CHAPTER 4

DATA ANALYSIS AND RESULTS

4.1 Overview

Chapter 4 is discussing on data analysis and results of each section of the questionnaire. The mediation analysis is selected to be used in this research where attributes in motivation factor act as the mediator for attributes in usability factor towards user experience in serious games. Hypotheses formation and results are the next sub-section explained in the chapter. All the analyses used in this research are discussed in detailed in each section. The last section before the summary of this chapter is a model validation discussion and suggestions from the experts.

4.2 Data Analysis in Each Section

Each section in the questionnaire has contributed to the data analysis. Section A which focuses on the demographic part has given out new statistics on serious games player for rehabilitation. Section B and C are totally focusing on formulating a new model for developing serious games for rehabilitation in the future. The last section of the questionnaire has shared the respondents' feedback on playing serious games as part of rehabilitation therapies and exercises to stay healthy. The results of each section are presented as follows.

4.2.1 Results in Section A

As for section A, the selected results which contributed to new statistics are tabulated as follows. Gender, age, races, diagnosis, and duration of diseases are the main results that

give a new perspective to this research. Each pie chart is together with an explanation and data.

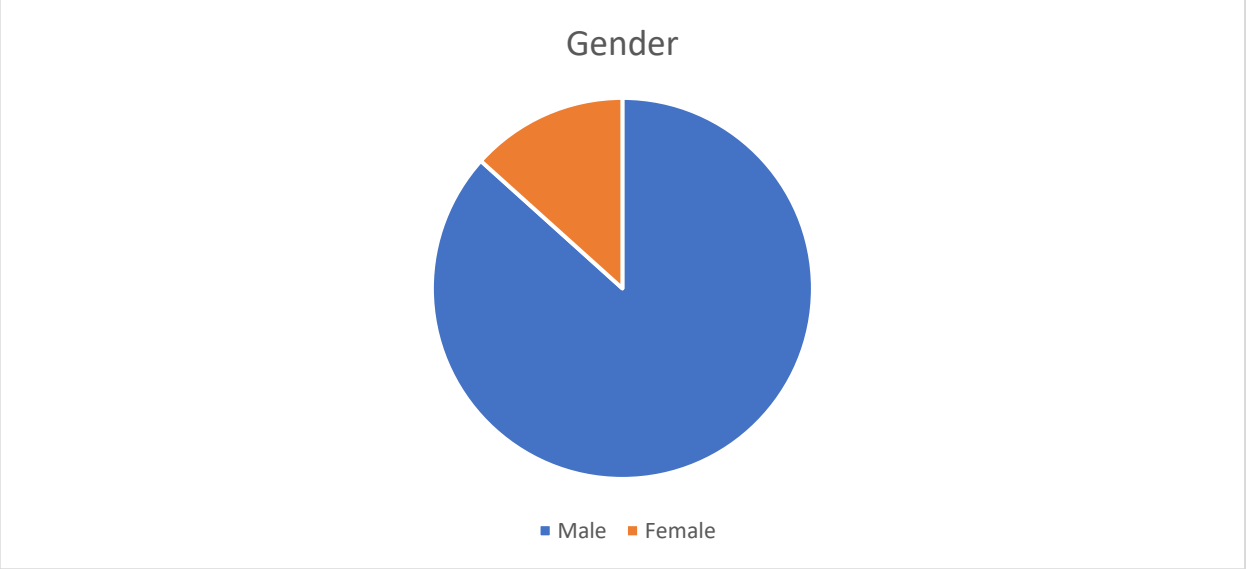


Chart 4.1: Gender Chart

Chart 4.1 shows the results on the number of genders from the overall respondents who have answered the questionnaires. The total respondents have been divided into two group: male and female. The result in the pie chart shows the male respondents are dominating in contributing their feedback and experiences. More than 75% out of the total number of 45 respondents are male. Of total of 45 respondents who have gone through the rehabilitation session by playing serious games using the selected assistive technology, 39 are male and the balance is female.

The next result is focusing on the respondent's age. There are five different stages of age in the questionnaires from 21 to 25 years old, 26 to 30 years old, 31 to 35 years old, 36 to 40 years old and above 40 years old. The result shows respondents who are above 40 years old get the highest number which is 28 and the lowest number of respondents at the age of 21-25

years old which is 3. Chart 4.2 shows respondents at the age of 26 to 30 years old and 36 to 40 years old have the same number of respondents which is 4. The second highest number of respondents are those age of 31 to 35 years old which is 6.

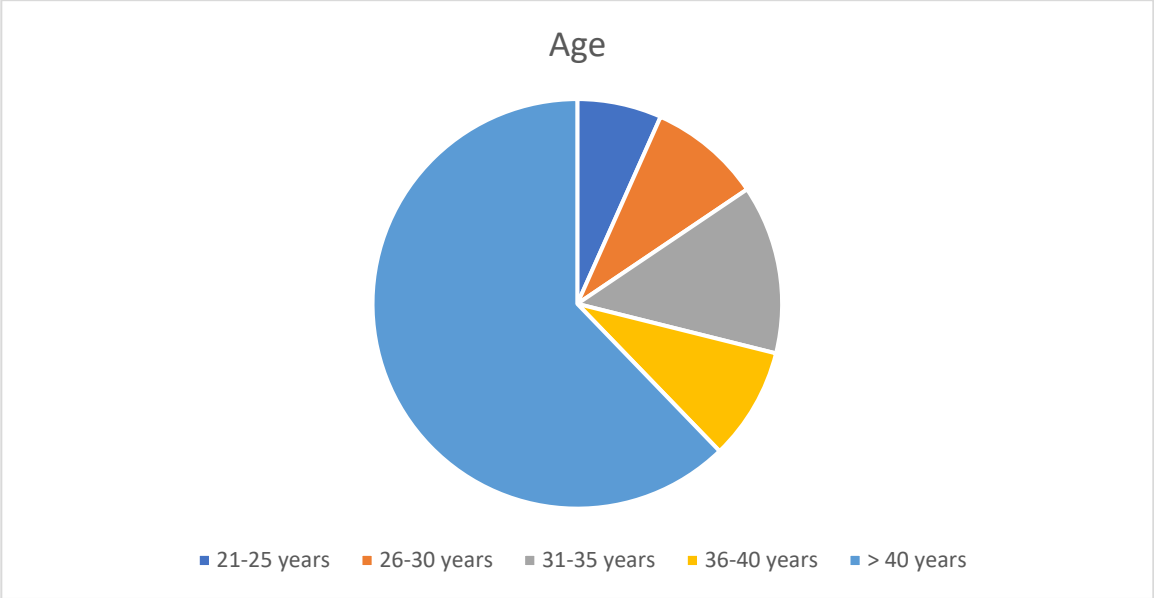


Chart 4.2: Age Chart

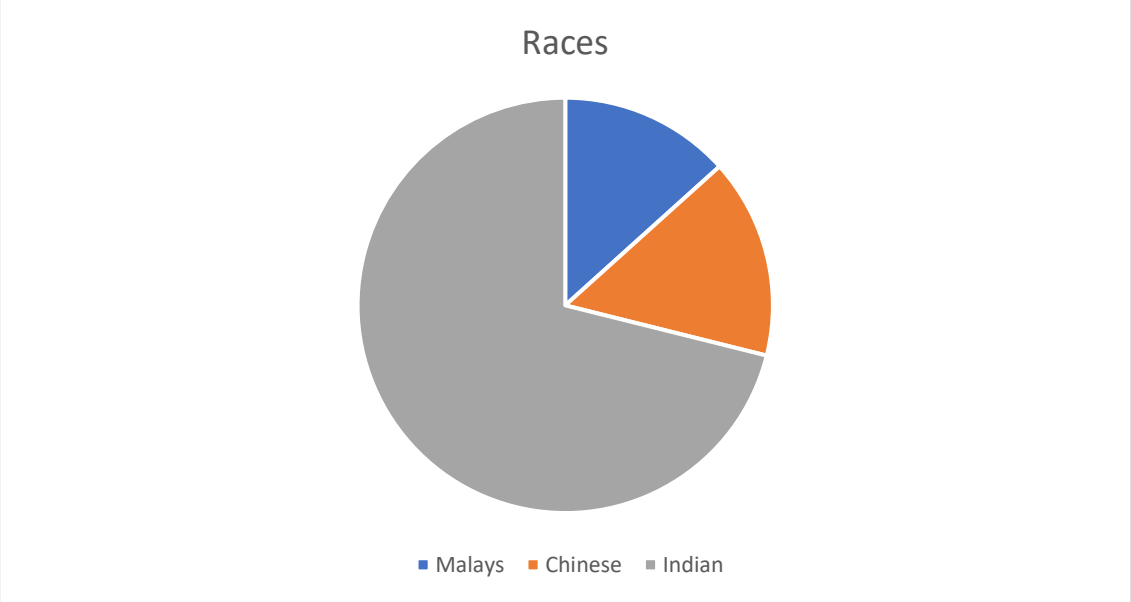


Chart 4.3: Races Chart

Chart 4.3 shows the races statistics of respondents. There are three main races to be selected for this research: Malays, Chinese, and Indian. The dominant races who have answered the questionnaire are Malays with a total number of 28 meanwhile for Chinese is 7 respondents and Indian has 6 respondents. The next analysis is on the diagnosis of respondents. Chart 4.4 shows the respondent's diagnosis involved in this research. There are only four diagnoses selected according to the recommendation from therapists that can played serious games for rehabilitation. These four diagnoses are stroke, traumatic brain injury, spinal cord injury, and amputee.

Stroke diagnosis consists of the highest number with a total of 31 respondents, followed by 7 respondents having a traumatic brain injury, 6 of them are suffering from spinal cord injury and 1 of the respondents is from amputee. The results on the duration of respondents having the diseases are shown in chart 4.5 where the longest period of the disease is 4 years.

The duration of 6 to 12 months and 2 to 4 years are at the same number of respondents which are 13 and the duration of more than a year to less than 2 years only 11 respondents.

