Adaptive 3D-Virtual Learning Environments:From Students Learning Perspective

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Abstract— **Adaptive 3D-Virtual Learning Environments (3D-VLEs) have the ability to dynamically change its contents according to the learning goals of each student which result in improved learning. This paper presents a new idea of horizontal transition inside adaptive 3D-VLEs. Using the proposed approach, same teaching concept is presented with more examples and learning material which help students understand the given concept and get more insight of the learning module, as a result students get motivated towards learning. The experimental results show that the proposed model is effective and can be used for enhancing the learning capabilities of students in 3D-VLEs.**

Keywords — Virtual reality in education; 3D-Virtual learning environments; Educational virtual environments; Adaptivity ; Horizental transition; Student learning

I. INTRODUCTION

Three dimensional virtual learning environments (3D-VLEs) are 3D computer representation of space which enables students to move freely inside the virtual world, pick and process different objects directly and as a result they get the sense of realism[1-3]. Adaptive 3D-VLEs are virtual learning environments which dynamically modify its contents according to the needs of individuals [4, 5]. It shows customized teaching materials to individual students, minimizes the chance of astray navigation within the virtual world and makes the difference between entertainment and education which encourage them to learn [6, 7].

In literature a lot of work has been done regarding the adaptivity of VLEs but this area still needs further attention for possible improvements [4]. Some researchers used customer behavior and personalization rules as adaptive criteria which help users to perform customized navigation inside virtual stores [8, 9]. Virtual agents and software sensors were used by [10, 11] that guide users during interaction with the virtual world. Moghim, M., et al [12] presented a dynamic virtual environment which can respond to human emotions. Al-Aubidy [13] conducted a pre-test from students to update learners model and display customize teaching materials for them. Similarly Alam, A., et al [5] used learning skill of a student as adaptation criterion to show customize teaching contents for different type of students, which results in improved learning. In this study we have introduced a new idea of horizontal transition inside adaptive 3D-VLEs which enables weak students to stay more in the current learning module and get more insight of the concept presented to them. It also provides an opportunity for good learners to increase their knowledge about the given concept with more teaching contents and examples. The experimental results show that the proposed system is effective and can be efficiently used to enhance the learning capabilities of students in 3D-VLEs.

The remaining of the paper is organized as follows. The proposed model is presented in section II. Section III contains experiments and evaluation followed by discussion in section IV. Conclusion and future work are presented in section v.

II. THE PROPOSED MODEL

From teaching practice, it has been observed that good and intelligent students understand a given concept quickly even if it is presented with abstraction while weak students need explanation and much detail to get the desired understanding of a concept. Similarly, some students get the desired knowledge easily if presented with the help of a figure while other students are good if the data is presented to them in the form of a table or with help of a graph.

In the proposed model we have made an attempt to provide an opportunity for students to get the desired knowledge according to their learning styles. knowledge is delivered to students in many levels. When a student completes a learning module M, he is given two choices to proceed. The student can make a vertical transition to next learning module N in which another concept will be presented to him. If the student understanding is low and he wishes to learn more about the given concept, the system give him an opportunity to make horizontal transition. Horizontal transition enables student to enter in learning module $M^{/}$, in which he will be provided details information about the topic presented in learning module M. The student remains in the same module and gets the opportunity to learn more about the given concept with different examples which motivate him/her for learning. The proposed model is presented in "Fig.1".

