Biology Teachers’ Perception of Laboratory Work in Afghanistan
A Survey Study of Secondary Schools in Kabul City

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ABSTRACT

This research is conducted for the purpose of identifying the approaches that secondary school teachers use to implement laboratory work in the subject of biology in secondary school of Afghanistan. A second aim is to identify the common barriers which might hinder teachers from implementing lab work. In order to achieve these aims a questionnaire was developed and distributed to 100 biology teachers from different schools in Kabul city in Afghanistan. The response rate was 79%. The collected data was analyzed by arranging the different items in separate categories and calculating the relative frequencies. The results were then interpreted by help of literature.

Lab work is a central activity in science education and if it is implemented in a coherent way it can enhance cognitive skills of the students. Also, the content knowledge cannot be taught effectively unless the learner is actively involved in the process, and practical work in the form of lab work can be one of the tools through which the learner is made an active part of the learning process, especially if it done through a so called inquiry style of lab work.

The findings shows that Afghan teachers consider the laboratory work an important inclusion of biology curriculum, but the way the teachers thought about implementing lab work follows a traditional *cook book style* and to low extent an inquiry style of teaching.

In comparison to past years a lot of changes have happened and a lot of facilities such as equipment, manuals for lab activities and lab material have paved the way for a better science education in Afghanistan. However, the results shows that teachers still face with problems like time shortage, low quality of material, and crowded classes that has to be dealt with in order to implement lab work in Afghan schools more successfully.
ACKNOWLEDGMENT

First of all I thank almighty Allah that helped me to reach this educational level and complete my research.

I want to thank Dr. Amir Mansory who attempted to hold this program and patiently guide us during courses as well as giving directions in process of thesis writing; also I am grateful to my supervisor Dr. Niklas Gericke who advises me in nice and humble manner. Many thanks go to Karlstad University and those teachers who participated in this program and we acquired all this knowledge from them.

I want to thank the authority in Center of Science and my friends who sincerely spent their time and helped me in this procedure as well as the teachers from different schools that filled the questionnaire and participated in this research.
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INTRODUCTION

For scientific subjects and particularly biology, it is very important that the teacher should, beside the lectures, implement practical work because the students learn and recall practical work faster than one-way communication as usually practiced in the lecture method.

According to Domin (1999), there are four main styles of laboratory work: expository, problem posing, discovery and inquiry. The result of experiment in first three styles is predetermined while in inquiry style, it is not determined. Instead in inquiry the students are responsible to create the procedure. The inquiry method is a constructivist approach that helps the students to be independent and construct their own knowledge. Each of the mentioned styles has their advantages as well as their critics which are discussed in following pages (Domin, 1999).

Center of Science in Kabul is responsible to support implementation of laboratory work in schools and has provided laboratory material for almost all the schools in Kabul and the provinces in Afghanistan; also they hold workshops to train the biology teachers in using the lab material. Their efforts have brought a lot of improvement, but still the question that needs to be answered is if and in what ways the lab material has been used and what lab work practices this introduction has induced. These are the questions addressed in this thesis.

Problem Area
It is very important to enhance the practical skills beside the lecture as it can facilitate the students’ learning of the deep concepts of the lesson as well as real implementation of the subject. In an Afghan context school curriculum has predetermined textbooks provided by the authorities that govern the enactment of the curricula in the classroom. The teacher teaches through these textbooks, which includes lab experiments that should be implemented after the teaching of theoretical parts. Also there are some guidebooks available for these laboratory experiments for teachers. Some laboratory experiments which are mentioned in biology textbooks are: test for indicating glucose in blood; identifying flower rings and drawing flower diagram; identifying starch by using iodine etc. Furthermore, it is not known for all of us and we experienced that the teachers manage the lesson plan by accommodating extra activities like dissection of kidney and heart.

Traditionally in Afghanistan most of the laboratory activities in schools follow the traditional *cook book recipe method*, which mean that the lab work offers predetermined procedure and results. As a result, laboratory work cannot provide satisfying cognitive improvement for the learner. Adjusting the laboratory teaching style with more constructivist inquiry and problem posed styles can change the cognitive demands of the learner from “applying” lower position skills and knowledge toward higher ranked skills and knowledge such as analysis, synthesis and evaluation according to the Bloom taxonomy (Bloom, 1956; Crowe et al. 2008) and give a chance for students to create the experiment, be critic and anticipate the results.

Aim/Objective:
The overall aim of this study is to investigate the influence of the Center of Science on lab works in the subject of biology in Kabul schools from grade 7 to grade 12. In what ways do biology teachers implement the laboratory material and what are their perceptions of laboratory work while teaching biology will be addressed as well as the perceived obstacles the teachers are confronted with.
Research Questions:
- In what ways do lab work were implemented according to the teachers?
- What is the perceived importance of lab work in the biology teacher’s point of view?
- Which obstacle do the biology teachers experience while implementing lab work?

LITERATURE REVIEW

Science is in its very nature tentative since knowledge is regarded as partial truth, and new knowledge is acquired through empirical observations and/or experiments. When moving from science into science education this way of acquiring knowledge is also an important ingredient in learning. By teaching those phenomena, which are common in daily life, through experiments and practical work, and by being engaged in solving the problem and discovery better results for the students can be achieved (Harlen, 1999). Practical work is one of the central parts of science education and seems to enhance students’ understanding of science when the learner is involved in laboratory activities (Hofstein & Lunetta, 1982; Tobin, 1990). Additionally, it gives chance to the learner to acquire laboratory skills such as knowing how to work with laboratory material and inquiry skills (Millar, 2004).