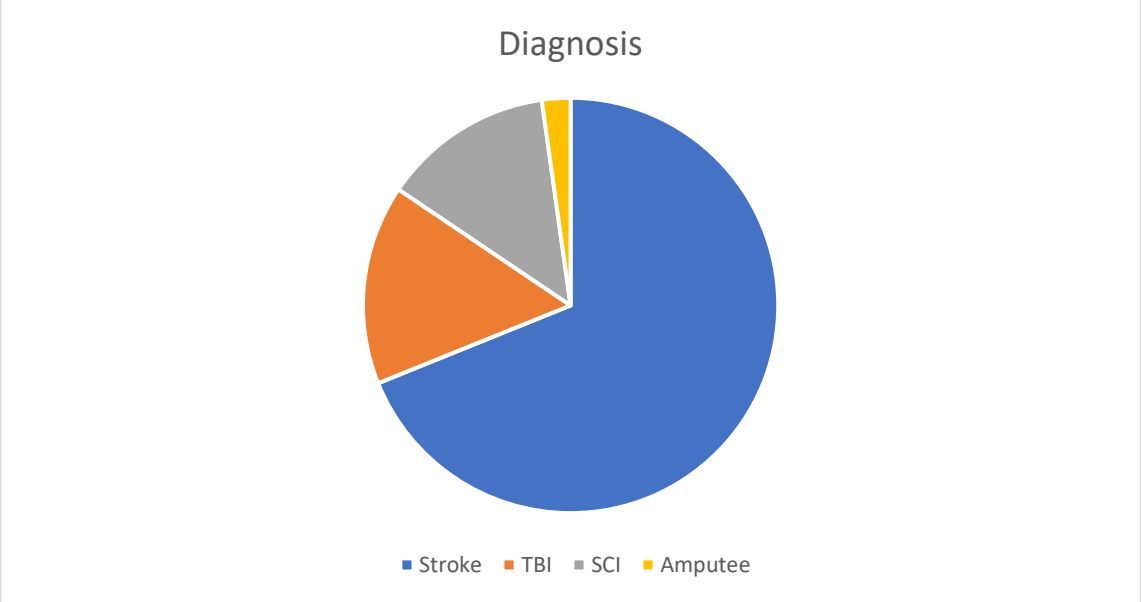


Chart 4.4: Diagnosis Chart

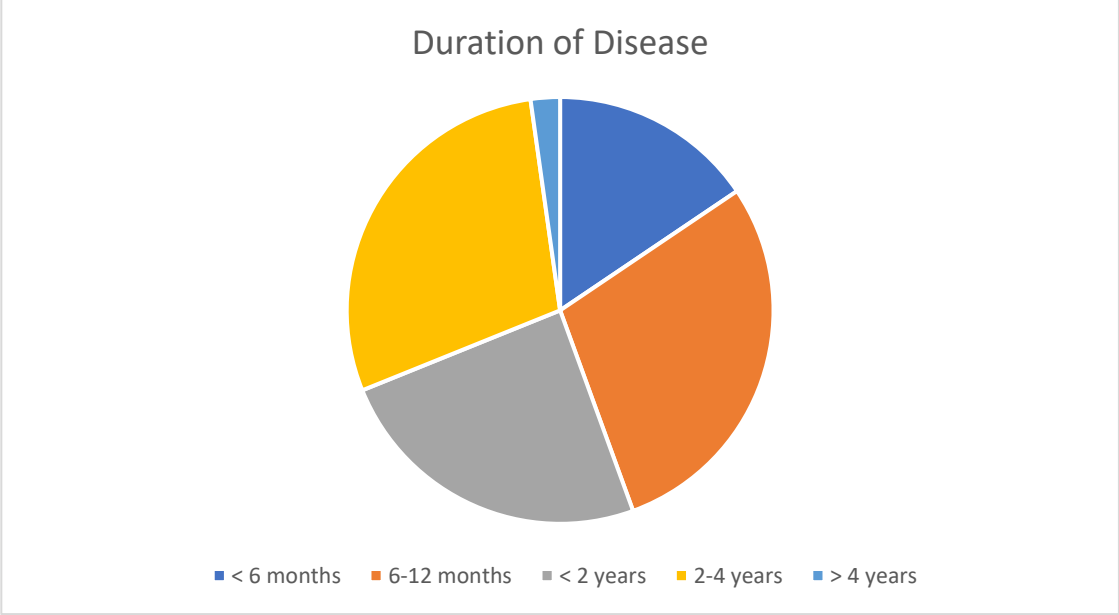


Chart 4.5: Duration of Disease Chart

4.2.2 Results in Section B and C

This section is combining the analysis of section B: usability and section C: motivation in the questionnaire as these two sections are the most important that need to be highlighted in this research. The analysis and results are based on the PLS-SEM method using SmartPLS software. There are three calculations for testing on reliability and validity of each question in questionnaires: Cronbach's Alpha, AVE for convergent validity and Fornell-Larcker Criterion for discriminant validity. The following tables are showing the results on each question in each attribute on Motivation and Usability.

(A) Cronbach's Alpha

Cronbach's Alpha is used to analyze on the reliability of the results and to calculate the internal consistency in assuring the data is reliable. Table 4.1 shows the results on internal consistency and indicator loading for section B and section C.

Table 4.1: Internal Consistency Realiability and Indicator Loading

Questions	Indicator Loading	Composite Reliability	Cronbach's Alpha
Ease -1	**0.686**		
Ease-2	**0.685**		
Ease-3	**0.741**		
Ease-4	**0.931**	**0.924**	**0.899**
Ease-5	**0.898**		
Ease-6	**0.921**		
Learnability-1	**0.801**		
Learnability-2	**0.262**	**0.812**	**0.715**
Learnability-3	**0.810**		

Learnability-4	**0.909**		
Memorability-1	**0.877**		
Memorability-2	**0.929**	**0.942**	**0.918**
Memorability-3	**0.883**		
Memorability-4	**0.894**		
SatisfactionU-1	**0.903**		
SatisfactionU-2	**0.843**		
SatisfactionU-3	**0.883**	**0.947**	**0.934**
SatisfactionU-4	**0.771**		
SatisfactionU-5	**0.738**		
SatisfactionU-6	**0.863**		
SatisfactionU-7	**0.921**		
Attention-1	**0.814**		
Attention-2	**0.896**		
Attention-3	**0.785**		
Attention-4	**0.806**	**0.944**	**0.931**
Attention-5	**0.891**		
Attention-6	**0.823**		
Attention-7	**0.868**		
Relevance-1	**0.903**		
Relevance-2	**0.945**		
Relevance-3	**0.879**	**0.949**	**0.932**
Relevance-4	**0.862**		
Relevance-5	**0.845**		
Confidence-1	**0.918**		
Confidence-2	**0.873**	**0.926**	**0.892**
Confidence-3	**0.760**		
Confidence-4	**0.924**		
SatisfactionM-1	**0.831**		
SatisfactionM-2	**0.923**		

SatisfactionM-3	**0.915**	**0.921**	**0.890**
SatisfactionM-4	**0.852**		
SatisfactionM-5	**0.643**		

From table 4.1, the value of Cronbach's Alpha and composite reliability is based on the average of indicator loading of each question. The most reliable attribute is satisfaction in usability with the value of the item is 0.934, followed by relevance with the value of 0.932 and attention at the value of 0.931. Though the learnability attribute has the lowest value of 0.715 Cronbach's Alpha, yet it is still at the acceptable value to be reliable. The overall composite reliability for each attribute in section B and section C shows a good and excellent value where the number is above 0.800 and the highest number is 0.947, respectively. Hence, the results showed the reliability of each item which surpassed the minimum requirement of internal consistency.

(B) Convergent and Discriminant Validity

The next analysis is focusing on the convergent and discriminant validity to ensure the correlation of variables. Table 4.2 shows the AVE results on each attribute towards user experience in serious games.

Table 4.2: Average Variance Extracted (AVE) Value

Attribute	AVE Value
Ease of Use	0.671
Learnability	0.548
Memorability	0.803

Satisfaction	0.720
Attention	0.708
Relevance	0.788
Confidence	0.759
Satisfaction	0.704
User Experience in Serious Games	0.700

Table 4.2 shows the AVE values in all attributes are at range from 0.550 to 0.803 value. The highest AVE value is the latent variable of Memorability, and the lowest value is Ease of Use. From the reliability construct and AVE shown, both values are supported to be reliable for the model. Discriminant validity is referring to the extent in which the construct is differing from one another empirically. It also measures the degree of differences between the overlapping constructs. Table 4.3 below shows the correlations and discriminant validity values in the Fornell-Larcker method.

Table 4.3: Discriminant Validity using Fornell-Larcker

	ATT	CON	EASE	LEA	MEM	REL	SAT-M	SAT-U
ATT	0.841							
CON	0.801	0.871						
EASE	0.526	0.512	0.819					
LEA	0.674	0.676	0.799	0.740				
MEM	0.677	0.574	0.711	0.827	0.896			
REL	0.774	0.802	0.687	0.700	0.680	0.888		
SAT-M	0.702	0.850	0.497	0.602	0.537	0.832	0.839	
SAT-U	0.578	0.538	0.917	0.853	0.718	0.654	0.518	0.848

Note: Att: Attention, Con: Confidence, Ease: Ease of Use, Lea: Learnability, Mem: Memorability, Rel: Relevance, Sat-M: Satisfaction-M, Sat-U: Satisfaction-U

Table 4.3 explains the results on discriminant validity on each attribute which shows the positive value of the Fornell-Larcker Criterion. The construct range is between 0.500 to less than 0.900 value that resulting in a significant value for serious games. The summary of results is explained on three basic calculations: Cronbach's Alpha, AVE, and Fornell-Larcker Criterion. The result shows all attributes that using three calculations have positive and significant value towards user experience in serious games and the values are accepted. Table 4.4 shows the overall results of the calculation and Figure 4.3 shows the overall calculation using SmartPLS.

