

Mind the Fact: Teaching Science without Practical as Body without Soul

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Abstract

Practical is considered key to make science learning more effective. Practical work is a very prominent feature of school science in many countries. Practical provide contrived experience to science learners and develop science skills, knowledge and understanding of their world. This article portray the opinion of science teachers about importance of practical work for teaching science subjects at secondary and higher secondary level. Twelve science teachers from secondary and higher secondary schools were sampled for getting opinion. A focus group discussion was organized to seek opinion of respondents. Respondents have point of view that practical work is an essential, practical work is a significant feature of school science in many countries, practical work gives understanding of material world, showing is better than telling, practical work indispensable to teach science content.

Key terms: Teaching science, Practical work, Laboratory Work.

Introduction

It is a common saying that 21st century is century of science. There is a significant advancement in technology over the last couple of decades and it is a fact the pace is accelerating. Every day there is an increase in scientific knowledge and new things are discovered. To cope with this situation scientific literate society is needed. Consequently there is an increase in demand for science educated students. Pakistan needs a scientifically literate society and a supply of scientists and technologists to sustain a flourishing economy to address a wide range of geopolitical, social and environmental challenges in global & regional context.

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Similarly science is also important in the international job market. The greater the advances in science and technology, the greater the demand for workers sufficiently educated in science subjects. Excellence in the sciences can open many doors of jobs in international market.

The goals of scientific literacy and a sufficient supply of science and technology graduates from higher education require that elementary, secondary and higher secondary schools offer realistic and inquiry oriented science curricula that engage students and inspire them to continue their studies of science (Chiappetta, & Koballa, 2006). Science practical work plays a vital role in developing scientific knowledge and enhancing scientific skills, attitude and inquiry based learning. Hofstein and Luneta (2003) define science practical activities as “learning experiences in which students interact with materials and/or with models to observe and understand the natural world”. Students learn by performing concrete activities, by comparing experimental data to a model, and/or by designing an investigation.

Many authors put emphasis on the distinctiveness of the learning experience through practical work. White (1996) have opinion that students learn manual skills like fine movements, precisions & care and the acquisition of specific techniques through science practical work. The practical work is also a tool to teach students how to design and conduct an investigation in order to solve a scientific problem (Hofstein & Lunetta, 2003).

The added value of practical is that it enhances motivation, and stimulates excitement by providing unusual objects and events - a contrast with the usual learning experience of sitting still and listening or doing exercises. Moreover, the laboratory is said to be a place where personal experience can be linked to a scientific way with real world. The students' personal experiences are either their direct observations of a phenomenon through hands-on manipulation or their recollection of past experiences (Gungor et al., 2007; Prain, 2007).

Science practical work is essential in order to create a learning situation that encourages and challenges students to develop experimentally-based inquiry skills. Laboratory work involves thinking, feeling and doing, and the science laboratory is a hub of interactions between these aspects (Gooding, 1992; Alsop and Watts 2003).

Researcher discuss the relationship between doing and learning in the laboratory, for instance between practical actions and reflection on scientific theories behind these actions. This relationship can make things more concrete by illustrating abstract phenomena and concepts and by making the facts visible. Millar (2004) defines practical work as: any teaching and learning activity which involves at some

point the students in observing or manipulating real objects and materials. It promote “knowledge in action”, and a more explicit, reflexive and declarative knowledge.

Science practical is compulsory component of science curricula at school and university level in all countries. It is also compulsory component of science curricula of subjects like biology, chemistry, physics at secondary and higher secondary level in Pakistan. Practical work of different science subjects are assessed by examining bodies. The marks awarded to students in practical examination are included in the transcript of students. Keeping in view the contribution of science practical work for effective science education it is important to know the opinion of science teachers of secondary and higher secondary schools about science practical work. Science teachers of secondary and higher secondary schools are practitioners who teach science subjects and their opinion regarding role and importance of science practical is momentous. The basic question of the research was whether science can be taught without science practical at secondary and higher secondary level.

Research Methodology

The primary focus of the study was to find out role of practical/laboratory work in teaching science at secondary and higher secondary level. Science teachers teaching at secondary and higher secondary schools having experience of teaching science subjects are relevant persons who can reflect their opinion regarding role of practical/laboratory work in teaching science at secondary and higher secondary level. Twelve science teachers: six secondary school teachers (SST) science from government high schools and six subject specialist (SS) science from government higher secondary schools situated in Lahore city were selected to seek their opinion regarding role of practical/laboratory work in teaching science. While selecting respondents concern of variety of science subjects i.e. Biology, Chemistry, Physics was addressed by selecting two respondents of each subject i.e. biology, chemistry, physics from secondary and higher secondary schools.

The focus group discussion (FGD) is a rapid assessment, semi-structured data

gathering method in which a purposively selected set of participants gather to discuss issues and concerns based on a list of key themes drawn up by the researcher (Robson, 2004). A focus group is a form of qualitative research in which a group of people are asked about their perceptions, opinions, beliefs and attitudes towards a process, product, service, concept or idea. Questions are asked in an interactive group

setting where participants are free to talk with other group members (Debus 1988; Henderson, 2009). Keeping in view the significance and relevance of focus group discussion to the topic, researcher used focus group discussion as tool of data collection.

A focused group discussion was managed with selected respondents. The main purpose of the study was described by the researcher prior to commencement of discussion. Researcher used a discussion guide that lists the main topics and themes were covered in the discussion. It served as a road map that helped the researcher in covering the list of topics and keeping the discussion on track.