Definition and purpose of practical work and laboratory work
There is no unique definition of practical work, the classical definition of practical work stated by Lunetta et al. (2007) is: “…learning experiences in which students interact with materials or with secondary source of data to observe and understand the natural world.” (p.394)

US National Research Council (1996) states that scientific inquiry is those approaches through which scientists perform investigations based on documents and evidences to explain the natural phenomena. Inquiry is scientific activities done by students to construct their knowledge as well as finding out how the scientists do scientific research. Defining the practical work is confusing as there are different types of activities which come under the title of practical work. Wellington (1998, p. 12) says that there are at least six types of practical work: teacher demonstration; class practical’s, with all learners on similar tasks, working in small groups; a circus of ‘experiments’ with small groups engaged in different activities, rotating in a carousel; investigations, organized in one of the above two ways; and problem-solving activities. Another classification was suggested by Woolnough and Allsop (1985); they divided the practical work into three main categories: exercises, experiences and investigations.

Millar (2004) defines practical work as an educative activity in which the learner is busy with observation or manipulating an object or any other laboratory materials. He also suggested that the term ‘practical work’ should be used instead of ‘laboratory work’, although they have the same meaning, because activities such as scientific observation and manipulating do not need any determined location and can be done in any other place. However in this study I will mainly use the term laboratory work or lab work since it relates to the introduction of such specific materials in the schools.

According to Hodson (1996) the goal of science education is divided into three categories: learning science (the content), learning about science (or nature of science including epistemology and philosophy of science) and learning to do science (skills such as inquiry and problem solving and being engaged in implementing the science). Practical work belongs to the third category of
the science curricula and is a kind of hand on experience of science that promotes critical thinking about the world we live in.

The purpose of practical work is to help students to link the abstract, theoretical ideas with real phenomenon. In fact there are two domains of knowledge in teaching science, the world of observable objects and events and the world of theories including principles, parameters and models (Tiberghien, 2000). White (1996) claims that the deep understanding of the scientific facts are the main purpose of practical work while Woolnough (1991) and Pikering (1980; 1985) argue that the real purpose of the laboratory work is to foster the students as scientists to learn the science in a scientific way. They believe that the laboratory should be a place for innovative and critical thinking and free of limited instruction which was common in traditional teaching of laboratory work.

Millar (2008) claims that practical work can be used as a tool to fulfill the aim of giving freedom to the learner to think and act independently, as in inquiry based laboratory work the student is free to be in touch with natural word, create his/her own hypothesis and predict the result.

To practice how to find the problem and their solutions is another aim of the practical work. This aim is based on the steps of scientific investigation, which means that the students by doing laboratory work should practice to create hypothesis, collect data, doing experiment, analysis and make result and conclusion. In addition, practical work is used to improve the analytical ability of students as well as working in groups and practice cooperative work and achieving practical skills (Dillon, 2008).

**Learning theory and lab work**

Lab work includes both the observing of natural phenomena as well as the actual doing of lab work, and if the teaching is directed by constructive feedback from the teacher, the outcome usually is positive as Schunk (2012) claims. Learning can be achieved either vicariously or actively, the first happens through observing, the latter occurs when the learner is engaged in practical work by him/herself. In addition, White (1996) claims that practical work helps the students to recall the topic better and keep the knowledge in long term memory, also it facilitates deep understanding beyond the surface as well as critical thinking.

Piaget suggested four developmental stages for a child’s learning, and as the child grows up mental maturation happens parallel to biological maturation and the child become independent in acquisition the knowledge (Wood, 2004). Based on this perspective of child learning, scientists believe that different kinds of laboratory work should be introduced according to the age or period of education of students. For instance, for primary level simple and interesting visual experiments are recommended and for middle school scientific methods can be implemented to enhance understanding. However at high school students are less dependent on concrete examples, because of their mental development, and are therefore able to understand more abstract concepts and consequently more advanced scientific methods and inquiry should be the main aim for practical work in that age group (Lunetta, 1998; Hodson, 1993).

Ergül et al. (2011) suggest that the teacher first should find a suitable program for implementing scientific skills and then thereafter adapt this program with science curriculum because science follow steps and its knowledge and skills are organized based on a hierarchical sequence. In school students are usually asked to directly implement the experiments though s/he does not have basic lab skills. Therefore, the process of acquiring science skills should be followed step by step in order to avoid syllabus overload and problem with time shortage.
Styles of lab work
According to Domin (1999) there are four teaching approaches of laboratory work: traditional expository style; discovery, posing problem style, and open-end inquiry style. The expository style also has been called by other terms such as verification, traditional, cookbook or recipe style. Similar to expository method, the result or outcome of the experiment is pre-determined in both discovery, and problem based instructions, but usually it is only the instructor who knows the outcome, not the student. The procedure in problem based instruction is similar to expository method as both of them follow a deductive approach to reach the result while on the contrary it is inductive for discovery and inquiry styles, and based on gathering of data as a principle, or a hypothesis is generated.

Table 1: Description of the laboratory instruction styles (Source: Domin, 1999, p. 543).