Table 4.4: Results of Overall Section B and C

Attribute	Question	Indicator Loading	Cronbach's Alpha	AVE	Discriminant Validity
Ease of Use	Ease -1	**0.686**	**0.899**	**0.671**	**YES**
	Ease-2	**0.685**			
	Ease-3	**0.741**			
	Ease-4	**0.931**			
	Ease-5	**0.898**			
	Ease-6	**0.921**			
Learnability	Learnability-1	**0.801**	**0.715**	**0.554**	**YES**
	Learnability-2	**0.262**			
	Learnability-3	**0.810**			
	Learnability-4	**0.909**			
Memorability	Memorability-1	**0.877**	**0.918**	**0.803**	**YES**
	Memorability-2	**0.929**			

	Memorability-3	**0.883**			
	Memorability-4	**0.894**			
	SatisfactionU-1	**0.903**			
	SatisfactionU-2	**0.843**			
Satisfaction	SatisfactionU-3	**0.883**	**0.934**	**0.720**	**YES**
	SatisfactionU-4	**0.771**			
	SatisfactionU-5	**0.738**			
	SatisfactionU-6	**0.863**			
	SatisfactionU-7	**0.921**			
	Attention-1	**0.814**			
	Attention-2	**0.896**			
	Attention-3	**0.785**			
Attention	Attention-4	**0.806**	**0.931**	**0.708**	**YES**
	Attention-5	**0.891**			
	Attention-6	**0.823**			
	Attention-7	**0.868**			
	Relevance-1	**0.903**			
	Relevance-2	**0.945**			
Relevance	Relevance-3	**0.879**	**0.932**	**0.788**	**YES**
	Relevance-4	**0.862**			
	Relevance-5	**0.845**			
	Confidence-1	**0.918**			
Confidence	Confidence-2	**0.873**	**0.892**	**0.759**	**YES**
	Confidence-3	**0.760**			
	Confidence-4	**0.924**			
	SatisfactionM-1	**0.831**			
	SatisfactionM-2	**0.923**			
Satisfaction	SatisfactionM-3	**0.915**	**0.890**	**0.704**	**YES**
	SatisfactionM-4	**0.852**			
	SatisfactionM-5	**0.643**			

4.2.3 Results on Section D

As for section D, there are two different ways of gathering data. The first part of section D is done by Likert-scale questions on the overall perception of serious games meanwhile the other one is focusing on gathering feedback from all respondents. Table 4.5 shows the results on Likert-scale questions.

Table 4.5: Results of Overall Perception in Section D

	Question	Indicator Loading	Cronbach's Alpha	AVE	Discriminant Validity
	Overall-1	**0.850**			
User	Overall-2	**0.852**			
Experience in	Overall-3	**0.935**			
Serious	Overall-4	**0.743**	**0.912**	**0.700**	**YES**
Games	Overall-5	**0.731**			
	0verall-6	**0.890**			

Table 4.5 shows the results of the overall perception for Likert-scale questions. The highest and most preferable question is focusing on the colour chosen for each serious game played with a different type of assistive technology. The results on Cronbach's Alpha, AVE and Fornell-Larcker Criterion for discriminant validity have shown a positive value. Next, the further results are selected based on the most concerning question to be contributed to formulating and enhancing a new model.

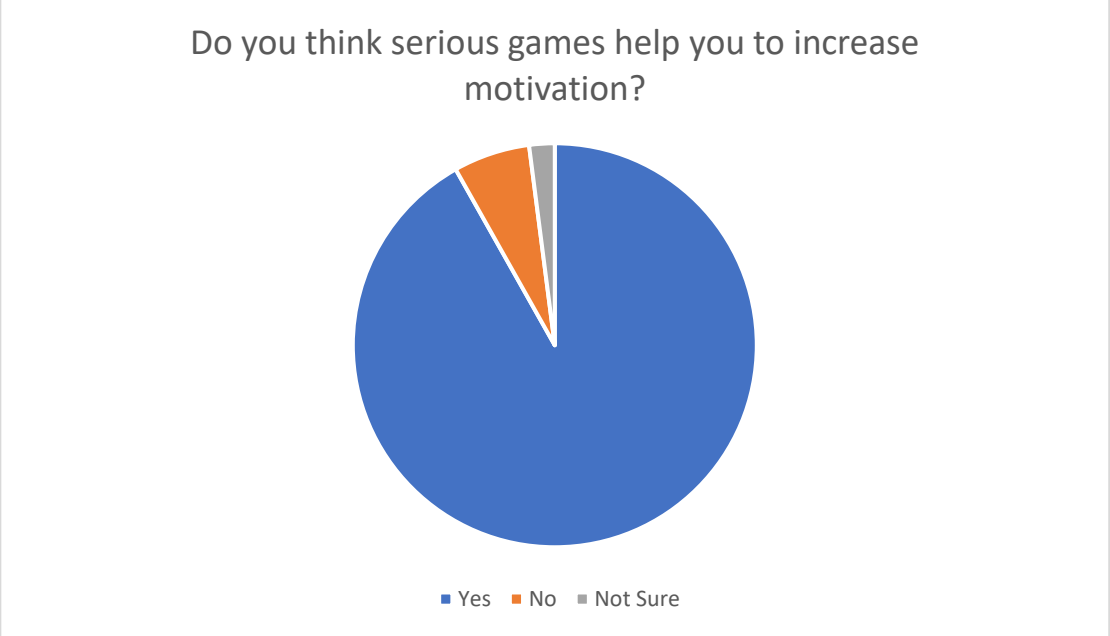


Chart 4.6: Importance of Motivation in Serious Games

Though in previous research has shown the positive feedback of respondents on serious games, there is still room for improvement that need to be fulfilled to feed the need of persons with disabilities. As shown in Chart 4.6, the first selected question from the open-ended is concerning on motivation level after playing serious games. Out of 45 respondents, there are three responded who answered 'No' to the question and one respondent did not answering the question as it can be sure whether the games are beneficial or not. Chart 4.7 is asking about the overall feelings on using serious games to do their exercises and therapies.

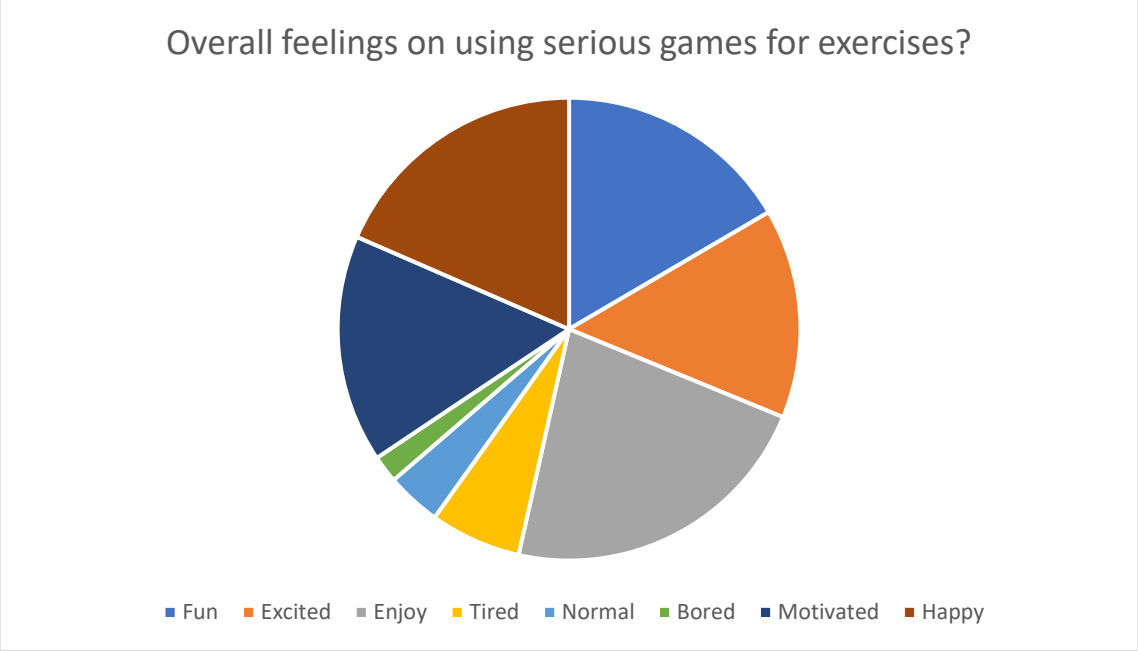


Chart 4.7: Overall Feelings of Playing Serious Games

The question in Chart 4.7 is focusing on getting the frequency of each optional feeling. The optional answers are based on the most mentioned attributes in previous studies. However, there is the optional answer to give respondents freedom in expressing their feelings when using serious games as a rehabilitation tool to stay healthy. Based on the frequencies answered by the respondents, 'enjoy' is the most frequent answer with 35 times repeated followed by the second highest number of frequencies with 29 answers, 'happy' feeling. Out of eight optional answers, there are answers on tired, normal, and boring feelings among the respondents. Gladly, the number of frequencies of these three feelings is not more than 10.

The last selected question for this section is shown in Chart 4.8. This question aims to get to know which is the most preferable assistive technology that serious games are best to be played. out of 45 respondents, only 26 are clearly answering the questions. The percentage of the chart is based on the frequency. Thus, the most preferable serious games are best to played

in the form of robotic rather than virtual reality and simulators with the highest number of 12 respondents.

