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INCULCATION OF THE USE OF SECONDARY SCIENCE KITS FOR CLASS X AT SCHOOLING

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ABSTRACT

Teaching-learning activity is not limited to the delivery of theory content and evaluation but they also include some experiment activity in laboratory for some subjects like Chemistry, Biology, Mathematics , Physics etc., laboratory experiment and other form of experiment in teaching-learning are expected to assist learner to acquire the technical ability. The experiments should be an important source of teaching-learning in order to have a better understanding of both concepts and theories. The reality of learning activities shows the fact that many institutions don't have the required instruments to conduct the experiment. It is because of the high laboratory operational cost. Only a few learners have the opportunity to develop thinking ability because of the lack of lab experiments.. It causes the learner's lack of interest and lack of curiosity which does not help in the enhancement of creative thinking skills. Currently many schools hold learning activities both theory and practical conventionally. The current curriculum emphasizes that learners are required to meet some competencies as subjects' minimum completion. The competency reached not only from conventional class but also from assignments, discussion, independent experiment and some activities that take place of school. Practical skills are important in the school, so that learners may perform experimental activity such as experiment in physical laboratory. The related to experimental skills effectiveness of use of secondary science kits for class 10th, the study was carried out in Demonstration Multipurpose School, Bhopal for students of class X at secondary school level in science. For this purpose tenth grade learners taught by the same teacher in DMS School, RIE, Bhopal, were enrolled in the study. The classes were randomly assigned as two groups .Learners in the first (control) group were instructed by traditionally designed instruction whereas learners in the second (experimental) group were taught by the instruction based (using science kit). The students of the school and were the sample for the study pre-test was conducted on 13th October 2020 and post-test also was conducted on 17th November 2020 as per prepared questionnaires of tenth class science experiments (Physics, Chemistry and Biology) . Achievement test were administered to both groups as a pre-test and post-test in order to assess their understanding of concepts related to tenth grade science concept using science kit. The results indicated that instruction based on constructivist approach caused significantly better acquisition of scientific conceptions.

KEYWORDS: Secondary science kit, Control groups, Experimental groups, Practical skills, science concepts and experimental activity.

INTRODUCTION

In many parts of the world, science education occupies a comparatively insignificant place in school. Unfortunately what actually happens in the classroom under the label of science is often totally inadequate. Teacher training both pre-service and in-service, is one of the keys to this problem. Starting from the premise that this training should be carried out in ways more closely related to the active methods which teachers are expected to use in their school.

The crucial role of experiments in the school science curriculum is universally accepted. A good science curriculum must not only give balanced emphasis to both theory and experiments but also integrate these two essential and complementary aspects of science in the teaching-learning process. Modern science, as we all know, is the result of a creative interplay of experiments, observations and theoretical inference.

There are several ways in which experiments facilitate and improve the learning of science. First and foremost, experiments help students develop the right perspective of science, namely that science is not just a theoretical abstraction – it is an attempt to describe the working of the real world around us. A hypothesis or idea in science is acceptable only if observations and experiments confirm it. Second, experiments are among the most effective ways to generate interest in science. For many students, an apparently 'dry', 'uninteresting' fact of theory in the textbook can become live and exciting when translated into an experiment. Third, experiments promote the basic skills and competencies of doing science: procedural and manipulative skills, observation skills, skills of representing and interpreting data and the accompanying conceptual and critical abilities. For these various reasons, promoting activity and experiment-based learning has been at the heart of many efforts aimed at improving science education in our country.

Despite several laudable efforts in the past, experiments, by and large, have continued to be marginalized in our schools. There seem to be two principal difficulties. Firstly, experiments require a certain minimum infrastructure – a laboratory with some basic equipment and consumables on a recurring basis. Secondly, an assessment of practical skills in science in a sound and objective manner is by no means an easy task. The difficulty multiplies manifold if an assessment is to be carried out on a large scale. Thus lack of infrastructure and, more important, lacks of reliable assessment have resulted in the unfortunate neglect of experimental work in most of the schools in India.

