

Providing an effective way of using the virtual laboratory to improve student learning process

¹Mohammad Nori Motlagh

Faculty of e-Learning
Shiraz University
Shiraz, Iran
m.nori.motlagh@gmail.com

²Marzieh Ahmadzadeh

Department of Computer Engineering and IT
Shiraz University of Technology
Shiraz, Iran
ahmadzadeh@sutech.ac.ir

Abstract— Virtual Laboratory is considered as one of the most comprehensive tools on human interaction with the computer. In this paper, the effects of virtual laboratories are identified and some successful experiences in this laboratory are accessed. One of the important points that can be noted in this study is the difference in student learning. Therefore, this paper also examines individual differences in learning styles and focuses on the interaction with students, teachers and parents as well as the missing link in the learning process. Finally, a combination method using virtual laboratories and actual laboratories is proposed which improves the Experimental – Research learning in the students in a virtual environment and helps them to feel better during the learning process.

Keywords- Human-computer interaction; virtual environments; virtual lab; students learning.

I. INTRODUCTION

Over time, many teaching models and teaching methods for students have been introduced. Methods including descriptive method, lecture method, exploratory method, discussion method, method of questions and answers, and other modern methods of scientific workflow [1, 2] Along with teaching methods, development of information technologies, have had a considerable impact on the learning process and have given new tools in a wide range of instructional practices to humanity. These new capabilities have led to the development of teaching strategies [3].

Training using various methods is an important factor to create enthusiasm for learning in students. Learning environment as the context for this work, made appropriate linkage between the interests and abilities of students to interact with academic concepts. Furthermore, different people according to their abilities have specific methods for learning, and if they are trained in that manner, the talents will flourish. Accordingly, one of the best educational environments with the experimental-research working ability [4] and appropriate facilities for teaching diverse students is in the lab. But in some labs, physical activity has always risks and limitations for students. Hazards of working with laboratory instruments, limitations of space, time and money, even these problems can cause suppress the student's curiosity or fear of experiencing. Thus providing an alternative to laboratory physical tools is

increasingly important to enhance the security and safety of students. Today, software tools and laboratory have changed. One of the results of these developments is the virtual environment. In a virtual educational environment, the virtual reality can be a wonderful opportunity to encourage people to provide training in effective teaching, as the use of these technologies is considered as part of the education process [5].

One of the most useful virtual environments is virtual laboratory. In the virtual laboratory, students can test their research concerns at any time, in a virtual environment, with fewer risks and limits. Many studies using the virtual laboratory have focused on education and teaching [5]. also in all of the educational processes, with the possibility of sharing a virtual lab with other educational establishments, the cost of using laboratory equipment significantly reduced the access to various tools increased [6]. In general, virtual laboratory environment is a distributed environment which allows remote access to a variety of scientific equipment and computing resources. Virtual environment is defined by the Cambridge Dictionary: it is the collection of images and sounds generated by the computer which seems to show a situation that people can carry on their experiments and experiences [7], which has defined the Virtual reality as a technology for building virtual laboratories made by a computer. In the virtual laboratory users present their tasks and activities as a scenario which includes a set of different tasks and dynamic computational and experimental measure [8].

This paper first discusses the importance of learning methods and individual differences in learning, then studies the effect of physical and virtual laboratories in the educational process, and examines barriers and advantages and disadvantages of using them. Then it studies the effect of interaction between teachers, students and parents in the use of virtual laboratories and in view of the characteristics and interests of students, presents a combination method that can lead to improved learning.

II. LITERATURE REVIEW

Nowadays, virtual labs are developed at different levels of education. Since presenting the first virtual lab, virtual lab for psychology in 2002 [9], there has been a conflict and

contradiction for learning or online courses. In the study by Sloan in the field of online education in America in 2008, it is shown that more than 3.9 million students have passed at least one online course in the fall semester of 2007 in America which has increased 12 per cent compared to the same extent in the last year [10]. Virtual laboratory is an interactive environment for creating and conducting simulated experiments and plays an important role as a platform for experiments in teaching learning process. Research has shown that computer-based learning experience enables people to complete the simulation experiment in a real laboratory [11]. In fact this definition introduces the virtual lab as a supplement for the actual labs and notes its complementary role.