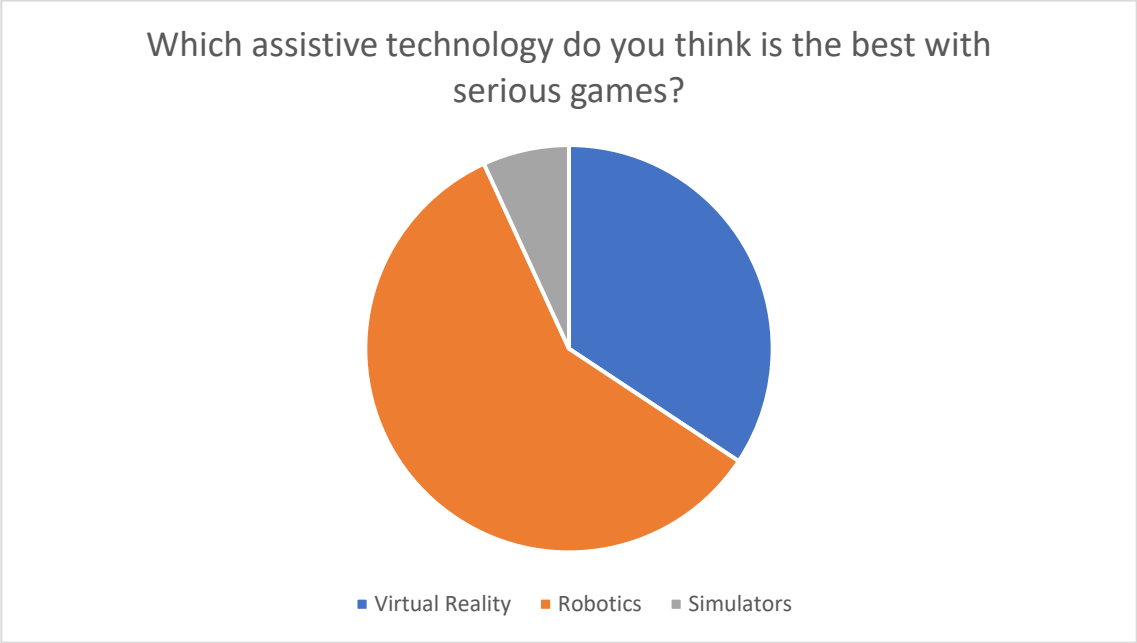


Chart 4.8: Selection of The Most Preferred Assistive Technology

4.3 Hypothesis Formations and Results

The investigation of motivation and usability factors is leading the researcher to seek positive relationships between user experience and serious games. To this end, there are three proposed hypotheses involving motivation and usability attributes in user experience towards serious games. The main purpose of these hypotheses is to prove that constructed relationships are affecting serious games and to show the progresses of taking the motivation factor as the mediator affect the overall results.

Hypotheses in H1 and H2 are having one-to-one relationship towards user experience in serious games meanwhile for H3, each attribute in usability is using each attribute in motivation as a mediator to connect the relationship and run the data. For relationship validation in this research, the researcher is using path coefficient together with the identification of T-value and P-value. Table 4.6 shows the list of research hypotheses and Figure 4.1 shows the flow of hypotheses in this research

Table 4.6: List of Research Hypotheses

No		Hypotheses
H1		Motivation is significantly affecting user experience in serious games
	H1a	Attention is significantly affecting the motivation of users in serious games
	H1b	Relevance is significantly affecting the motivation of users in serious games
	H1c	Confidence is significantly affecting the motivation of users in serious games
	H1d	Satisfaction is significantly affecting the motivation of users in serious games
H2		Usability is significantly affecting user experience in serious games
	H2a	Ease of use is significantly affecting the usability of user experience in serious games
	H2b	Learnability is significantly affecting the usability of user experience in serious games
	H2c	Memorability is significantly affecting the usability of user experience in serious games
	H2d	Satisfaction is significantly affecting the usability of user experience in serious games

H3	Usability factor is significantly affecting user experience in serious games using motivation factor as a mediator

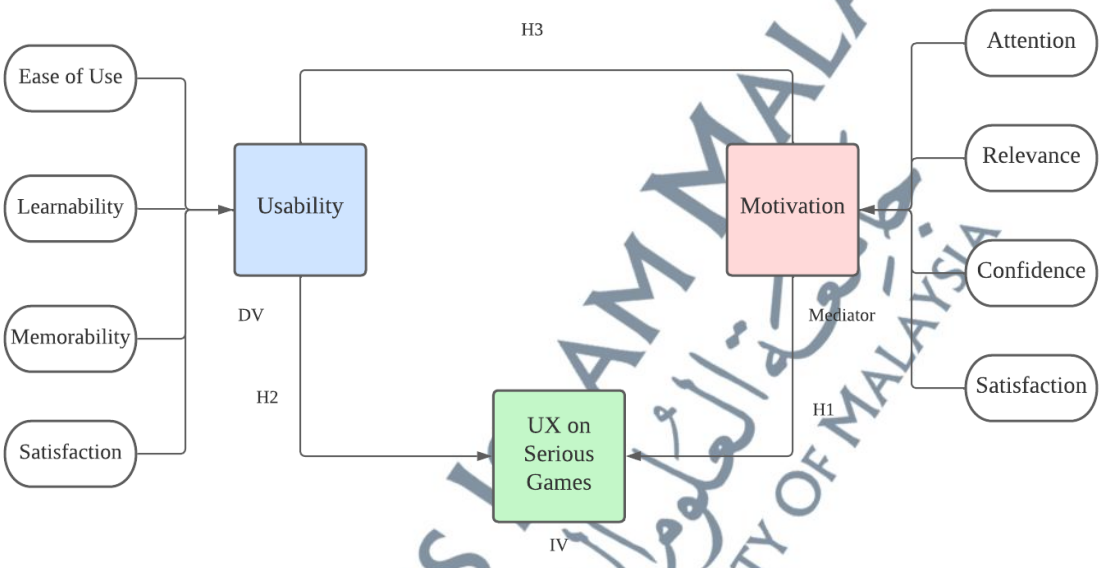


Figure 4.1: Research Hypotheses Flow

The relationship between attributes in usability factors towards user experience in serious games using mediation analysis is shown in Figure 4.1 above. The mediation analysis is used to prove the impact of motivation attributes on the direction of the relationship. The attributes of the motivation factor play the role in making sure the relationship between the attributes of the usability factor is significant and strong towards user experience in serious games.

The results of the hypotheses are explained in the next section. The researcher is focusing on each analysis in different subsections to make a clear discussion of each relationship in the

research hypotheses. Each calculation in a one-to-one relationship is calculated using SmartPLS software. Figure 4.2 shows the one-to-one relationship of all attributes to serious games and followed by Figure 4.3; the overall relationship based on hypotheses.

