CHAPTER 5

DISCUSSION AND CONCLUSIONS

5.1 Overview

In this chapter, the research discussion, output, contributions, and recommendation for potential future works are summarized. The research discussion is based on the research objectives and followed by the output of each objectives in the next subsection. The success of the research objectives and the contributions of this study are discussed. The research contributions are based on the theoretical and empirical parts. Though there are contributions, benefits, and advantages from the research to researchers and the rehabilitation field, there are a few limitations of this study that need to be enhanced in for future work. The last section in this chapter is recommendations future works for researchers in the rehabilitation field that focusing on assistive technology. The continuation of this research will be heading to the future findings.

5.2 Research Discussion

In this section, the researcher discusses the findings of the study by viewing the research questions and objectives. The achievements of the research objectives are explained in the identification of user experience factors, the recognition of the relationship between user experience factors through motivation and usability towards serious games and the formulation of a user experience model in serious games for rehabilitation.

5.2.1 Research Objective 1

The first research objective is focuses on the identification of user experience attributes based on the two factors: motivation and usability. The researcher is using the primary sources in the literature review to recognize and classify each keywords highlighted from the previous research into their specific attribute. The attributes are ease of use, learnability, memorability, and satisfactions from usability factors and attention, relevance, confidence, and satisfaction from motivation factor. Hence, the identification of attributes from user experience factors becomes the research contribution to the rehabilitation field and the enhancement in the development of serious games.

From the first research objective, the researcher has outlined many type of keywords from the previous studies and divided them into two main factors. (Bonnechère et al., 2016; Hellweger et al., 2015; Merilampi et al., 2017, 2019) have highlighted the importance of having motivation and usability factors in helping the persons with disabilities to sustain and maintain their focus and attention to the repeated exercises and therapies held by the rehabilitation centre. The importance of their experiences in playing serious games has been highlighted with many keywords to emphasize the attributes in developing the games.

Adaptive, interactive, focus, meaningful, engaging, challenging, and simple are the keywords found and used by recent researchers to focus on usability and motivation in user experience. The results in previous studies, it shows that user experience attributes through motivation and usability factors that have been used to bring new experiences to persons with disabilities to undergo rehabilitation. Hence, the first objective of determining and identifying user experience attributes through motivation and usability factors in serious games for rehabilitation is achieved. The results of user

experiences attributes identification from previous research are shown in chapter 2, from Table 2.8 and Table 2.9.

5.2.2 Research Objective 2

The second research objective is to determine the relationship of user experience factors through motivation and usability towards serious games. The research is continues to explore the relationships on eight (8) identified attributes that come from the two main factors in user experience using the mediator analysis in chapter 3 and 4. The second objective is referring to the research hypothesis (RH). As there are three main research hypotheses, RH1 and RH2 are focusing on the one-to-one relationship between motivation factor and user experience in serious games for rehabilitation. Meanwhile RH3 is determining the relationship between usability factor through motivation factor on user experience in serious games for rehabilitation.

The results of RH1, RH2 and RH3 have been explained throughout the research starting from chapter 1 for the introduction to chapter 4 for the results. Hence, Figure 5.1 shows the overall relationships in research hypothesis and is followed by Table 5.1 on the overall relationships involved in the research.

Mediator
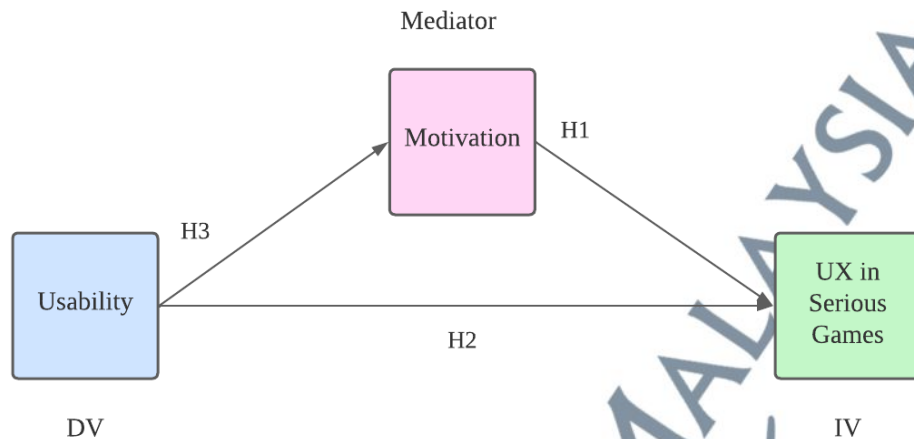
Figure 5.1: Overall Relationship in Research Hypothesis

