

# Engaging Children with Severe Autism in Learning Al-Quran through the Serious Game

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## Abstract

**Objectives:** Serious game is experiencing an exponential growth especially in the education sector. With the parallel growth of mobile devices, the mobile learning is becoming an essential element in the development of serious game. The accessibility and convenience offered by these technologies could be advantageous especially for **Methods/Statistical analysis:** children with severe autism who require special attention. In connection with that, this study is aimed to design an interactive mobile serious game that exploits the strengths and skills of children with severe autism. This study thus put an important step forward by integrating of Listening, Arranging, Constructing, Imitation and Pronunciation (LACIP) skills with the creation of game. **Findings:** The evaluation is intended to measure the effectiveness of the serious game in engaging children with severe autism in learning based on two main aspects, i.e. Involvement Scale and time related factor. **Application/ Improvement:** In general, the results show that the involvement of children in playing game affects the level of engagement as the analysis indicates there is a significant relationship between involvement and engagement level. Besides that, the engagement level of children with severe autism in learning increased after using the serious game compared to the traditional approach.

**Keywords:** Al-Quran, Engagement, Mobile Learning, Serious Game

## 1. Introduction

Children with severe autism experience low level of engagement which limits their opportunities in learning<sup>1</sup>. This is due to the short attention span and other natural impairments experienced by them. Because of that, educating and learning process has been a challenge for them as they are not able to give a good and appropriate response to the conventional and traditional approach of education. Constant concern and intensive care are required towards a better quality of life for the children with autism<sup>2</sup>. Creating engagement among them during learning is a major challenge and requires extensive research and studies. Certainly, engagement and enjoyment in learning are very important because it can enhance children's motivation and increase their par-

ticipation in activities<sup>3</sup>. Besides that, an engaged children show curiosity, desire to learn more and positive emotional response to learning<sup>4</sup>.

As autism is often associated with problem in learning, many intervention has been established to assist in attracting their attention and focus in learning. Indeed, they require an interactive and interesting method to provide them with a fun learning environment. Currently, one of the most applied methods in learning is the use of serious game technology. The popularity of serious game has grown rapidly and being widely accepted by individual with autism especially in learning. Serious game is a game created for certain purposes and not solely for entertainment. Some of the serious games are a simulation of real world event that is created for the purpose of problem solving. Although some serious games can be

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entertaining, its main objective is to educate and train its users. According to<sup>5</sup> the usage of games for education is increasing. Some of the reasons why serious games can be beneficial for education is that student will usually be more motivated to play the game. Basically, motivated children will study better and besides that, game is also an effective way to engage students and make them active in learning<sup>6</sup>. In fact, people nowadays are more interested and stimulated in serious game which is engaging and entertaining to play<sup>7,8</sup>. Due to that, they are more fascinated in learning with game-based rather than with the traditional way<sup>9-11</sup>.

With the parallel growth of mobile devices, the mobile learning is becoming an essential element in the development of serious game. In this digital era, children nowadays are really comfortable in using devices such as iPad, tablets, laptops and any other high-tech gadget<sup>12</sup>. One of the most valuable things the mobile learning can do is its ability to assist learners in acquiring knowledge regardless of time and place<sup>13</sup>. In fact, it allows the students to access the material course easily as it readily accessible only through one device. Based on the study<sup>14,15</sup> it is shown that the use of mobile devices could help people with disability to be independent and improve their quality of life. Moreover, mobile devices offer various kind of assistance for them including to support the learning process<sup>16</sup>.

Nowadays, many application and games have been developed to enhance the learning process of children with autism. However not many of them are appropriately designed and developed to engage and facilitate the children with autism in learning Al-Quran. This is due to the lack of guidance for software developers in developing the appropriate applications and games for that purpose. Considering that the majority of Malaysia's populations are Muslims, the teaching of Al-Quran for children with autism is an important element that needs greater attention. Therefore, this study aims to propose a new approach by exploring the use of serious game with specific focus on mobile serious game in supporting Al-Quran learning process among student with learning difficulties specifically for children with severe autism. A Quranic game prototype was developed to teach the very basic principle in learning Al-Quran which focuses in learning Arabic letters (known as Hijaiyah letters). The goal of the Quranic game is to focus on the strengths of the children with severe autism and exploit them rather than solely focusing on their deficiencies. Moreover, this paper

will discuss the experimental study of Quranic game in engaging the children to learn in learning Al-Quran in particular.

