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Availability of Essential Laboratory Equipment for Biology: A Case Study of North Nazimabad Town, Karachi

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Abstract

Laboratory work is regarded as an important component in school biology education. In this study, the central importance of laboratory is outlined and the basic resources to enable such laboratory work to be undertaken are outlined. For the present study, descriptive research method was used. Survey was then employed. A purposive sample of 8 secondary schools (4 boys and 4 Girls) was selected for the collection of data. A sample of fifty (50) biology teachers was randomly selected from eight (8) schools of Government secondary schools, of North Nazimabad Town, Karachi. This study looked at the provision of microscopes, test tubes, petri dishes and slides, probes, scalpels and forceps, bunsen burners, beakers and flasks. The responses revealed that there are significant shortages of usable equipment in several schools. Microscopes were not available to about one quarter of the biology teachers surveyed. Similarly, non functioning of slides, test tubes, and petri dishes was also found. Moreover, forceps, probes, and scalpels were not available to nearly half of the biology teachers surveyed. Beakers, flasks, and Bunsen burners are employed across all three sciences but only just over two thirds of the biology teachers surveyed indicated that they had adequate access to those fundamental resources. It is recommended that for effective teaching and learning of Biology subject, there must be proper provision of laboratory equipment.

Keywords: school biology education, laboratory equipment, availability

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Introduction

Science education started to make its way into schools in the west in the late 19th century. However, the central place of school science education worldwide only really developed in the latter half of the 20th century. By that time, the place of the laboratory was well established in many Western countries. Indeed, today, the laboratory work is seen as an integral part of all science education, including biology, at school level but this has placed stresses on schools, especially in developing countries. Much has been reviewed in several studies at both school and university levels (Green, 1964; Reid and Shah, 2007; Hanif*et al.*, 2009; Beyessa, 2014):

- The resources (laboratories and equipment) needed are expensive for schools
- The role and purpose of school laboratory work is not agreed
- Teachers need to know *how* to employ laboratory work to greatest advantage

Compared to book-based school subjects, the sciences are expensive. Laboratories are required and, ideally, these have to be specialist in nature - the needs of biology are very different from physics, for example. However, equipment and chemicals require to be replaced, another expense. Secondly, there is a lack of clarity about the purpose of laboratory work and this has been considered by Shah et al. (2007). A simple analysis reveals that most of the school students will not move onto specialist careers in any of the sciences. Therefore, the actual practical skills are not central. The key role of laboratory work allows the science to be made real for the students but, more importantly, all science subjects draw their understandings of the world around by means of experimentation. This determines how laboratories should be employed in the education of school students. Thus, the experiments undertaken by students can be used to illustrate the way the sciences gain their understandings. Thirdly, biology laboratory work must be directed by teachers qualified in biology (the same applies to the other sciences). In simple terms, there needs to be an adequate supply of qualified teachers in each specific science discipline and these teachers need to the trained and supported in the effective use of laboratories. Training poses specific problems for a country like Pakistan in that those offering the training often themselves have had minimal experience in the effective use of laboratories in school education.

There is no evidence that laboratory work makes much difference in achievements in school and national examinations in the sciences. However, lack of good laboratory experiences for school students tends to make their studies in the sciences somewhat detached from reality and, frequently, they have little concept of how the sciences work in developing their understandings of the world (Almadani, 2005).

Literature Review

Biology (like chemistry and physics) is a science in which the curriculum constantly changes. Developments and new insights are coming from worldwide research at an enormous rate. This places great stress on biology teachers. Not only they have to cope with new biology content, but they have to develop ways to present that content too (Koba and Tweed et al., 2009). To make matters even more difficult, curricula planners often add on content without removing older (and perhaps less relevant) content, making curriculum coverage almost impossible. With excessive content to cover, there is not sufficient time to carry the inquiry activities and experiments to engage the students with the ideas.

In their review, Hofstein and Lunetta (2003) noted that the laboratory has been given a central and distinctive role in science education and science educators have suggested that rich benefits in learning science come as a result of using laboratory activities. In the year 1958, '*International Biological Laboratories*' was established to produce and export equipment and resources for schools and colleges. The aim is to produce modern equipment so that learners might undertake laboratory experiments in the sciences. However, the equipment must be available to schools and teachers need to know how to employ it to the best advantage.

Studies, for example, Reid and Skryabina, (2002) and Suzuki (2007) have shown the critical importance of the teacher in learning in the science areas at school. Teachers need to be competent in the subject matter they are to teach. For biology, this means a minimum of a first degree in biology. Teachers also need to be trained so that they can enable the young learners to understand what is presented to them. This is more difficult that to might seem for questions have been raised about the effectiveness of teacher education (Carroll, 2005; El-Sawaf, 2007). In addition, learners need to see the point and value of what they asked to study and the role of the teacher in terms of having strong empathy for the learner is critical (Reid and Skryabina, 2002).For schools, there are key items of basic equipment that underpin all attempts to develop quality laboratory experiences. These include test tubes, Bunsen burners, microscopes and beakers as well as the more specialized items. This is now discussed ahead. For most schools, microscopes must be of high enough quality to enable key biological features to be seen easily. The naked eye can perhaps see down to 0.2 mm but light microscopes expand cells up to 1,000 times. University and research establishments will employ election microscopes which can increase the size of an object by 200,000 times. Slides, slide covers and fixation agents will be required for inspecting specimens. Petri dishes are required for culture

development (and thermostatic tanks may be essential for temperature control). Of course, test-tubes must be readily available including small test-tubes along with a centrifuge so that separations can be effected. Dyes and indicators are also necessary. Dyes like ethylene blue and iodine epermit the structures in cells to be more simply observed while indicators can be used to reveal pH. Forceps, scalpels and probes are essential for undertaking dissections and learners need to be shown the skills in using such equipment safely. Beakers are essential for liquid storage along with measuring cylinders for indicating volumes. Bunsen burners give a controlled source of heat while flasks are often required.

