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The Impact of Virtual Lab Learning Experiences on 9th Grade Students' Achievement and Their Attitudes Towards Science and Learning by Virtual Lab

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ABSTRACT

Laboratories are important environments in science teaching. There is no doubt that the employment of technology in these environments may change the learning of science, especially as the technology has made its way into nearly every aspect of daily life. This study aimed to investigate the impact of using virtual labs on students' achievement and as well as their attitudes towards science and learning by virtual lab. Achievement pre and posttest and attitudes scale towards science were examined for 69 students divided into two control and experimental groups. Another attitude scale towards virtual labs was only administered to the experimental group. The results indicate that the virtual lab has no impact on students' academic achievement or their attitudes towards science. The results show that the students had overall positive attitudes toward learning by virtual lab. Some recommendations and suggestions are proposed to develop effective learning of science.

Keywords: Virtual Lab., Achievement, Attitudes.

INTRODUCTION

Laboratories are an important part of teaching science and achieving its objectives. They can be described as controlled conditions in which scientific experiments are carried out. Previous researches (Bretz, Fay, Bruck, & Towns, 2013, Bruck, Towns, & Bretz, 2010, Johnstone & Al-Shuaili, 2001) have been shown that there are many advantages of using labs in teaching science such as students' deep understanding of science concepts and correcting their misconceptions. In addition, it develops students' abilities in design, evaluation, and problem solving. Furthermore, science laboratory increases students' curiosity and positive attitudes toward science while nurturing communication skills between students. Laboratory activities can support meaningful learning by forming a link between the new information and

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the existing information, thus improving students' conceptual understanding of the material (Hakim, Liliasari, Kadarohman, & Syah, 2016).

The use of computers in education has increased dramatically in recent years and now computers and related technologies are in most schools all over the world (Dincer, 2015). There is no doubt that the use of information and communication technology (ICT) in classrooms has been increasing dramatically in science classrooms. This is not because the technology provides one way to help science teachers overcome obstacles of their teaching and improve the learning outcomes (Keller & Keller, 2005) only, but it goes beyond that to support the individual with different life skills. One of the recent advances in ICT is what is known as virtual lab, which is appeared besides the traditional laboratories. Virtual lab offers interesting possibilities for disseminating educational material to students (Fridman, 2014). Rajendran and Divya (2010) considered virtual labs as educational potential because they provide an opportunity to "learning by doing for everyone." Users can explore a variety of scenarios by changing the input and observing the effect on the output.

In the traditional laboratories students use hands-on to activate experiential ideas and engage with scientific phenomena in real conditions. This type of laboratory benefits students by incorporating concrete objects in science learning and give opportunities to interact directly with the scientific phenomena being studied (Lunetta, Hofstein, & Clough, 2007). It can be distinguished from the virtual laboratory in two ways;1) all the equipment required to perform the laboratory is physically set up; and 2) the students who perform the laboratory are physically present in the lab(Ma& Nickerson, 2006). There are some challenges that have limited the effectiveness of this type of laboratory and led to the emergence of other types of laboratories. These challenges including:1) only a limited number of tests and lab exercises can be undertaken in the time available with the limited resources,2) keeping students safe and secure while they are working in the practical experiments and 3) the materials and instruments that should be provided in these laboratories are highly costs.

The virtual laboratories facilitate the formation of conceptual models by several processes utilizing the benefits of technology. This type of laboratories centered on three basic phases including: 1) immersion that enables the student to experience the phenomena by themselves rather than teachers' eyes or textbooks. 2) Interaction, which allows the students to move from passive observers to active thinkers. Finally, 3)engagement where the learners control the computer to reach their targets in sophisticated ways (Trindade, Fiohais & Almida, 2002). Utilizing technology in virtual laboratories taking into account the containment of animations and interactive programs has remarkable effects in science learning. Several studies showed that interactive animations and computerized learning have been found an effective tool for enhancing conceptual understanding of different scientific concepts (Akpınar 2014; Karacop and Doymus 2013; Khan 2011; Kumar et al. 2011). Other advantages of virtual labs have been highlighted by previous researches. For example, this type of laboratory gives the students experience in planning an experiment and analyzing data, participating in a team, operating a pipette or microscope, and exercising any of the other practical and social skills essential for success in science. In addition, it may also be used to simulate complicated, expensive, and/or inaccessible devices (for example, a nuclear reactor) or to replace environmentally hazardous laboratory experiments (Kocijancic& O'Sullivan, 2004). It allows for free exploration and collecting/assembling items of apparatus. It also helps students to read information about the items of apparatus and about laboratory procedures (Dalgarno, Bishop & Bedgood, n.d). The students also will be able to carry out safe, rapid, and cost-efficiency experiments with minimization of error (El-Sabagh, 2010). Virtual laboratories can also be presented as a solution to distance learning because they offer to students the possibility to interact and practice the content and enrich way (Joao & Clara, 2007). In addition to that, virtual experiments enable students to experience an activity via images and data presented online sharing with large numbers of students (Gibbins & Perkin, 2013).