## 2. Method

This study applied a mixed method of qualitative and quantitative approach. The need for qualitative design approach for the first phase of this study is to identify elements that will be required in developing the appropriate education serious game which can enhance the attention of children with severe autism in learning Al-Quran. Serious game developed will subsequently be evaluated by using experimental study. Figure 1 illustrates the overview of the entire research methodology of this study.



Figure 1. Overview Research Methodology

### 2.1 Phase 1: Understanding User's Needs

Understanding user's needs serves as the first phase in this study. During this phase, the following steps were conducted:

- a) *In-depth study about the learners.* The main essence of this step is to gather knowledge and information about previous studies on autism, specifically children with severe autism, in order to guide the interview and observation session.
- b) *Interview related people with the learners.* An open-ended interview was conducted as a part of understanding user's needs and requirements. This interview session involved persons who have the affiliation with autism such as mothers, teachers and special education expert. The questions presented are related to the education perspective such as challenges

in providing appropriate education, learning behaviour and learning trait.

c) *Observe the learners.* This step was conducted with the purpose of getting familiar with the behaviour of children with severe autism during their learning process in class. It is also aimed at knowing how the teachers teach these children in class and exploring the skills that are often employed by them. The observation was done over a period of sixteen weeks (four months) starting from January 2013 until April 2013. In order to gain a reliable outcome, the observation was systematically recorded by using video-taping method. From the video, the card-sorting method was employed to help the process of looking for the themes or patterns.

The outcome obtained from all the steps taken in Phase 1 act as the game requirements. It can be summarized that there are four main things to be highlighted as the basis for the design and development of the serious game phase:

1. Children with severe autism are inclined to use several skills in learning Al-Quran which are Listening, Arranging, Constructing, Imitation and Pronunciation (LACIP).
2. Listening to the sounds of 'hijaiyah' letters seems to represent the first step in learning Al-Quran for children with severe autism followed by the help of other skills.
3. The ABAHATA Al-Jabari Al-Quran learning technique was found suitable and relevant to be implemented for children with autism as the technique applies learning through singing which could attract their psychology and mood in learning Al-Quran.

## 2.2 Phase 2: Design and Development of Serious Game

The Yusoff's framework<sup>17</sup> has been considered as the framework that will be adapted for the design and development of the Quranic game. One of the main reasons in selecting the framework is because of its intelligible, clear and very straightforward approach. This framework includes pedagogy and learning theory in combination with gaming requirement<sup>18-21</sup>. It is shown as a structural class diagram and consists of several individual components that generate an effective model in learning by using serious game. Each component inside the framework plays a role in order to ensure that the learning

process will take place while the game is played. The components included in this framework are Capability, Instructional Content, Intended Learning Outcome, Serious Game Attributes, Learning Activity, Reflection, Game Genre, Game mechanics and Game Achievement. Table 1 summarizes the role of every component and also the association with the Quranic game. Figure 2-6 show the interface of the Quranic game prototype. For the development, the Quranic game was developed by using the Android Studio which is a famous Integrated Environment (IDE) for android platform development.

**Table 1.** Association game components with Quranic game

| No | Component of Framework    | Description of the Component                                     | Association with Quranic Game                                                                                                                                                                                                                                                                                             |
|----|---------------------------|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Capability                | Refers to cognitive, psychomotor & possibility affective skills  | Emphasize on LACIP Skills; Listening, Arranging, Constructing, Imitation, Pronunciation                                                                                                                                                                                                                                   |
| 2  | Instructional Content     | Subject matter that it is intended that the learner should learn | Student should learn Hijaiyah letters.                                                                                                                                                                                                                                                                                    |
| 3  | Intended Learning Outcome | The goal to be achieved from playing the serious game            | Students should be able to know and pronounce Hijaiyah letters                                                                                                                                                                                                                                                            |
| 4  | Serious Game Attributes   | Aspect of the game which support learning & engagement           | Musical (sound): By adapting sound & audio learning become more enjoyable & appealing<br>Reward: Important to keep them motivated and keep going<br>Learner Control: Gives degree of freedom to learn what he wants and at his own pace<br>Repetition: Help learner in memorizing and getting familiar with the knowledge |