Table 5.1: Overall Relationships in The Research

| No		Hypotheses
H1		Motivation is significantly affecting user experience in serious games
	H1a	Attention is significantly affecting the motivation in serious games
	H1b	Relevance is significantly affecting the motivation in serious games
	H1c	Confidence is significantly affecting the motivation in serious games
	H1d	Satisfaction is significantly affecting the motivation in serious games
H2		Usability is significantly affecting user experience in serious games
	H2a	Ease of use is significantly affecting user experience in serious games
	H2b	Learnability is significantly affecting user experience in serious games
	H2c	Memorability is significantly affecting user experience in serious games
	H2d	Satisfaction is significantly affecting usability of serious games
H3		Usability is significantly affecting motivation of user experience in serious games
	H3i	Ease of use is significant using attention towards user experience in serious games
	H3ii	Ease of use is significant using relevance towards user experience in serious games

H3iii   Ease of use is significant by confidence towards user experience in serious games

H3iv   Ease of use is significant by satisfaction towards user experience in serious games

H3v   Learnability is significant by attention towards user experience in serious games

H3vi   Learnability is significant by relevance towards user experience in serious games

H3vii   Learnability is significant by confidence towards user experience in serious games

H3viii   Learnability is significant by satisfaction towards user experience in serious games

H3ix   Memorability is significant in using attention towards user experience in serious games

H3x   Memorability is significant in using relevance towards user experience in serious games

H3xi   Memorability is significant in using confidence towards user experience in serious games

H3xii   Memorability is significant in using satisfaction towards user experience in serious games

H3xiii   Satisfaction is significant using attention towards user experience in serious games

H3xiv   Satisfaction is significant using relevance towards user experience in serious games

H3xv   Satisfaction is significant using satisfaction towards user experience in serious games

H3xvi   Satisfaction is significant using confidence towards user experience in serious games

Hence, from Figure 5.1 and Table 5.1 it can be concluded that there are significant relationships between user experience and serious games through motivation and usability factors. The eight (8) attributes are affecting user experience in serious games

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for rehabilitation. Motivation and usability are important in making the user experience a vital characteristics to be embedded in developing serious games for rehabilitation. As assistive technologies using robotics, simulator and virtual reality have given users dynamically responses with the process of adaptive change planned in lifestyle, interaction and motivation are the attributes that have been used repeatedly in the previous research. Figure 5.2 shows the relationship between user experience factors and serious games for rehabilitation.
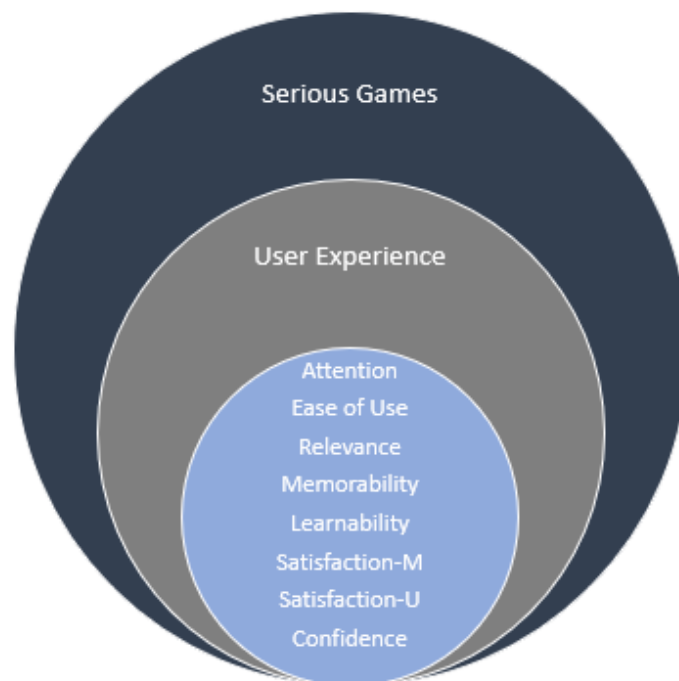
Figure 5.2: Relationship between User Experience Factors in Serious Games

Figure 5.2 shows the Venn diagram which has led to a theory construction that the attributes in motivation and usability factors are the user experiences that affect serious games for rehabilitation. Usability and motivation factors are important in

providing memorable experiences through learning and sustaining motivation through positive feelings and attitudes (Merilampi et al., 2017, 2018). Hence, the research hypotheses helps to identify the relationship between user experience factors that influenced serious games for rehabilitation.

