The Impact of Virtual Laboratories on Academic Achievement and Learning Motivation in the Students of Sudanese Secondary School

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Abstract

This study aimed to investigate the impact of virtual laboratories (V Labs) on academic achievement and Learning Motivation in the Students of Sudanese Secondary School in the subject of chemistry. The study followed a quasi-experimental method. The population consisted of second-grade students of Almutamaar school boys in Omdurman, the study sample was selected randomly totaling 54 students were divided randomly into two groups: 27 for experimental group and 27 for control group. The study used achievement pre & post tests, and Learning Motivation scale as tools for data collection.

The result showed that there were statistically significant differences at the level (0.05) between the mean scores of students of the experimental group (a group is taught by V Labs) and control group (a group is taught by conventional method) in the post test in favor of the experimental group, and there were statistically significant differences at the level (0.05) between the mean scores of pre and post test for the students of the experimental group in favor of the post test, and there were statistically significant differences at the level (0.05) in the Learning Motivation scale between the experimental group (taught by V Labs) and control group (taught by conventional method) for the favor of the experimental group too.

Key words: Virtual laboratories, Academic achievement, Learning, Motivation, Sudanese Secondary School.

INTRODUCTION

It is well known that Virtual reality offers a lot of possibilities and challenges. So, there is already some learning environments for drill and practice, some of them are used to train people in situations which are difficult or dangerous to generate in real life (explosions and
fires). Thus, virtual reality seeks to develop a learning environment in which users can develop and train higher order cognitive abilities such as critical, thinking and problem solving (Rothkrantz, 2009).

Laboratories applications are of significant importance in science teaching. Teaching through the laboratories is one of the basic characteristics of the teaching of science, whether in schools or in universities, so, the using of lab to conduct scientific experiments by students; the most important characteristic of the teaching of Science studies than the Humanities studies (Baraka, 2011).

Developments was contributed in the field of digital communications, tremendous advances in information technology such as the spread of computer networks, the World Wide Web and expand in the use and development of multimedia software and simulation programs to create a virtual laboratory (VLabs).

VLabs can be defined as a simulated interaction encompassing the contributions of technology innovations, instructional theories and individual human influences. VLabs have the benefit of increased safety, as there is no exposure to potentially harmful substances or apparatus, and decreased amount of time it takes to actually complete the laboratory assignment (Toth & Morrow, 2012). They are also necessary to run complex simulations of well-known theories which would otherwise be impossible to demonstrate (Singh, 2012).

LITERATURE REVIEW

Despite the importance of laboratory in teaching science as general and chemistry in particular, but there are some obstacles may inhibit using it as an effective technique in the Sudanese secondary schools, can be summarized as follow:

- In carrying out experiments and arranging with equipment.
- Checking students’ performance during the activities, that can be difficult in overcrowded classes. (The numbers of students in one class in some secondary schools in Sudan have up to 90 students).
- Lack of laboratories and equipment, or insufficient lab conditions which limits the teacher to perform a simple lab activity.

Therefore, use of Virtual laboratory (VLab) so as to overcome these obstacles and make positive contributions in reaching the aims of an instructional Sudanese system, and also overcome the possible dangers that can be seen in the real laboratory such as a dangerous, difficult or impossible experiments. (Rodrigues, 1997).
In particular, science teaching was greatly affected by technology in terms of the nature of the laboratories’ work, devices and media. VLabs simulate a real laboratory environment and processes, and are defined as learning environments in which students convert their theoretical knowledge into practical knowledge by conducting experiments (Woodfield, 2005).

According to Tatli, & Ayas (2013), VLabs is one of the solutions provided by instructional technology that is very important in chemistry teaching, also it provides students with meaningful virtual experiences and present important concepts, principles, and processes, by means of them, students have the opportunities of repeating any incorrect experiment or to deepen the intended experiences.

So the researcher means by the virtual laboratory in this study, is an electronic lab designed by computer, by British Crocodile chemistry that arabized by the Development Majd company, contains: videos, animations and graphics from which to simulate what happens from chemical experiments in a real lab, as it allows the teacher the learner conduct laboratories activities and dangerous and difficult experiences in a safe environment. Therefore, VLab according to Hatherly (2007) is one where the students interact with an experiment or activity which is intrinsically remote from the student or which has no immediate reality.