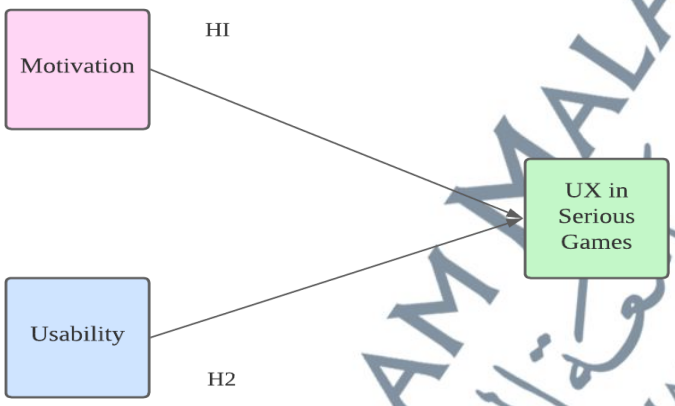


Figure 4.2: One-To-One Relationship of H1 and H2

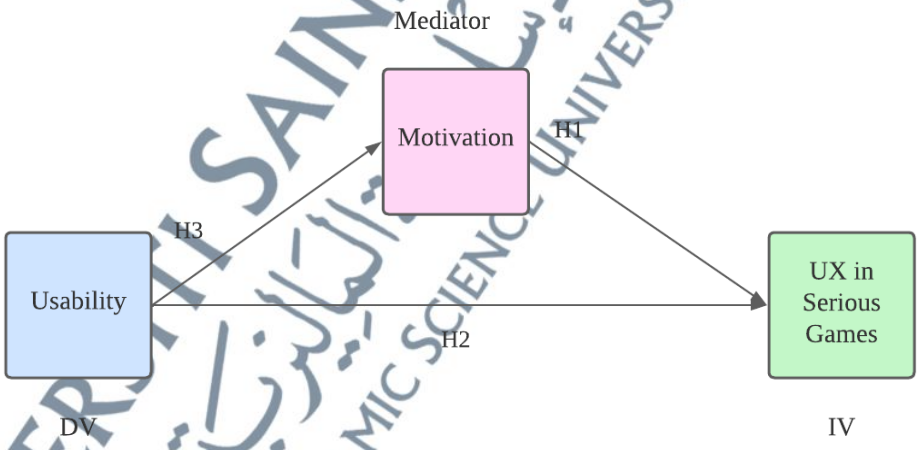


Figure 4.3: Overall Research Hypotheses

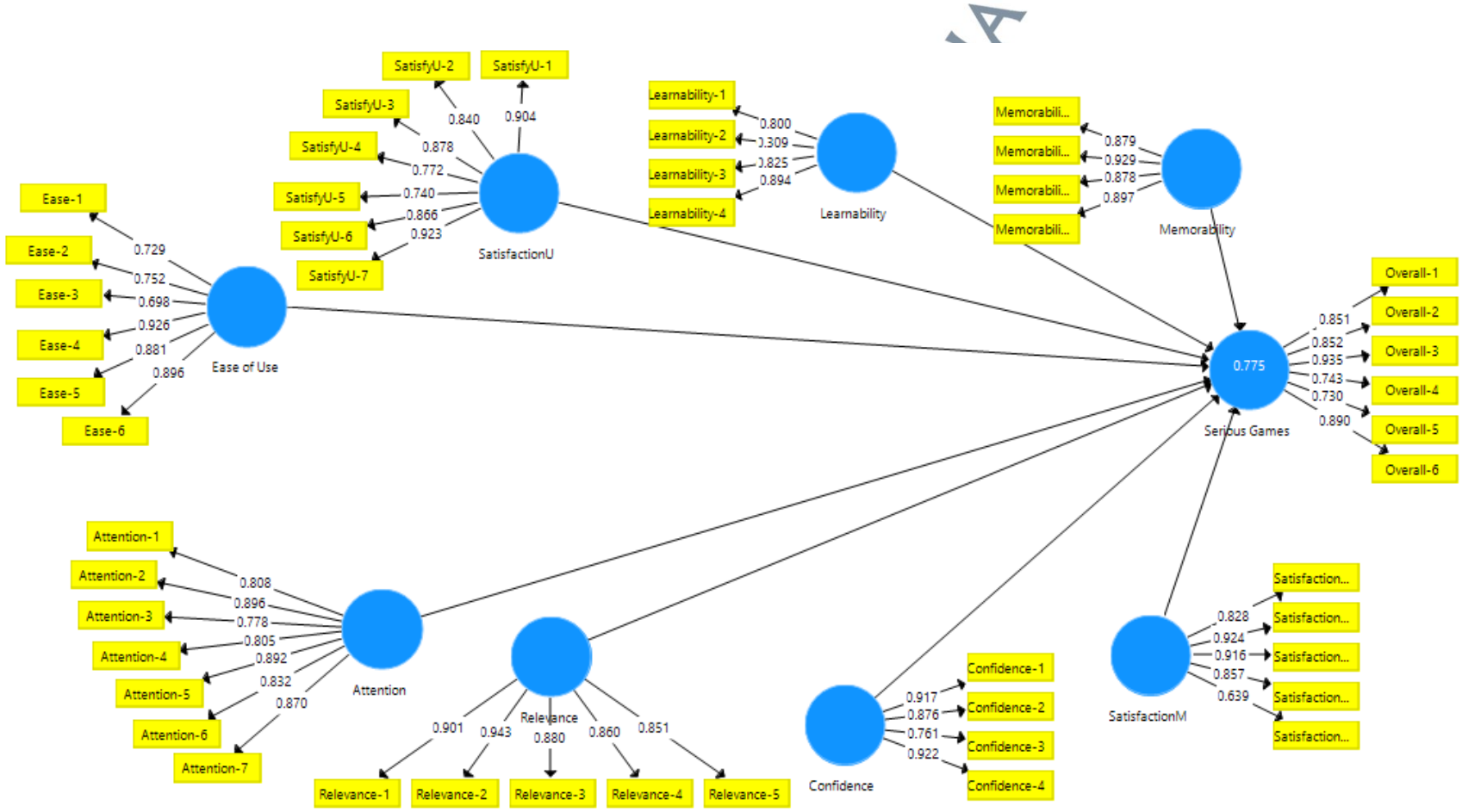


Figure 4.4: One-to-One Relationship in SmartPLS

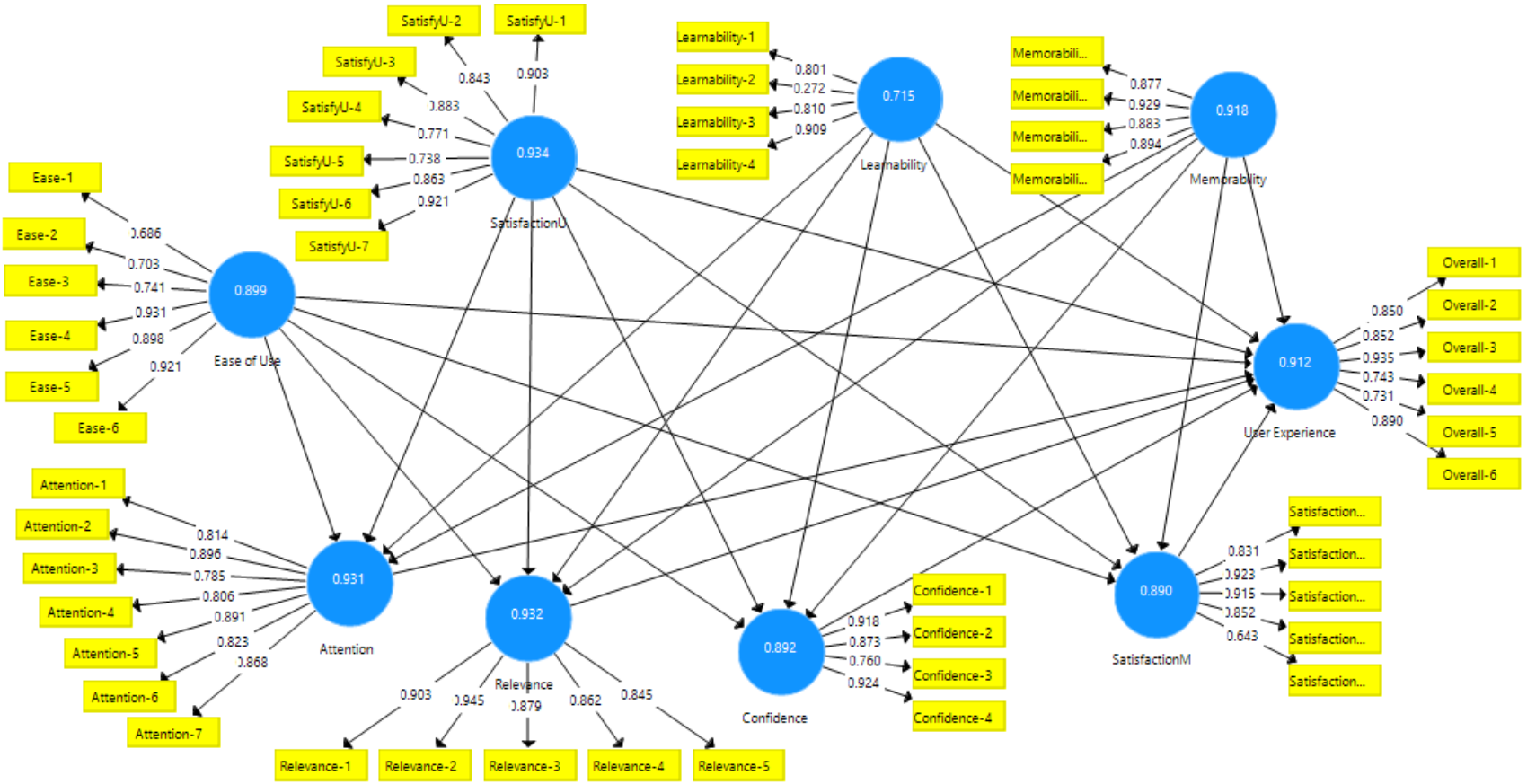


Figure 4.5: Overall Calculation in SmartPLS

The relationship results shown in Figures 4.4 and 4.5 are the real data run in SmartPLS software. Each value from each attribute has been tabulated in the summary of the overall results in Table 4.4. In this section, the importance of respondents' preferences in playing serious games as the assistive technology for rehabilitation shows in each relationship. There is a total of eight attributes from user experience factors: motivation and usability which are affecting the performances in their daily therapy and exercises towards the user experience in serious games. Table 4.7 shows the interpretation of the relationship based on the path coefficient using SmartPLS.

Table 4.7: Path Coefficient Results with All Attributes

Attributes	**Path Coeffici ent**	**Interpretation**
Attention → User Experience	**0.249**	Positive
Relevance → User Experience	**0.227**	Positive
Confidence → User Experience	**-0.012**	**Negative**
Satisfaction in Usability→ User Experience	**0.306**	Positive
Ease of Use → User Experience	**0.102**	Positive
Learnability → User Experience	**-0.095**	**Negative**
Memorability → User Experience	**0.121**	Positive
Satisfaction in Motivation→ User Experience	**0.115**	Positive

Table 4.7 shows the interpretation of each attribute's relationship is based on the path coefficient towards user experience. There are six attributes out of eight which are positive relationship meanwhile for confidence and learnability have been categorized as negative relationships. As the best value to describe the impact on the model according to the coefficient value, the six attributes: attention, relevance, satisfaction in usability, ease of use, memorability, and satisfaction in motivation are showing a positive impact on the relationship.

However, the negative relationship is still significant to be used as data for this research. Table 4.8 shows the results of path coefficient results on the relationship between usability attributes towards motivation attributes.

Table 4.8: Path Coefficient Result of Usability and Motivation Attributes

Relationship	Path Coefficient	Interpretation
Ease of Use → Attention	-0.214	**Negative**
Learnability → Attention	0.336	Positive
Memorability → Attention	0.415	Positive
Satisfaction → Attention	0.190	Positive
Ease of Use → Relevance	0.410	Positive
Learnability → Relevance	0.287	Positive
Memorability → Relevance	0.263	Positive
Satisfaction → Relevance	-0.157	**Negative**
Ease of Use → Confidence	0.002	Positive
Learnability → Confidence	0.735	Positive
Memorability → Confidence	0.063	Positive
Satisfaction → Confidence	-0.136	**Negative**
Ease of Use → Satisfaction	0.035	Positive
Learnability → Satisfaction	0.475	Positive
Memorability → Satisfaction	0.128	Positive
Satisfaction U → Satisfaction M	-0.011	**Negative**

Table 4.7 shows the interpretation of each usability attribute with the motivation attributes as the mediator towards user experience in serious games. There are 13 relationship out of 16 are having positive relationship meanwhile the relationship between ease of use to attention, satisfaction with relevance and satisfaction in usability to satisfaction in motivation are stated to be negative. Learnability has been categorized as a negative relationship. T-value and P-value are two main calculation used in

identifying the significance of the relationship. Table 4.9 shows the overall path coefficient results of each attribute.

Table 4.9: Results on Path Coefficient of Each Attribute

Question	Indicator Loading	Cronbach's Alpha	Path Coefficient	T-value	P-value
Ease -1	**0.686**			**8.602**	**0.00**
Ease-2	**0.685**			**5.163**	**0.00**
Ease-3	**0.741**	**0.924**		**10.605**	**0.00**
Ease-4	**0.931**		**0.102**	**32.018**	**0.00**
Ease-5	**0.898**			**22.203**	**0.00**
Ease-6	**0.921**			**41.730**	**0.00**
Learnability-1	**0.801**			**6.454**	**0.00**
Learnability-2	**0.262**	**0.812**	**-0.095**	**1.067**	**0.286**
Learnability-3	**0.810**			**7.486**	**0.00**
Learnability-4	**0.909**			**38.111**	**0.00**
Memorability-1	**0.877**			**28.872**	**0.00**
Memorability-2	**0.929**	**0.942**	**0.121**	**49.371**	**0.00**
Memorability-3	**0.883**			**18.981**	**0.00**
Memorability-4	**0.894**			**32.669**	**0.00**
SatisfactionU-1	**0.903**			**24.288**	**0.00**
SatisfactionU-2	**0.843**			**16.076**	**0.00**
SatisfactionU-3	**0.883**	**0.947**		**21.613**	**0.00**
SatisfactionU-4	**0.771**		**0.115**	**10.717**	**0.00**
SatisfactionU-5	**0.738**			**7.801**	**0.00**
SatisfactionU-6	**0.863**			**19.543**	**0.00**
SatisfactionU-7	**0.921**			**28.741**	**0.00**
Attention-1	**0.814**			**11.677**	**0.00**
Attention-2	**0.896**			**31.784**	**0.00**
Attention-3	**0.785**	**0.944**		**14.849**	**0.00**
Attention-4	**0.806**		**0.249**	**12.134**	**0.00**

Attention-5	**0.891**			**26.492**	**0.00**
Attention-6	**0.823**			**21.105**	**0.00**
Attention-7	**0.868**			**30.039**	**0.00**
Relevance-1	**0.903**			**28.451**	**0.00**
Relevance-2	**0.945**			**43.124**	**0.00**
Relevance-3	**0.879**	**0.949**		**17.110**	**0.00**
Relevance-4	**0.862**		**0.227**	**16.117**	**0.00**
Relevance-5	**0.845**			**11.769**	**0.00**
Confidence-1	**0.918**			**26.987**	**0.00**
Confidence-2	**0.873**	**0.926**		**21.795**	**0.00**
Confidence-3	**0.760**		**-0.012**	**8.122**	**0.00**
Confidence-4	**0.924**			**32.023**	**0.00**
SatisfactionM-1	**0.831**			**12.867**	**0.00**
SatisfactionM-2	**0.923**			**30.062**	**0.00**
SatisfactionM-3	**0.915**	**0.921**		**25.237**	**0.00**
SatisfactionM-4	**0.852**		**0.306**	**14.116**	**0.00**
SatisfactionM-5	**0.643**			**4.598**	**0.00**

The overall results in Table 4.9 shows the significant value of each attributes. However, to validate each hypothesis for this research, it is very important in summarizing the whole results of each hypothesis and relationship. Thus, Table 4.10 shows the data of path coefficient and T-statistics to validate the relationship for this research.