The determination of the relationship of the user experience factors: motivation and usability fills the limitation to inadequate available evidence to find the specific attributes in serious games for rehabilitation. From the previous studies, there is the intersection of criteria between attributes in motivation and usability factors. Hence, Table 5.2 shows the results of intersection criteria in user experience factors.

Table 5.2: Results of Intersection Criteria in User Experience Factors

Attribute	Criteria	Attributes
Learnability of Usability and Relevance of Motivation	Easy to learn to achieve a goal and it based on goal orientation and motive matching	Adaptive, reliable, presence, cooperative, interactive
Satisfaction of Usability and Satisfaction of Motivation	Pleasant feelings such as freedom of choosing to self-expressed on achievements	Exciting, enjoyable, fun, comfortable, positive feedback, motivating
Ease of Use of Usability and Attention of Motivation	Help users to feel at ease and bring perceptual and inquiry	Low risk, easy to start, navigate, and set up, cooperative, focus, immersive, real

Table 5.2 shows the intersection of criteria between user experience factors in serious games for rehabilitation. From eight (8) quality attributes in user experience factors through motivation and usability, six of them are intersected by criteria and keywords mapped from the previous research. Learnability of usability factor and

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relevance of motivation factor explained on goal orientation and ways to achieve the goals. Since serious games are developed to be one of the platforms for assistive technology in rehabilitation and every rehabilitation session has its own goals, learnability and relevance attributes can work together to fulfil the target.

As rehabilitation exercises are repeated and tedious therapies, persons with disabilities require an adaptive, interactive, reliable, presence, cooperative, and interactive serious games to undergo the sessions according to previous research. Satisfaction is another usability attributes that brings freedom and pleasant feelings towards persons with disabilities who played serious games for rehabilitation. Though the path coefficient of the attribute towards satisfaction of motivation factor is negative, the criteria bring pleasant feelings such as freedom of choosing to self-express on achievements. Hence, exciting, enjoyable, fun, comfort, positive feedback and motivating are the keywords highlighted by the recent researchers.

5.2.3   Research Objective 3

The last objective of this research is to formulate a new model based on the user experience factors in serious games. The new model is formulated according to the previous model chosen in Chapter 2: The ARCS Model for motivation and Nielsen's Model for usability which also have been used in previous research. According to (Keller, 2016), technology has infused a lot in the learning and exercising environment and accelerated with new innovative application. Yet, the adaptations of basic knowledge of motivation are getting challenging. Hence, in managing motivational components in the environment, the integration of technology can be the delivery sytems.

The ARCS motivation model can stimulate and sustain the motivation in users using systematic ways (Hamzah et al., 2015). Apart from the use of the ARCS Motivation Model in formulating serious games for rehabilitation, Nielsen's Usability Model is bringing a few aspects that set freedom, easy to learn and easy to remember (Yuniarto & Herdiana, 2018). The resulted model is validated through the partial least square from structural evaluation modelling (PLS-SEM) using SmartPLS software and SPSS software. Thus, the intersection of the two models from the ARCS Motivation Model and Nielsen's Usability Model is important to assist in developing serious games for rehabilitation in Malaysia.

5.3   Research Output

This subsection is outlining the output that has been achieved throughout the research. There are two findings which can be concluded as the output. The formation of user experience factors new model is the main output at the end of the research. The formation of the model from this research is established through motivation and usability factors in user experience. The process of identifying and determining the factors from two different user experience factors: motivation and usability, has led to the questionnaire design for this research. The combination of motivation and usability has encouraged the researcher to explore more on the benefits and advantages of the two main factors towards serious games for rehabilitation.