Although technology and virtual environments have not been developed as an educational methodology known as CBT or PB, but they have been widely used as a "teaching method" in various applications such as storytelling, using plays for educational purposes, personal training, health and community[12]. The previous researches suggest that virtual laboratories using imposing restrictions empower students to control their feelings at work and allow them to practice their abilities actively [13]. Rachford and colleagues reported in 1998 that the value of remote laboratories for some students is ambiguous [14]. In a Virtual Reality Lab in Pisa in Italy, PERCRO, there have been many integrated tests with this type of applications. These tests have been done in collaboration with some Italian museums to identify a series of educational games in the museum. In this regard, a study found that the use of this particular museum encourages students to play and see the museum [15]. Another significant experience in this method is CORAL method of online collaboration in education and research. In this study, two university students were involved in two different courses. Both groups worked using a variety of technological tools including discussion boards, video conferencing, facilities management, horoscope, calendar and online chat rooms (similar to a virtual environment). In this way, teachers of CORAL made questions during the training process to help the students. The students understood work experience and collaboration in a virtual environment thus teaching and training in groups of simulated real world were the most encouraging factors [16]. In another project, two classes at an elementary school in the town of Lucca, Italy were studied with the use of three-dimensional interactive video game about a story. In this course, students played different roles in the story and tried to improve their diction and their activities. In this experience, students were interested to hear their voice and see the roles that were played on the stage and it was the most important factor in learning [15]. In another experiment, NICE provides a persistent virtual garden. In this environment, students actively were dealt with plants and fruit trees, vegetables, greed and status light sources and effects of water on plant growth. And they could apply their own configuration and carry out their experiments on plants to see results. One of these tools is designed to teach a student is known as Kids Room. In this experiment, using images, lighting, sound and

computer vision technology, cognitive activities, student room has become a world based on a story. Various objects in the room are characterized as the students can change them and choose an activity to do with the story. Virtual games as well as industrial environments have developed applications that made use of Virtual Reality technologies. Virtual games are also used as some tools to simplify the examples of electronic games like Sims or World of Ware Craft. Some virtual gaming can be applied independently, using their own personal settings and other people can work and play as a team with other players [12]. Even virtual environments have created some benefits for training and researches in health. Many works in the health field have been done using the virtual environments. Such use of virtual labs and simulations of these processes have found a wonderful application. For example, in a work, the safety performance of students is taught in a virtual laboratory [17].

Many studies have examined the impact of technology on education and proved that some of these tools improve the level of knowledge, understanding, performance and motivation of the students in a group [12]. Furthermore, the effect of mutual interaction between teachers and students for improving the learning of students is evident today. Many scholars believe that interaction can improve barriers to teaching and learning with the active encouragement of students [18]. Thus, virtual laboratories have undeniable roles in the training process and are used in different educational institutions from primary to university levels.

III. INDIVIDUAL DIFFERENCES AND LEARNING METHODS

Approaches to student learning are so different such as rainbow colors and different personalities have different tastes. When teachers and parents are aware of these differences then they can crystallize the children's abilities. In a division, learning methods of students are presented as follows: verbal learners (verbal), who have sensitive sense of rhythm and musicality and storytelling, reading, poetry and enjoy writing creative texts. Logical learners who are looking for problem solving, reasoning, memory games and tests and like order and step by step instructions. Visual learners, who create visual patterns and fantasize, and enjoy the artistic talents, Musical learners who enjoy music, the sounds, rhythms and song. Physical learners who are interested in activity, touching, dancing and body language to express thoughts and feelings. Eccentric learners who are very social, good leaders and enjoy being in groups. Introverted learners who want to work independently and are able to know feelings, motivations and identify their creations [1, 2]. So we should provide a learning environment in which all students with different learning styles experiment their success. In order to teach students effectively and according to the new ideas of training and new needs of students, various methods have been introduced over time to raise any kind of creative students. Advances in technology also have significant impacts on learning patterns. According to the research from the heart of all these methods, those researches which have been established based on experiential

learning and research have lasting and productive effect [2, 19]. In fact this method will provoke creativity in students and gives them fun learning. In addition, each student will research with his training methods.

IV. PROPOSED MODEL

The approach presented in this paper chooses a method of teaching which has the flexibility to adapt to the learning needs instead of providing a virtual laboratory with the same group of disparate and different abilities. It should enable teachers to consider the education for students at low, intermediate and high levels, diversity of educational resources, teaching different times, allowing students to curriculum content and assessment in accordance with individual abilities in educational planning. In this method the main focus is on the feedback from students working in virtual laboratories in continuous interaction between the parents and the teachers. Because of the removing the restrictions of time and place in a virtual laboratory for a more accurate assessment of quality, it is better to consider performance feedback and feelings of students outside the learning environment and the home environment. In this interaction, the differences in student learning assessment should be checked and teachers should use the virtual lab to determine access levels for students. The previous studies lead us to this important issue that it is better to use Virtual Laboratory alongside the physical labs. In the proposed method, we believe that the presence of students at the beginning of the real laboratory work, before providing Virtual laboratory for them can be very useful on their perception of the virtual environment. In this way, we actually use real and virtual laboratories as a linkage in different time periods. In addition, teachers should be able to define a framework for students to set permissions in the virtual lab tools and install Laboratory modules consistent with the interests of students and their profiles.