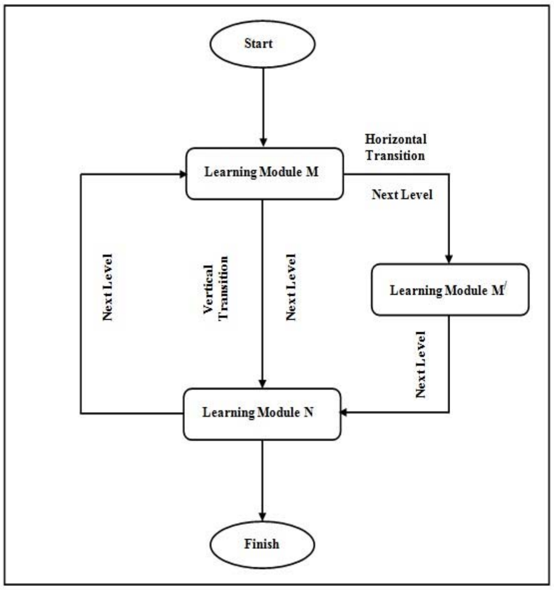


Figure 1. The Proposed System Architecture

The two types of transitions vertical and horizontal are explained below.

A. Vertical Transition

In literature it has been discussed that displaying large information on the screen has negative effects on the performance of students in 3D-VLEs [4, 6, 14]. The students are overwhelmed with teaching materials and get lost in the environment. As a result they lose their concentration which results in low performance. In vertical transition the next learning unit is presented with abstraction. It only includes the summary of a concept which is quite enough for good quality learners and prevents them from being overwhelmed. "Fig. 2", is the example of vertical transition. The student makes transition from learning module M to learning module N in which two different concepts "atom" and "molecule" are discussed with enough details.

B. Horizontal Transition

In horizontal transition, the same learning module is presented in different way with more examples and explanation. It includes in depth details of the learning unit that facilitates the learning process of weak learners. In horizontal transition, efforts should be made to include different figures, graphs or tables which may help the students to understand the given concept easily. "Fig. 3", is the example of horizontal transition. The student makes transition from learning module M to learning module M/ in which the same concept" atom" is presented with much details. A different figure is added for explaining subatomic particles and also a table is used for presenting different attributes of these particles which helps students to understand and memorize this data easily.

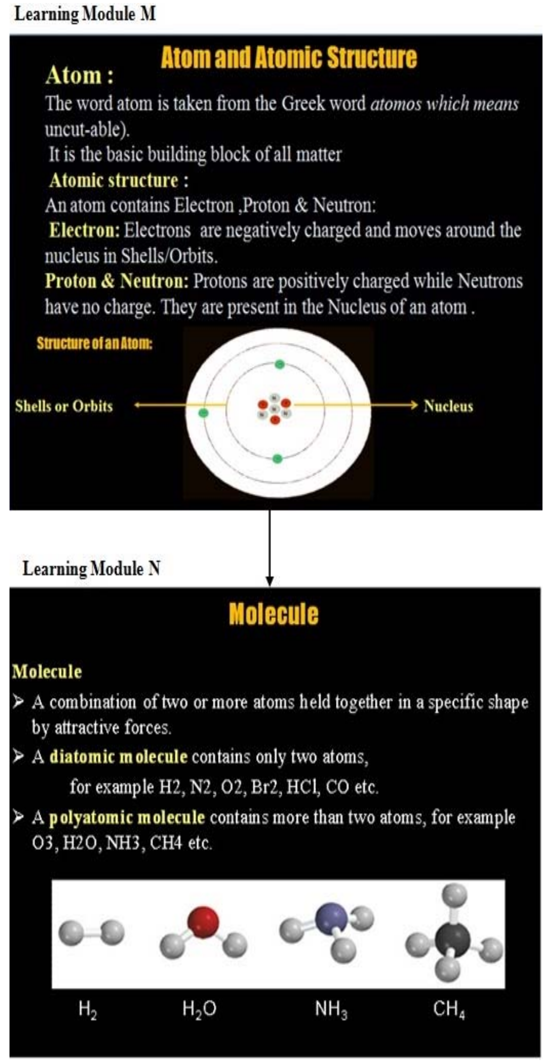
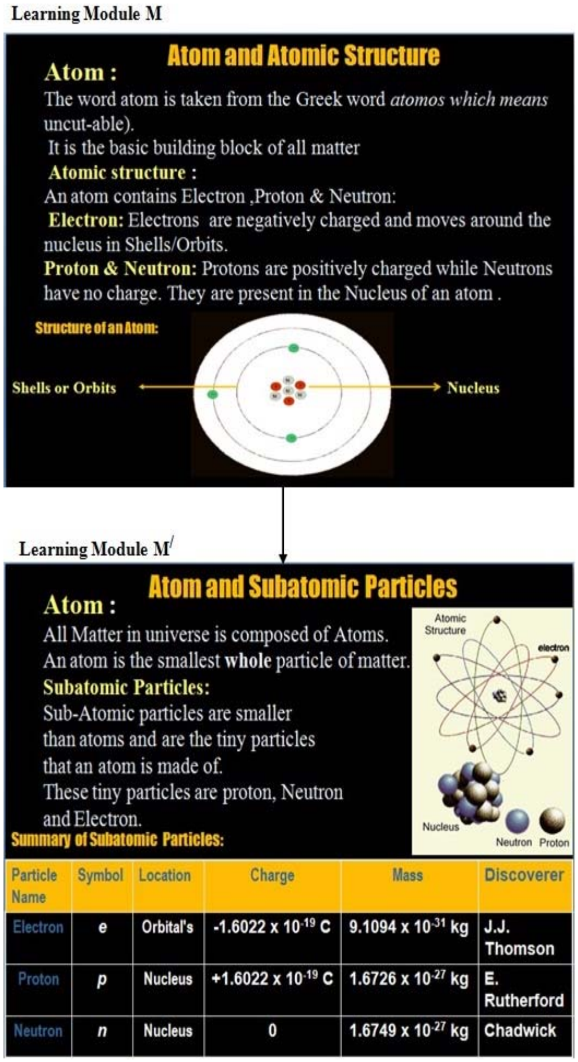