The output of the systematic review in chapter 2 has turned out to outline eight (8) final factors from motivation and usability attributes in user experience. The factors are formed from two different models: ARCS Motivation Model and Nielsen's

Usability Model. Table 5.3 shows the final attributes from two factors in user experience that affect serious games for rehabilitation.

Table 5.3: Finalize Attributes from User Experience Factors

Attributes	User Experience Factors
Satisfaction-U	Usability
Attention	Motivation
Relevance	Motivation
Memorability	Usability
Ease of Use	Usability
Confidence	Motivation
Satisfaction-M	Motivation
Learnability	Usability

From the finalize attributes in user experience factors in Table 5.3 above, the characteristics needed in developing serious games for rehabilitation are highlighted. A set of questions are designed to find the user's feedback and perceptions on serious games for rehabilitation. Survey design and quantitative based method are applied to show the user experience factors in motivation and usability. Hence, from the user experience factors, a new model is formulated and summarized all the factors from two different factors: motivation and usability that give the impact on serious games for rehabilitation.

The second research output is started from the formation of a research hypothesis that lead to the formulation and calculation of a total of 24 relationships in this research. A new model then has been formulated by combining motivation and usability attributes that finally show the total number of 22 relationships are approved

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by the experts and the analyzed results of feedback from the questionnaire using PLS-SEM. Figure 5.3 shows the output model from this research.
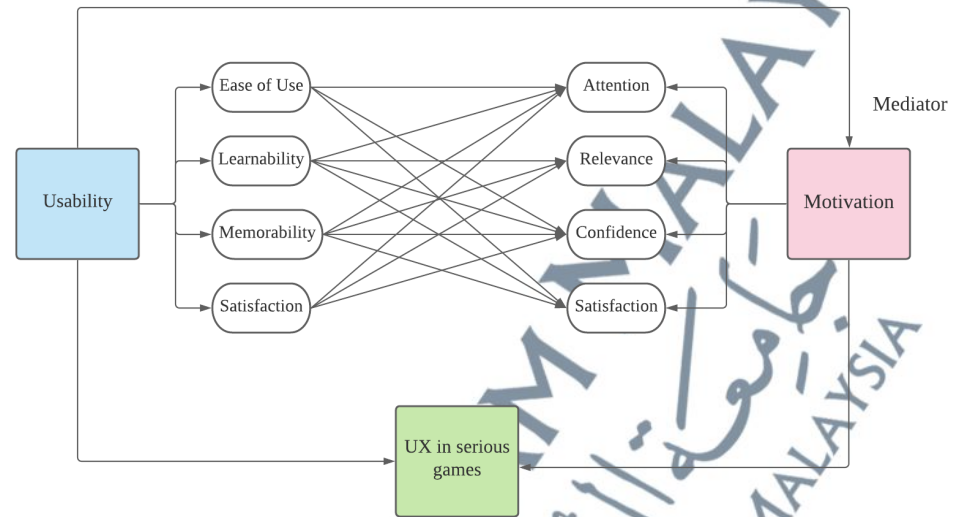
Figure 5.3: New Model as The Output

Starting from the identification of the user experience attributes in motivation and usability to the recognition of the relationship between the two main factors towards serious games, this research has come out with a new formulation of the model which benefited the rehabilitation field and assistive technology development. Thus, the new model is the summarizes factors from user experience factors: motivation and usability that affect towards serious games for rehabilitation.

5.4 Research Contribution

The contribution of this research is important in assisting the development of future works. The contributions are divided into three: theoretical, empirical and practical. The theoretical contribution is based on the user experience studies in rehabilitation from

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the literature review. The empirical contribution is based on the relationship between the user experiences factors and the new model formulated at the end of the research. Lastly, the practical contribution is focusing on four different groups that have been benefited from this research. Thus, this section is delivering the essential message to the future development of serious games for rehabilitation.

5.4.1 Theoretical Contribution

The theoretical contribution is referring to the previous studies that have been tabulated in the literature review in chapter 2. The contributions are focusing on the user experience studies that helped in outlining the most usable characteristics of motivation and usability called as attributes from serious games developed for rehabilitation purposes. Serious games are giving out a positive impact on persons with disabilities to feel at ease while undergoing rehabilitation therapies, yet it helps users in gaining confidence, more focus and satisfied with the services offered in serious games.