<table>
<thead>
<tr>
<th>Lab Style</th>
<th>Outcome</th>
<th>Approach</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expository</td>
<td>Predetermine</td>
<td>Deductive</td>
<td>Given</td>
</tr>
<tr>
<td>Inquiry</td>
<td>Undetermined</td>
<td>Inductive</td>
<td>Student generated</td>
</tr>
<tr>
<td>Discovery</td>
<td>Predetermine</td>
<td>Inductive</td>
<td>Given</td>
</tr>
<tr>
<td>Problem based</td>
<td>Predetermine</td>
<td>Deductive</td>
<td>Student generated</td>
</tr>
</tbody>
</table>

Most commonly used laboratory style by school teachers is traditional (or verification) style in which the instructor explains the topic which is going to be investigated and link it with previous work, then the students just repeat the steps by imitating the teacher or follow the lab manual (Tamir, 1977). Lagowski (1990) says that the advantage of this style is to providing the opportunity for a large number of students to perform the same activity and saving resources such as time, instructors, place equipment and materials.

Since the procedure is predetermined for both the students and the teachers there is no chance for students to challenge the prediction of the outcome or interpreting the data (Pickering, 1987). The other critic is that the learner does not think about the scientific principles applied behind the lab work. Yet another critic is that the design of traditional lab work only stimulates lower level of cognitive skills (Novak & Gowin, 1984). Bloom (1966) stated that the learning steps can be categorized into six levels and accordingly knowledge, comprehension and applying are lower levels and on the contrary, analysis, synthesis and evaluation are higher levels of learning. Domain (1999) claims that based on satisfying any of each mentioned goal of learning, practical work can be categorized into any of Bloom’s cognitive levels, and his studies show that most of traditional laboratory works succeed only to promote lower levels learning according to the Bloom taxonomy.

Opposite to the ‘cook book style’ there is the (open ended) inquiry style in which the directions of the instructions is less provided and the student is more involved and responsible for creating the procedure, and to link the lab work with previous lessons or to theoretical parts. This method can be said to be similar to the scientific method that scientists use for their research and investigations (Domin, 1999). The critic about this style is its applicability since the expectations from the students in this approach are very high (Kohlberg & Giligan, 1971). The students should
learn content knowledge by using unfamiliar lab equipment and in the same time be challenged
with problem-solving (Linn, 1977), which could be more demanding then the students could cope
with. The main focus in inquiry is on the procedure of the work and less attention is on the content
to be learned (Hegarty-Hazel, 1990).

In discovery style, the procedure is predetermined and the instructor tries to direct the
students to find the desired outcome. This method has its own critics as well. For example, in
comparison to the expository method it takes more time (Johnstone & Al-Shuaiili, 2001), and
Hodson (1996) adds that it is a confusing procedure that sometimes leads to that the learner is not
“conceptually” ready to take in all this complexity. Furthermore, Domin (1999) criticizes that
when the procedure and the outcome are known by the instructor the process cannot be called
“discovery” any more.

Problem based lab work is a similar approach as inquiry. In this style of practical work the
opportunity for answering unsolved questions of the students becomes more available. In this
approach the student pose the question or his/her hypothesis and the teacher direct the students to
the right answer by giving instruction, also a written paper is prepared by the student for explaining
the hypothesis and the procedure used to reach the answers including the discussion and conclusion
(Domin, 1999). If expository method is compared with problem based style, expository method is
more successful in teaching the principles and skills as well as building stronger confidence of
students (Young et al., 1968).

In conclusion, the style of laboratory work should be adopted according to the learning
environment, sometimes the best way for some particular laboratory work is traditional style and
sometimes the highest learning outcome can be achieved when inquiry based is implemented.
There is no good or bad laboratory style but each kind of laboratory work can be effective
whenever it is used in its right place (Domin, 2006).

**Problems and obstacles of implementing lab work**

Teaching practical or lab work doesn’t necessarily mean a better education; instead the efforts
should improve the quality of lab work. Betterment of “practical and enquiry skills” might be the
right steps toward effective science education (Dillon, 2008). Similarly, Tobin (1990) claims that
although teachers believe that laboratory work is an essential activity for learning of students they
do not follow the appropriate manner to implement it. The most usual way to do practical work is
following the “cook book method” which does not motivates the students to be ready for thinking,
challenging and improvement of their “cognitive development”.

Traditional laboratory methods failed to introduce the nature of science accurately and as
a consequence of this failure students tend to accept science as a collection of facts to be
memorized rather than set of scientific principles confirmed by evidences (Burbules & Linn,
1991). Tobin (1990) characterizes such practical work as verification of scientific laws and finding
the knowable facts and the students collect the data without understanding the relation between
that information and understanding its deep meaning, consequently such cook book laboratory
work alone cannot be an appropriate method for learning.

Implementing investigative approaches can be problematic as well. This style of lab work
is hard to assess since the knowledge which is acquired through this approach is tacit and
measuring the result of the investigation is difficult. Furthermore, due to different reasons such as
time shortage, research errors and being novice the data can be inaccurate, or incomplete, and
therefore the students do not reach the desired result, and even if the data would be correct the
students have difficulties in interpreting and explaining them. Moreover, a second problem is that
the students rely on the teacher for the right answer and even with reaching wrong answer s/he knows the teacher will make it correct (Miller, 2004).

Lack of resources such as materials, time and space are among other difficulties which hinders successful implementation of laboratory work (Tobin, 1990).

METHODS

This research has been done using a quantitative strategy. The research design is based on a survey aimed for finding out the perception of teachers regarding practical work including the purpose and styles of lab work as well as the barriers for implementing it in schools. The instrument used in this research is a questionnaire which was translated in Dari before distribution and consists of both open and closed questions also, the questions in questionnaire is categorized into three parts
based on my research question and each question is created to meet the response to the related research question.