'Science teaching must take place in a laboratory … Science simply belongs there as naturally as cooking belongs in the kitchen and gardening in garden … so the teaching of it must involve real contact with those aspects of nature which are to be studied' . (Solomon, 1980, p.13)

Dahar (2011) also argued that the science laboratory is a very important resource input for teaching science and is an important predictor of academic achievement. However, the evidence does not support the latter assertion. It is quite possible to pass examinations and pass them well with little laboratory input. However, when the sciences are reduced to book-based subjects, the learners lack the reality that comes from experience of the real world around. This is where the school laboratory is critical: it allows the subject matter to be become real and tangible to the learners, a point noted by Hunde and Tegegne (2010).

Tenaw (2015) argued that the secondary school is the base in preparing students to be the science students and it is important for them to be exposed to laboratory equipment, activities, and precautions and safety rules. The secondary school laboratory should have the equipment necessary to conduct meaningful demonstration and experiments. However, there is a weakness in the argument. Secondary schools exist to educate students widely, to prepare them for life. Only a minority will continue on into scientific careers and yet understanding the sciences is an important part of life for all future citizens. Thus, quality equipment is required as part of the process of education of the next generation. However, Dahar (2011) noted the lack of adequate facilities for teaching sciences up to the standard at secondary and higher secondary school stages. The identified inadequacies relate to inadequate science teaching materials and insufficient funds to purchase key equipment.

Objectives of the Study

The following are objectives of study:

1. find out the availability of laboratory and equipment for effective teaching of Biology in secondary schools within North Nazimabad

Town Karachi.
2. evaluate the quantity and perceived quality of equipment in teaching biology in secondary schools in North Nazimabad Town Karachi.
3. identify the perceived factors militating against the availability of laboratory equipment in the secondary schools in North Nazimabad Town Karachi.

Methodology

A quantitative research designed was used for the study, which included a survey for gathering data from the research participants. This study was delimited to secondary schools of North Nazimabad Town of Karachi. The data were gathered from students about the use of essential laboratory equipment in teaching of biology. A purposive sample of 8 secondary schools (4 boys and 4 Girls) was selected for the collection of data. These are labeled A, B, C….H.

A simple survey was employed to find out the availability of key biological laboratory equipment. The following options were used:

Available and functional (AF), Available and nonfunctional (ANF) and Not available (NA)

Fifty (50) Biology teachers were surveyed in this way and the data were expressed as percentages.

Results

The results are presented and discussed in the tables below. All data is presented in the form of percentages.

Table 1

Microscope Availability

Schools	% (N = 50)		
	Available and functional	Not Available	Available and Non-functional
A	82	18	-
B	56	35	8
C	61	31	8
D	91	9	-
E	85	15	-
F	30	45	25
G	52	40	8
H	53	38	9
Overall	74	22	4

Microscopes are essential equipment in all biology education and it is a matter of concern that they are not available to about one quarter of the biology teachers surveyed.

Table 2

Slides, test tubes, and petri dishes

Schools	% (N = 50)		
	Available and Functional	Not Available	Available and Non-functional
A	43	54	2
B	52	34	14
C	54	41	5
D	55	45	-
E	50	25	25
F	50	44	6
G	55	14	-
H	50	42	8
Overall	59	31	10

The situation is even worse when looking at the non functioning of slides, test tubes, and petri dishes. These are absolutely essential for all basic biology laboratory work.

Table 3

Forceps, probes, and scalpels

Schools	% (N = 50)		
	Available and Functional	Not Available	Available and Non-functional
A	55	45	-
B	63	30	7
C	62	35	3
D	43	49	8
E	54	37	9
F	51	46	4
G	55	42	3
H	46	41	14
Overall	55	40	5

Forceps, probes, and scalpels are not expensive but adequate resources are not available to nearly half of the biology teachers surveyed.

Table 4

Beakers, flasks, and Bunsen burners

Schools	% (N = 50)		
	Available and Functional	Not Available	Available and Non-functional
A	54	34	13
B	60	-	40
C	56	45	-
D	63	36	1
E	65	-	35
F	65	30	5
G	62	33	5
H	66	15	19
Overall	69	19	13

Beakers, flasks, and Bunsen burners are employed across all three sciences but only just over two thirds of the biology teachers surveyed indicated that they had adequate access to those fundamental resources.

Discussion

The key roles for student laboratory work in biology include making the biology real and tangible for the strident as well as giving them insights into the way biology, as a science, gains its understandings of the living world. Those cannot happen if the resources are not there and teachers are not enabled to use these resources effectively. This study has focused on the resource availability and it is clear that, overall, the resources are far for adequate. Without such resources, it is almost impossible to fulfill some key goals for biology education.

Recommendations

1. Government should make concerted efforts through the ministry of Education in providing equipment for teaching of biology in Government secondary schools.
2. It is also the responsibility of Government to provide biology laboratory equipment in both Quantity and Quality to these secondary schools.
3. In each secondary school, the parent teachers association should be encouraged to get the parents involved in the provision of basics essential laboratory equipment for teaching of biology.
4. Government should supervise the secondary schools in order to asserting the level of the use of biology laboratory equipment for having the knowledge about the supply of the same.
5. Number of trained teachers should be increased in secondary schools for giving the accurate knowledge to students about biology subject in both theory and practical context.

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