Experiments play a crucial role in the progress of science. A large number of path-breaking discoveries and inventions have been possible through investigations done usually in laboratories. The experimental work is, therefore, an essential component of any course in science. A course on practical work in science curricula in schools at the secondary stage is essentially designed to acquaint the learners with the basic tools and techniques used in a science laboratory. It also envisages developing problem-solving skills. These skills help the learner to acquire the ability to identify a problem, to design and to set up the experiment, to collect and analyze data through experiment, and to interpret data to arrive at a plausible solution in due course of time. These are, in fact, the long term objectives of laboratory work and become the nucleus of the philosophy of construction of knowledge by the learner. A school science laboratory is a place where basic experimental skills are learned by systematically performing a set of prescribed and suitably designed experiments. Performing experiments by one's own hands are not only a thrilling experience but are also important because it entails learning by doing. It also facilitates an understanding of the concepts of science. The experiments and project work suggested at the secondary stage intend to develop basic skills of measurement, handling of some common measuring instruments, equipment, and chemicals, setting simple apparatus, handling microscope and preparing slides, making observations, collecting data and presenting it in appropriate format interpreting and drawing conclusions, and preparation of report. There are certain rules and regulations that every student must be familiar with before undertaking practical work in a laboratory. A student is required to be acquainted with the general facilities and the equipment available in the laboratory and follow the rules and regulations. Generally, at the beginning of the session, the teacher takes the students around the laboratory to familiarize them with the general facilities available in the laboratory and tells them about certain do's and don'ts while performing the experiments in the laboratory. For the laboratory work categories of practical skills are given below:

1. Procedural and manipulative skills

- Select appropriate apparatus / instruments for performing the experiment.
- Know the limitations of the apparatus/instruments regarding their size, least count and accuracy.
- Arrange/assemble/ set and adjust the apparatus systematically.
- Handle the apparatus, instruments, chemicals carefully to avoid any damage or injury.
- Perform the experiment with reasonable efficiency and accuracy.
- Separate and remove desired parts of a specimen for detailed study without damaging it.
- Use appropriate methods and materials for specimen mounting.
- Locate and rectify the errors in apparatus, instruments, etc.
- Add chemicals in the appropriate quantity.

- Dismantle the experimental set-up carefully.
- Practice the precautions in handling sensitive apparatus or chemicals or flame.

2. Observational skills

- Find the least count of the instrument.
- Read the instrument correctly.
- Notice color change, the evolution of gases, formation of precipitates, chemical reactions, etc., carefully.
- Notice the relevant details in the given specimens minutely.
- Locate the desired parts in a specimen accurately.
- Take observations carefully and in a systematic manner.
- Read the graph correctly.

3. Drawing skills

- Make proper observation tables.
- Draw circuit diagrams, ray diagrams, experimental set-ups, sketches, etc. correctly and proportionately.
- Label sketches and diagrams correctly.
- Draw graphs from observed data correctly.

4. Reporting and interpretative skills

- Make a proper plan for recording the observations.
- Record the observations/data/information correctly and systematically.
- Classify and categorize organisms.
- Make correct calculations/predictions.
- Use proper formulae and mode of summarizing and reporting the result.
- Report the result using correct symbols, units, terms, and chemical equations.
- Interpret the observations and results correctly.

An experimental skill for science concepts, on the other hand, involves a search to understand the unknown and begins with a question. In doing the usual science concept for practical, you report on, something that someone else has discovered. This does not mean that doing an experiment will earn your world- fame as a discoverer. It does mean that you can discover something, a fact or relationship that was unknown to you and that was not recorded in any book available to you. Scientists refer to this as an independent discovery.

The National Policy of Education (NPE) 1986, stresses the importance of science education, in these words," science education will be strengthened so as to develop in the child well-defined abilities and values such as the spirit of inquiry, creativity, objectivity, the courage to ask questions and an aesthetic sensitivity". According to NCF-2005 teacher should act as a facilitator and not as a transformer of content where they can think, realize, analyze and develop their own way of learning which something beyond the textbook.