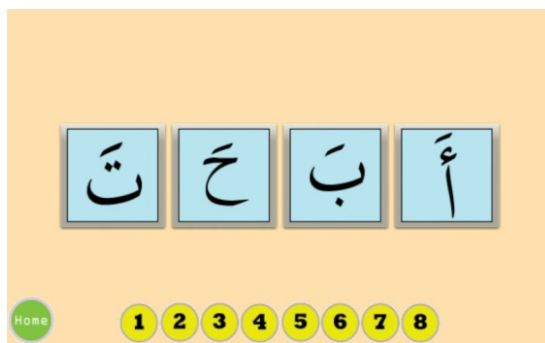
|   |                   |                                                           |                                                                                          |
|---|-------------------|-----------------------------------------------------------|------------------------------------------------------------------------------------------|
| 5 | Learning Activity | Keep the learner engaged & learning in the game world     | Apply few interactive activity e.g. matching, drag & drop, touching and displaying video |
| 6 | Reflection        | Learner decide the strategy to apply during next activity | Corrective suggestion provided to learner                                                |
| 7 | Game Genre        | Type or category of the game played                       | Education: Learning Al-Quran                                                             |
| 8 | Game Mechanics    | Define the details of game                                | Puzzle like, Drag & Drop, Touch & Listen, Touch& Watch                                   |
| 9 | Game Achievement  | Level of achievement in playing the game                  | Each of the LACIP skills has been categorized into few levels.                           |



Figure 2: Main Menu page- Learners have freedom to choose any categories according to the preferences

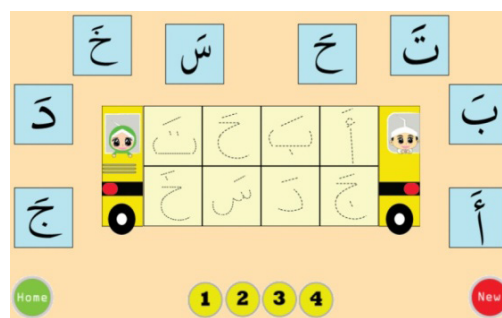


(i)



(ii)

Figure 3: Listening Page- The sound of each hijaiyah letter will be produced once the button is touched



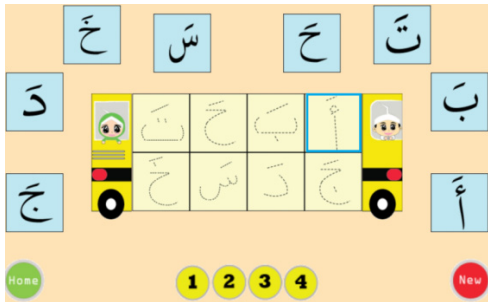
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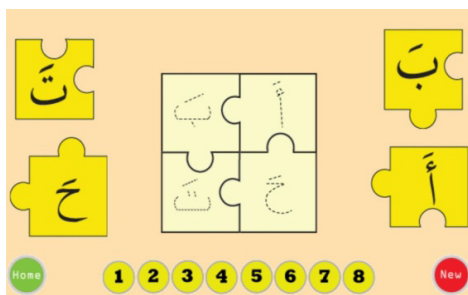
(ii)



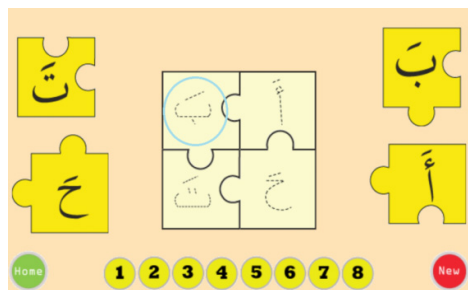
(iii)



**Figure 4:** Arranging page- Dragging and matching the hijiyah letters at the correct spaces provided. Reward and word of encouragement are provided in order to motivate the user. Corrective suggestion act as a clue for the learners on how to get the correct answer

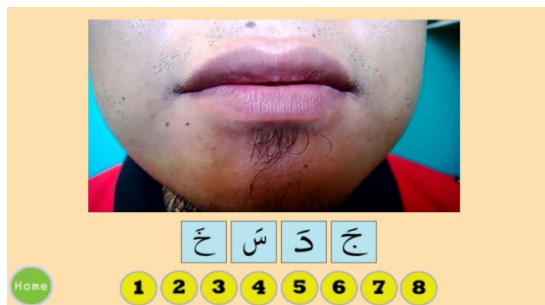


(i)



(ii)

**Figure 5:** Constructing page- Dragging and matching the puzzles at the correct spaces provided



**Figure 6:** Imitation and Pronunciation page- Displaying video on how to pronounce hijiyah letters. Learners can imitate the movement of the mouth thus helping them to pronounce the hijiyah letter. The purpose of displaying

