

Research on virtual simulation design of mathematics education game based on web cloud architecture

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Abstract. The paper constructed the digital instructional game design framework of teaching based on Web cloud architecture. This study integrated the game design theory, instructional design theory and related theory of computational thinking, from the goal of learning, learner characteristics, tasks and game design processes such as learning situation, combining the teaching of digital game design, the process of thought and problem solving to build a digital game framework to promote the development of computational thinking. The paper presents the software design model of educational game. From the perspective of the software system design, based on this study, we propose the teaching game design framework to construct the teaching game of the software design mode, the game system is divided into game function and support module, provided the supporting for the development of educational games. The paper developed a digital teaching game for promoting the development of computational thinking. The experiment result shows the proposed method can improve the overall performance substantially.

Key words. virtual simulation design, mathematics education game, web cloud architecture.

1. Introduction

In recent years, teaching the game has become the focus of widespread attention in the industry and academia, also the different degree has made some achievements; the research focuses on the study of basic theory, the three aspects of technology, design and development and applied research [1-3]. According to the purpose and

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content of this research, based on case analysis and game software design method on the literature analysis, mainly focuses on the following four aspects.

(1) Fundamental research of promoting the development of computational thinking. On the basis of literature review, this paper analyzes the connotation of computational thinking and research status about computational thinking training, the basis of the theory teaching game design. Then based on computing thinking related theory research, combined with the theory of game design, analysis of game design elements, seeking the effective ways of computational thinking combined with teaching game, aimed to providing the theory support for the design and development of teaching games [4-5].

(2) The construction of instructional design framework for promoting the development of computational thinking. On the basis of the analysis of domestic and foreign teaching game design model, presents the design of digital game elements and basic structure. By using the theory of instructional design construct the instructional design framework of teaching games.

(3) The software design model of promote the development of computational thinking. Starting from the objective of promoting the development of computational thinking, in the demand for digital instructional game based on the analysis, overall design and detailed design, this study constructs the system design model of teaching game to promote the development of computational thinking [6].

(4) The design and development of the game case. In Flash CS 5 for development platform, this study used the Action Script 3.0 language, selection of junior middle school information technology curriculum, design and development [7] to promote the development of computational thinking game example. By collecting a large number of research topic relevant literature at home and abroad, related research results and combining with actual, this paper made the following progress through a series of work.

2. 2The Web Learning Environment Model and Algorithm

Computational thinking is one of the critical thinking to master programming courses which has attracted widely international attention in the domain of computer technology currently. In order to solve this problem, in this study from the perspective of computational thinking, on the carrier of teaching games and the basis of subject knowledge to design and develop a teaching game to promote the development of computational thinking [8]. Expectations of improving the learners' thinking ability through the process of gaming experience. Many students do not like mathematics. They often perceive mathematics as an unpleasant and difficult subject [9]. It is a global issue as well as critical issue in developing nations the massive failure of mathematics course that resulted to mathematics anxiety and affecting all aspects of mathematics teaching and learning style. The theoretical nature of mathematics is usually taught in ways that make the information monotonous, unsuitable and confusing to students' experiences that pave the way towards an ever-growing population of individuals with mathematical apprehension. The AHP evaluation method is used for data processing. The basic algorithm is shown in the following

equations [10]:

$$\varpi_{ji}(\mu_j) = \exp\left(\frac{-(\mu_j - C_{ji})^2}{b_{ji}^2}\right), \text{ for } i = 1, 2, \dots, H \quad (1)$$

In this space, the m th multidimensional receptive-field function is defined as

$$\Phi_m(\mu) = \prod_{j=1}^L \varpi_{ji}(\mu_j), \text{ form } = 1, 2, \dots, N \quad (2)$$

The function can be written in a vector notation as

$$\Phi(\mu, C, b) = [\Phi_1, \Phi_m, \dots, \Phi_N]^T \quad (3)$$

where $C = [C_{11}, \dots, C_{L1}, C_{12}, \dots, C_{L2}, \dots, C_{1H}, \dots, C_{LH}]^T$
and $b = [b_{11}, \dots, b_{L1}, b_{12}, \dots, b_{L2}, \dots, b_{1H}, \dots, b_{LH}]^T$

The weight memory space with N components can be expressed in a vector as

$$W = [W_1, W_m, \dots, W_N]^T \quad (4)$$

The activated weights in weight memory space, which can be written in a vector form as

$$y = W^T \Phi(\mu) \quad (5)$$

Figure 1 shows the cloud architecture in network model. One of the most excellent systems to alleviate the effects of multipath fading is diversity combining of separately fading signal paths. The diversity combining exploits the reality that independent signal paths experiencing deep fades at the same time. These small possibilities of paths are merged in such a way to decrease the fading of the resultant signal. Figure 2 shows the algorithm procedure. In money dynamic education information resources, through adjusting the education information resources development and construction funds and the proportion of school information environment construction funds, to achieve dynamic balance, to promote education information resources utilization efficiency and quality. Many online open platforms have become a way of sharing educational resources.