The philosophy of virtual labs (VL) depend on many principles, including the following: (Salem, 2009: 136) & Mahdi, 2008: 74 - 84)

- Exceeded the true reality: The VLabs were created as an alternative to reality due to the difficulty of access to it or to its gravity. For example, three-dimensional science virtual labs seeking to build the worlds from symbols; in order to simulate reality, or the establishment of worlds fantasy digital creature and multimedia which takes the learner to practice experiences that, difficult for him to do in the real his world, like a prowling the outer space or wandering around inside the nuclear reactor.

- Individual learning and learner freedom: as each learner depend on its self, according to his possessions from the preparations, capabilities and its needs from required variables, that are leading in terms of interest of learning more than instruction, and attention of training to produce knowledge rather than receive it.

- Continuity of instruction: by providing lifelong learning, which is an urgent necessity that can’t be dispensed under the dictates of the times of the new requirements and
variables, as it allows anyone to join him at the time that he deems appropriate to his circumstances; to develop acquaintances constantly in order to yield the best instructional outcomes and the cognitive best results, that lead to the formation of a learner who has ability to take responsibility.

- Remove the temporal and spatial barriers in the traditional instructional systems and to emphasize the continuity of lifelong learning, diversity of methods, means, and breadth of instruction for all.
- Reliance on computer technology; where the computer is used in the synthesis of sensory experience that makes the learner can’t distinguish between real and virtual experience.

**Objectives of the VLabs** (Bose, 2013).

- To provide remote-access to Labs in various disciplines of Science. These VLabs would cater to students at the undergraduate level, post graduate level as well as to scientific research.
- To enthuse students to conduct experiments by arousing their curiosity. This would help them in learning basic and advanced concepts through remote experimentation.
- To share costly equipment and resources, which are otherwise available to limited number of users due to constraints on time and geographical distances.
- To provide a complete Learning Management System around the VLabs where the students can avail the various tools for learning, including additional web-resources, video-lectures, animated Demonstrations and self-evaluation.
- In the related studies several addresses the use of virtual laboratories in science especially in chemistry education. For example, Josephsen & Kristensen (2006) investigated in their studies which aimed to elucidate undergraduate chemistry students’ response to the simulated lab computer-based learning environment, which simulates a 20 hours laboratory assignment. The main objective of their study was to increase the students' experience and knowledge of chemical reactions and the physical and chemical properties of common inorganic compounds. The results concluded that the students liked to work with this simulation program. They found it motivating, and they realized that it created a lot of experience, which they could be remembered more easily.
The study of Amin & Hafiz (2012) was aimed to investigate the effect of using the Virtual Laboratory in experiments physics and chemistry in the development of observation and cognitive achievement; researchers used experimental method for a sample of 35 students, as a result of study, there is no statistically significant differences between the experimental and control groups in the physics' cognitive achievement. There is statistically significant differences between the experimental and control groups in the chemistry' cognitive achievement for the favor of the experimental group. On the other hand, some other studies investigated the effect of the Virtual Laboratory on Students’ Achievement and Attitude in Chemistry for example Cengiz, (2010), the result of this study showed that virtual laboratory applications made positive effects on students’ achievements and attitudes when compared to traditional teaching methods.

**Motivation** is one of the important states that drive the students to learning behaviors. Thus, motivation to learn science at the Secondary School level is one of the most important predictors of science course success (Britner & Pajares 2006).

According to (Fredricks, & et.al, 2004; Reeve, 2006) Motivation is something that energizes, directs, and sustains behavior; it gets students moving, points them in a particular direction, and keeps them going. We often see students’ motivation reflected in personal investment and in cognitive, emotional, and behavioral engagement in school activities. From here, the educators seen to motivation as an instructional goal sought by any educational system, so many teachers seek to raise their students' motivation toward learning, using a variety of teaching methods (Noor Hadi, 2006). As if raising students’ motivation and guidance and generate certain concerns, they have make them to practice of cognitive, emotional and skill activities beyond the scope of the school, it is also a means used to achieve instructional goals.