Table 4.10: Results on Path Coefficient and T-Value

No	Hypothesis	Path Coefficient	T-value (>0.05)	Results
H1a	Attention -> UX	**0.249**	**0.959**	Accepted
H1b	Relevance -> UX	**-0.012**	**0.691**	Accepted
H1c	Confidence-> UX	**0.102**	**0.061**	Accepted
H1d	Satisfaction -> UX	**-0.095**	**1.456**	Accepted

H2a	Ease of Use -> UX	**0.121**	**0.233**	Accepted
H2b	Learnability -> UX	**0.227**	**0.295**	Accepted
H2c	Memorability -> UX	**0.306**	**0.580**	Accepted
H2d	Satisfaction -> UX	**0.115**	**0.262**	Accepted
H3i	Ease of Use -> Attention	**-0.214**	**0.566**	Accepted
H3ii	Ease of Use > Relevance	**0.410**	**0.003**	**Rejected**
H3iii	Ease of Use -> Confidence	**0.002**	**1.318**	Accepted
H3iv	Ease of Use -> Satisfaction	**0.035**	**0.073**	Accepted
H3v	Learnability -> Attention	**0.336**	**0.937**	Accepted
H3vi	Learnability -> Relevance	**0.287**	**2.263**	Accepted
H3vii	Learnability -> Confidence	**0.735**	**0.845**	Accepted
H3viii	Learnability -> Satisfaction	**0.475**	**1.226**	Accepted
H3ix	Memorability -> Attention	**0.415**	**1.469**	Accepted
H3x	Memorability -> Relevance	**0.063**	**1.014**	Accepted
H3xi	Memorability -> Confidence	**0.263**	**0.243**	Accepted
H3xii	Memorability -> Satisfaction	**0.128**	**0.477**	Accepted
H3xii	Satisfaction -> Attention	**0.190**	**0.524**	Accepted
H3xiv	Satisfaction -> Relevance	**-0.136**	**0.427**	Accepted
H3xv	Satisfaction -> Confidence	**-0.157**	**0.312**	Accepted
H3xvi	Satisfaction-U -> Satisfaction-M	**-0.011**	**0.021**	**Rejected**

The analysis in Table 4.10 shows the result of each hypothesis from H1 to H3. The results show the significant value of each relationship and the acceptance of the hypotheses. From the table, there are two rejected hypotheses based on the path coefficient and their T-value which need to be more than 0.05. Although H3 that specifically focus on the relationship between ease of use and relevance is positive according to the path coefficient, yet the T-value is below of the standard. Same with the relationship between satisfaction in usability and satisfaction in motivation, whereas the path coefficient is negative, and the T-value is 0.021. The other 13 relationship and

hypotheses are accepted as the stated T-value is higher than 0.0.5 despite there are four negative relationship generated. Figure 4.6 and Table 4.11 shows the summary of the hypotheses results on H1 and H2 separately with the third hypothesis.

Table 4.11: Summary of H1 and H2

No		Hypotheses	Result
H1		Motivation is significantly affecting user experience in serious games	Accepted
	H1a	Attention is significantly affecting the motivation in serious games	Accepted
	H1b	Relevance is significantly affecting the motivation in serious games	Accepted
	H1c	Confidence is significantly affecting the motivation in serious games	Accepted
	H1d	Satisfaction is significantly affecting the motivation in serious games	Accepted
H2		Usability is significantly affecting user experience in serious games	Accepted
	H2a	Ease of use is significantly affecting user experience in serious games	Accepted
	H2b	Learnability is significantly affecting user experience in serious games	Accepted
	H2c	Memorability is significantly affecting user experience in serious games	Accepted
	H2d	Satisfaction is significantly affecting the usability of serious games	Accepted

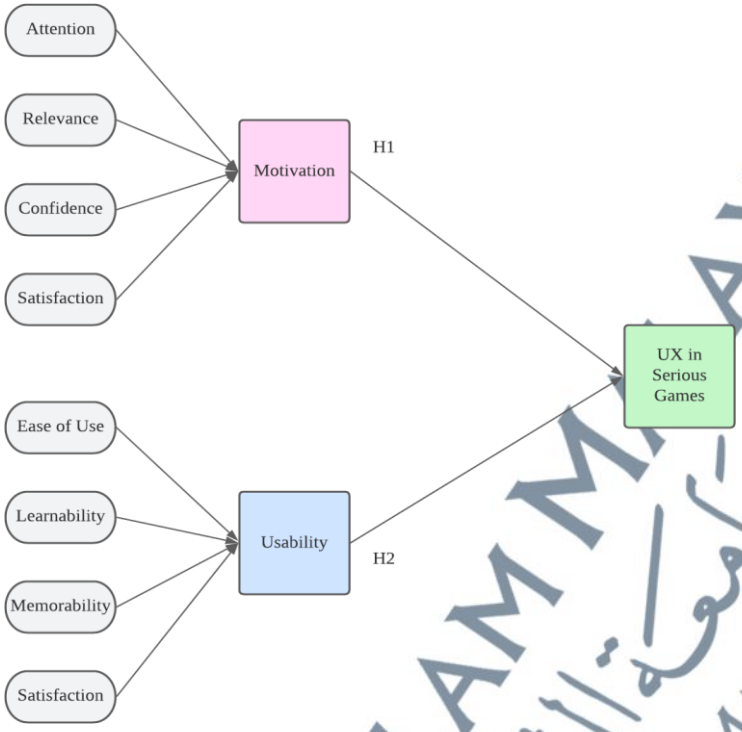


Figure 4.6: Summary of H1 and H2

Figure 4.7 and Table 4.12 shows the summary of the hypotheses results on H3, the third hypothesis that involves attributes in motivation factor as a mediator towards the independent variable, and user experience in serious games.

Table 4.12: Summary of H3

No		Hypotheses	Result
H3		Usability factor is significantly affecting user experience in serious games using motivation factor as a mediator	Accepted
	H3i	Ease of use is significant for user experience in serious games using attention	Accepted
	H3ii	Ease of use is significant for user experience in serious games using relevance	Rejected
	H3iii	Ease of use is significant for user experience in serious games using confidence	Accepted

H3iv	Ease of use is significant for user experience in serious games using satisfaction	Accepted
H3v	Learnability is significant for user experience in serious games using attention	Accepted
H3vi	Learnability is significant for user experience in serious games using relevance	Accepted
H3vii	Learnability is significant for user experience in serious games using confidence	Accepted
H3viii	Learnability is significant for user experience in serious games using satisfaction	Accepted
H3ix	Memorability is significant for user experience in serious games using attention	Accepted
H3x	Memorability is significant for user experience in serious games using relevance	Accepted
H3xi	Memorability is significant for user experience in serious games using confidence	Accepted
H3xii	Memorability is significant for user experience in serious games using satisfaction	Accepted
H3xiii	Satisfaction is significant for user experience in serious games using attention	Accepted
H3xiv	Satisfaction is significant for user experience in serious games using relevance	Accepted
H3xv	Satisfaction is significant for user experience in serious games using confidence	Accepted
H3xvi	Satisfaction is significant for user experience in serious games using satisfaction	Rejected

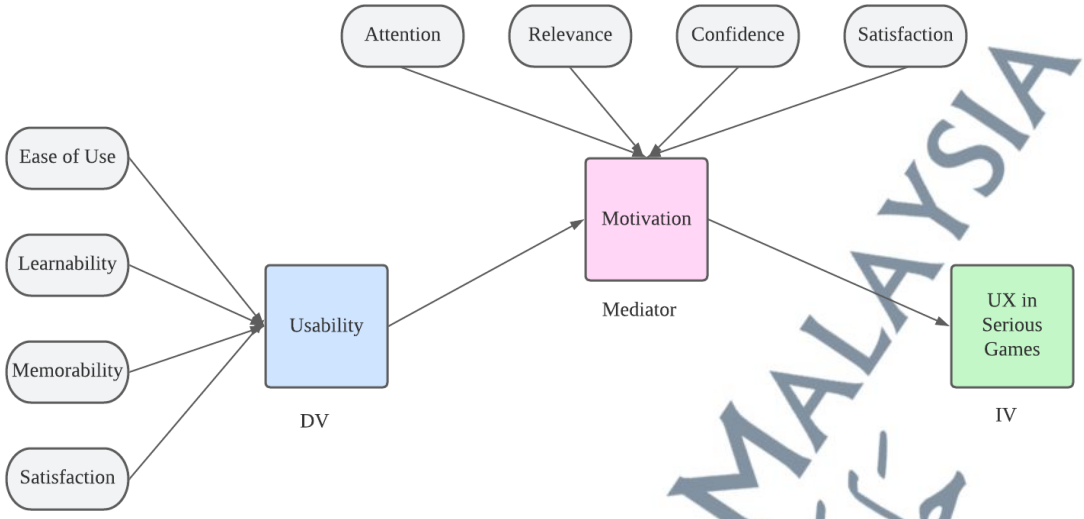


Figure 4.7: Summary of H3

From Table 4.11 and Figure 4.7, the summary of H3 consists of two rejected relationships which ease of use attribute in usability factor using relevance attribute in motivation factor and satisfaction attribute in usability factor using satisfaction attribute in motivation factor. Both relationships are getting negative path coefficients that lead to rejection.

