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Help The Math Town: Adaptive Multiplayer Math-Science Games using Fuzzy Logic

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Abstract

The mobile games for education and entertainment are rapidly developed. Unfortunately the development of interesting and entertaining adaptive multiplayer game based learning for math and science that consider psychological aspects and game balancing for students on mobile platforms that have game balancing is very limited. This paper proposes an integrated model of adaptive Math and Science game based learning for elementary school students with adjustable level of difficulty based on user's ability and additional option for "Free" and "Adventures" modes. We propose a method where level of difficulty can be adjusted based on previous score, using fuzzy two inputs in the form of percentage correct and the speed of answer to produce output. The experimental results are presented and show the adaptive games are running well on mobile devices based on Android platform and well received by elementary school students grade 3 to 6.

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Keywords: adaptive games, fuzzy, android, psychological aspects.

1. Introduction

Today, students have grown up using devices like computers, mobile phones, and video consoles for almost every activity, from studying and work to entertainment and communication. UNICEF and Indonesia's Ministry of

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communication and Informatics survey 400 children age 10-19 in Indonesia and found that 80% children have used internet, 21% of that number are using smart phone to access internet. Most of the children use internet to look for something (40% female and 40% male) and for entertainment purpose (33% female and 40% male)[1].
On the other hand, according to PISA (Programme for International Student Assessment) survey in 2012, Indonesian students

have low ability in Math and Science compare to other country[2] detik.com. Initial survey to 75 elementary school students in Jakarta found that 55% perceived science as quite difficult and 19% perceived science as very difficult subject. While 45% perceived Math as quite difficult and 17% perceived Math as difficult subject. Accessibility of internet and smart phone for children in Indonesia opens opportunity to use smart phone games as educational tool, especially in Math and Science, two subjects that are perceived difficult by elementary students. Learning, from constructivism point of view can be understood as achieving understanding through active discovery[3]. Constructivism learning theory view students as self regulated learners, who are motivated by learning itself, not only by grade or other's approval. The Learner-Centered Psychological Principles describe learner as actively seeking knowledge by (1) reinterpreting information and experience for himself or herself, (2) being self-motivated by the quest for knowledge, (3) working with others to socially construct meaning, and (4) being aware of his or her own learning strategies and capable of applying them to new problems or circumstances[4]. Therefore, there is a need of a game that induces student's intrinsic motivation to learn.

Learning can occur if the learner is actively engaged in the process. According to Ling Fu, Chang Su, Chin Yu[5], whether or not a game offers enjoyment to the player is a key factor in determining whether the player will became engage and continue to learn through the game. This situation of complete absorption or engagement in an activity is called flow experience[6]. Under this condition, one enter a state with these characteristics: focused and concentration, merging of action and awareness, loss of awareness of oneself, a sense that one is in control of one's action, distortion of temporal experience, experience of the activity as intrinsically rewarding[6]. Faiola, Newlon, Pfaff, Smyslova[7] found a significant correlation of flow experience and telepresence in virtual world (Second Life game). This finding suggests that learner who experience flow may acquire an improved attitude of learning online.

Being in the condition of flow is describe by subjective experience of engaging just manageable challenges by tackling a series of goals, continuously processing feedback about progress, and adjusting action based on this feedback[6]. Therefore, well design games that promote effective learning should consider several conditions such as specific goal, interpretation (thinking, action, extracting lesson learned), practice, explanations, debriefing, feedback, and learn from others experiences through social interaction[8].

Adaptive games-based learning style aims to support and encourage the learner considering his needs, strengths and weaknesses. A crucial factor for adaptive game is challenging method, which can be solved using computational intelligence. It can result from adapting the level of difficulty of the tasks to the learners' ability level so that a constant challenge is felt. Not only the level of difficulty of the tasks is adjusted to the learners' ability level, but also the system reacts to personal learning styles and preferences[9]. There have been many studies on the development of multiplayer games for mobile applications such as[10,11]. But in the study, there is no comprehensive mechanism of how to identify the ability of users (students) who have a genuine interest in games or games that comes with a lessons and quizzes, as well as not using a Neural Network-based intelligence to input the percentage of correct answers, speed of answer and interest mode of games (animation /lessons). Research shows that game based learning can increase spatial orientation and spatial memory for 6th grade students[12] and young children's taxonomic concept development[13]. Our previous projects have developed adaptive educational games on Blackberry platform in Bahasa Indonesia for elementary school[10,11]. Besides that, research on the development and use of adaptive educational Math and Science games on mobile platforms in Bahasa Indonesia for elementary school students is very limited.

This paper proposes adaptive multiplayer games using the method of identifying the ability of the user t answer question using fuzzy logic with 2 inputs and 1 output. The final result of this research is a framework of multiplayer Math and Science games in Android using Fuzzy Logic.