3. 3Experiment Result and Discussion

True experimental method was used in this study to establish a formal procedure for comparing the achievement level of the control and the experimental groups. The subjects were chosen using the cluster random sampling technique because the subjects were selected as classes not as individuals. The criteria of the subjects included are nursing students of University of Santo Tomas, First Year College, enrolled in the mathematics class, and ages 16 to 19 years old. Data gathering was conducted in University of Santo Tomas College of Nursing, specifically in the respective mathematics classes of the subjects to control any extraneous factors such as noise and heat.

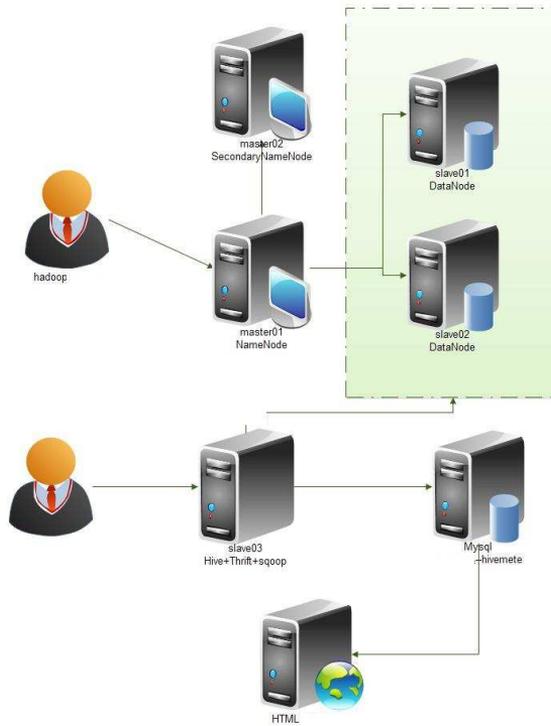


Fig. 1. The basic principle for adaptive video image scaling technology.

The study lasted for six weeks, which includes pre-test, treatment, post-test, and distribution and collection of motivational questionnaires. There were three experimental groups and three control groups. Three mathematics classes of the researcher were selected, as the experimental group while another three mathematics classes from the other math professors were designate as the control group. Both experimental and control groups had 145 respondents. The pre-test and post-test were used to measure their achievement level with Cronbach alpha 0.823 and 0.808. Pre-post survey questionnaires were used to determine their degree of motivation with Cronbach alpha 0.995 and 0.939. The researcher obtained a written consent from the administration of the College of Nursing. On the first week, pre-test and pre-motivational survey was done. Pre-test and pre-motivational survey was administered in order to measure the base line achievement level of the subjects and the prior interest for the subject.

After the pre-test, a brief discussion was given for the nature of the study, its objectives and significance, as well as the benefits and risks involved. Then each class was subdivided into 10 groups using stratified sampling technique. The students served as the developer and at the same time facilitator of the assigned topic for the games. The distribution of topic to the sub-groups was done by draw lots method. Guidelines were set for designing of games and simulation activities. These were

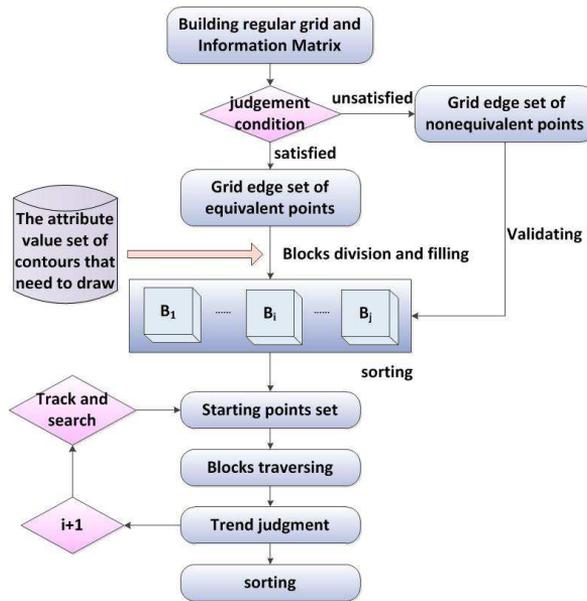


Fig. 2. The algorithm procedure

the following: to develop their own mechanics; the mechanics of the games must be participative, creative and with originality; formulated their own problems; the activity was limited for 45 minutes; to facilitate the games inside the classroom; the use of props for the games was encouraged and there should be three winners and the winners received prizes (i.e. candies, chocolates, biscuits, etc.) from facilitators. Winners of the game were given corresponding additional grades, and facilitators' grades were based on criterion-reference. The games-simulation activity was given after every discussion of each topic. The researcher-teacher first discussed and explained the topic before the implementation of games. Figure 3 shows self-adaptive learning based on grids