From the literature review, the study of user experience has been widely used for enhancing the development of serious games for rehabilitation therapies. The attributes from motivation and usability factors in previous research are focusing on giving the ease to persons with disabilities and patients to undergo rehabilitation exercises. There are nearly 60 outlined attributes from both motivation and usability factors that can be used as one of the essential keys in contributing to future works of serious games for rehabilitation.

Besides, from this research it shows that user experience factors through motivation and usability have positively influenced the rehabilitation in the healthcare sector. It contributes to a new discovery of eight (8) vital attributes from two different

user experience factors for developing the best serious games for patients or persons with disabilities to undergo their therapies and exercises. The eight (8) attributes are ease of use, learnability, memorability, satisfaction in usability, attention, relevance, confidence and satisfaction in motivation.

The attributes in motivation helped the therapists to outline the best goals for persons with disabilities or patients to improve their health performances meanwhile the attributes in usability helped the therapists to suggest the best assistive technology according to their needs and sustainability in rehabilitation therapies and exercises. user experience benefits both person with disabilities and therapists in rehabilitation. The discovery of the relationship between motivation and usability factors in user experience, it helps the rehabilitation field to take seriously the use of assistive technology in therapy.

In conclusion, user experience factors through motivation and usability are essential in making a quality life and goals of patients and persons with disabilities who undergo rehabilitation using serious games.

5.4.2 Empirical Contribution

The empirical contributions hence helped in exploring the relationship between the user experience factors and formulating new model. Though there is a positive and negative value in the relationship between the motivation and usability factors, yet the only relationship that has been eliminated from being part of the model is ease of use with relevance and the relationship between the satisfaction attribute in usability and motivation. The process of rejecting the two relationship is started from the data

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generated from SmartPLS software to the suggestion by the expert as both relationships are not affecting much the therapy objectives in the rehabilitation field.

This research has come out with a new model that helps in both assistive technology and rehabilitation fields in ensuring the best service is provided for persons with disabilities who undergo therapy sessions by playing serious games. Serious games which have been one new method in the rehabilitation field in Malaysia according to the expert, has become the first choice to be chosen by the therapist and patients in terms of assisting and boosting motivation level. The most concerning factors that bring motivation to play serious games for rehabilitation are attention, relevance, and memorability while the chosen quality for usability at the end of the research are satisfaction and ease of use.

Hence from the finalize relationships, have created new concept of using assistive technology in the rehabilitation field. The more relevant the game, the more confident and satisfied the users will respond toward the rehabilitation exercises. When users are getting more confident and satisfied with the assistive technology used by playing serious games as the tool, their rehabilitation goals are going to be successful in terms of motivation gaining and health performances.

5.4.3   Practical Contribution

In this subsection, the practical contribution is highlighting four focused group that benefited from this research. The four special groups are the Ministry of Health Malaysia (KKM), the rehabilitation centre in Malaysia, the persons with disabilities and patients and serious games developers.

(A) Ministry of Health Malaysia (KKM)

Assitive technology has been used widely for the past recent years in many countries around the world for rehabilitation purposes. The development of serious games as the assistive technology has brought benefits to the society along with the growth of technology. Serious games for rehabilitation will bring more benefits to the Ministry of Health Malaysia (KKM) in terms of many ways.

    1.   Security of data is assured

    2.   Energy saving in workers

    3.   The efficiency of rehabilitation therapies

(B) Rehabilitation Centre in Malaysia

Despite providing benefits for the Ministry of Health Malaysia (KKM), serious games also can be an asset for rehabilitation centre in Malaysia. As this research is done in one of the rehabilitations centrers that equipped with various types of assistive technology, the researcher has seen the bright sides of using serious games as the treatment tools for rehabilitation. Hence, the benefits are as follows:

    1.   Therapies schedules become more strategic

    2.   Rehabilitation goals can be set easily

    3.   Performances are monitored by the results shown

(C) People of Disabilities and Patients

From this research, serious games have been selected as the assistive technology tool to be practically played by patients who undergo rehabilitation to stay healthy. Serious games have benefited the users in many ways such as

motivational gaining, confidence gaining and the quality of performances in therapies. Thus, the following are the advantages of playing serious games for rehabilitation.