A permission paper was taken from ministry of education, and then it was ratified further by Kabul city directorate of education to be officially permitted to conduct the research in schools of Kabul. The Research sample was taken from Kabul city because in comparison to other cities of Afghanistan, Kabul has more rich labs due to the nearby Center of Science. Laboratory materials and equipment have been distributed in most of the schools in Kabul and the other facilities such as seminars and workshops have been presented for the teachers.

In pre study several interviews were conducted with authorities in the Center of Science in Kabul (who distributes and gives support to schools for enhancing laboratory works) as well as with biology school teachers in order to find out their perceptions of laboratory work. These preliminary findings, as well as the presented literature about lab works, formed then the base for most of the categories in the questionnaire. The items in the questionnaire were then formulated based on these categories. After completion of the questionnaire and improvement from my supervisor I distributed 7 questionnaires among biology teacher of two secondary schools in a second pilot in order to validate the instrument. Based on the response from the teachers in the second pilot I changed the formulation of several questions in my questionnaire in order to make them language wise more understandable for secondary biology teachers. The questionnaire is available in the Appendix of this thesis.

The data collection took place in September 2014. The respondents were biology teachers who are teaching in different secondary schools of Kabul from grade 7 to 12. This cohort was chosen because my own university field is biology and I can use my background knowledge for biology laboratories. Also in Afghanistan educational curriculum, biology from grade 7 is separated from general science and is taught as a separate subject. Additionally, inquiry based lab work is more possible to be implemented for secondary level than primary level and makes therefore this school level more appropriate for this study.

Kabul city is divided into 17 districts and I chose at least two schools in each district and distributed overall 5 questionnaires in each district. I distributed 100 questionnaires and I got response from 79, i.e. a response rate of 79 %. Among the respondents there were 58 female and 21 male teachers who participated in this study.

There were several colleagues who helped me in the data collection and most of them have studied science, i.e. they have insights about lab works. I believe that my colleagues were suitable for this task of data collection and did not interfere with the outcomes when they are knowledgeable about laboratory and its aims. The colleagues were instructed to answer clarification questions regarding the questions and not influence the respondents in any direction about how to answer the questionnaire. So I selected those colleagues in the data collection process as co-workers so that the teachers, who filled in the questionnaire, could get answers to clarification questions while filling in the questionnaire.

The data after compilation was arranged in excel sheets and in organized tables, and after that it was analyzed.

**LIMITATIONS**

I distributed 100 questionnaires in different schools, and the response rate of 79 % is good. In the opened-ended question (number 18) I asked for the respondents comments but only 14 teachers
commented. The rest of the participants did not give any comments. Therefore I do not know much about the teachers’ experiences besides their answers to the closed questions. I think the use of an observation tool would be useful to complement my results, such a tool could provide more deep understanding of implementing laboratory work, but due to shortage of time I could not observe the procedure of laboratory work by teachers. However since I did pre study interviews from which the questions in the questionnaire were constructed the questions in that sense are validated as relevant. Also the questions are based on relevant literature.

In my study it was also problematic to get access to equipment such as printers, but perhaps the main limitation of my study is also the limited number of participating teachers and their narrow geographical distribution to Kabul City.

To consider the honesty and authenticity of the study, I think the teachers responded honestly because I explained the aim of the study and further usage of this research for improving the laboratory work in schools in Afghanistan.

Regarding to the generalization, as the nature of my research is survey; it can be generalized only for Kabul city in conditions that the current situation remains the same.

FINDINGS

Facilities and equipments

Table 2 shows the laboratory equipment and facilities for practical teaching in schools. Most of the schools have a laboratory and a lab technician, but a high percentage of the teachers believed that the material and equipment is not enough for teaching biology and about half of the teachers who participated in this research said that the materials are not of good enough standard and not adopted
for teaching. However, about half of the teachers had participated in laboratory seminars held by different organizations.

In table 2 the frequencies of answers are shown for questions 3 and 5-8 in the questionnaire (see Appendix).

**Table 2: Equipment and support for lab work**

<table>
<thead>
<tr>
<th>Yes(%)</th>
<th>53</th>
<th>85</th>
<th>59</th>
<th>53</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>No (%)</td>
<td>47</td>
<td>15</td>
<td>41</td>
<td>47</td>
<td>64</td>
</tr>
</tbody>
</table>

Figure 1 illustrates to what extent the teachers are familiar with the lab works described in their biology textbooks. Generally, the teachers who participated in lab seminar/workshops are more familiar about their knowledge in practical work in comparison to those who did not take such seminars. More than half of the trained teachers stated that their knowledge is adequate for their practical lab teaching, but only 17% of the teachers claimed that they implement the practical work an excellent way. On the other side, less than half of the untrained teachers said that they have adequate information in laboratory works and 20% of them said they had serious problem in lab work.

**Figure 1: Comparing of lab use by trained and not trained teachers**

The above bar chart shows in what ways teachers are familiar with the prescribed lab works in their textbooks, i.e. the frequency of answers to question 9 in the questionnaire (see Appendix).
Importance of lab work from teachers’ perspective

Table 3 shows Afghan teachers’ perceptions about the importance of laboratory work. In this table, almost all the teachers believed that laboratory work has positive effect on students’ learning, while a very small percentage of them stated that lab work has no role in the learning of the students. Also, a high percentage of the teachers found that the lab work is an essential factor for enhancing learning and again a very small percentage of them believed that doing lab is not very important.