Learning Intrinsic motivation refers to the learner internal case, which is rewarded by completing the task itself, whereas extrinsic motivation refers to performance of a task in order to receive an external reward (Ryan & Deci, 2000).

In academic cases, intrinsic motivation leads to deeper processing, greater mastery and best implementation of learning (Covington, 2000). Intrinsically motivated students are also more likely to persist with challenging tasks and other positive classroom behaviors as well as perform better academically than extrinsically motivated students who might have to been bribed before they perform the given tasks (Ryan & Deci, 2000; Walker & et al. 2006).
With respect to the previous related studies, mentioned to Olakanmi1,& et.al (2016) they study aimed to identify the impact of computer-assisted instruction in promoting intrinsic and extrinsic motivation among 90 senior students from three secondary schools in Minna, Niger state Nigeria. A pre-test and post-test experimental design was used during which students were randomly assigned into either the experimental groups or the control group. The experimental group 1 was taught two selected concepts of chemistry using a computer simulation instructional package; the experimental group 2 was exposed to computer tutorial instructional package, while a conventional teaching method was used for the control group. The result of this study revealed that students taught with computer simulation instructional package performed better than those in computer tutorial instructional package and conventional teaching method groups.

Kaufman & et al. (2008) investigated whether intrinsic and extrinsic motivation separately predicted students’ performance. A significant positive relationship between intrinsic motivation and students’ performance was found, and there was a negative relationship between extrinsic motivation and students’ performance. While Watson,& et al. (2004) ’study reviewed the impact of both intrinsic and extrinsic motivation on a specific college final course grade. They found that higher achievement levels of both motivation orientation variables positively correlated with higher course grades. While Garcia (1993) found both intrinsic and extrinsic motivation positively predicted final course grades in organic chemistry. In contrast, Yu (1999) found that intrinsic motivation negatively predicted course performance in college chemistry. Glynn, & et al. (2007) investigated the relationship between overall motivation to learn science and science performance. They concluded that students found science courses relevant to their careers, and both their motivation and science performance were higher.

As we are going to examine motivation more closely, we recognize that it is not always something that is added to the instructional situation. It can be something that comes from within us.

**OBJECTIVES OF STUDY**

Researcher seeks to achieve the following objectives:

- Identify the effectiveness of virtual labs on academic achievement in chemistry for the second-grade students at the secondary stage.
- Determine statistically significant differences in Learning motivation between the use of technique virtual labs and teaching by traditional method at the second-grade students at the secondary stage.

- Confirmation of the principle of individual learning by investing the abilities of secondary students to repeat the conduct laboratory chemistry experiments according to their self-speeds.

**QUESTIONS OF STUDY**

The study is guided by the following research questions:

1- Are there any statistically significant differences at the level (0.05) between the mean scores of the experimental group who taught by virtual labs and the control group who taught by traditional method) in the post test?

2- Are there any statistically significant differences at the level (0.05) between the mean scores of pre and post-test for the students of the experimental group?

3- Are there any statistically significant differences at the level (0.05) in the total relationship to the Learning Motivation scale between the experimental group taught by virtual laboratories and control group taught by control method?

**MATERIALS AND METHODS**

**STUDY DESIGN**

The study was adopted quasi-experimental method as one of the most accurate ways to get to the scientific facts enjoys with a high degree of validity and reliability. By this design the researcher, used pre-test/post-test control group, which is one of the quasi-experimental designs.

**SAMPLE AND STUDY GROUPS**

The sample for this study is 54 students selected randomly from Almutamaar secondary school boys in Omdurman locality, were divided randomly into two groups: The names of the students was recorded while performing the pre-test, then was taken names that are individual numbered as a first group, and that are marital numbered the second, then was chosen two students so as to conduct the lottery to choose names that represent the experimental or control group, the individual numbered represents the control group, while the marital number represents the experimental group, bringing the number of the experimental group students (27) students and the control group students (27 students).