A review of several studies as presented below using virtual laboratories in different science classes indicated that they varied in their effectiveness (Hawkins & helps, 2013). Despite the positives points mentioned above, there are some drawbacks regarding the use of virtual laboratories. One of the criticisms of virtual laboratories is the fact that they do not teach laboratory techniques and manipulative skills well (Hawkins & Phelps, 2013). The experiment in the virtual lab does not exist in reality and therefore, the dangerous or unsafe for the real experiments do not exist. Because students do not work with real materials and equipment, they lack their responsibility, and carefulness towards them. Students in this type of laboratories feel like they are playing a video game, not in a learning situation (Potkonjak et al., 2016).

Baladoh, Elgamal & Abas (2017) conducted a study to investigate the effectiveness of virtual lab in improving students' understanding of concepts and their skills in handling electronic circuits. The experimental work was carried out in Mansoura vocational preparatory schools for hearing-impaired students in Egypt. The results clearly revealed the effectiveness of the virtual lab in improving students' achievement and practical skills with respect to handling electronic circuits.

Tuysuz (2010) stated that the use of virtual labs overcomes some of the problems faced in traditional laboratory applications and makes positive contributions in reaching the objectives of an educational system. The findings of his study in a unit of "Separation of Matter" for 9th grade students showed that virtual laboratory applications made positive effects on students' achievements and attitudes when compared to traditional teaching methods.

El-Sabagh (2010) illustrated that utilizing the virtual lab as a tool enhances understanding, improves operational skills, promotes learning interest, and inspires innovation. In his study, he compared the impact of a web-based virtual lab environment with traditional teaching method in relation to conceptual understanding and science process skills among 4th grade primary school by using an instructional design model of 3D animations and interactive experimental activities. Pretest results indicated that the entry-level for conceptual understanding in science and science process skills of both groups of students were equivalent. The findings of the posttest showed that students in the experimental group had significantly better performance in both conceptual understanding and science process skills.

Tatli and Ayas (2013) examined the effect of a virtual chemistry laboratory on 90 students' achievement from three different 9th grade classrooms divided into one experimental group and two control groups. Study data were gathered with pre and post chemical-changes unit achievement test, laboratory equipment test, and unstructured observations. It was concluded that the developed virtual chemistry laboratory software was at least as effective as the real laboratory, both in terms of student achievement in the unit and students' ability to recognize laboratory equipment. In their study, Borrero and Marquez (2012) investigated the effect of using virtual learning in teaching some engineering concepts. The study sample consisted of 10 teachers and 20 students chosen randomly. The results indicated that the views of teachers and students were similar, and that positive attitudes were developed using virtual learning to teach engineering concepts. In addition, the results showed that using virtual learning caused satisfaction and acceptance among teachers and students. The presence of the graphics interface and the ease of use and installation process were good elements to exist in such learning that made it preferable to users.

Redha's (2010) study aimed at investigating the effective use of virtual lab in teaching chemistry on students' development of scientific thinking. The study used quasi-experimental approach in which the sample was divided into two experimental groups and one control group. The results showed the effectiveness of the virtual lab in the development of scientific thinking which is varied according to lab type in favor of the enquiry-based virtual labs. Ahmad (2010) carried out a study entitled “the effect of using a virtual lab on the physics concepts achievement, acquisition of higher-order thinking skills and motivation toward science learning among students of the third preparatory class.” The researcher pursued a quasi-experimental approach with a sample consisted of 90 female students randomly selected from the 3rd preparatory class and equally distributed to two experimental and control groups. Achievement test in physics concepts and achievement test were used to measure the acquisition of higher-order thinking, along with a motivation scale towards science learning. In addition, multimedia software adopted by the Ministry of Education in teaching “sound and light” unit for the 3rd preparatory class was used. The results indicated statistically significant differences in favor of using the virtual lab. The study revealed the effectiveness of the virtual lab in the development of thinking skills in addition to raising the level of achievement in academic concepts. The results also demonstrated the impact of the virtual lab in increasing students’ motivation toward science learning.