4.4 Model Validation from The Experts

Model validation from the experts is vital to fulfilling the last objective of this research. The formation of the new model through motivation and usability factors in user experience towards serious games is validated in this section. For model validation, the researcher is referring to the experienced physiotherapist who has been more than 5 years in the rehabilitation field. The procedure of taking every opinion and recommendation from the expert is very important to make sure the new model is ready to be used in that field.

There are two model which have been shown to the expert: pre-model and post-model. The overall pre-model is shown in Figure 4.7 below. The pre-model in Figure 4.7 shows the overall attribute that involved in this research. The proposed of pre-model is based on the selected attributes from the selected model that have been discussed in chapter 2. After the collection of results from data analysis, the reseacher come out with a post-model where there are two relationships have been eliminated.

From the overall pre-model, a total of eight attribtues are contributing to each research hypothesis. However, through a few analyses in the previous sections, two hypotheses that need to be eliminated based on the result. Thus, the opinion and recommendation from the expert are needed to make sure the result taken from the questionnaire is validated by the therapist. The decision of focusing on motivation and usability in user experience is supported by the therapist.

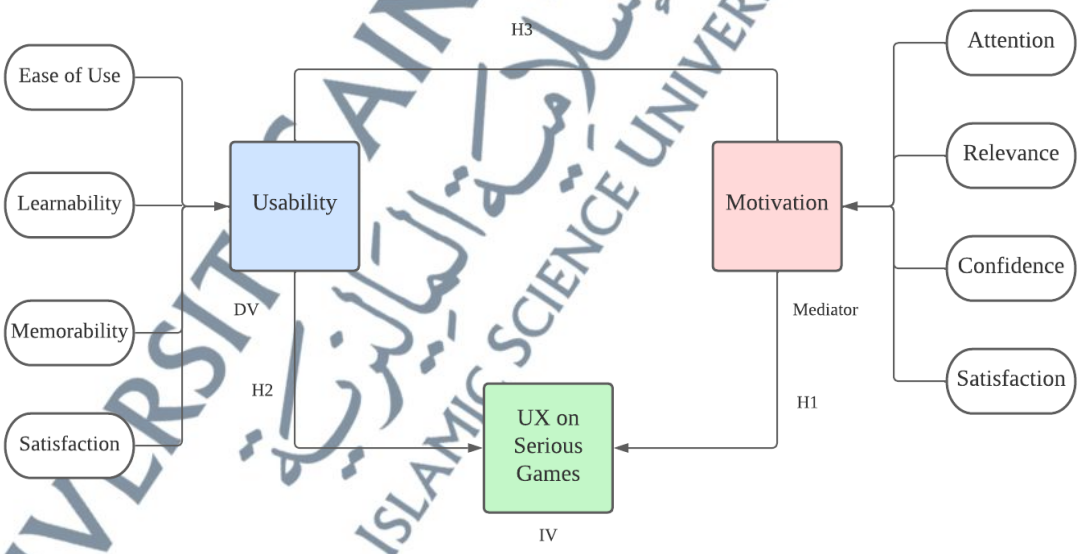
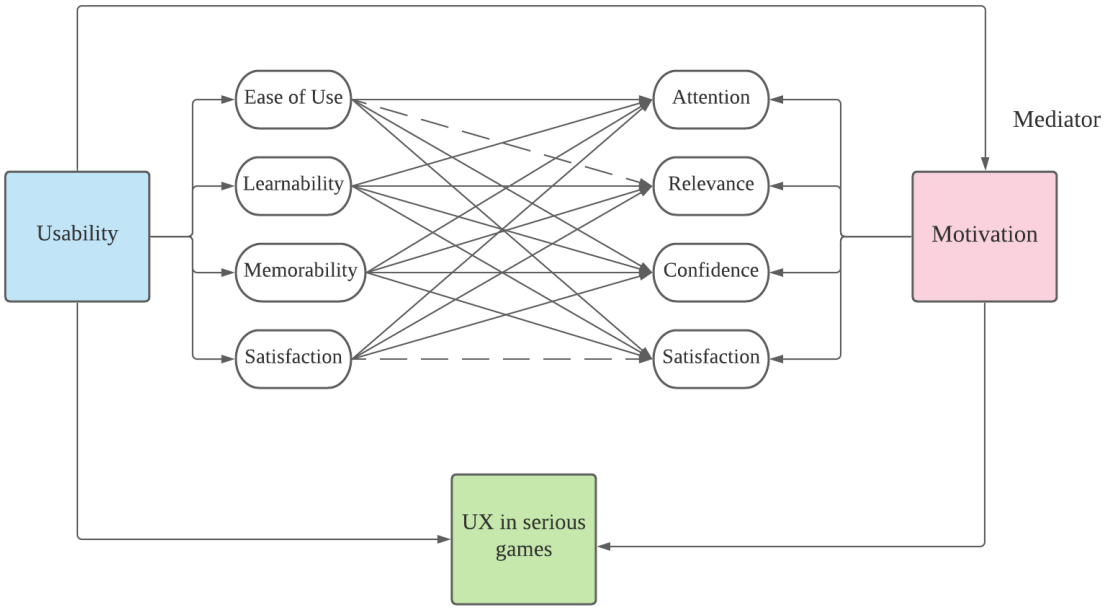


Figure 4.8: Overall Pre-Model

Motivation and usability are needed to sustain and maintain the progression and performances of people with disability who undergo rehabilitation. According to the expert, it is very essential to get to know their self-improvement while using serious games as one of the tools for therapies and exercises. Figure 4.8 shows the post-model before getting data analysis.



Sign: The doted lines shows the two relationship which need to be eliminated based on the results.

Figure 4.9: Post-Model

Table 4.13: Expert's Recommendation for H3

No	Hypothesis	Results	Reason
H3i	Ease of Use -> Attention	Accepted	Patients need to feel at ease to get more attention while playing games.
H3ii	Ease of Use > Relevance	**Rejected**	It is sufficient if the patient can have the attention, confidence and satisfaction.

H3iii	Ease of Use -> Confidence	Accepted	Helps in gaining confidence.
H3iv	Ease of Use -> Satisfaction	Accepted	This affects individual satisfaction after playing games.
H3v	Learnability -> Attention	Accepted	It is acceptable to have learnable games for patients but normally patients are not focusing on the learning process to correct the movement. Besides, there is more to enjoying themselves playing games.
H3vi	Learnability -> Relevance	Accepted	
H3vii	Learnability -> Confidence	Accepted	
H3viii	Learnability -> Satisfaction	Accepted	
H3ix	Memorability -> Attention	Accepted	Memorability is very useful in assiting patients who are in brain injury or neurological impairment.
H3x	Memorability -> Relevance	Accepted	
H3xi	Memorability -> Confidence	Accepted	
H3xii	Memorability -> Satisfaction	Accepted	
H3xii	Satisfaction -> Attention	Accepted	Satisfaction is an individual perceptions but it helps patients in getting self-improvement.
H3xiv	Satisfaction -> Relevance	Accepted	
H3xv	Satisfaction -> Confidence	Accepted	
H3xvi	Satisfaction-U -> Satisfaction-M	**Rejected**	It is sufficient to only focus on the effect of satisfaction in usability with attention, relevance and confidence.

Table 4.13 shows the expert's opinion on each relationship. The expert is agreeing to follow the post model by rejecting the two relationships as generated results from the questionnaire. The reason to eliminate the relationships is stated in the table. Though relevance is important to increase performances for patients, the expert believe that relevance can works with learnability, memorability, and satisfaction. The other relationship is satisfaction in usability to usability in motivation, the expert believes that this relationship is strongly influenced by the personal preferences of patients. As most

of the patients with stroke and traumatic brain injury, who are responding to the questionnaire are having a neurological impairment, the basis of satisfaction might slightly be different from one another. Hence, it is enough to only focus on the relationship between satisfaction in usability with attention, relevance, and confidence attributes. Figure 4.10 shows the results of the most preferable questions from each attribute based on the results of the questionnaire.

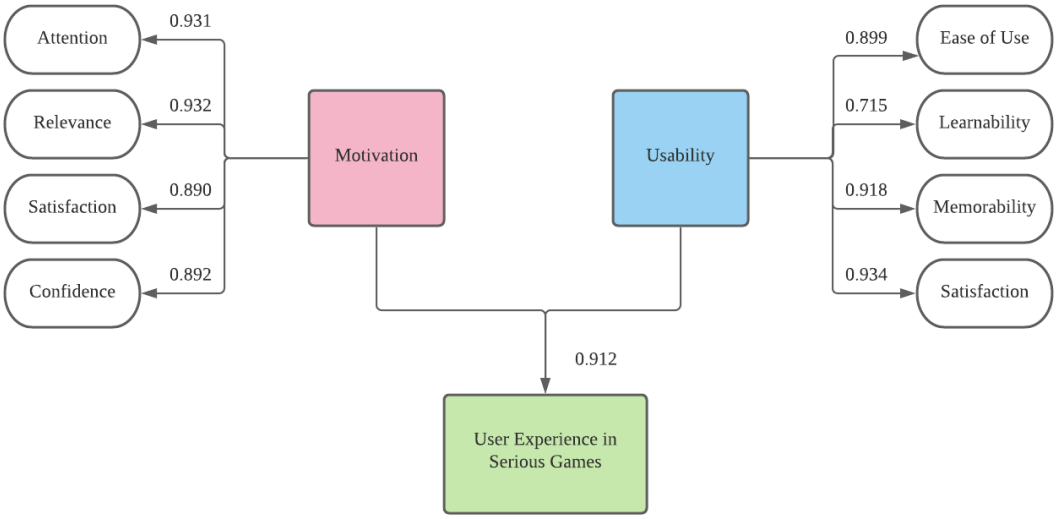


Figure 4.10: Highest Value of User Experience Attributes

The highest value of each attribute in user experience towards serious games is as shown in Figure 4.10. The following Table 4.14 shows the ranking of each attribute according to the most and highest value after generated using Cronbach's Alpha and Table 4.13 will explain the feedback in the rehabilitation field and rank accordingly to the expert.

