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Animal Thematic Game Based on Kinect Sensor for Mental Retardation Rehabilitation

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Abstract: The children with mental retardation syndrome have diverse limitations on their life that are concentration, synchronization, interaction, planning, a problem solving. they need solution to take care of their limitations. In this paper, we propose the framework to make them feel comfort to learn more and to do for rehabilitation. It comprises 3 components that are the computer sensor device, intellectual functions, and thematic game. Such framework is as a reference to create the design of the animal thematic game which will be applied to the children with mental retardation syndrome. Before applied to them, the proposed design needs an experiment whether it has an eligibility aspect or no. The results of this research showed that there was no significantly different between the observed data and the expected data, it implied that the design of an animal thematic game based on Kinect sensor was deserved by the children with mental retardation syndrome.

Keywords: mental retardation syndrome, Kinect sensor, intellectual function, thematic game.

1. Introduction

Children with mental retardation have diverse limitations on their life, that is concentration, synchronization, interaction, planning, problem solving, etc. (American Psychiatric Association, 2013), (Deuel, 2003), & (Seay, 2006). They need a facilitation to make them feel comport to do exercise because that is as a part of rehabilitation process which gives them competencies related to mental retardation syndrome (D. González-Ortega, F.J. Díaz-Pernas, M. Martínez-Zarzuela, 2013).

Rehabilitation is the process for recovering. Children with mental retardation could conduct the exercise by doing rehabilitation. Their limitations make them have restraint in doing exercise, even they do not want to engage in exercising. Therefore, we need an interested media to conduct rehabilitation in order to make them feel motivated and enjoy. When they feel comfortable to condition and situation, the children would have fast growth to learn (Griffiths, 2002), (Oh et al., 2012), (Agarwal & Singh, 2012), (Garris, Ahlers, & Driskell, 2002), (Avola, Spezialetti, & Placidi, 2013), (Su, 2013), (Lange et al., 2011), (Huang, 2011), & (D. González-Ortega, F.J. Díaz-Pernas, M. Martínez-Zarzuela, 2013).

In order to facilitate them to learn, we propose the framework of the rehabilitation process as shown in figure1. The framework is a reference to make the design of animal thematic game based on a Kinect Sensor, which has diverse features to take care of the children with mental retardation syndrome. The process of rehabilitation itself comprises three components, computer sensory devices, intellectual functions, and a thematic game, each of which has strong relation to the others.

Computer sensory device is one of the components referred to convert the data from analog to digital. In this research, we adopted a Microsoft Kinect sensor as the computer sensory device because it converts children's motion, face, and voice to digital signal as an input of the game. The intellectual functions are the most importance component, because it implies to the competencies reached through the game, it covers limitations of the children. In the other component, the thematic game refers to the topic which has a relation to an instructional program at schools or rehabilitation centers. The game covers topics related to the requirement of the children.

In this paper, we discuss about the design of the animal thematic game for the children with mental retardation syndrome based on the Kinect sensor. It was implemented from the framework of

the rehabilitation process. The design of the game should have an eligibility before played by the children. Therefore, we need to make an experiment by their teachers in the design itself. The hypothesis of the research is H_0: The observed data and expected data are consistent, which means that there is no significantly different between both of the data. In short, the design of the animal thematic game based on the Kinect sensor is worth to play by the children with mental retardation and H_1: The observed data and expected data are not consistent, which mean there is no relation between one to each other.

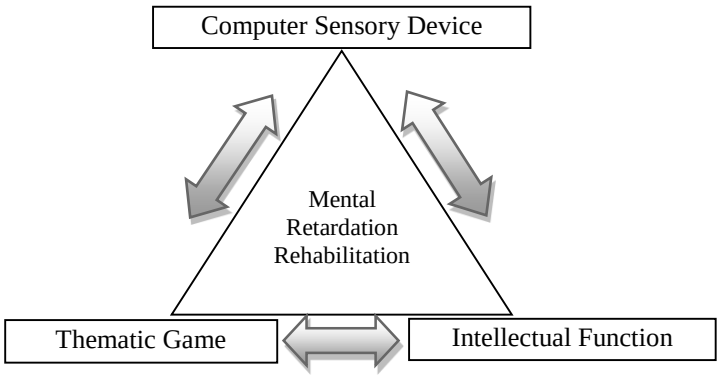

Figure 1. Framework of rehabilitation process.

2. Design of Game

The design of an animal thematic game based on Kinect sensor had been implemented in the prototype, The design of the game scenario was oriented to the children with mental retardation syndrome in elementary schools. They became the players of the game. They should raise one of their hands to move the animal. The game had 2 different animal with its own cage, namely horse and tiger. One of these animal would appear randomly at the starting point, every animal lead to each of the cage respectively by initiating the player's gesturing. The instructional program was the children raised their hand to make a practise to their motoric skill, in order to know deeply the concept of right and left hand.