Sahin (2006) highlighted that the appropriate use of multimedia in laboratories (computer simulation) offers a high degree of interaction and attractiveness. It also supports both constructivist learning and problem-solving skills and develops many science process skills including hypotheses, interpretation, and prediction. The study by Kerr et al. (2004) compared achievement among students instructed using hands-on chemistry labs versus those instructed using virtual chemistry labs. They found out that there were no significant differences in achievement gain scores for the traditional versus the virtual lab students. They commented that the findings obtained from their study demonstrated that students who completed the traditional, hands-on labs performed as well as students who completed the virtual labs.

In Omani context, Al-Balushi (2009) conducted a quasi-experimental approach study that aimed at investigating the effectiveness of chemistry virtual lab on the development of practical skills and achievement of students at the post basic education and their attitudes toward it. The results showed statistically significant differences between the mean scores of pre-posttests in the academic achievement in the experimental group in favor of the posttest. In addition, the results showed statistically significant differences between the mean scores of the experimental group and the control group in the improvement of the practical skills in favor of the experimental group. Statistical significant differences were also found between the mean scores of pre-post applications of the attitudinal scale toward chemistry virtual lab in the experimental group in favor of the post application. There was a positive attitude towards this type of labs among 11th grade students.

Al Balushi, Al-Musawi, Ambusaidi, & Al Hajri (2016) conducted a study to reveal the effectiveness of interacting with scientific animations in chemistry using mobile devices on the Omani 12th grade students’ spatial ability and scientific reasoning skills. A quasi-experimental design was used with an experimental group of 32 students and a control group of 28 students. The experimental group studied chemistry using mobile tablets that had a digital instructional package with different animation and simulations. A spatial ability test and a scientific reasoning test were administered to both groups before and after the study. The findings showed that there were significant statistical differences between the two groups in terms of spatial ability in favor of the experimental group and that there were no significant differences between the two groups in terms of reasoning ability.

This study was conducted to test the efficacy of virtual labs as a replacement for the hands-on laboratory normally used in science teaching, and to investigate the impact of virtual labs on the Omani students’ achievement and to report on their attitudes towards science and

learning by virtual lab. Therefore, the study is seeking to answer the follwoing research questions:
1. What is the impact of virtual lab learning experiences on the Omani 9th grade students' academic achievement?
2. What is the impact of virtual lab learning experiences in developing the Omani 9th grade students' attitudes toward science?
3. What is the impact of virtual lab learning experiences in developing the Omani 9th grade students' attitudes towards using virtual lab in learning science?

METHODS

a) The Study Group

The sample of the study consisted of 69 9th grade students selected from one Second Cycle Basic Education girls school (grades 5–10). All public schools in Oman with grades 5–12 are characterized as single-gendered and taught by the same gender teacher. The researchers selected this school intentionally because it was equipped with technological materials and resources required to conduct the experiment and its principal and science teacher expressed willingness to cooperate in applying the treatment for the experimental group. Two classes were selected from the school, with one serving as an experimental group and the second as a control group. The experimental group consisted of 34 students who studied science supported by virtual lab learning that was prepared by the researchers specifically for the purposes of this study. The control group consisted of 35 students who studied science through the conventional method of teaching (i.e. in normal science class.

b) Data Collection Tools

One test (achievement test) and two scales (attitude towards science and attitudes towards virtual lab) were developed and used to collect quantitative data. For both groups, the difference in students' knowledge levels and attitudes towards science before and after the study were measured, whereas attitudes toward virtual lab were measured after the treatment and only for the experimental group.

Academic Achievement Test

An academic achievement test was developed to measure participants' academic achievement. The test encompassed of 21 items: 8 multiple-choice items and 13 open-ended questions. To ensure that the test questions were fair for both groups, all questions were based on the science content existed in student textbooks. Panel of experts reviewed the test to check the validity of the achievement test. The panel checked the appropriateness of the test for the purpose of the study and its scientific accuracy, readability, alignment with the textbook content, appropriateness for 9th grade students. The panel also checked whether each item measured the assigned cognitive level. The panel suggested re-phrasing of some items and clarification of certain figures. The estimated test time was 40 minutes (approximately one lesson period). The test was administered to similar sample to test its reliability using internal consistency using Cronbach's Alpha, which was 0.83.

