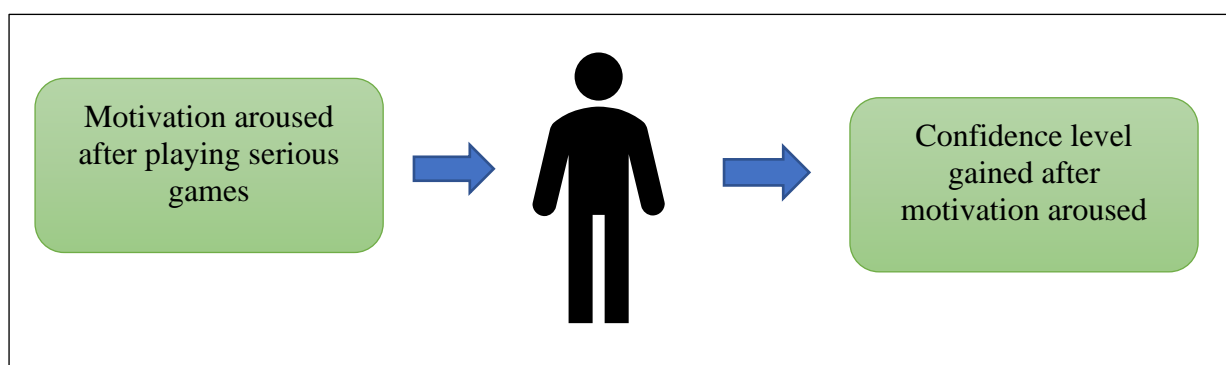


Figure 3: Relationship of motivation attribute and confidence level

6. CONCLUSION

The findings and systematic review process of the present studies have shown number of recommendations that can be implied into future studies. First, future scholars should focus on strategies to counter the negative performances based on the negative adaptation of serious games for rehabilitation in special needs patients. Despite the advantages of serious games as the assistive technology tools for exercises and educational purposes, it is vital to examine the factors on usability and user experience in terms of motivation. Though motivation is part of user experience, yet it

should be noted that the improvement of relationship between motivation and confidence can be made while playing serious games.

The recent studies on special needs patients in using serious games as the rehabilitation tools has bring to an exploration on the use of the ARCS motivation model. The model has reflected a basic understanding of how special needs patients show their response and preferences while playing serious games for exercises and therapies instead of using the traditional ways repeatedly. Each serious game played has different functions and resulted various feelings and experience to special needs. From the findings, the researchers found a massive attribute which influence special needs patients to continue rehabilitation with satisfaction and enjoyable.

The ARCS motivation model helps the researchers in identified the attributes according to the previous research in Table 4. The motivation model helps to classify the motivational characteristics and problems of learners especially on special needs patients by listing the self-reflective checklist (J. M. Keller, 2016). Serious games for rehabilitation used as the assistive technology benefit for special needs patients to gain confidence and concentrate on the exercises and therapies. Though serious games intentionally developed for educational and entertainment purpose, yet it still promotes health and bring goods to special need patients for rehabilitation. The interactive and immersive characteristics of serious games have fondly affected the special needs patient's performance and experience.

Motivation has become the most influence attribute in special needs patients according to the ARCS motivation model while undergoing rehabilitation using serious games (Novak et al., 2014). This research has showed that the special needs patients gained their confidence through motivation and satisfaction came after having a positive experience while doing the exercises and therapies (Vugts et al., 2016). In other words, the previous studies successfully support the essential of motivation in special needs patients to continue the exercises repeatedly. Hence with the help of assistive technologies through serious games, it is vital for the special needs patients to sustain their performances while undergo rehabilitation (Cordella et al., 2012).

In sum, special needs patients undergoing their rehabilitation exercises to keep their health momentum and stay healthy (D'Ornellas et al., 2014). Purposively with the intervention of serious games as the assistive technology tools for rehabilitation, special needs patients are benefiting the enjoyment and immersive characteristics while they are in the schedule of therapies. The use of the ARCS motivation model is to identify, classified and recognize the motivation attributes from the previous studies which affected the group of special needs patients.

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