Laboratory skill is an integral part of school level science curriculum (Primary, Upper Primary, Secondary, and Higher Secondary level). If properly planned and conducted, practical skills can provide a first-hand experience of the various activities that comprise science. Practical skills are meant to (i) develop the skills required to perform the experiments and (ii) to strengthen the understanding of the theoretical concepts pertaining to the experiments done in the laboratory. The important skills required in science practical are meant to assist the learners to learn and develop the skills of manipulation- involve the correct and skillful handling of the apparatus by the experimenter. Observation- involves the use of senses hearing, sight, touch and smell to detect changes/reactions. Reading- refers to the ability to comprehend written or printed information. Recording-entails writing down, for example, measurements or statements of facts or other details for reference. Computation- the use and application of mathematical knowledge on the data collected. Interpretation- studying the data collected and drawing conclusions based on the established science principles/theories. The success achieved by following these skills not only trains one in these abilities but also increases confidence in the method of science. Encouraging learners to carry out practical would also help develop in them the scientific attitude with its emphasis on objectivity and open-mindedness. The idea for practical skill may originate from something that has been taught in the class or read in a

book or from the general surroundings. Science can be learned efficiently through experimentation. Abstract scientific principles can be understood and can be correlated with daily life experiences through activities and experiments. Though a science textbook incorporates many activities these activities are not being performed properly in the classrooms. Hence these activities need to be systematized and procedure of some important experiments must be formulated which will translate the basic scientific principles. The science teachers at the school level must be trained properly to perform some basic experiments in order to inculcate scientific temperament and appreciation for science. Use of the practical skills for science concepts may be helpful to understand several science terms.

Practical skills for science concepts and experiments using science kits can make the study of science more exciting, enjoyable and educational. This provides an opportunity to teachers and learners to get a firsthand experience of the process involved in scientific concepts at school level. It represents one method of helping learners, explore their special interests in depth. The resulting findings are often for more valuable to the students who are involved, than the information presented in regular class periods.

Conceptual framework

Practical skills is a way in the field of science laboratories through which the learner is study and clarify the experiments their relation to theory so the learner can understand the meaning of conducting practical experiment while doing them. The benefits of practical skills can be summarized in the following points.

1. Science kit is an excellent substitute for laboratory as it offers learners experience of skills close to the direct experience.
2. It contributes to overcoming the obstacles that prevent the learners from conducting actual experiments.
3. Science kit provides learners with an interesting interactive scientific environment.
4. It allows learners the possibility to conduct scientific experiment step-by-step with immediate feedback.

METHODOLOGY

Science is a systematic study and knowledge of natural and physical phenomena. In this era, scientific education is much emphasized in all societies the world over. The main goal of science education is to prepare the right type of environment for the individual; to allow learners grow physically, mentally and spiritually in order that learner can develop harmoniously with fellow human beings. The practical skill is recognized as an effective teaching-learning for science. A laboratory is a place. According to NCF-2005 teacher should act as a facilitator and not as a transformer of contents where they can think, realize, analyze and develop their own way of learning which should be something beyond the text book. Hence, practical skills are considered to be a new based learning, it provides the learner with a wider range of scientific vision. A laboratory is a place that provides an opportunity for the teachers and students of science to try out and investigate his scientific hypotheses and arrive at conclusions. This ensures effective learning on the part of the learner. Science can be learnt efficiently by experimentations. Abstract Scientific Principles can be understood and can be correlated with daily life experiences through activities and experiments. Though science text books incorporate many activities but these activities are not being performed properly in the class rooms. Hence, these activities must used to be systematic and procedure of some important experiments must be formulated which will translate the basic scientific principles. The science teachers and students at secondary stage must be performing some basic experiments in order to inculcate scientific temperament and appreciation for science. Practical skills will be helpful for science teachers in learning the systematic performance of science experiments. Certainly the whole effort will be for the benefit of students. The researcher used a quasi-experiment following a non-equivalent control design to verify the effectiveness of the experiments using science kits. It involved the comparison of students performed practical's through using science kits experiments to those who performed the practical's through traditional methods. The student's achievement score were gathered and measured before and after they have performed the practical through using science kits experiments.