Attitude towards Science Scale

This scale was developed for measuring the attitudes of students toward science. It consisted of 35 items using five-point Likert type scale (strongly agree, agree, neutral, disagree, and strongly disagree). The followings are some items from the scale:

- I like to study science
- Studying science helps me to get a good job.

- I feel very comfortable when I study science.
- Studying science helps me understand issues of nature to better my life.

Validity of this scale was conducted by a panel of six reviewers specialized in curriculum and instruction and seven science supervisors working at the Ministry of Education. The panel was asked to verify that the five-point Likert type was appropriate for the purpose of the study and that the items were clear, readable, and accurate. Based on their feedback, the researchers rephrased some items. Reliability was calculated using Cronbach's Alpha, which was (0.75).

Attitude towards Virtual Labs Scale

This scale was developed to measure the attitudes of students toward virtual labs. It consisted of 38 items in its final version. The scale used a three-point Likert-type scale (agree neutral and disagree). The followings are some items from the scale:

- Using virtual lab develops my mental accuracy skills.
- Learning science through virtual lab is fun and interesting.
- Virtual lab focuses on observation, inquiry, and exploration that enhance my scientific knowledge.
- I like conducting practical experiments and procedural activities through virtual lab.
- Virtual lab provides me with new skills and practical development.

The validity of this scale was examined by a panel of eight reviewers specialized in curriculum and instruction and seven science supervisors working at the Ministry of Education. The panel members were asked to verify that the three-point Likert type was appropriate for the purpose of the study and that the items were clear, readable, and accurate. Based on their feedback, the researchers rephrased some items. Reliability was calculated using Cronbach's Alpha, which was (0.75).

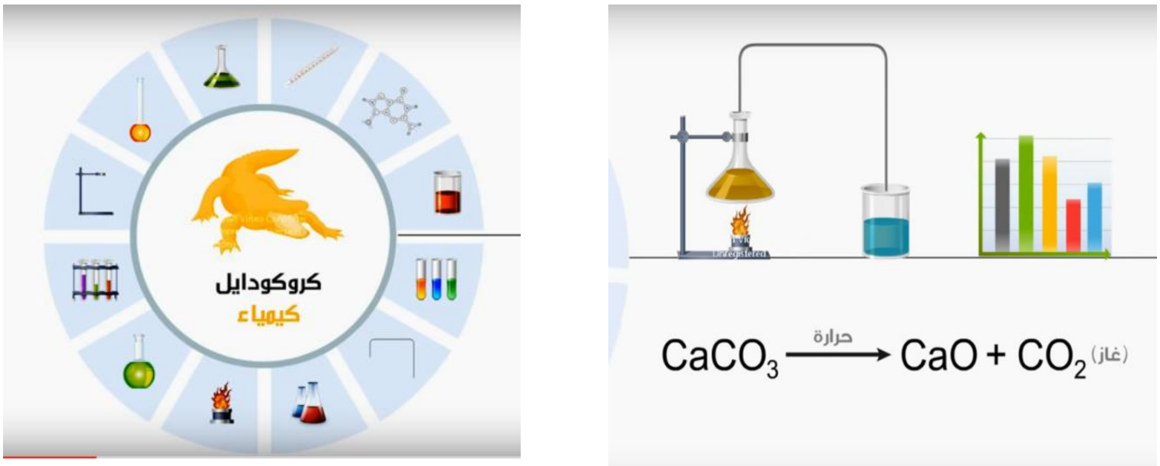
The Virtual Lab

Crocodile virtual lab, originated from academic work implemented on chemistry lessons with computer simulations, was used. It is a unique product in that it incorporates both an interactive simulation and a lab notebook workspace with separate areas for theory, procedures and student observations (Tatli & Ayas, 2013). Commonly used lab equipment and procedures were used to simulate the steps involved in performing an experiment. Users go through the actual lab procedure while interacting with animated equipment in a way that is similar to the real lab experience. This virtual lab also comes with a range of pre-designed lab experiments for general chemistry. Users can expand upon the original lab set by using virtual materials and equipment, thus allowing educators develop curriculum specific lab simulation (Alexiou, Bouras & Giannaka, 2001). These users designed simulations combine both text based instructions and the simulation into a single distributable file.

The researchers prepared the virtual lab learning to specifically serve the instructional purposes of this study by aligning it to the Omani science curricular content, modifying the instructional activities as described in student textbooks, and choosing Arabic modules as this is the language of instruction in Oman.