<table>
<thead>
<tr>
<th>Teacher perception of relationship between the laboratory work and students’ learning (%)</th>
<th>For enhancing students’ learning, do you think doing laboratory is (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>implementing laboratory work can improve learning</td>
<td>98</td>
</tr>
<tr>
<td>implementing laboratory work has no effect on learning</td>
<td>2</td>
</tr>
<tr>
<td>implementing laboratory work negatively effects learning</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>unnecessary</td>
</tr>
</tbody>
</table>

Table 4 presents information about the purpose of the laboratory work from the view of Afghan biology teachers. Most teachers stated that the purpose of the laboratory work is to implement the content knowledge while they to a lesser degree believed that the purpose of the lab is to learn lab skills.

Table 4 shows teachers’ perceptions of the purpose of lab work according to the results from question 16 in the questionnaire (see Appendix).

<table>
<thead>
<tr>
<th>Teachers perception of purpose of lab work</th>
</tr>
</thead>
<tbody>
<tr>
<td>strongly agree %</td>
</tr>
<tr>
<td>The purpose of laboratory work is to implement the content knowledge from the lecture</td>
</tr>
<tr>
<td>The purpose of laboratory work is to improve laboratory skills</td>
</tr>
</tbody>
</table>

**Implementation**

Table 5 shows the way Afghan biology teachers implement laboratory work and the procedure they follow. All the teachers use a prescribed laboratory manual and do not give the students any chance to create or influence the work procedure during the lab work. Consequently, the approach which they follow mostly is based on a predetermined experiment in a lab manual and by their direct demonstration. There is a difference in using IT presentation since young teacher are more
interested in using computers in comparison to the experienced teachers. The difference of clearness of outcome is not so tangible between experienced and new teachers and both of them prefer to high extend a clear outcome for both the student and the teacher and only few biology teachers think that the outcome should be clear only for the teacher while no one select the unclear outcome.

Additionally, these methods and approaches verify cook book method which according to the data, for both the trained and untrained teachers were almost the same.

**Table 5: Teachers implement implementation modes of laboratory work**

<table>
<thead>
<tr>
<th>Type of lab work</th>
<th>Teaching approach</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearness outcome for both student and teacher (%)</td>
<td>By using a prescribed lab manual %</td>
<td>Prescribed lab manual %</td>
</tr>
<tr>
<td></td>
<td>78</td>
<td>56</td>
</tr>
<tr>
<td>Outcome is clear only for teacher %</td>
<td>By direct instruction/demonstration %</td>
<td>Created by student %</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>30</td>
</tr>
<tr>
<td>The outcome is unclear %</td>
<td>IT presentation %</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>14</td>
</tr>
</tbody>
</table>

Table 6 illustrates the ways the teachers assess their laboratory work. In this table, the mean for work experience of the respondents was counted 5 years so, new and old teachers were separated based on the counted mean. The most common ways of assessment for both experienced and new teachers were direct observation and orally by asking questions to the students during laboratory work. While, assessing the lab reports got less percentage and giving marks comes in lowest rank, probably because there is no special place for laboratory mark in midterm and final exams.

If the two categories of the teachers, new respectively experienced, is compared regarding giving marks for lab work, new teachers are more interested to assess the practical work by giving marks than experienced teachers.

This table shows result of teacher’s answer to the way of assessing lab work that corresponds to question 15 in the questionnaire (See appendix).

**Table 6: ways of assessment of lab work and teaching experiences**

<table>
<thead>
<tr>
<th>Option</th>
<th>Teachers with &lt;5 years work experience (%)</th>
<th>Teachers with 5&lt; years work experience (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marks of practical work</td>
<td>12</td>
<td>6</td>
</tr>
</tbody>
</table>
Time shortage, crowded classes and inexpert teachers are the most common problem for laboratory work according to the teachers (see figure 2). Around 40 percent of the teachers claimed the quality of materials is low and the expected result does not take place. However the textbooks and their content of practical work seem less problematic, although there were some complain about the book content and its balance as the teachers claimed that number of laboratory works in text book is not in balance keeping the large number of theoretical lessons in mind.
Figure 2: Problems of lab work

This figure shows the results of answers to question 17 in the questionnaire about the problems which teacher face in implementing laboratory work (See appendix).

Table 7 shows other problems teachers face in teaching practical work extracted and categorized from the open-ended question. Unfortunately, a few teachers responded to this question (14 teachers and some of them mentioned more than one barrier), but the findings of this question were interesting. Most of the teachers had problem in finding extra material from environment for example, one of the female teachers said that for implementing experiment of worm of human liver (Faciola hepatica) she had to search a lot of the butcheries in Kabul for liver of infected animals with this worm, similarly the another teacher said that she teaches botany and accidentally the chapters of the textbook related to systematic of the plants (especially flower) is
planned to be taught in a season which flowers and most of monocotyledon plants are very hard to find.

About 30 percent of the teachers emphasized the problem of a mismatch between the high demands of the curriculum in comparison to the current low level of the students’ knowledge levels. A few percentages believed that there should be more cooperation with the school office for implementing laboratory work, for instance one of the teachers complained that the manager of their school is more interested in implementing theoretical lessons and deny teachers to participate in laboratory seminars as provided from different organizations.