Objectives of the study

1. Effectiveness of training programme on the use of secondary science kit at school level
2. To compare the achievement scores of learners in science at secondary level.

Sample

The study was carried out in Demonstration Multipurpose School, Bhopal for students of class X at secondary school level in science. The students of the school and were the sample for the study.

Tools

1. The intervention was done using the developed package on practical skills using science kits
2. In the present study questionnaire was developed and administered to study the effectiveness of training programme on the use of secondary science kits at school level.
3. Observation schedule

Variable : Effectiveness of training programme on Science kit, student achievement.

Data processing

In this study pre-test and post test two group experimental design or experimental research and control group was made. The data was collected by administering developed tools on students. The Qualitative and quantitative analysis of collected data was done using SPSS Software.

The research made use of the following

1. The Pre and Post Achievement Test
2. The traditional approach
3. Developed training package of practical using science textbooks class X with help of secondary science kits (constructivist approach).

The pre-achievement test was administered to the two groups. Experimental group performed practical with the help of developed training package of practical using science textbooks class X with help of secondary science kits the control group with traditional method for a period of time. At the end of the study, a post achievement test was again administered to measure the achievement level of students.

The t-test was used to determine if there was difference between the experimental and control groups in their:

- Pre-achievement scores in chemistry, physics , and biology
- Post- achievement scores in chemistry, physics , and biology
- Pre-achievement and post achievement scores in Science of both the experimental and control groups

ANALYSIS AND INTERPRETATION OF DATA

The data analysis deals with pre-test scores and post-test scores in chemistry, physics and biology for both the control and experimental groups of class class X.

I. The difference between the pre-achievement and post- achievement scores of experimental and control groups class X

The pre-achievement test was conducted in order to find out if the respondents of both the groups possess the same cognitive level before the conduct of the study. The null hypothesis states that there is no significant difference between the pre-achievement scores of experimental and control groups. Table 1.1 shows the difference between the

pre-achievement scores of both the experimental and control groups.

TABLE 1.1: The difference between the pre-achievement and post achievement scores in Science of both the experimental and control groups class X

GROUP	PRE TEST		POST TEST		t	Df
	Mean	SD	Mean	SD		
Control	9.777	2.211	13.396	3.001	3.021	25
Experimental	10.285	3.876	13.714	3.989	11.770	25

As it is understood from table 1.1, that there was no significant difference at level (0.05) between the average scores of students in the experimental and control groups of class X in achievement scores in the pre test and post test and therefore any differences was established among in the group due to practical skills using science kits training modules.

The above table of the pre –test and post-test means of experimental and control groups indicates that in case of experimental group, the pre and post-test mean and SD were 10.285(3.876) and 13.714(3.989) respectively. In case of contol, the pre-test and post-test mean and SD were 9.777 (2.211) and 13.396 (3.001), respectively.

It also 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. It indicates that the learning through practical skills using science kits enhances the conceptual understanding in science among students. The t-test value for experimental group is found to be 11.770 and for the control group the corresponding t- value is 3.021. As seen in the table, 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 practical skills using science kits) and the control groups Students (who taught by traditional method) in the post-test in favour to the experimental groups .Which confirms the superiority of the experimental groups that taught by the practical skills using science kits to the control groups , that taught by conventional method ?This result is due to the use of practical skills using science kits impact on academic achievement for the sample from of class X grade students of Demonstration Multipurpose school Bhopal, where the differences in favour of the experimental groups , which is testimony to the effectiveness of practical skills using science kit to increase the academic achievement of the students of the experimental groups compared to the academic achievement of control groups. These results indicate that students valued the ease of manipulation and experimentation within the practical skills using science kits more than the manual Lab.