A panel of eight reviewers specialized in curriculum and instruction and seven science supervisors working at the Ministry of Education ensured the content validity of the lab. The panel members were asked to verify that the curricular content of the lab was appropriate and clear for the purpose of the study. Based on their feedback, the researchers made the required modifications. Figures 1 shows icons and implementation of the program.

Figure 1: *Sample of virtual lab program used in experimental group*



Focus Group

A focus group discussion was used to provide a natural setting in which students normally state and form their opinions about the virtual lab. Discussions took place during two sessions arranged for the experimental group only with 12 students selected as members of the focus groups. In each session of the two, three participants from those who scored high and three of those who scored low in achievement test.

A semi-structured protocol was used for every focus group discussion to make sure that differences between the groups were minimized and that the same procedures were followed in every discussion. The protocol consisted of two parts: the student opinions in science teaching, and benefits gained in science lessons during the experiment period.
At the beginning, the interviewer (the 4thauthor) welcomed the group members explained the purpose of the discussion and that the information collected would be used for research purposes only and assured the members that their identity would be kept anonymous. Participants were asked to discuss their opinion about the two parts of the above-mentioned protocol. They were asked to express their opinions and state whether the program helped them to learn science better. Each group discussion lasted between 1–2 hours.

C) Study Design

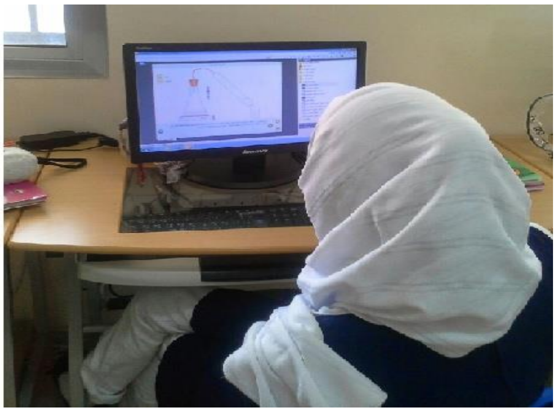
A quasi-experimental design was used in which the two groups were divided into a control and experimental group (Table 1). Pre and posttests were used for two instruments and a posttest was used the third one only.
Table (1): *The Research Design*

Pre- Test	Group	Instructional method	Post-Test
• Achievement Test • Attitude towards science Scale	Experimental	• Taught by Virtual experiments (Crocodile software)	• Attitude towards virtual labsScale
			• Achievement test • Attitude towards science
	Control	• Taught by Conventional method of instruction	

For the control group (with 33 students), the chemistry experiments were taught by using the conventional method (i.e. inside the classrooms as demonstrations and mostly by the teachers). Most of the experiments in this form of teaching carried out in the lab manually as mentioned in the textbook starting with the practical presentation by the teacher and the participating of students. The main role of the student was recording observations and results followed by discussion with the teacher and other students.

For the experimental group (with 35 students), the chemistry experiments were taught to students using Crocodile virtual lab. This software stimulates real laboratory where the students carried out chemistry experiments virtually. Each computer uploaded with a large number of readymade reactions. Animations provided to the software units in different languages. Arabic version used since the Arabic is the language of instruction for science subjects in public schools in Oman. The experiment lasted for 12 weeks, during two lessons per day. Each student in the experiment group worked in separate PC to view and interact with different animations related to different topics that belonged to the chapters in the 9th grade science textbook (Chemistry Unit). Figure 3 shows examples of students working in the experiments.

Figure 2. Sample of students working in the virtual lab program.



d) Data Analysis

The data collected in this study were analyzed using the SPSS statistical package. Means and standard deviations for achievement test and attitudes towards science were calculated before the treatment, and a t-test was used to determine if there is any significant difference between the two means for each test.

Group equivalence in pretest of academic achievement test and attitude towards science was calculated. Table (2) summarizes the results.

Table 2: *Pretest of academic achievement test and attitude towards science*

Variables	Experimental group		Control group		t-Test
	Mean	SD	Mean	SD	
Academic achievement	9.59	4.35	7.36	4.14	0.033*
Attitude towards science	2.46	0.32	2.36	0.393	0.238

* Significant at (α = 0.05)

Table (2) shows that there is a significant difference in the mean scores of pretest implementation of the achievement test between the two groups in favor of the experimental group (see Table 3 for details). However, there is no such difference in the attitudes towards the science test so that the two groups are equivalent in their attitudes towards science.