However, there are also some good examples of inquiry style teaching. A lab technician from an investigated high school claimed that he implement the botany and systematic practical work and said that he shows parts of the plant and flower diagram in one plant and the students are then responsible for implementing a problem posed approach for identifying the other parts of the plants while drawing flower diagram. He also said that students follow a discovery approach to collect samples of different plants in Kabul and make a herbarium which is kept in the laboratory of the school.

The table below presents the frequency of categories identified in the answers to the open-ended question regarding the teachers’ perceptions of barriers for implementing lab works in school, i.e. question 18 in the questionnaire (see appendix).

**Table 7: problems of implementing lab work according to teachers**

<table>
<thead>
<tr>
<th>problem and barriers</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>lack of cooperation from office</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>problem in finding environmental materials</td>
<td>11</td>
<td>65</td>
</tr>
<tr>
<td>low level of the students</td>
<td>5</td>
<td>29</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>100</td>
</tr>
</tbody>
</table>
DISCUSSION

There are many reasons to include lab work in the curriculum of the schools. Shulman and Tamir (1973) suggested three main reasons for using lab in science teaching; the first reason is that theoretical lessons are abstract and hard to understand and lab work can facilitate theoretical understanding. Secondly, lab work is important for learners to acquire laboratory skills and finally, the learner considers the practical work intrinsically interesting. The finding in this research shows that Afghan teacher find laboratory work as an important part of the lesson. However, regarding the teachers’ perceptions of what could be achieved from laboratory work, the teachers believed that the main purpose of the practical work is to apply and implement the theoretical knowledge presented in lectures and work with this body of knowledge in a practical way, and only some of the teachers believed that practical work is a practice for developing laboratory skills. Similarly, the research mentioned by Dillon (2008) showed that teaching lab skills can be a purpose of lab work, but teaching scientific concept was less emphasized by the respondents as an aim of lab work.

Almost half of the participants in this study were trained through seminars or workshops held by different organizations, which among them Center of Science in Kabul has held a lot of workshops. As figure 1 shows trained teachers were more confident about their knowledge in laboratory work in comparison to untrained teachers, but the nature of these workshops, their aim and the style of laboratory work followed by them again is more of the “cookbook method” as there is almost no difference between the approaches that the teachers use (independent of they have taken the courses or not) while implement the lab work. Maybe the workshops should adapt their program toward more constructivist approaches like inquiry and problem based styles.

The last research question relating to the barriers and obstacles, most of the teachers mentioned the need for more workshops. The teachers should have deep understanding of the different lab work styles so that they can implement it in a purposeful way and in its right place and time. Lunetta (1998) believes that unsuitable educational lab style and not applying new lab activity approaches wastes time of the class and the desired outcome cannot be achieved. Similarly, Tobin (1990) stated that lack of familiarity of the teachers and laboratory technicians with correct implementation of laboratory activities is among the most crucial problems in science education, for solving this problem Tobin suggests that besides training the teachers, guide books for inquiry skills should be written for teachers of different science fields, and this could be a way forward to implement these lab work styles also in Afghan schools.

Many biology teacher shad complaint about the high number of students in one class and consequently the teacher cannot respond to all the students’ and give individual feedback.

Gwimbi and Monk (2003) said that crowded classes hinders implementation of lab work also Ozturk (2003) says that in overcrowded classroom the opportunity to access lab material is not the same for all the students and the teacher feels constrained and under pressure to implement the heavy curriculum.

Also a main barrier in implementing laboratory work cited by teachers was time shortage. As Tobin (1987) stated time shortage is a main reason for teacher to feel constrained to implement a heavy syllabus and as a result the teacher cannot implement the task effectively and as a consequence there is less chance for students to state their ideas and practice lab work.

Obstacles such as time shortage, overcrowded classes and inadequate material force the teacher to follow traditional style of laboratory work, i.e. the “cook book style”. Most of the time the teachers do the experiment and simultaneously, s/he gives a lecture in the same time, the role
of the learner remains just the observer. For example one of the teachers said that for anatomy of heart or kidney or any other animal, he performs the dissection and the students watch the process and write notes and draw simple diagrams, but most of the time there is no opportunity for the students do the dissection by them.

Almost all of the schools in Kabul have received laboratory materials for practical work but teachers complain that these materials are not enough and cannot respond to the needs of their lab work. Additionally, the quality of materials is low. For example, one of the teachers stated that the chemical solutions for blood tests (blood grouping) do not give the expected result.

The style used by the teachers is widely the cook book approaches as all the teachers prefer the clear and predetermined outcome for their laboratory outcome and they do not ask the students to create the procedure and instead they use a prescribed manual. One of the staff members of Center of Science said during the pilot interview that most of the school laboratories in Kabul are equipped with microscopes but usually it is used for showing microscopic samples mentioned in manuals, which again verifies that the recipe method is most commonly used.

According to my experience and also confirmed in this study inquiry based approach is very rare and just some occasional schools implement some projects in this way.

CONCLUSION

Practical work is an important part of science education and paves the way for the student to construct knowledge. Acquiring lab skills is an exercise for doing science in scientific way as scientists conduct their researches. Within practical work the learner actively is involved in the process and as a result the produced knowledge is stored permanently in the memory of the learner and additionally it motivates critical and innovative thinking (Millar, 2004). Also, lab work fosters active learning and acquiring skills which help the learner in daily life(White, 1996).