As shown in the table 1.1 above that the of t-calculated is more than the t-tabulated at the significance level (0.05),where the mean average of the pre-test (10.285) and the post-test (13.714), that indicates the presence of significant differences for experimental group in favour of the post-test. The existence of statistically significant differences in the level (0.05) between pre-test and post-test in favour of the post test, demonstrates clearly the effectiveness of practical skills using science kits chemistry lab to increase the academic achievement of the students in the experimental group in post-test compared their achievement in the pre-test.

TABLE -1.2: The difference between the pre-achievement scores in chemistry, Physics and biology of both the experimental and control group of class X:

Group	Mean	SD	Df	t
Chemistry Control	11.9047	1.386	25	5.987
Experimental	11.7142	0.986		
Physics Control	8.4761	0.897		
Experimental	8.9523	1.002		

Biology Control	8.9523	1.032	25	6.876
Experimental	10.1904	1.654		

From the table 1.2, it clearly shows that in chemistry, control group has a mean score of 11.9047 and standard deviation of 1.386 and the experimental has a mean score of 11.7142 and standard deviation of 0.986 .In orders to find out whether there is significant difference between the two means t-test was performed. It has been assumed that the distribution of the achievement scores for the pre-achievement test for the groups was normal.

The value in physics for the control group has a mean score of 8.4761 and a standard deviation of 0.897 and the experimental group has a mean score of 8.9523 and standard deviation of 1.002.In order to find out whether there is significant difference between the two means t-test was performed. It has been assumed that the distribution of the achievement scores for the pre-achievement test for the groups was normal.

The value in Biology for the control group has a mean score of 8.9523 and a standard deviation of 1.032 and the experimental group has a mean score of 10.1904 and standard deviation of 1.654. In order to find out whether there is significant difference between the two means t-test was performed. It has been assumed that the distribution of the achievement scores for the pre achievement test for the groups was normal.

The obtained t-value is less than table t value at 0.05 level of significance. Hence, the null hypothesis is not rejected. This show that the significant differences between the pre-test mean scores of the two groups have the same cognitive level before the study was conducted.

II .The difference between the post-achievement scores in chemistry, physics, and biology of experimental and control groups, class X

The effect of practical skills using science kits based teaching and non-practical skills using science kits based teaching approach in chemistry, physics and biology was determined. The actual scored of the two groups were treated. The null hypothesis that there is no difference in the post-achievement scores of experimental and control groups.

Table 1.3: the difference between the post-achievement scores in chemistry, physics and biology of experimental and control groups class X

Group	Mean	SD	DF	t
Chemistry Control	14.7619	1.353	25	9.987
Experimental	15.5238	1.998		
Physics Control	12.0952	0.867	26	2.432
Experimental	12 .9523	0.987		
Biology Control	12.5714	1.213	25	9.875
Experimental	13.4285	1.978		

Table 1.3 shows the student taught with the practical skills using science kits in chemistry had a post-test mean score of 15.5238 and a standard deviation of 1.998 while the group which was not taught with the practical skills using science kits had a pre-test mean score of 14.7619 and std. Deviation of 1.353. The t ratio of 9.987 has an associated probability of 0.00. The t-value obtained is greater than the table t value at 0.01 level of significance hence the null hypothesis is rejected. Therefore, there is a significant difference between the achievement scores of the two classes after intervention.

The students taught with the practical skills using science kits in physics had a post-test mean score of 12.9523 and std. deviation of 0.987 while the group which was not taught with the practical skills using science kits had a pre-

test mean score of 12.0952 and STD deviation of 0.867. The t ratio of 2.432 has an associated probability of 0.01 .The t-value obtained is greater than the table t value at 0.01. Level of significance hence the null hypothesis is rejected. Therefore, there is a significant difference between the achievement scores of the two classes after intervention.

The students taught with the practical skills using science kits in biology had a post-test mean score of 13.4285 and std. deviation of 1.978 while the group which was not taught with the practical skills using science kits had a pre-test mean score of 12.5714 and std deviation of 1.213. The t ratio of 9.875 has an associated probability of 0.01 .The t-value obtained is greater than the table t value at 0.01. Level of significance hence the null hypothesis is rejected. Therefore, there is a significant difference between the achievement scores of the two classes after intervention.