FINDINGS and DISCUSSION

Posttest for the Achievement Test

As shown above in Table (2), the pretest results of the achievement test showed significant difference between the control group and experimental group (t = 0.03< 0.05). Therefore, ANCOVA was used for the posttest of the Achievement Test in this case (Tables 3 and 4). All ANCOVA assumptions were met.

Table 3: *Posttest of the academic achievement*

Variable	Experimental group		Control group	
	M	SD	M	SD
Academic Achievement	12.79	5.68	13.74	4.46

Table 4: *ANCOVA results of achievement test*

Source	Sum of Squares	Df	Mean Square	F	Sig.	Eta Square
Corrected Model	865.667	2	432.833	32.058	.001	.493
Intercept	516.787	1	516.787	38.276	.001	0.367
Pretest	850.143	1	850.143	62.966	.001	0.488
Group	127.834	1	127.834	9.468	.003	0.125
Error	891.101	66	13.502			
Total	13917.000	69				
Corrected Total	1756.768	68				

Post- test for attitudes towards science and attitudes towards virtual lab Table (3) and (4) show that when the effect of the covariant in the dependent variable (pretest) was deleted, the variance resulting from the dependent variable was statistically significant (F = 0.03, α< 0.05). This means that in the achievement test there is a significant difference between the experimental and the control groups in favor of the control group. This result was in line with many previous studies (Kerr et. al, 2004; Akpan 2004; Rosenquist, Shavelson, &Araceli, 2000; Lee, Wong & Fung, 2010), which found that using virtual lab had no effect on students' achievement. There are many reasons behind this result. The important reason is that virtual laboratories do a poor job of acquiring students 'practical skills compared to traditional laboratories in which the teacher clearly outlines procedures and action steps. Students in traditional laboratories work with real materials and equipment, which allow them to acquire easily the practical skills. The only way to acquire scientific skills is often through actual hands-on experience which is not available in virtual laboratories (Potkonjak et al., 2016).

However, many studies related to virtual experiments, proved that students generally facilitated by virtual experiments and outperforms others in performance (Tuysuz, 2010; El-

Sabagh, 2010; Herga & Direvski, 2012; Siegel& Foster, 2001; Shegog et al., 2012; Baltzis & Koukias, 2009). These studies attribute this result to many benefits of the virtual lab. For example, virtual lab provides opportunities to students for self-learning and a chance for arranging time needed depending on their pace of learning. The virtual lab also may increase the understanding level of the scientific concepts faster than the traditional lab. Furthermore, using animation and simulation containing sounds and movement raise students' motivation in the laboratory activities and make chemistry learning more fun and interesting.

In order to find out if there was a significant difference between the two groups in the attitudes towards science, independent t-test was used (Table 5).

Table 5: *Posttest results of attitudes towards science scale*

Variable	Experimental group		Control group		t-Test
	M	SD	M	SD	
Attitude towards science	2.46	0.39	2.46	0.39	0.94

As it can be seen from table (5), there was no significant difference between the two groups in terms of students' attitudes toward science. Therefore, it is not obvious that teaching chemistry experiments using virtual lab is effective than traditional lab in developing students' attitudes towards science. This may be because laboratories usually motivate students to learn since that students interact positively while conducting experiments by using new tools and reaching exciting results in reality, which is weak in virtual experiments. Students' attitudes toward science along with the many factors affecting it, ranging from students' gender to the involvement of parents or guardians at home (Zangmo, Churngchow, Kanin, & Mophan, 2016). This finding was in line with Shegog et al. (2012) study results, while in opposition to Tuysuz (2010) study that found a positive impact of using virtual labs on science attitude.

For the attitudes towards virtual labs, the students' responses of each item in the three-rating scale were calculated and presented in Table (6).