In conclusion, the finding of this research shows that Biology teachers in Kabul city to a varied extent use all four styles of laboratory work, however, the traditional approach is the most dominant way of implementing the practical work in schools studied in this study. Since the curriculum in Afghanistan is fixed and textbooks are the main guiding for teachers’ work in classrooms and the same textbooks are used in Kabul and all the provinces, the findings of this study can be generalized to a high extent and be applicable for other parts of the country as well. However in other parts of the country, in addition to the problems in Kabul city, lack of resources such as experienced teachers, equipment and security issues might be additional problems of implementing laboratory work to be even greater in most of the provinces.

Maybe a suggestion for improved laboratory work in secondary level could be that the laboratory work should be started and emphasized already from primary levels. In that way the students will be better prepared when they enter secondary school and can start at higher levels of practical work in next educational step. Furthermore, the general information about the practical work and laboratory style in this research as well as the problems that biology teachers face can probably to high extent be applicable for laboratory work in other subjects as well, such as chemistry and physics. Similarly, practical work for other subjects should implement more enquiry-based approaches, foster constructivist learning and let the students experience the lab by themselves.

In comparison to the past, i.e. the war period, especially between 1980 to 2001, the situation of laboratories in schools have had a lot of positive changes like equipping laboratories with
materials, publishing of guidebooks for laboratory work and holding a lot of workshops for teachers in Kabul and provinces, still improvement is needed, however now attention should more be drawn toward the quality of practical work and not only to the materials and equipments. The current implementation of practical work in Afghan secondary biology classrooms seems just to fulfill primary aims of Bloom taxonomy knowledge levels. Instead attempts should be done to increase the development of higher levels of knowledge and skills such as analyzing, synthesis and evaluation, by the implementation of more inquiry based lab work teaching methods.

Also, still a lot of barriers hinders implementation of lab work and force the teachers toward choosing traditional methods which was critically discussed in the literature review. These obstacles put high pressure on teacher and decrease intrinsic motivation in learners and should be overcome.

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APPENDIX 1

Questionnaire

Name of school:________________ district:_____________

Gender: male □ female □

1. In which grade/s do you teach?

________________________________

2. How long is your work experience as a teacher?

---------- Years

3. Have you taken any workshop or courses regarding the use of laboratory work?
   Yes □ No □

4. If your answer is yes please write the name of this/those course/s.

____________________________________________

5. Do you have a specially designated place for laboratory works at your school?
   Yes □ No □

6. Is there any technician to help you in the laboratory?
   Yes □ No □

7. Is the laboratory material and equipment suitable and adopted for the students you teach?
   Yes □ No □

8. Is the available of laboratory material and equipment enough for requirements of the students?
   Yes □ No □

9. To what extend are you familiar with the material and equipment in the laboratory?
   Excellent □ Good □ Adequate □ Poor □

10. For enhancing students’ learning, do you think doing laboratory is:
   Essential □ important □ not very important □ unnecessary □

11. Do you think that there is any relationship between the laboratory work and students’ learning during theoretical lessons?
   A. implementing laboratory work can improve learning during the theoretical lessons
   B. implementing laboratory work has no effect on learning during the theoretical lessons
Implementing laboratory

Part a: (in the questions of this part of the questionnaire the “outcome” of the experiment means the result of the laboratory that is going to be done)

12. Which type of laboratory work do you prefer to implement (tick one of the following alternatives)?

I. The outcome of the experiment is clear for both the student and the teacher
II. The outcome of the experiment is known only by the teacher
III. The outcome is undetermined

Part b:

13. How do you implement laboratory work.

I. By using a prescribed laboratory manual
II. By direct instruction/demonstration
III. Using an IT presentation

Part c:

14. How is the laboratory procedure determined

I. Through laboratory manual
II. Chosen by the student

15. How do you assess laboratory work?

I. Marks of practical work
II. observation of the work during laboratory
III. Assessing written reports
IV. asking questions about laboratory work

Purpose of laboratory work

16. To what extent do you agree with following sentences?

a. The purpose of laboratory work is to implement the content knowledge from the lecture

Strongly disagree Disagree Agree Strongly agree

b. The purpose of laboratory work is to improve laboratory skills

Strongly disagree Disagree Agree Strongly agree

17. To what extend do you face with following problems during implementation of laboratory work?

A. There is not appropriate balance between largeness of the textbook and number of laboratory works
<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Text book contains too many laboratory experiments</td>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Agree</td>
</tr>
<tr>
<td>C. I don’t have enough time to implement laboratory work</td>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Agree</td>
</tr>
<tr>
<td>E. high number of the students in a class is a practical problem in implementing laboratory work</td>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Agree</td>
</tr>
<tr>
<td>F. The quality of laboratory material is low.</td>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Agree</td>
</tr>
<tr>
<td>g. more seminars/workshops are needed to be held for more information about practical works.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

18. **If you face with any other problem in laboratory work write it down in the following lines.**

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پرسشنامه فعالیت های لابراتواری

پرسش‌ها:

1. در کدام صنوف تدریس می‌کنید؟

2. تجربه کاری شما به حیث یک استاد چند سال است؟

3. آیا در کدام سمینار در ارتباط با لابراتوار شرکت نموده اید؟
   - بله
   - خیر

4. اگر جواب شما بله است، لطفاً نام آن سمینار/ها را ذکر نمایید.