No brief discussion was given. After every discussion of each topic the usual practice exercises were given to the subjects. After the four-week activity (2nd week to 5th week), a post-test was given to both the experimental and the control groups. The pre-tests and post-tests consisted of different set of questionnaires, which were formulated by the mathematics professors, and an item-analysis of the two tests was done. The collections of examinations were done immediately. Figure 4 shows the system retrieval flow chart. The post-motivational survey questionnaire was distributed to the experimental and control groups after the post-test. The pre-post motivational survey was adapted from Keller's Instructional Materials Motivation Scale (IMMS) and was rephrased for the study based on Keller's guides for modifying the survey without altering the original source. Then collections of survey questionnaires were also done thereafter. After data collection, the test and survey questionnaires were collated and were subjected to the statistical analysis and interpretation.

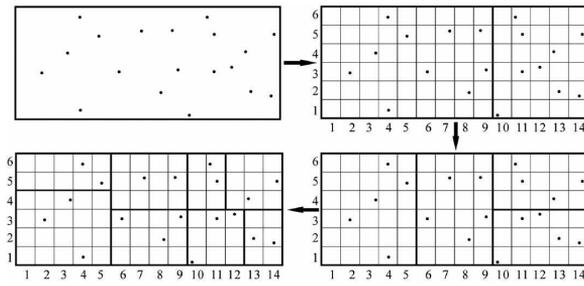


Fig. 3. Self-adaptive Learning based on Grids

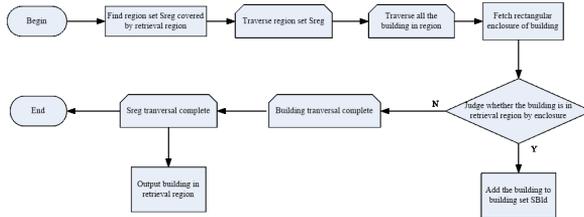


Fig. 4. System Retrieval Flow Chart

Improving learners’ knowledge, skills, attitudes and behaviors are potential factors through games. Games require transfer of learning from other venues like life, home, and school. In students’ devised games and simulations, the learners were challenged to participate and to develop their own games for them to implement problems and solutions in action. It promotes the development of interpersonal, analytical and creative skills of students into a higher level than the current traditional delivery system of education. In academics, it raises the level of performance to a point where students are more alert and attentive to class activities. Undeniably, most of the students are looking forward for their rounds to facilitate and to present their creativity and originality and were eager to win the games because of additional grades and the new concepts that they have experienced. The study showed that there was a great improvement in the motivation and academic achievement in mathematics of the students applying students’ devised games and simulations.

It is therefore concluded that learning through participative tool construction and playing made the students motivated and achieved more academically. It is also a way to prevent students from absenteeism, feeling bored and reluctant. Devised games and simulations teaching strategy also encourages the teachers the eagerness to teach mathematics. Thus, utilizing interactive teaching through students’ devised games-simulation activities should be implemented in a classroom setting. Since different teachers (experimental groups and control groups) participated in the study, the researcher highly encourages further study of this topic using the same teachers to control the delivery of the topics and another study using other subjects and to include more participants. Future research studies also need to investigate the effect of different variables in the learning process.

4. Conclusion

In this paper, the author researched on design and development of mathematics education game based on mobile learning environment. The paper developed a digital teaching game for promoting the development of computational thinking. The paper chooses VB programming language "magic loop statement" as learning content, under the guidance of instructional design framework and software design scheme, development of the "robot recruit" game instance, verified the feasibility of the game. In this way indigenous games are used as an endogenous knowledge, which demonstrates that mathematical concepts are not exogenous, is our cultural practices. The new look, as suggested earlier in the paper will be easily realized in the teaching and learning of Mathematics. The experiment result shows the proposed method can improve the overall performance. Due to the limit of time and capacity, the teaching games have achieved a certain research results at the same time, there are also some problems, computational thinking combining with teaching game is not yet perfect. So, it needs to be completed in the future.

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