The planning capability and regulating tests in virtual labs by teachers, give the opportunity to students who can experiment success with any level of knowledge. Here capabilities which are not the true natures of laboratories should be tested [14]. Teachers in an interaction with students study the feedback of students on their behavior in the time periods. This process continues dynamically until the end of the course. One advantage of this is that teachers can motivate the students and correct their false beliefs in virtual environments. So the sense of understanding, depict circumstances, beliefs led to improved interaction and interface for building virtual laboratories will be provided for students [14]. Rigby's study in 2003 has shown that the concerns which are not considered are effective on schools goals and their individual health [12]. Virtual laboratories due to the lack of spatial and temporal constraints, make more concerns in other environments outside of school Therefore, this method is also considered.

The use of sound, music and artistic expressions in the laboratory programs which are presented in the context of any particular test in the virtual laboratory are features that allow

students to present their ideas and their creativity to be blown spontaneous. In this way in virtual laboratories, digital technology for noise removal, painting, music and the others must be used as a new medium of communication and the impact of different emotional trigger should be created. Assigning different activities and interactive modes defined in the laboratory is also possible. Similar to a real virtual set, we can put lighting, cameras and other characters together and make an animation and convert it to the appropriate format, and then we can get it to work in the education and teaching [15]. However, before changing the level and adding capabilities and facilities for students, teachers evaluate the results of this work in constant interaction with parents. Designing a virtual laboratory for students should not simulate necessarily the real environment. Because of using different software environments and new tools and tests, we can design environments and experiments beyond the students' common conceptions. This creates a new intellectual challenge in students and supports their curiosity.

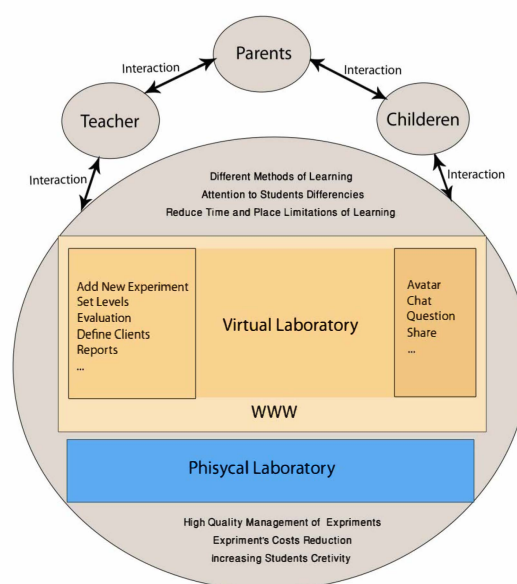


Figure No. 1. The combined model of virtual labs and physics labs (figure from the author)

Because those virtual laboratories which are not online, but are only presented as CD or DVD have fewer updates and Students cannot interact with each other and they have one-way interaction with the software in the virtual laboratory, so they have not the passion to make it work. In the proposed method, virtual labs were online and can be programmed from any location. Each of the students can express their own avatar in the virtual environment. They can determine their feelings by these avatars and the avatar can be used as an important factor in the evaluation. The proposed Model for training in this study is shown in Figure 1. As can be seen the teacher and the child's family interacted and the teacher assesses the child's performance at home with working in the virtual laboratory. There is close interaction between the child and the teacher in the context of integrated virtual and physical laboratories.



Shiraz University

Advantage of Virtual Laboratory System, Poland: Computational Methods In Science And Technology 15(1), pages 31-40.

Students' interests in computer games can be an important factor to be considered in the design and delivery of virtual laboratories. Some studies have suggested that virtual environments including virtual games should be used in education because it supports some rules. It covers individual building, feedback, active learning, and other discussions such as motivation, social relationships, knowledge and ability to assess [20]. This has some advantages including providing better visual mode, providing multiple frameworks for training, supporting active learning where students are driven training and finally a positive emotional reaction from those who use virtual game as an example of the use of virtual environments, [21]. Obviously people, who want to play PC games in the virtual world, are seeking more than just a game. They find some other gamers and an environment will be prepared for competition, cooperation, communication [22]. So enjoying the game in a virtual lab environment, specific capabilities of these can be used in the teaching and learning process.

V. FUTURE WORK

Despite the high cost, using virtual laboratory can have can have long-term favorable results and the use of a real lab, alongside them overlaps disadvantages and problems of the laboratory work. In the proposed model teachers interact with family of the child and assesses the child's performance at home with working in the virtual laboratory. There is close interaction between the child and the teacher in the context of integrated virtual and physical laboratories. This model due to the various features of student learning styles, the use of games, Teamwork facilities, determining the level of work with tools, using avatars and Other Benefits of virtual environments can grow and transform the learning process. In future work, the proposed model is implemented as a practical model for teaching a particular concept.