5. آیا در مکتب شما مکان خاص برای فعالیت‌های لابراتواری وجود دارد؟
   - بله
   - خیر

6. در مکتب شما تکنیشن‌های لبراتواری برای همکاری در فعالیت‌های لابراتواری موجود است؟
   - بله
   - خیر

7. آیا مواد لابراتواری برای تدریس مناسب و عیار شده است؟
   - بله
   - خیر

8. آیا مواد لابراتواری برای تدریس کافی است؟

نام مکتب:                            ناحیه:

جنسیت: زن □ مرد □

لطفا سوالات را با دقت کامل بخوانید و آنها را جواب دهید. جوابات شما کامل محفوظ است و بر علیه شما و یا مؤسسه‌تان استفاده نمی‌گردد. از همکاری شما چهار سپاس.
بلی ــــ خیر ــــ ــــ 10. برای بهبود یادگیری در شاگردان، وجود لابراتوار ــــ ــــ ــــ ــــ ــــ ـ است.

۹.تا چه اندازه، با استفاده از مواد لابراتواری آشنا هستید؟

ب) بسیار زیاد
الف) زیاد
متوسط
ب) کم
۱۱. به نظر شما، آیا بین کار لابراتواری و تدریس نظری (درس های تیوری/لکچر) کدام رابطه وجود دارد؟
الف. تطبیق فعالیت‌های لابراتواری یادگیری را در جریان دروس لکچر بهبود می‌بخشد.
ب. تطبیق فعالیت‌های لابراتواری هیچ کننک تاثیر بالایی ندارد.
الف. تطبیق فعالیت‌های لابراتواری تاثیر منفی بالایی یادگیری شاگردان دارد.

چگونه تطبیق فعالیت‌های لابراتواری:
(در بخش‌های ذیل مقصد از آزمایش، فعالیت‌های تحقیقاتی و لابراتواری است که شما در مکاتب اجرا می‌نمایید و مقصد از نتیجه آزمایش، هدف نهایی است که در پایان فعالیت لابراتواری بدست می‌آید.)

بخش اول:
۱۲. کدام نوع آزمایش را (برای فعالیت‌های تحقیقاتی) ترجیح می‌دهید؟
الف) نتیجه آزمایش برای شاگرد و معلم مشخص شده است.
ب) نتیجه آزمایش صرف برای استاد معلوم است.
ج) نتیجه آزمایش برای استاد و شاگرد مشخص شده نیست.

بخش دوم:
۱۳. برای اجرای فعالیت‌های لابراتواری از دستور کار لابراتوار استفاده می‌کنید یا پروسه فعالیت لابراتواری توسط شاگرد طرح ریزی می‌کند؟
الف) بروز فعالیت لابراتواری بر اساس دستور کار لابراتوار و یا کار عملی مشخص شده در کتاب درسی (اجرا می‌کنند.)
ب) پروسه فعالیت لابراتواری توسط شاگرد طرح می‌رند.

بخش سوم:
۱۴. فعالیت‌های لابراتواری چگونه تطبیق می‌کردد؟ (شما می‌توانید اضافه کنید یا یک گزینه را انتخاب نمایید)
الف) از طریق دستور کار لابراتوار (و یا کار عملی مشخص شده در کتاب درسی)
ب) از طریق هدایت و تشریحات مستقیم معلم
با استفاده از سلایدسی کامپیوتری

۱۵. چگونه فعالیت‌های لابراتواری شاگردان را ارزیابی می‌نمایید؟ (شما می‌توانید اضافه کنید یا یک گزینه را انتخاب نمایید)

۲۴
از طریق نمره جداکانه برای کار عملی مشاهده کار شاگرد در جریان فعالیت لابراتواری ارزیابی رای های کار عملی نوشته شده توسط شاگرد پرسیدن سوالات راجع به لابراتوار

اهداف:

۶. چه اندیشه با جملات ذیل موافق هستید؟
الف) هدف از اجرای فعالیت‌های لابراتواری، تطیف مفاهیمی است که در جریان لکچر ارایه می‌گردد.
کاملا موافق نسبتا موافق نسبتا مخالف کاملا مخالف
ب) هدف از اجرای فعالیت‌های لابراتواری، استفاده مهارت‌های لابراتوری است.
کاملا موافق نسبتا موافق نسبتا مخالف کاملا مخالف

۷. در هنگام اجرای فعالیت‌های لابراتواری، چه اندیشه با مشکلات ذیل برخورد می‌کنید.
الف) تعادل مناسب در بین تعداد فعالیت‌های لابراتوری و حجم کتاب درسی وجود دارد.
کاملا موافق نسبتا موافق نسبتا مخالف کاملا مخالف
ب) تعداد فعالیت‌های لابراتوری در کتاب درسی بسیار زیاد است.
کاملا موافق نسبتا موافق نسبتا مخالف کاملا مخالف
ت) وقت کافی برای اجرای فعالیت‌های درسی وجود ندارد.
کاملا موافق نسبتا موافق نسبتا مخالف کاملا مخالف
ج) تعداد زیاد شاگردان در صنف مانع از اجرای صحیح فعالیت‌های لابراتوری می‌گردد.
کاملا موافق نسبتا موافق نسبتا مخالف کاملا مخالف
د) کیفیت مواد لابراتوری باید است.
کاملا موافق نسبتا موافق نسبتا مخالف کاملا مخالف
ه) سمینارهای بیشتری جهت آشنایی با فعالیت‌های لابراتوری ضرورت است.
کاملا موافق نسبتا موافق نسبتا مخالف کاملا مخالف

۸. اگر با مشکلات دیگری نیز مواجه می‌شوید، لطفاً آن را در ذیل یادداشت نمایید.

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