**DATA COLLECTION INSTRUMENTS**
The instruments, which have been used in the collection of data included the following
1-achievement test aims to measure academic achievement in the teaching of chemistry after using the virtual lab' software, which obtained from technological education project in Sudan designed by the British Company Crocodile.

2- Learning Motivation scale.

**Achievement test:**
Achievement pre and post- test reference criterion was designed and its development after the reference to the literature of chemistry book for second grade of secondary stage, it contains lessons that wants to be applied to the experimental group. It has been verified the external validity, and then was determined the reliability coefficient through the test retest method, where it is applied on a pilot sample, then the reliability coefficient was calculated accordingly the equation of Pearson to calculate correlation coefficient, of (0.89 - 0.91) was obtained, which is an acceptable reliability coefficient.

**Learning Motivation scale.**
In order to complete the study requirements and achieve its objectives, the researcher used the Learning Motivation scale, which prepared by Khader and organized to suit the Sudanese environment for secondary school students; it has a high validity degree.

To ensure reliability and validity coefficients, the Learning Motivation scale was distrusted to the pilot sample and by Using the method Asbierman and Brown & alpha Cronbach respectively to determine the reliability coefficient of the final form of the scale, was (0.79) Accordingly, the coefficient of self-validity to be account, amounted (0.88), which is a suitable reliability and validity coefficients can be trusted. Then, to be in its final form consisting of (25) items (Appendix 1) and became valid for distribution.

**DATA ANALYSIS**
The SPSS 16.0 statistical analysis program was used to analyze the data. Where the use of t-test for comparison between the experimental and control groups in the pre and post test and of motivation scale degrees. To correct the scale items, given numerical grades for each item according to the five options (Likert type) it has identified the numbers 5, 4, 3, 2 and 1 respectively, so that gives (5) degrees to those who strongly agree and (4) degrees to those who agree and (3) degrees to those who do not know and (2) those who do not agree and (1) those who do not strongly agree in the case of positive items. In the case of negative statements given (5) those who do not strongly agree and (4) those who do not agree and (3) those who do not
know and (2) those who agree and (1) those who strongly agree. The respondent who obtained high marks indicates that to strength motivation, while respondent who is obtained low marks indicates to weakness motivation.

STUDY PROCEDURES
The study procedures were implemented according to the following:

1- Processing and preparing instructional software.
2- Taken the application approval from the school that has been selected.
3- Application the pre-test to ensure equality of the two groups, the result is presented in Table 1.
4- The study has been applied on the sample was selected during the period from January 7, 2016 until January 28, 2016. Where it has been teaching the experimental group (27) by using virtual labs the Halogens unit within the chemistry course to second grade of secondary in Sudan. While it has been teaching the control group (27) using the traditional method the same unit that taught the experimental group.
5- After the completion of the teaching of the two groups, the post-test was applied on the two groups in order to identify the implications of the differences between the averages of the experimental and control group, then applied the motivation scale on the two groups.
6- Analyses the data statistically, and extracting results.

FINDINGS AND DISCUSSION
As it is understood from the table 1, that there was no significant difference at level (0.05) between the average scores of students in the experimental and control group in academic achievement in the pre-test and therefore any differences was established among the group due to VL.

Table 1: The equalization of the two groups in pre-test

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>Df</th>
<th>t-value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>27</td>
<td>76.15</td>
<td>10.89</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>27</td>
<td>77.04</td>
<td>09.87</td>
<td>52</td>
<td>0.358</td>
<td>Not Significant</td>
</tr>
</tbody>
</table>
*Significant at the 0.05 level

Question 1: Are there any statistically significant differences at the level (0.05) between the mean scores of the experimental group who taught by virtual labs) and the control group who taught by conventional method) in the post- test.

Table 2 shows that a result of t- test for samples of the mean grades of the two groups in the post-test indicated statistically significant differences between the two groups.