REFERENCES

- [1] Saif Ali Akbar. 2005. Educational Psychology, Psychology of Learning and Education, Tehran: Agah Publications, Fourteenth Edition.
- [2] Safavi, Aman Ullah. 2009. Methods of Teaching Technology, Tehran: Contemporary Publishing, 13th edition..
- [3] Chen, X. Zhang, Y. Kehinde, L. and Olowokere, D. 2010. Developing Virtual and Remote Undergraduate Laboratory for Engineering Technology. USA: American Society for Engineering Education.
- [4] Sternberg, R. J. and Zhang, L. F. 2000. Perspectives on cognitive, learning and thinking styles. NJ: Lawrence Erlbaum.
- [5] Popovici, D. M. and Marhan, A.M. 2008. Virtual Reality-Based Environments for Learning and Training. Romania: International Conference on Virtual Learning.
- [6] Selmer, A. Kraft, M. Moros, R. and Colton, C.K. 2007. Web labs in Chemical Engineering Education. UK: Trans IChemE, Part D, Volume 2.
- [7] Cambridge Online Dictionary. 2012. Virtual Reality (1) <http://dictionary.cambridge.org/dictionary/american-english/virtual-reality?q=virtual+reality> (available on 2012.03.09)
- [8] Handschuh, L. Lawenda, M. Stepniak, P. Figlerowicz, M. Stroiński, M. and Węglarz, J. 2009. New approach to Genomics Experiments Taking

- [9] Wikipedia, The Free Encyclopedia. 2012. Virtual Laboratory http://en.wikipedia.org/wiki/Virtual_Laboratory (available on 2012.02.17)
- [10] Allen, E. and Seaman, J. 2008. Staying the Course: Online Education in the United States, 2008. USA: The Sloan Consortium.
- [11] TermWiki. 2012. Virtual Laboratory http://www.termwiki.com/EN:virtual_laboratory (available on 2012.03.05)
- [12] Molka-Danielsen, J. Carter, B.W. and Creelman, A. 2009. Empathy in virtual learning environments. Int. J. Networking and Virtual Organizations, Vol. 6, No. 2, pp. 123-139.
- [13] Rezza, R.J. Sprague, C. Matkins, J.J. and McDonnough, J.T. 2007. Learning And Assessing Science Process Skills. USA: Kendall Hunt publishing company.
- [14] Ma, J. AND Nickerson, J.V. 2006. Hands-On, Simulated, and Remote Laboratories: A Comparative Literature Review, USA: ACM Computing Surveys, Vol. 38, No. 3, Article 7.
- [15] Evangelista, C. Neri, V. and Bergamasco, M. 2009. Interactive storytelling for children education. UK: Conference in Games and Virtual Worlds for Serious Applications, IEEE DOI 10.1109/VSGAMES. Pages 198-201.
- [16] (Ashcraft et al. 2008) Ashcraft, D. Treadwell, T. and Kumar, V.K. 2008. Collaborative Online Learning: A Constructivist Example, USA: MERLOT Journal of Online Learning and Teaching Vol. 4, No. 1.
- [17] (Schwebel et al. 2008) Schwebel, C.D. Gaines, J. and Severson, J. 2008. Validation of virtual reality as a tool to understand and prevent child pedestrian injury, USA: Accident Analysis and Prevention 40. 1394-1400, Elsevier Ltd. All rights reserved.
- [18] Jensen, N. Voigt, G.v. Nejd, W. and Olbrich, S. 2004. Development of a Virtual Laboratory System for Science Education, Germany: Interactive Multimedia Electronic Journal computer-enhanced Learning (IMEJ), Volume 6, Number 2, Wake Forest University, Hanover.
- [19] (Joyce and others 2005) Joyce, Bruce, Marshavyl, Emily Kalhvn. , 2005. New models of teaching.
- [20] Baer, L.L. 2005. The generation gap: bridging learners and educators. iDMAA: The International Digital Media and Arts Association Journal, Spring, Vol. 1, No. 3, pp.43-46.
- [21] Chen, J.C. 2006. The design, development and evaluation of a virtual reality based learning environment. Australia: Australasian Journal of Educational Technology, Vol. 22, No. 1, pp.39-63.
- [22] Ludlow, P. and Wallace, M. 2006. Only a Game: Online Worlds and the Virtual Journalist Who Knew Too Much. O'Reilly Media, ISBN-10: 0596101597, O'Reilly Press, p.7.