After the intervention the respondents of the two groups varied statistically in terms of their chemistry, physics and biology achievement. It also signifies that the practical skills using science kits as a tool in teaching science(chemistry, physics and biology) did enhance better achievement of students than the traditional method i.e., non-practical skills using science kits.

III. The difference between the pre and post achievement scores of the students taught with the help of practical skills using science kits approach, class X

The pre and post achievement test were administered in order to find out whether was a significant change on the achievement of the students taught with the help of practical skills using science kits in science (chemistry, physics and biology). Table 1.4 shows the difference between the pre and post achievement scores of the students taught with the help of practical skills using science kits.

Table1.4: T**he difference between the pre and post achievement scores of the students taught with the help of practical skills using science kits, Class X**

Group	Mean	SD	df	t
Chemistry Pre-test	11.8095	1.765	25	11.765
Post-test	15.1428	2.032		
Physics Pre-test	8.71428	1.453	25	12.905
Post-test	12.5238	1.904		
Biology Pre-test	9.57142	1.056	25	11.231
Post-test	13.000	1.897		

The table 1.4 shows a remarkable difference in the mean scores of the students before and after intervention. Before intervention the mean score of the students in chemistry was 11.8095 with a STD deviation of 1.765 which was increased significantly to 15.1428 with a standard deviation of 2.032 after intervention. The table also shows that the t-ratio is 11.765 after the null hypothesis is rejected. The obtained t value is greater than the table t value at 0.01 level of significance.

A remarkable difference in the mean scores of the students before and after the intervention. Before intervention the mean scores of the students in physics was 8.7142 with a standard deviation of 1.453 which was increased significantly to 12.5238 with a standard deviation of 1.904 after intervention. The table also shows that the t-ratio is 12.905 which show that the null hypothesis is rejected. The obtained t value is greater than the table t value at 0.01 level of significance.

A remarkable difference in the mean scores of the students before and after the intervention. Before intervention the mean scores of the students in biology was 9.5714 with a standard deviation of 1.056 which was increased significantly to 13.000 with a standard deviation of 1.897 after intervention. The table also shows that the t-ratio is 11.231 which show that the null hypothesis is rejected. The obtained t value is greater than the table t value at 0.01 level of significance.

Hence, there is significant difference between the pre and post achievement scores of the students taught with the

help of practical skills using science kits (experimental group). Thus, the null hypothesis is rejected. The students showed keen interest and performed better with practical skills using science kits teaching approach.

The result shown in the table means that there is significant increase in the mean score of the students after the intervention as well as the traditional approach of teaching is also effective in improving the performance of students in science; therefore, it should not be discarded. But the practical skills using science kits have more impact hence it should be employed in teaching of science.

SUMMARY AND CONCLUSION

In the present study efforts were made to study the effectiveness of training programme on the use of secondary science kits at school level teaching learning material of Demonstration Multipurpose School students (class X).

Based on the findings of the study, the following conclusions were drawn

- The practical skills using science kits of teaching is effective in enhancing students' achievement and inspiring, motivating to develop modules of interest to understand the concept with clarity.
- The achievement scores of pre and post control group were satisfactory.
- The achievement scores of pre and post experimental group were found to be more than the control group which was encouraging
- The achievement scores of pre and post test of experimental group did not show a significant difference, which suggest there is no difference in the understanding level of the students.
- The pre-test scores indicated that the two groups respondents had the same cognitive level before the study was conducted.
- After the intervention the two groups varied statistically in terms of their achievement in science (chemistry physics, biology).
- The enhancement in the achievement scores of after the intervention signifies that the developed practical skills using science kits can serve as a tool in teaching learning process of science.
- The higher post achievement scores of the experimental group attributes to the fact that the students are interested to accept a change in the methodology of teaching learning process from traditional method to the practical skills using science kits method.
- The students were highly motivated to play an active part in their acquisition of knowledge by giving them an active role of learning which helped them to perform better after the intervention.

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