Figure 2. Vertical Transition

The proposed model has many advantages. It is very much effective for weak students as it give them the opportunity of horizontal transition. Students stay more in the current learning module and see the details of the concept with different examples which help them to understand the learning unit. Secondly, it enables good students to make vertical transitions to finish his work in less time and make some quick progress, which motivate them for learning.

It is important to mention that horizontal transition is different from repeating the same learning module. In traditional systems if a student repeats some learning module, he is provided the same teaching material in the same way which may not produce satisfactory results. While in case of horizontal transition the same learning unit is presented in different ways with more examples and details which help the student in understanding the given concept. Students see the same concept in new fashion which may fit their learning style. Therefore the proposed approach is efficient than the traditional repetition.



Particle Name	Symbol	Location	Charge	Mass	Discoverer
Electron	e	Orbital's	-1.6022×10^{-19} C	9.1094×10^{-31} kg	J.J. Thomson
Proton	p	Nucleus	$+1.6022 \times 10^{-19}$ C	1.6726×10^{-27} kg	E. Rutherford
Neutron	n	Nucleus	0	1.6749×10^{-27} kg	Chadwick

Figure 3. Horizontal Transition

III. EXPERIMENTS AND EVALUATION

We used MS Visual Studio 2010 along with OpenGL Graphics Library using HP Corei3 Laptop having 1.8 GHz processor, 4GB of RAM and window 7 (64- bits) operating system to implement the proposed model. To evaluate the efficiency of the proposed model we also used traditional system in our experiments. In traditional system when a student repeats a learning module, he gets the same amount of information in repetition about the concept presented. The proposed model behaves differently by allowing students to make horizontal transition. The students get details and different information in repetition which helps them in understanding the given concept.

For the purpose of experiments we randomly selected 40 students of class 10 from different schools. Two different topics having almost the same difficulty level were chosen from the subject of chemistry to perform the experiments. Topic 1 was taught to students using the traditional system and at the end we conducted a written test T1 from them. Similarly topic 2 was taught to students using the proposed system and we got another test T2 from them. In "Fig. 4", we have summarized the results of T1 and T2.