The following steps were used for focus group discussion:

1. Obtained the background information of participants such as their names, qualification, teaching experience, practical work examination experience.
2. After a brief introduction, the purpose and scope of the discussion were explained.
3. Major topics were segregated into discussion points or themes.
4. The discussion was structured around the key themes using the probe questions.
5. Discussion was conducted.
6. During the discussion, all participants are given the opportunity to participate.
7. A variety of moderating tactics were used to facilitate the group.

These strategies were adopted by the researcher during discussion:

- Stimulate the participants to talk to each other.
- Encourage shy participants to speak.
- Discourage dominant participants through verbal and nonverbal cues.
- Politely intervene
- Recording and taking notes of discussion

Open-ended questions were considered most appropriate during the discussion because they allowed participants to answer from different angles. As the possible responses were not pre-conceived, open-ended questions gave the

participants opportunities to express their thoughts and feelings based on specific situations
(Robson, 2004).

Results and Discussion

On the basis of information sought from participants following conclusions were drawn.

Practical work is an essential

Practical work is an essential – indeed inevitable and certain aspect of teaching science – because of the subject matter of science. Currently, science educators and teachers agree that science practical work is indispensable to the understanding of science (Ottander & Grelsson, 2006; Cardak et al., 2007; Tan, 2008). The role of practical work in science education has been explained by some researchers (Lazarowitz & Tamir, 1994; Lunetta, 1998).

Practical work is a significant feature of school science in many countries

Practical work is a very significant feature of school science in many countries. A high proportion of lesson time is given to practical work, usually carried out by pupils working together in small groups.

Practical work gives understanding of material world

The aim of science is to gain an understanding of the material world and learner may be able to explain events and phenomena around him in physical environment and become able to control some of them. To disseminate knowledge and understanding of material world is important for learners to adjust in a scientific society (Millar, 2004).

Showing is better than telling

Theory is taught in the class through lecture, question answer or discussion students participate in learning activity passively and to communicate to someone who had never observed an object, phenomena, law or principle while words only convey part of the information present in the actual event. When they are given opportunity to participate in demonstration and perform practical work in laboratory they show their more interest in learning and it is natural that this involves acts of showing which is better than telling (Lazarowitz & Tamir, 1994).

Practical Work Indispensable to Teach Science Content

The basic purpose of practical work is to help learner develop links between domain of real objects/observable things and domain of ideas.

In practical work, the emphasis is more strongly on the domain of real objects and observables. The aim of the practical work is to help learners to observe a phenomenon and to look at it in more detail than theoretical knowledge and to remember it. Practical work helps learner to learn a new concept and use of terms in refined manner (Arnold and Millar, 1996). The main purpose of science practical work in science education is to provide students with conceptual and theoretical knowledge to help them learn scientific concepts, and through scientific methods, to understand the nature of science. Science practical work also gives the students the opportunity to experience science by using scientific research procedures. In order to achieve meaning full learning, scientific theories and their application methods should be experienced by students. Moreover, science practical work should encourage the development of analytical and critical thinking skills and encourage interest in science (Ottander & Grelsson, 2006).

Practical Work to Develop Skill of Using Scientific Method

One of the aims of science teaching is to teach students about scientific method and developing skills of using scientific method. Scientific method normally includes:

- developing questions about the physical world that could be investigated scientifically
- devise a suitable plan for collecting data to answer such questions
- use collected data to draw conclusions.

To develop skill of using scientific method, it is needed to use tasks in which the learner have control of the decision-making process, and do not only have to follow a 'recipe'. Thus practical becomes compulsory part of teaching science (Tiberghien et al., 2001).

Science is a product (Body of knowledge) as well as process (Method of acquiring knowledge)

The content of science is regarded as product and is result of use of scientific method (skill of acquiring method).

Science exhibits itself as "an accumulated body of knowledge, and a process of knowledge generating (Schulz, 2009). Practical work enables students to learn application of scientific method to generate knowledge and nurture creativity and critical thinking skills. Practical work can help student acquire a better understanding

of concepts and principles as a result of concrete experiences (Lunetta, 1998; Freedman 2002).

Developing Science Related Skills

Practical work provides ample opportunity to learner to develop science related skills. The science laboratory is important to science teaching and it offers a different environment from traditional classroom. Scientific knowledge deals with experiments, practical and theoretical knowledge of laws, principles and theories of content (Klein, 2006; Prain & Tytler, 2007; Ogborn, 2008). In addition, various skills are needed and used, such as observation, measurement, recording, analysis, handling equipment's, following instructions, decision makings and problem-solving skills (Talisayon, 2008). Hand-eye co-ordination, instruction-sequence-following and decision making skills are developed by practical work (Henderson & Fisher 1998). The laboratory work has the potential to engage students in authentic investigation in which they can identify the problem to investigate, design procedures and draw conclusion. These activities can give students a sense as to how scientists go about their work, which in turn may influence their attitudes about scientific enterprise (Chiappetta & Koballa 2006).

Conclusion

Science practical work is interesting and engages learner in learning process through activity and hands on experience, thus providing motivation and inspiration that improves progress in science. Practical work is an effective way of learning and reinforcing theoretical concepts in science. Much of science content i.e. laws, principles, theories and models has been discovered by people doing practical work and so practical work is an essential for science education at every level. It is recommended that science laboratories in secondary and higher secondary schools may be enriched with suitable equipment, material and facilities. Refresher courses for Science teachers may be organized to nurture them in holding laboratory work activities. Content of theory may be taught in alignment with its practical activities. Sufficient Practical work time may be allocated in the school time table and may be observed strictly.

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