**Table 2: Shows the result of t- test for grades experimental & control group students in the post-test**

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>Df</th>
<th>t- value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>27</td>
<td>22.22</td>
<td>3.61</td>
<td></td>
<td></td>
<td>Significant differences at level (0.05)</td>
</tr>
<tr>
<td>Control</td>
<td>27</td>
<td>16.66</td>
<td>4.42</td>
<td>52</td>
<td>5.34</td>
<td></td>
</tr>
</tbody>
</table>

As seen in table 2, that the value of t- calculated is greater than the value of t- tabulated at the significance level (0.05), which indicates the presence of significant differences between the mean scores of the experimental group students (who taught by virtual labs) and the control group students (who taught by conventional method) in the post-test in favor to the experimental group. Which confirms the superiority of the experimental group that taught by virtual labs to the control group, that taught by conventional method.

The researcher proposes that this result is due to the use of V Labs impact on academic achievement for the sample from of second-grade students of Almutamaar secondary school boys in Omdurman. Where the differences in favor of the experimental group, which is testimony to the effectiveness of virtual chemistry lab to increase the academic achievement of the students of the experimental group compared to the academic achievement of control group students.

On the other hand, it could be interpret this result on the basis of the contents of the virtual labs program of instructional activities linked to the student environment, to make it easier to understand and absorb, and the extent to which the availability of the program for the student...
to learn by self-speed, Which contributed to increasing the motivation of students toward learning, as well as the involvement of more than senses in the learning and the variety of stimuli, make the student an active and interactive, leading to the survival of the learning impact of the student; all of these factors combined and made available through virtual laboratories contributed to increased academic achievement among respondents.

Several studies have shown that VL effectively improve students achievement in Chemistry (Tatli, & Ayas, 2013). On the contrary a few studies shown that VL is not as much impact as real laboratory (Dalgarno, 2004).

These results indicate that students valued the ease of manipulation and experimentation within the VL more than the manual Lab that many chemistry educators assert is the integral component of a laboratory experience.

Question 2: Are there any statistically significant differences at the level (0.05) between the mean scores of pre and post-test for the students of the experimental group?

Table 3 shows that a result of t-tests between the mean scores of pre and post-test for the students of the experimental group.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>Df</th>
<th>t-value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>27</td>
<td>8.30</td>
<td>2.92</td>
<td>26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-test</td>
<td>27</td>
<td>23.11</td>
<td>1.79</td>
<td>26</td>
<td>6.30</td>
<td>Significant differences at level (0.05)</td>
</tr>
</tbody>
</table>

As shown in the table 3 above that the value of t-calculated is more than the t-tabulated at the significance level (0.05), where the mean average of the pre-test (8.30) and the post-test (23.11), that indicates the presence of significant differences for experimental group students in favor of the post-test. The existence of statistically significant differences in the level of
(0.05) between pre-test and post-test in favor of the post test, demonstrates clearly the effectiveness of virtual chemistry lab to increase the academic achievement of the students in the experimental group in post-test compared their achievement in the pre-test. This may be due to the possibility of covering all curriculum ideas with experiences an interactive process that is difficult to achieve through traditional Lab as a result of limited resources, space and time available. Also it perhaps due to synchronization between theoretical ideas and practical application provided by the virtual laboratory process.

In order to investigate the effectiveness of virtual lab on academic achievement, was determined the value of the square ETA (η²) (Impact size) for the results of the experimental and control groups of the scores post-test academic achievement.

Note that the effect size is measured as follows: Large: ≤ (0.8). Average: < (0.2) > (0.8) 
Small: ≥ (0.2) (Zahranı , 2010: 111). Table 4 shows the result.

**Table 4: Shows the result of Impact size (η²) for students’ scores in the experimental and control groups in the post-test.**

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>variance</th>
<th>Impact size (η²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>16.6</td>
<td>3.21</td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>23.1</td>
<td>4.44</td>
<td>2.30</td>
</tr>
</tbody>
</table>

On the result given on table 4 above, we find that the value of η² has reached (2.30) , according to the scale to measure the impact size, is considered high-impact, which confirms the effectiveness of virtual labs so that led to increased academic achievement for students of the second grade for secondary school.