Table 6: *Descriptive statistics of students' responses in the attitudes towards virtual labs post scale*

No. item	Items	Mean	SD
1	I would love to be an educational designer for the virtual lab in the future	2.18	0.75
2	I am not worrying that I will lose the information because of pressing the wrong button in the virtual lab program.	2.15	0.81
3	I like doing practical experiments through the virtual lab	2.05	0.62
4	I do not feel worried and scared when dealing with the virtual laboratory	1.97	0.61
5	I do not need the presence of a lab technician in conducting any experiment in the virtual lab	1.91	0.8
6	The virtual lab helps in developing my practical.	1.91	0.63
7	I do not feel the length of about the time I spend in conducting practical experiments and learning through the virtual lab	1.88	0.61

8	There is not difficulty in transferring the results and observations of my colleagues in the virtual lab.	1.83	0.67
9	The work in virtual lab is enjoyable	1.82	0.53
10	I trust my ability to conduct practical experiments by myself without a guide in the virtual lab.	1.80	0.92
11	I love writing reports of practical experiments and its equations in the virtual lab rather than in the traditional lab.	1.80	0.79
12	The virtual Lab made me love science, despite its difficulties	1.78	0.94
13	I do not fear to make mistakes when conducting experiments in the virtual lab.	1.71	0.86
14	Learning shapes, symbols and scientific equations became easy in the existence of the virtual lab	1.68	0.88
15	The virtual lab tools help me to evaluate my practical skills	1.66	0.91
16	I like conducting practical experiments and procedural activities through the virtual lab	1.63	0.43
17	I can follow in the progress in conducting of practical experiment and record my observation as my speed in learning	1.6	1.42
18	I like to practice on the basic skills of using tools and experiment materials before starting out in the virtual lab.	1.6	0.86
19	I feel happy while performing practical experiments through virtual lab rather than the traditional lab.	1.57	0.81
20	What I learn in the virtual lab integrates with what I learn in theoretical lessons.	1.57	0.87
21	The virtual lab helps me to organize thinking and expect the results more than the traditional lab.	1.55	0.79
22	I like the idea of having an integrated virtual lab within in the computer tablet.	1.54	0.83
23	I feel confident and responsible when I do practical experiments in the virtual lab.	1.51	0.83
24	I felt active and interactive learner in the virtual lab more than being the recipient of the information only	1.51	0.81
25	The Virtual lab helps me to form an accurate mental view of learning	1.49	0.81
26	The Virtual lab focuses on observation, inquiry and exploration that enhance my scientific knowledge	1.48	0.81
27	I like the form of the virtual lab and its design that includes interesting scientific materials and instruments	1.48	0.81
28	The virtual lab makes me feel safe and secure when dealing with dangerous lab materials and experiments.	1.47	0.75
29	I am sure of the availability of materials and tools that I need for the experiments in the virtual lab.	1.45	0.83
30	The virtual lab allows me to conduct any practical experiment without fear.	1.45	0.81
31	I like the idea of self-learning through the virtual lab	1.43	0.75

32	I feel free and interested in repeating the practical experiments until I am able to learn it	1.43	0.77
33	There are clear instructions to guide my activities in the virtual lab.	1.43	0.75
34	I like the diversity of activities and lab instruments in the virtual lab and accurate design and ease of use	1.42	0.77
35	I feel I can do well in the virtual lab.	1.42	0.75
36	I can conduct practical experiments and record my observations and results in a calm atmosphere when using virtual lab	1.41	0.7
37	The Virtual lab provides me with new skills and practical development	1.38	0.72
38	The virtual lab allows individual and collective work.	1.34	0.69
	Total Mean	1.63	0.24

The table above refers to the students' responses about Virtual Laboratory in descending order, where it was found that there were several items that shows positive impacts of using virtual lab. These items illustrate the features that made the students enjoyed and motivated while working with this kind of labs. For examples the highest mean value (2.18) was achieved in the item “I would love to be an educational designer for the virtual lab in the future.” Furthermore, both items “I am not worrying that I will lose the information as a result of pressing the wrong button in the virtual lab program” and “I like doing practical experiments through the virtual lab” also achieved high means (2.15, 2.05) respectively. This means that students relay on such program while studying science. In addition, it seems to be that students like much doing the practical experiments through the virtual lab. Students also indicated that there is no need to have a lab technician working with them while they are conducting any experiment in the virtual lab with mean value of (1.91) which shows that students owned confidence and responsibility during their practical experiences. Moreover, this type of lab can be cost effectiveness in terms of utilizing human resources (less needed of lab technician). Similarly, both items “trusting students’ ability to conduct practical experiments by themselves without a guide in the virtual lab” and “love writing reports of practical experiments and its equations in the virtual lab rather than in the traditional lab” with a mean of (1.80) confirmed the previous result, which indicate positive attitudes towards the virtual lab.