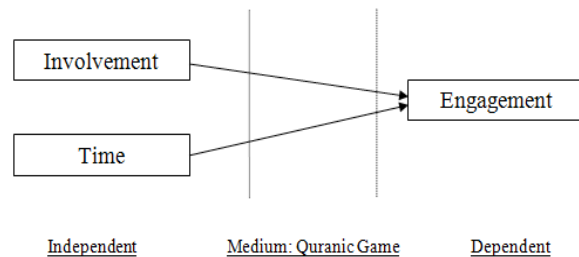
only the mouth part is to allow the learners to focus on the movement of the mouth in pronouncing the hijiyah letter without distracting the view of the learners on the other parts such as the eyes or nose

### 2.3 Phase 3: Evaluation of Serious Game

The aim of this phase is to evaluate the effectiveness of the serious game in engaging children with severe autism in learning Al-Quran. There are two independent variables concerned in this experiment in order to assess the engagement level of the participants. The first independent variable is Involvement Scale by<sup>22</sup>. The Involvement Scale consists of nine signals that have been rated using five-point scale (1 = Extremely Low, 2 = Low, 3 = Moderate, 4 = High and 5 = Extremely High). The nine signals include concentration, energy, complexity/creativity, facial expression and posture (non-verbal), persistence, precision, reaction time, verbal utterance/language and satisfaction.

The second independent variable is time related factor<sup>23</sup> whereby the amount of time the participants spent in playing the Quranic game was measured. In this connection, the focus time of five students with severe autism in using traditional way in learning was taken. The result is required to compare the total focus time of students after using the assistance of the Quranic game.

There is only one dependent variable assessed in this experiment which is the engagement level of participant in playing the Quranic game. The engagement level is an indicator to measure and identify the effectiveness of the Quranic game. Figure. 7 illustrate the framework for conducting effectiveness evaluation for the Quranic game.



**Figure 7:** Framework for Conducting Effectiveness Evaluation for Quranic Game

#### 2.3.1 Procedure

The procedure starts off by the selection of participants in accordance with the scope of study in order to test/play the game. Fifteen students with autism, thirteen boys and

two girls were selected to be the participant of this experiment. All of the participants were from The Foundation of Quranic Education for Special Needs Children, also known as FAQEH Foundation. The criteria for selection of students for this study are based on the following:

- a) The age of the selected students was from five to thirteen years' old and the median age for the recruited participants is 7 years old.
- b) Based on the diagnosis form filled by the parents, the students were shown to possess severe autism characteristic such as not able to speak properly, have difficulty to sit still for long period of time and fail to give good eye contact and proper respond to the teachers during the learning process.
- c) A medical diagnosis given by doctors or clinical psychologists indicating the type of autism and functioning levels.

Before the session start, the teacher was requested to briefly introduce his/her students who were the participants of this experiment. The session then began with live demonstration to the participants and teachers on how to play the Quranic game. After that, the participants were given a chance to play the game and explore it on their own with the teacher providing assistance when necessary. The researcher would start recording their time and observing the process two minutes after the participants started playing the game. The first two minutes was actually to familiarize the participants with the Quranic game. The recording will be dismissed once the participants stopped playing the game by showing action like reluctant to continue playing or left away for two minutes.

### 3. Result and Discussion

#### 3.1 First Result

Table 2 presents the mean and standard deviation of each of the nine areas included in the Involvement Scale. The means were presented in the order, from highest to the lowest value. It shows that "Facial Expression and Posture" was rated the highest while "Language" was rated the lowest compared to other signals. All the signals were rated above "moderate" except "Language". This is mainly due to the fact that most of the participants involved were non-verbal where most of their communications were without voice. Because of their lacking in verbal skills, they are

more likely to use facial expression, posture and gesture while communicating and expressing their feeling.

It is essential to investigate the relationship engagement between all these nine different signals by rating each one of them, hence the differences across the signals can be identified through the average rating. Analysis of variance (ANOVA) was used in order to indicate the significant effect among the nine signals involved. A one-way between subjects ANOVA was conducted to compare the nine signals of the Involvement Scale on the engagement level of the participants. Based on Table 3, there was a significant effect of nine signals included at the P-value  $< 0.05$  level for the three conditions [ $F(8,126) = 3.99$ ,  $P = 0.0003$ ]. In general, the results agreed with<sup>24</sup> who said that engaged and involved children pay their attention on a specific focus, persists in activity, experience on how quickly the time passes, extremely sensitive and alert to any relevant stimuli, release a great amount of energy and sense an incredible feeling of satisfaction.