This result also corroborates the finding of Tuysuz (2010) that teaching the chemistry topics by using virtual lab is more effective in students’ achievement and their attitudes towards chemistry compared to the traditional teaching method.

In this context, some researchers even argue that performing experiments within a virtual environment is more effective than performing experiments in real laboratories (Svec & Anderson, 1995; Kozma, et.al, 2000).
Concerning the effect size, it can be said that virtual laboratories software is important for all laboratory activities. In this context, many of the results of previous studies have indicated that virtual laboratories comparing with real ones are superior in terms of experiment materials and equipment and they lead to higher student performance. (Tatli, & Ayas, 2013; Gorghi, et al., 2009; Dalgarno, et al., 2009).

Question 3: Are there any statistically significant differences at the level (0.05) in the total relationship to the Learning Motivation scale between the experimental group taught by virtual laboratories and control group taught by control method?

Table 5 shows that a result of t-tests for samples of the mean grades of the two groups in the total relationship to the Learning Motivation scale.

**Table 5: Shows the result of t-test for grades experimental & control group students in the total relationship to the Learning Motivation scale**

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>Df</th>
<th>t-value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>27</td>
<td>34.16</td>
<td>1.43</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>27</td>
<td>26.90</td>
<td>2.75</td>
<td>52</td>
<td>4.46</td>
<td>Significant differences at level (0.05)</td>
</tr>
</tbody>
</table>

From the result on Table 5, it was very evident that the value of t-calculated is more than the value of t-tabulated at the significance level (0.05), which indicates that the presence of significant differences between the mean scores of the experimental group (who taught by using virtual labs) and the control group (who taught by using the conventional method) in the total relationship to the learning motivation scale in favor of the students who studying by using virtual labs technique.

This result can be interpreted on the basis that, teaching usage by virtual labs is a sort of prefer renewal for the students as something new and unfamiliar, it helped them to get out of the routine. Use of virtual labs may allow for students some kind of thrill so as to use of colors, sounds and animated shapes as the student interacts with instructional programming, live in an environment full of enthusiasm and diligence, while missing such enthusiasm and diligence in the traditional method. In addition to let the availability of time to conduct laboratory experiments at all times and from any location, With the possibility of an
experience as possible any number of times, according to the learner's ability to comprehend and at the suitable time for him, and without the presence of a human sergeant. In this context, the researcher may be attributed this to the fact that the virtual lab software would not allow students to progress to the end of an experiment without the correct data entered in his computer.

This result perhaps is attributable to what can be done by using virtual labs in the teaching of chemistry to urge students to inquire about all that is new, and give their opinions about what they have learned, and it allows the opportunity to expose the learner to positions that deprived from him in traditional labs due to gravity and thus integrate his information with respect to those positions, and that the use of the software in virtual labs to get the information quickly, increases the students cognitive outcome and motivation, thus constitutes a structure of knowledge assisted him on dialogue and discussion.

The result can also be interpreted in the light of a succinct description of the process followed in a typical virtual exercise that mentioned by Rothkrantz, (2009): There were always questions at the beginning, then they would go over the steps and procedure and review it, then you actually tried it, also you had a notebook on the side to record the data as you went along.

CONCLUSION

- It seems clear from the results of this study that the use of VL increased students’ achievement levels and made a positive impact on students’ attitudes towards chemistry.

- The presence of significant differences at the significance level between the mean scores of the experimental group who taught by using virtual labs) and the control group who studied using the conventional method) in the post-test and the learning motivation scale in favor to the experimental group, that clearly demonstrates what effect on students achievement can be caused by VLabs with experiment process. Also, it can be indicated that the material developed and used in this study increased the students’ achievement level and motivation by creating an entertaining learning environment.

- These findings indicated that VL software is important for laboratory activities, and that virtual chemistry laboratories are an effective as traditional laboratories. Previous studies comparing virtual laboratories with traditional ones also support the finding
that VLabs are superior in terms of experiment materials and equipment and they lead to secondary students performance. (Tatli & Ayas, 2013; Dalgarno et al., 2009; Gorghiu et al., 2009). This will provide not only an effective learning environment but will also minimize school expenditures and the time that secondary students spent in his school on such activities.