The items with a low means value are “The Virtual lab provides me with new skills and practical development” (1.38) and “The virtual lab allows individual and collective work” (1.34). Virtual labs from students’ point of view do not add a value to students" practical skills. This means that students are not gaining any skills that will develop their abilities to carry out the experiments. Virtual labs, from students' point of view, is the same as normal practical work, which can be done individually and collectively. This means that virtual lab has no unique thing that is weight more than normal lab work in term of the way of conducts it.

These results were supported by student's responses in the focus group discussion. For example, students stated that the virtual lab program was very comprehensive and contained many methods of delivering and explaining the information to students. “Graphs and chemical equations in this program make the learning much easier and more interesting.” Some students also connected their experience with a game or something they enjoyed doing, therefore it was a better choice for them. Backing it up we had one student saying, “Of course there was a positive impact of the virtual lab on my thinking. I felt that dealing with this type of lab like a game or puzzle, it is more fun and faster to get the idea. I felt that I was doing a real experiment regardless. I did not feel about the computer screen at all." Taking in account an individual learning time for each student was also another impact of the virtual lab. "In the virtual lab we can adjust the time during the working with the experiments and that cannot be done in the normal laboratory" one student replied.

However, some responses were not in favor of the virtual lab in which the mean of related items were less than the total mean. For example, students found that the ability of conduct practical experiments and record observations and results in a calm atmosphere when using virtual lab achieved mean of (1.41) only. Similarly, students respond on "virtual lab provides new skills and practical development" and "the virtual lab allows individual and collective work" were also low with means of (1.38, 1.34) respectively.

The results of students' attitudes towards virtual labs were consistent with many previous research findings (Borrero & Marquez 2012; Ketelhut, et al., 2010). Virtual environment overall and virtual laboratory in particular develop students' self-confidence and contribute to developing self-responsibility in their own learning. In addition, in this type of learning, students prepare materials and tools of the experiments, implement the steps, record their observations and make own conclusions without relying on the teacher. This is what has been generally concluded from the qualitative results related to focus group discussion. Students thought that the animations used in the program helped to them to better understand and remember the information. The integration between different stimuli (i.e. pictures, sounds and motions)make students to interact throughout the learning time. Furthermore, the richness of information provided and the opportunity to recall the previous information and linked them in an integrated template was another point that student highlighted very clearly. Finally, the ability of the program to take into account the individual differences between students and learning according to their abilities and potential. It's worth to mention that although there is no statistical impact of this program on students' achievement and their attitudes towards science, students seem to be very positive towards using their teachers the program in their science practical work lessons.

CONCULSIONS and SUGGESATIONS

In the current era, technology plays a major role in the development of different learning environments providing educational atmosphere that stimulate students and motive them for better learning. Therefore, active and meaningful learning conditions are likely to accomplish with virtual environments due to the development of virtual/computer tools nowadays. Although using the virtual lab did not show a positive impact on academic achievement but it has had a clear impact in raising their attitudes towards it. As mentioned in students' responds in focus group interviews, it decreases the level of abstractness that usually accompanies normal or traditional chemical labs works and helps the students to interact both with theoretical and practical knowledge. Hand on activities also is an inseparable part of the nature of science, and it is an interesting and important part of learning science because students in this type of activities working with real equipment. The only way to acquire these fine skills is often through actual hands-on experience (Potkonjak et al, 2016).

No doubt that the virtual lab provides opportunities of diversifying of activities and the use of various laboratory instruments in different experiments. The students have chances to carryout experiments including testing the cases, observing, and recording the results in a peaceful and safe environment. Despite that, this study showed that a virtual lab was just as good as the traditional laboratory at teaching concepts in chemistry. Thus, it is good to use a mixed system that involves a lab consisting of real (authentic, physical) equipment and virtual equipment, "co-present" at the same time (Potkonjak et al., 2016). Therefore, this study recommends more research needs to be done to determine virtual laboratories efficacy integrating with traditional hands-on laboratory. The research conducted in this filed should also go in depth and try to find out the factors that affect more students learning via virtual labs. More research should be conducted to explore more benefits of the virtual learning in science education and other subjects. For example, more research is needed to explore the impact of virtual environment in improving students' self-regulation and science process skills.

Some limitations may affect the results of this study. One limitation of current study was the relatively short time for the study. Although the study was implemented in 12 weeks, but the actual use of virtual lab was related to the presence of the practical experiment in the lesson or not. Further researches could consider the extension of the of the study longer period with higher chance of more practical experiments. Some students were also unfamiliar with the program despite their beginner-level training, which led them to be delayed in their performance compared to other students. It is thus important to consider the proper preparation of all students in any new program.

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