2.1 Hardware system

The participants did exercise in front of Kinect sensor, it recognized the participant's motion. The captured signal was sent to a computer and finally it was reflected on the game as shown in figure 2.

Figure 2. Design of game infrastructure

2.2 Design of Game Architecture

The design of the game is oriented to introduce the concept of right and left hand and also to practice motoric skill for the children with mental retardation. The game has many features among them are the participant can practice their understanding of the concept of right and left hand. The rule of the game is the left side hand leads the tiger into the cage and the right side hand leads the horse into the cage. When there is one of the animal appears randomly at the starting point, the participant should raise one of his exactly hand refers to the animal at the starting point as shown in figure 3.

If participant does a mistake in raising his hand refer to the animal appearing at the first time. The game will count the number of fault done by the participant and also it will give notification to the user as shown in figure 4. The game will stop after the participant can lead 5 animals on each cage.

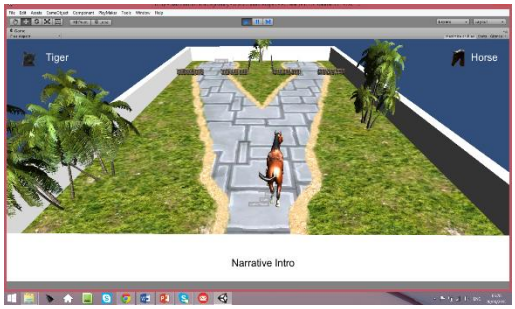

Figure 3. Game program application designs

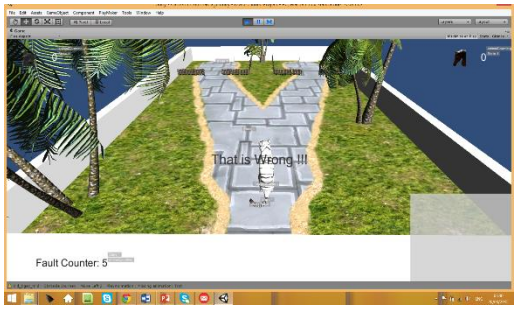

Figure 4. Implementation Feedback system

3. Methodology

This research was related to the students in rehabilitating syndrome of mental retardation. As shown in figure 5, before conducting the game by students, we firstly discussed with some of the teachers in each of schools of special education about some material to support the instructional program through forum group discussion. In this part of the session, the teacher filled in some questionnaires as the references for the game design. The data resulted was associated as the expected data because it was yielded and formulated ideally from all the teachers before the game was played.

On the other side, after having forum group discussion, the game was conducted by a small group of the children (limited testing) to play application program, meanwhile the teachers paid attention to the activity played by the children. At the end of the activity, we discussed again to evaluate the game design by filling in some questionnaires. The data resulted in this part of the session was associated as an observed data because the data came from the game played by the children and judged by the teachers. As the result, this data were not ideal but real.

In short, all data from each part of the sessions are oriented to determine whether the design was deserved by the children or no by comparing both of the data, that was the expected data and the observed data. If the observed data similar to the expected data, it means that the game design was almost ideal to be conducted by the children. In contrast, the game design was not deserved by the children, if there is no any similarity between both of the data.

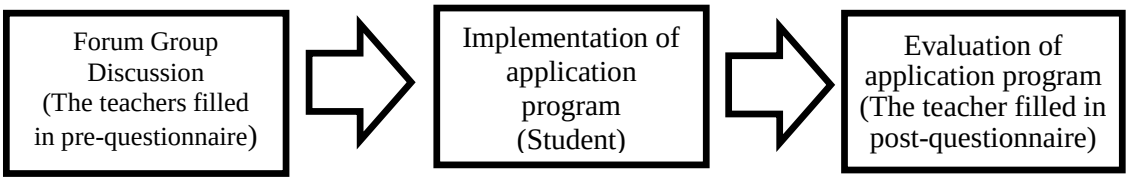

Figure 5. Research methodology.

3.1 Participant

This research was conducted in several schools for special education, it was comprised of 3 schools in different area based on demography, one was in the capital of the town and the others were on the village, because it was oriented to recognize the teachers in the area of difference. The participants evolved were 13 teachers for mental retardation field in the elementary schools. They had competencies to handle the children who were classified as mild mental retardation.