**Table 2.** Means and Standard Deviations of Nine Signals in Involvement Scale

|                             | Mean | SD   | N  |
|-----------------------------|------|------|----|
| Facial Expression & Posture | 4.27 | 0.96 | 15 |
| Concentration               | 4.13 | 1.13 | 15 |
| Persistence                 | 4.01 | 0.88 | 15 |
| Reaction Time               | 3.80 | 1.40 | 15 |
| Satisfaction                | 3.80 | 1.15 | 15 |
| Complexity and Creativity   | 3.73 | 1.22 | 15 |
| Precision                   | 3.47 | 1.15 | 15 |
| Energy                      | 3.47 | 0.92 | 15 |
| Language                    | 2.33 | 1.40 | 15 |

#### 3.2 Second Result

The amount of time of the participants playing the Quranic game; in other word, total playtime was used to measure the level of engagement. Figure 8 presents the total playtime of every fifteen participants involved in this experiment. Based on the graph, the longest total playtime recorded is 21.08 minutes while the shortest total playtime recorded is 3.27 minutes. The overall average of total playtime for all participants is 7.93 minutes as compared with the previous total average of focus time while using traditional way in learning Al-Quran which is 4.79 minutes it shows an increase by two-fold Figure 9. From

the results it implies that the level of student's engagement in learning Al-Quran increase after using the Quranic game. The result is certainly consistent with<sup>25</sup> who defined engagement as the notion that the program makes the learner want to be there. Indeed, fun learning environment can enhance the children's motivation, develop their curiosity and lead them to give positive response in learning<sup>3,4</sup>.

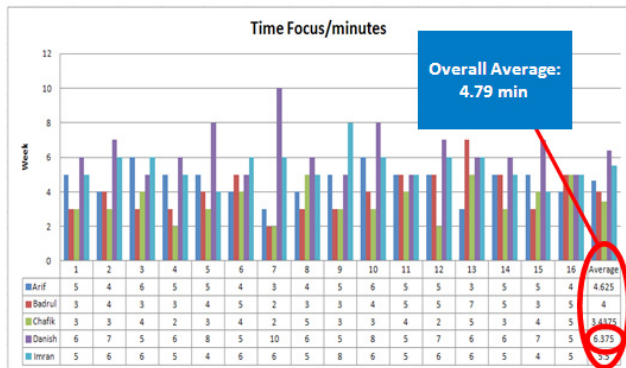


Figure 8: Students' focus time

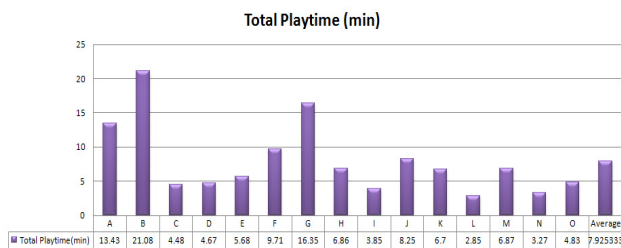


Figure 9: Participant's total playtime

## 4. Conclusion

Serious game is believed to be an effective intervention tool that can facilitate an individual, specifically children, in their learning process. The fact that the users are engaged and motivated by the game certainly causes them to train for longer hours and therefore contributes to a positive effect to their learning progress<sup>26</sup>. Despite the explosion of the development of mobile serious game for education purposes, very little research has been carried out that investigate the strengths, skills and abilities of children with severe autism and make full use of it in developing a game that can assist their learning specifically in learning Al-Quran. This factor has become the biggest motivation to carry out this study.

As a conclusion, individual with severe autism have differences in various aspects including interests and

abilities. As mentioned by<sup>27</sup> children are most likely to become engaged in the learning process whenever the learning environment is compatible with their certain basic psychological needs. Therefore, interest and strength of children should be considered in developing learning game application because their brain development will be at maximum level when they are interested and delighted in doing something. Lastly, with the creation of the Quranic game, it is hoped that this study could contribute to the teaching of children with severe autism in learning Al-Quran, thus offering them with opportunities to study Al-Quran like other normal Muslim children.