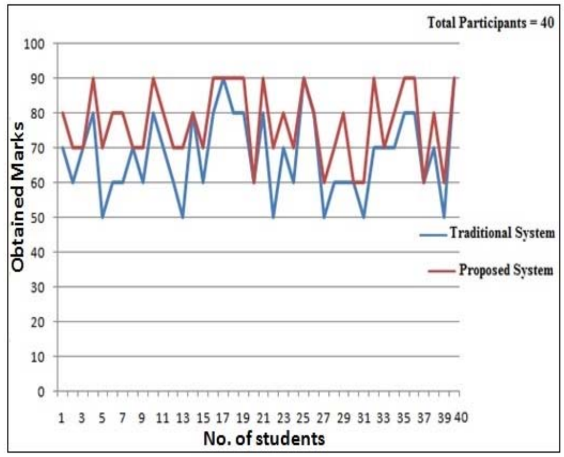


Figure 4. Performances of Students on both Systems

The graph for T1 and T2 shows that majority of the students showed positive results when they were using the proposed system for learning. Statistically, 62% students got high marks in T2 as compared to T1. Similarly, 25 % got same marks in both tests. The remaining 13% students showed negative results and they got less marks in T2 as compared to T1.

We also used some statistical techniques to further analyze the proposed model. Using the results of T1 and T2, we performed ANOVA ($F(1, 39) = 3.918$, $p < 0.006$) which is significant. Student also showed positive response in terms of Mean and Standard Deviation for the proposed system. Using the tests scores of students, the Mean and Standard Deviation for the traditional system were 66.71 and 12.05 while for the proposed system these were 10.66 and 75.40 as shown in "Fig. 5". On average students showed an improvement of 10 marks when they were using the proposed system for learning. The results show the effectiveness of our approach.

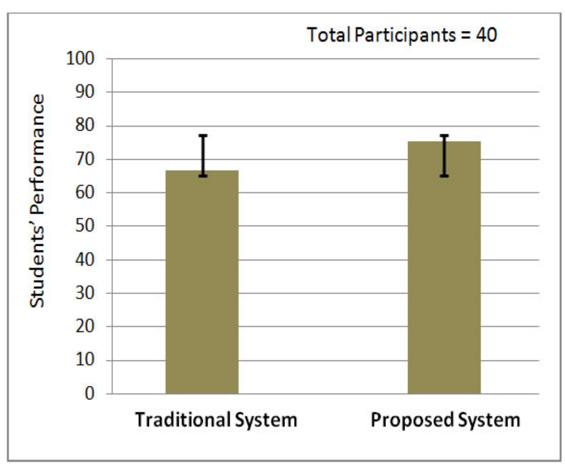


Figure 5. Students' performance in terms of Mean and Std. Deviation

IV. DISCUSSTION

In the proposed model we have made an attempt to implement the real teaching behavior in 3D-VLEs. In practice, a teacher treats weak and good students differently. He gives more time to weak students for teaching some concept while he took less time if students are intelligent. With this approach all students become satisfied because they get the desired time for learning**.** The proposed approach behaves in similar way. If a weak student makes horizontal transition, he stays more in the learning module and he is provided details information about the given concept. On the other hand a good learner is provided only standard information about the learning unit when he performs vertical transition; therefore he makes quick progress and can finish his work in less time. The proposed model is designed for adaptive 3D-VLEs but it is generic and can be used in any learning environment.

V. CONCLUSION AND FUTURE WORK

In this paper we have presented a new idea of horizontal and vertical transition in adaptive 3D-VLEs. Horizontal transition enhances the learning capabilities of students in 3D-VLEs by providing them details information about the given concept presented in different ways which boosts their minds for learning. Similarly vertical transition enables good students to finish their work in less time and make quick progress which prevent them from being overwhelmed with teaching materials and losing interest and focus.

In future work, a proper framework shall be designed for horizontal transition to make the approach more effective. The future work shall see the effect of changing font color, font size, and different guide lines support on student's performance in horizontal transition.

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