3.2 Questionnaires

The design of the game would be deserved by the children to play after doing for some of the experiment to the design itself, we made 9 questions to represent all game application program design. The question was divided into 2 categories. First, the ideal or true data, this categories of data were associated as the references or expected data, these data were produced and formulated by the teachers as the experts in their field of special education in mental retardation. Secondly, the other data were produced from the

teachers also but in different sessions of time, they judged the game played by the children, these data were associated as the observed data.
All participants filled in the questionnaires, the counted value of questionnaire appeared in the frequency responses in table 1. The data resulted in both of pre and post questionnaires were in the Likert scale data, which were 1 represented strongly disagree, 2 represented disagree, 3 represented neutral, 4 represented agree, and 5 represented strongly agree.

3.3 Research data analysis

In analyzing, we used chi-square analysis which gives a statistical model to describe how well an expected data fits into a set of observation, it evaluates two different distribution through goodness of fit testing (Maydeu-Olivares, A. & Garcı´a-Forero, C. 2010). In this case, the distribution data resulted from the game application program $(q(x))$ were as the observed data. On the other side, the distribution data resulted from forum group discussion $(p(x))$ were as the expected data. The formula was shown on figure 6.

Definition of chi-square analysis (X^2) between two probability distribution functions of $p(x)$ and $q(x)$ is defined as follows:

$$X^2 = \sum \frac{(q(x) - p(x))^2}{p(x)}$$

Figure 6. Research data formula.

After chi-square was defined and then the next step is to calculate the degree of freedom(df), the definition is $df = k - 1$, where k is the number of the categorical variable level. This value determined condition of the results, whether the hypothesis is accepted or rejected by comparing the value of degree of freedom(df) to the table of critical values of chi-square distribution based on the relative standard value commonly used in research (α) = 0.05 and calculated data resulted from X^2.

4. Result and Discussion

The table 1. Each question had its own value of calculated data of chi square (X^2), degree of freedom, and $P - value$. In order to analyze null hypothesis (H_0) for each question, we compared the data between $P - value$ and the relative research standard value (α) = 0.05. The results of the analysis were most of the questions had the $P - value$ was greater than the relative research standard value (α) = 0.05. In short, H_0 was accepted for such of the questions, which mean there were no significantly different between the expected data and the observed data. Therefore, those of the data were consistent. In contrast, there were two questions different between the expected data and the observed data, the question number 2 was about thematic game and the number 8 was about concurrency between the material of game and learning.

Both of the questions for number 2 and 8 were classified rejecting the null hypothesis, because the range of such data frequency was significantly different. Therefore, the $P - value$ was less than the relative research standard value (α) = 0.05. If both of the questions were analyzed more, in each question, the data frequency of the observed data was more than the expected data. For instance, after converting the Likert scale data into the nominal data, both of the questions for the number 2 had the expected data was 4.15 and the observed data was 4.77 and also the number 8 had the expected data was 4.15 and the observed data was 4.69. In short, due to the assumption of participants, such condition of both questions were still much better to be implemented to the children because the observed data was more than the expected data.

In general, it implied that the animal thematic game based on the computer sensory devices was worth to conduct by the children with mental retardation syndrome, because null hypothesis was accepted by most of the questions, which mean that the observed data and the expected data were consistent or having similarity.

5. Conclusion and future works

The students with mental retardation syndrome need the right treatment to be conducted. They had diverse limitations in their life. Therefore, we should take care of them carefully. So we proposed the design of animal thematic game based on Kinect sensor with many features which can be conducted by the children. All those features were represented in questionnaires, in order to be examined before applied to the children. From the experiment results, most of the questions in the observed data was consistent to the expected data. Which means in general that the animal thematic game based on Kinect sensor could be conducted by the children with mental retardation syndrome.

Our future work will focus to improve the design of animal thematic game based on Kinect sensor with an extra level of the game and complicated motion detection adaptively to the children with mental retardation syndrome.

Table 1: The data analysis

No	Question (about)	Data Categories	Frequency Response (%)					X2	Df	$P-value$
			1	2	3	4	5			
1	Facility	Expected					100	0.69	4	0.406
		Observed				23	77			
2	Thematic game style	Expected				85	15	37.84	4	0.00001
		Observed				23	77			
3	Planning aspect	Expected				54	46	2.79	4	0.59
		Observed				77	23			
4	Interaction aspect	Expected				46	54	2.79	4	0.59
		Observed				23	77			
5	Good judge	Expected				77	23	0.43	4	0.98
		Observed				69	31			
6	Recalling Information back	Expected				46	54	0	4	1
		Observed				46	54			
7	Problem solving	Expected				62	38	1.93	4	0.75
		Observed			15	69	15			
8	Concurrency to learning material	Expected				85	15	28.95	4	0.00001
		Observed				31	69			
9	New experience on learning through computer sensory devices	Expected			54	46		8.9	4	0.06
		Observed				15	85			

6. Acknowledgements

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