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## 6. References

- Keen D. Engagement of children with autism in learning. *Australasian Journal of Special Education*. 2009; 33(2):130-40.
- Kang GY, Choi CS, Ju SJ. Parenting Experience of Mothers with Children with Autism Spectrum Disorder: An Analysis of the Mothers' Diaries. *Indian Journal of Science and Technology*. 2016; 9(20):1-7.
- Weiss MR. Self-esteem and achievement in children's sport and physical activity. *Advances in Pediatric Sport Sciences*. 1987; 2:87-119.
- Akey TM. School Context, Student Attitudes and Behavior, and Academic Achievement: An Exploratory Analysis. MDRC, 2006.
- Squire KD. Video games in education. *Int. J. Intell Games and Simulation*. 2003; 2(1):49-62.
- Winn B. The design, play, and experience framework. *Handbook of Research on Effective Electronic Gaming in Education*. 2008; 3:1010-24.
- Papastergiou M. Digital game-based learning in high school computer science education: Impact on educational effectiveness and student motivation. *Computers and Education*. 2009; 52(1):1-12.
- Radillo A. L'expérimentation de l'utilisation des jeux vidéo en remédiation cognitive. *Enfances and Psy*. 2009; (3):174-9.
- Johnson WL, Vilhjálmsón HH, Marsella S. Editors. Serious games for language learning: How much game, how much AI? AIED, 2005.

10. Westera W, Nadolski R, Hummel H, Wopereis I. Serious games for higher education: a framework for reducing design complexity. *Journal of Computer Assisted Learning*. 2008; 24(5):420-32.
11. Wrzesien M, Raya MA. Learning in serious virtual worlds: Evaluation of learning effectiveness and appeal to students in the E-Junior project. *Computers and Education*. 2010; 55(1):178-87.
12. Prensky M. Digital natives, digital immigrants part 1. *On the Horizon*. 2001; 9(5):1-6.
13. Lee DH, Shon JG, Kim Y. Design and implementation of OSMD based learning management system for mobile learning. *Indian Journal of Science and Technology*. 2015; 8(S1):154-60.
14. Brown DJ, McHugh D, Standen P, Evett L, Shopland N, Battersby S. Designing location-based learning experiences for people with intellectual disabilities and additional sensory impairments. *Computers and Education*. 2011; 56(1):11-20.
15. Gentry T, Wallace J, Kvarfordt C, Lynch KB. Personal digital assistants as cognitive aids for high school students with autism: Results of a community-based trial. *Journal of Vocational Rehabilitation*. 2010; 32(2):101-7.
16. Upadhyay N. M-Learning—A New Paradigm in Education. *International Journal of Instructional Technology and Distance Learning*. 2006; 3(2):27-34.
17. Yusoff A, Crowder R, Gilbert L, Wills G, editors. A conceptual framework for serious games. *Advanced Learning Technologies, 2009 ICALT 2009 Ninth IEEE International Conference on 2009, IEEE*.
18. Garris R, Ahlers R, Driskell JE. Games, motivation, and learning: A research and practice model. *Simulation and Gaming*. 2002; 33(4):441-67.
19. Thompson J, Berbank-Green B, Cusworth N. *The computer game design course: principles, practices and techniques for the aspiring game designer*: Thames and Hudson London, 2007.
20. Gilbert L, Gale V. *Principles of e-learning systems engineering*: Elsevier, 2007.
21. Prensky M. Digital game-based learning. *Computers in Entertainment (CIE)*. 2003; 1(1):21-21.
22. Bertram CPT, Pascal C, Bertram T. *Effective early learning: case studies in improvement*: Sage, 1997.
23. Xie L, Antle AN, Motamedi N, editors. Are tangibles more fun?: comparing children's enjoyment and engagement using physical, graphical and tangible user interfaces. *Proceedings of the 2nd international conference on Tangible and embedded interaction*, ACM, 2008, p. 191-98.
24. Bertram T, Pascal C. Effective early learning programme child involvement scale. Birmingham Download unter: URL: [http://www.decs.sa.gov.au/northerncountry/files/links/link\\_84047.pdf](http://www.decs.sa.gov.au/northerncountry/files/links/link_84047.pdf). Date accessed: 2002.
25. Jones MG. *Creating Electronic Learning Environments: Games, Flow, and the User Interface*, 1998.
26. Annetta LA, Minogue J, Holmes SY, Cheng M-T. Investigating the impact of video games on high school students' engagement and learning about genetics. *Computers and Education*. 2009; 53(1):74-85.
27. Newmann FM. *Student Engagement and Achievement in American Secondary Schools*: ERIC, 1992.