Table 4.14: The Attributes' Ranking

Attribute	Cronbach's Alpha	Respondent's Rank	Expert's Rank
Ease of Use	**0.899**	5	5
Learnability	**0.715**	8	8
Memorability	**0.918**	4	4
Satisfaction-U	**0.934**	1	1
Attention	**0.931**	3	3
Relevance	**0.932**	2	2
Confidence	**0.892**	6	6
Satisfaction-M	**0.890**	7	7

Table 4.15: The Feedback from The Expert

Attribute	Expert's Rank	Reason
Satisfaction-U	1	Patients will choose the most preferable games according to their satisfaction
Attention	2	Attention is important in assisting the patient to stay focused while undergoing therapy by playing games
Relevance	3	It is a must to assess a patient's self-improvement by increasing the level of repeated games
Memorability	4	Bring benefit to neurological impairment patients
Ease of Use	5	The challenges of each game need to be changed every time patient has passed one level
Confidence	6	Playing games is one of the therapy's methods so the thing in need is to feel enjoy while undergoing therapy using games

Satisfaction-M	7	Not all brain injury patient feels satisfied with their achievement. Satisfaction in terms of usability is more important
Learnability	8	Games are one of the methods that we use to distract the patient from being bored with traditional ways of rehabilitation. So, learning accurate movement or getting learned from playing games is not the focus.

From Table 4.15 the feedback from the expert on serious games is mainly focused on satisfaction in terms of usability which can bring attention and are relevant for persons with disabilities to play while undergoing rehabilitation therapies. As according to the expert, nowadays the rehabilitation field is improving its therapies by introducing games as part of therapy's methods. Playing serious games which more immersive and user-friendly, help persons with disabilities to feel the real-life experience.

Thus, the result from the feedback above shows that the top 5 of most preferable attributes for serious games are satisfaction, attention, relevance, memorability, and ease of use. Hence, three out of five of the most preferable attributes are from the ARCS motivation model and the other two is from the usability model. Figure 4.11 shows the most preferable question in each section representing in each attribute.

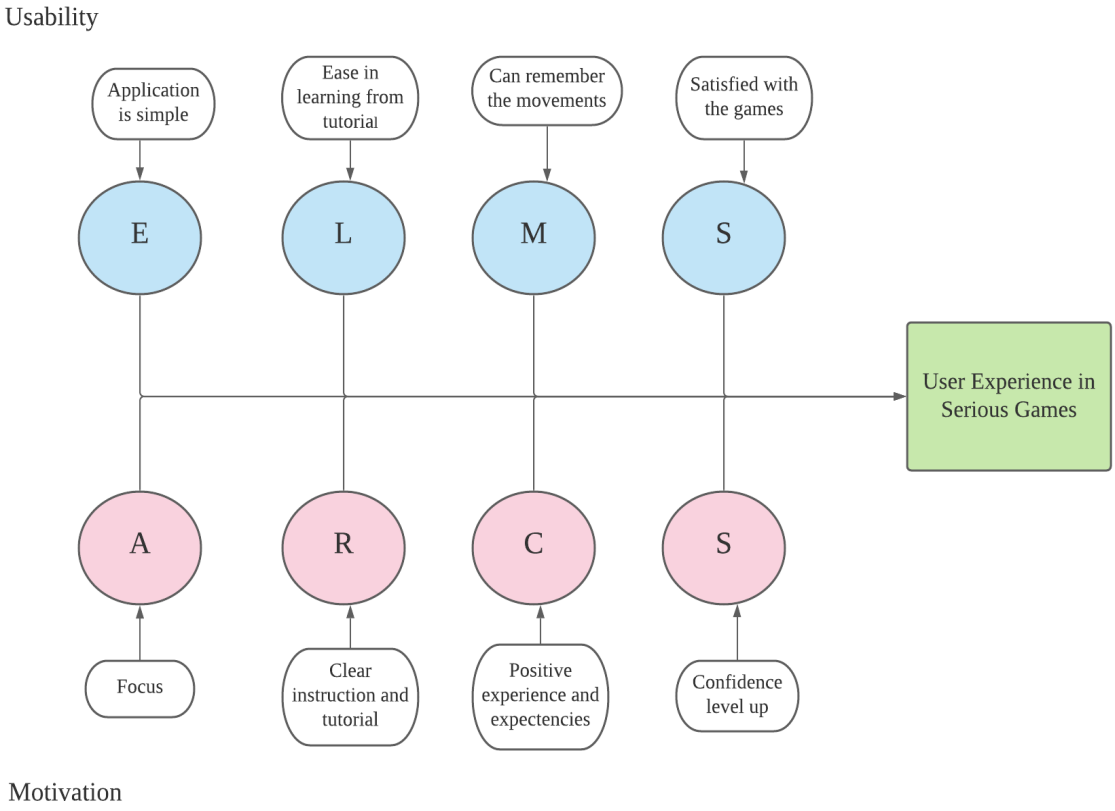


Figure 4.11: Most Preferable Questions

Figure 4.11 shows the most preferable questions from each attribute which help persons with disabilities to gain motivation and sustain their performances. The selected questions are based on the highest value of Cronbach's Alpha which shows it is reliable. Simple application, ease in learning tutorial, movement can be easily remembered and satisfied with the games are the key points in each usability attributes. These questions need to be highlighted for future enhancement, according to the expert.

Meanwhile for motivation attributes, the selected questions are games that can give focus, have clear instruction and tutorial, give positive experience and expectancies and lastly, help in boost up the confidence level. As a conclusion for model validation from the expert, it is important to have serious games as the therapy's methods in which

it can help persons with disabilities to keep motivated and feel satisfied with self-improvement. The following Figure 4.12 is the finalized post model.

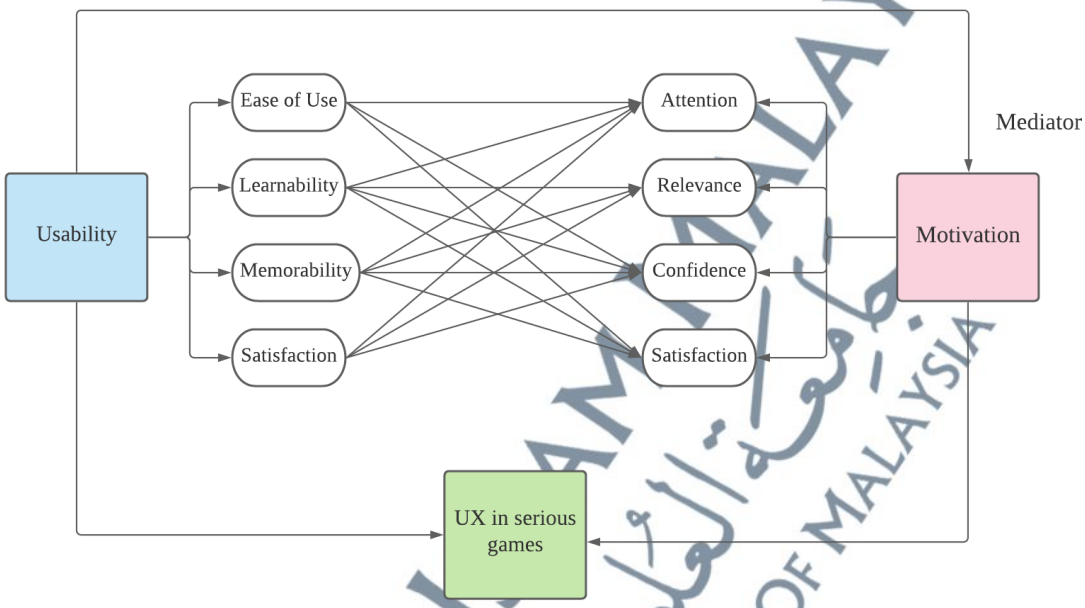


Figure 4.12: Finalize Model

4.5 Summary

Data analysis and results for each section of the questionnaire are explained in this chapter. The hypotheses formation and results are also being discussed to formulate a new model in the last section of the chapter. Each hypothesis became relationship that need to be discovered with each reliability and validity through Cronbach's Alpha, Average Variance Extracted (AVE) and Fornell-Larcker Criterion using SmartPLS software. Hence, over 24 hypotheses formed in this research, there are two relationship which have been eliminated according to the value gained from data analysis and suggestion from the expert.

As result, the model which begins with three major hypotheses H1 (1a to 1d), H2 (2a to 2d) and H3 (3i to 3xvi) has ended with only a total of 3 main hypotheses with 22 relationships. Table 4.16 shows the finalize relationship of this research.

Table 4.16: Summary of Finalize Relationship

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 the usability of serious games
H3		Usability is significantly affecting motivation of user experience in serious games
	H3i	Ease of use is significant by using attention towards user experience in serious games
	H3ii	Ease of use is significant by using confidence towards user experience in serious games
	H3iii	Ease of use is significant by using satisfaction towards user experience in serious games
	H3iv	Learnability is significant by using attention towards user experience in serious games
	H3v	Learnability is significant by using relevance towards user experience in serious games
	H3vi	Learnability is significant by using confidence towards user experience in serious games

H3vii Learnability is significant by using satisfaction towards user experience in serious games

H3viii Memorability is significant by using attention towards user experience in serious games

H3viiii Memorability is significant by using relevance towards user experience in serious games

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

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

H3xii Satisfaction is significant by using attention towards user experience in serious games

H3xiii Satisfaction is significant by using relevance towards user experience in serious games

H3xiv Satisfaction is significant by using confidence towards user experience in serious games

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The following dialogues are the answers from the questionnaires which have contributed in constructing the new model.

"Give me great experience to work harder and reach the target" – Spinal Cord Injury patient using robotic serious games

"I gain my confidence to walk by playing the games" – Stroke patient using virtual reality serious games

"By playing the game, it helps me to be more focus" – Spinal Cord Injury patient using robotic serious games

"Have the confidence to drive in my condition" – Amputee patient using simulator serious games