- However, In Sudanese secondary school some experiments can usually only be performed using a VL, for reasons such as a lack of laboratories, insufficient material and crowded classrooms. For these experiments, it is clear that virtual laboratories can provide students with the opportunity to develop themselves.

- At the end of present study, we have to be aware, to move from the traditional labs to use virtual ones as an innovative teaching and learning strategy to prepare learners to live and function in society that relies on technology at every aspect, as working in virtual chemistry lab and viewing simulations provide important ways of teaching chemistry. Therefore, it is necessity to activate the virtual laboratories in teaching in secondary school and seen as a technology that helps raise the level of students’ learning motivation, and urged the Ministry of Education to provide a central science VLabs to serve all schools in the region to overcome problems faced by teachers from a lack of real laboratories in many schools.

Acknowledgements

The researcher would like to thank and gratitude to the management of Almutamaar secondary school boys in Omdurman for approval to conduct the practical application of the study and provide all the facilities, moral and material support that helped to success the experiment.
References:


Appendix

**Learning Motivation scale.**

<table>
<thead>
<tr>
<th>N</th>
<th>Items</th>
<th>Totally Agree</th>
<th>Agree</th>
<th>I don't Know</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>It’s rarely to ask help from someone, when I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Have the ability to face study difficulties and overcome it.</td>
</tr>
<tr>
<td>3</td>
<td>It’s hard for me, and it’s hurting to obtain lower degree than I expected.</td>
</tr>
<tr>
<td>4</td>
<td>I got used to organize my times of reading since the beginning of my study life.</td>
</tr>
<tr>
<td>5</td>
<td>Working hard of effort and do my best in study to raise my family name.</td>
</tr>
<tr>
<td>6</td>
<td>I don’t compare my degrees to other students degrees.</td>
</tr>
<tr>
<td>7</td>
<td>I am serious in most of my life matters.</td>
</tr>
<tr>
<td>8</td>
<td>I’m enjoying the long time when I spend it with my friends.</td>
</tr>
<tr>
<td>9</td>
<td>I am not working hard of effort and do my best in study.</td>
</tr>
<tr>
<td>10</td>
<td>I continue in studying, in spite of my family problems.</td>
</tr>
<tr>
<td>11</td>
<td>I feel that I will not pass in many lessons.</td>
</tr>
<tr>
<td>12</td>
<td>My relationships with girls get me away from academic achievement.</td>
</tr>
<tr>
<td>13</td>
<td>I feel time is moving slowly in the classroom/</td>
</tr>
<tr>
<td>14</td>
<td>It hurt me, when the teachers didn’t get satisfied of my academic achievement</td>
</tr>
<tr>
<td>15</td>
<td>My family interested to follow my study.</td>
</tr>
<tr>
<td>16</td>
<td>For me, the sport and other activities are most important than study.</td>
</tr>
<tr>
<td>17</td>
<td>I feel comfort when suspension of the classes happening for some reasons.</td>
</tr>
<tr>
<td>18</td>
<td>When I obtain lower degrees I study hard to obtain higher degrees in the next exam.</td>
</tr>
<tr>
<td>19</td>
<td>My feeling for necessity and need of improving of myself, lead me toward seriousness and perseverance in studying the lessons.</td>
</tr>
<tr>
<td>20</td>
<td>It doesn’t matter to do my best and time as long as it will help me to reach success.</td>
</tr>
<tr>
<td>21</td>
<td>I feel the study is great responsibility I can’t</td>
</tr>
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</tr>
<tr>
<td>22</td>
<td>The liberal professions is better for me than continuing in the study.</td>
</tr>
<tr>
<td>23</td>
<td>I focus on the lessons demonstrations inside the classroom.</td>
</tr>
<tr>
<td>24</td>
<td>I argued and discuss the teacher about my degrees in their subject.</td>
</tr>
<tr>
<td>25</td>
<td>It’s boring, when I read from books and references.</td>
</tr>
</tbody>
</table>