1. Not affected by the tedious and repeated exercises

2. Feeling enjoy and satisfies

3. Reward-based increase motivation

(D) Serious Games Developers

The development of serious games has been in the topic since the formulation of a new model has been made from the user experience attributes through motivation and usability factors. This shows that developers play an important role in the advancement of serious games for rehabilitation. In practical contribution, the research is contributing the idea to developers to create an evolution for serious games. The contributions are mentioned as follows:

1. Importance of inserting motivation elements in games

2. The quality of serious games is depending on the usability

5.5 Future Works Recommendations

As there are still rooms for improvement that need to be done in the future works, here are some suggestions for new researchers. Despite the research output and contribution to the society, assistive technology and the rehabilitation field, several limitations that can be considered and hence, the recommendations for future studies are as follows. Table 5.4 shows the suggestions for future works.

Table 5.4: Suggestions for Future Works

Topic	Suggestions
User Experience Attributes	From this research, the total attributes in both motivation and usability are 60. Hence, the suggestion for future works is to explore any other user experience attributes that can focus on color and design and music acceptance in serious games for rehabilitation. Other than that, lots more characteristics that can be added in motivation and usability attributes which can contribute to assisting persons with disabilities to undergo their therapies.
Model	In this research, there are two models were used to formulate a new model in user experience at the end of study. Thus, other than using Nielsen's Usability Model and the ARCS Motivation Model, the future works recommendation is to examine other models that are suitable for developing serious games for rehabilitation and help commit in the user experience fields.
Game Type	Besides using the same type of games and movements while doing the research, it is suggested to have played different types of games in the future and explore other movements that can be played simultaneously with any groups of diagnosis in the rehabilitation centre. Moreover, the serious games need to be varied for persons with disabilities to challenge themselves by unlocking their rehabilitation goals.
Study Design	As this research is using survey design and quantitative based method, it is suggested for future

studies to diverse the study design by using
experimental design and qualitative based.

Table 5.4 shows the suggestions in four different topics from this research which aimed to adjunct for future enhancement. As this research is faced time constrains while doing the data collection, it is suggested to play more different types of games where persons with disabilities have chances to challenge themselves to unlock new achievements. Besides, developing a new type of serious games for rehabilitation using the simplest English for communication can assist them to understand better on the purpose and aim of each movement and game that they played.

In conjunction with the development of serious games, it is recommended to explore more user experience attributes that can be important characteristics. The focus can be on colour and design or music acceptance among persons with disabilities to perform their exercises. Other than that, to create an interesting feedback and preferences from users, it is essential to diverse the study design from a survey design and quantitative based method to an experimental design and qualitative based method. Hence, the reference models for the next research can be examined to help commit to the user experience field and serious games for rehabilitation.

5.6   Summary

User experience in motivation and usability are two essential factors in ensuring the continuity of feeling, behavior, and spirit which commit to a positive impact on user performances. Their preferences from the feedback gathered in questionnaires are measured and the result indicates that motivation is important and usability of the serious games is vital for persons with disabilities to continue their rehabilitation

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sessions. Serious games are the assistive technology that has been used widely in the rehabilitation field and the key of this research has achieved the target when it has contributed to rehabilitation centers and serious games developers.

The questions of how user experience is important in sustaining motivation and the usability of serious games developed for persons with disabilities have led to this whole research. The doubt of hows and whys has opend a new journey in exploring user experience and assistive technology in the rehabilitation field. The research has contributed more to serious games development for rehabilitation starting from the development of the research objectives. The identification and determination of user experience factors and the relationship shaped by the two main factors have led to the formulation of a new model for researchers that can be used as a reference in their future works.

The conceptual framework in this research has been discovered from the tabulation of attributes used in the previous study. In the literature review, the outlined of new characteristics in developing serious games for rehabilitation that can cater to more users from different medical history and diagnosis background has been done. The use of the ARCS Motivation Model and Nielsen's Usability Model to encourage persons with disabilities to stay focused in their therapy sessions has contributed in building the questionnaire.

The designed set of questionnaires is vital in getting users' feedback and their experiences are validated and measured by using the structural equation modelling based on partial least square calculation. The measurement of data from each attribute and the calculation of their relationship has led to the discovery of a new model. The presentation of data is analysed in chapter 4. Hence, from the whole research has shown the importance of valuing and validating the user experience in developing serious