



ORIGINAL CONTRIBUTION

Effectiveness of Low Cost Material to Teach Science at Primary Level

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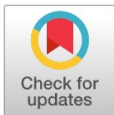
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Abstract— The main objective of the study was to develop the interest and conceptual knowledge about science in students. For this purpose, the 'Low-Cost Material' concept was taught to the students using different instructional aids. The study was quantitative in nature. Experimental research design was used to check the effectiveness of low-cost material to teach science at the primary level, which were measured through pre and post-test. An action research was conducted in a public sector high school in Rawalpindi. Students of 4th grade were selected to conduct the study. Intervention was carried for one whole week. Pre-test and post-test were taken to collect data, and the collected data was analyzed using mean and *t*-test. The study found a significant difference between teaching of science through use of "low-cost material" and without using it. The students, when taught science by using "low-cost material", "performed significantly high on the post-test. It was concluded that using low-cost material to teach science positively affected students' learning. The study will act as a model and guideline for science teachers at primary level to make their teaching more effective by using "low-cost material" as AV aids during science lessons. This will contribute to better science teaching in schools with low or no resources for science teaching.

Index Terms— Low-cost material, Instructional aids, Conceptual knowledge, Students' learning, Science teaching, Primary level, Public sector

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Introduction

Education is the basic need of every person. Education is something that makes a person self-reliant and selfless. It is an ongoing process; we learn from our mistakes and experiences. It is a constantly learning phase and lifelong journey.

Education is not a preparation for life but the living. Education is the process of living through a continuous reconstruction of experiences. It is the development of all those capacities in the individual which will enable him to control his environment and fulfill his possibilities". According to (Alsop & Hicks, 2013) "The influence of the environment of the individual to produce a permanent change in his habits of behavior, or thought and attitude."

Science education

Science is a mental activity planned to discover new knowledge or information about the world in which humans live.

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The word Science comes from Latin word Scientia meaning knowledge or to know."It is a systematic Knowledge-Based or prescriptive practice capable of resulting in predication science can also be science tells people how the world operates. The term science is defined in many ways by many people in every area. According to Memon, (2007).

"Science is a cumulative and endless series of empirical observations which result in the formation of concepts and theories, with both concepts and theories being subject to modification in the light of further empirical observations. Science is both a body of knowledge and the process of acquiring it."

Science is defined as the observation, identification, description, experimental investigation and theoretical explanation of natural phenomena. According to the present studies of researchers, Science is scientific information, a method that helps in making hypotheses, and a way of observation. Mohan (2002) defined Science as "a multidisciplinary and dual subject in which man subject are related .it has two interconnected disciplines."

Knowledge

Understood as highly-skilled techniques or practices." According to John Woodburn and E.O.Obourn, "Science is a human endeavor that seeks to describe the events and circumstances which occur or exist within our natural environment."

As yearly (2005) defined that science is a measure of knowledge

Skills

These two disciplines make science isolated or special.Basic purpose of teaching science at primary level is its contribution to children's development towards being an adult in a world. According to Sun and Vaidya (1996), the term science is "Etymologically synonymous with knowledge"; therefore, Science is systematic knowledge. Sykes defined "science as systematic and formulated knowledge that is based on observation, experiments, and inductions." Mohan (2002) explained a threefold nature of science.

- Body of knowledge
- Way of investigation
- A way of thinking

Science is a system of acquiring knowledge based on the scientific process or method in order to organize a body of knowledge gained through research. According to Einstein science, "An attempt to make the chaotic diversity of our sense experience correspond to logically uniform system of thought".

Science teachers have realized that learning through investigations helps pupils to gain maximum understanding of the scientific concepts. Pupils with the opportunities to investigate, explore and draw conclusions learn faster than those without these opportunities (Hussain. I, 1998).

Teaching Method for Science

There are varieties of methods that a teacher can use for teaching science. However, the choice of a method depends on the objectives of education and the conditions under which learning is to take place. Yitbarek (2012), classified all teaching methods into three categories: oral, observation, and practical. These categories have further teaching techniques that teachers use during their teaching of subjects.

- Oral Method
- Observation Method
- Practical Method

There are following important methods that are used for teaching science.

- Lecture method
- Ask questioning method
- Demonstration method
- Discussion method
- Collaborative learning
- Laboratories

Instructional aids

Instructional materials, also known as Teaching/Learning Materials it, is any collection of materials, including animate and inanimate objects and human and non-human resources that a teacher may use in teaching and learning situations to help achieve desired learning

objectives. Instructional materials are defined as “resources that organize and support instruction, such as textbooks, tasks, and supplementary resources” (adapted from Remillard & Heck, 2014).

Types of instructional aids

Instructional materials have the following types, which include prints, visuals, and audiovisuals:

Prints: It includes textbooks, pamphlets, manuals and study guides, etc .

Audio title: It includes a microphone, cassettes.

Visual: It includes charts, real objects, photographs, transparencies.

Audiovisual: It includes multimedia, television, films, tapes, slides, videos, and film strips.

Low Cost Teaching Aids

Low cost teaching aids require no cost or less expensive and are prepared with simple material or resources and expedite the learning process in the classroom. The science teacher with a certain amount of skills and enthusiasm can replace many pieces of apparatus with an adequate approach to the teaching-learning process.

Effective science teaching depends on the three-factor Teaching, equipment, and material. Locally produced low-cost equipment, teaching aid, or models can serve the needs of the teacher, the students and the curriculum more effectively and is easier to maintain (Simo, Fernandez, Algaba, Salan, Enache, Albareda-Sambola, ... & Rajadell, 2010).

In spite of various efforts, the shortage of school laboratory equipment continues to be a major problem which should be of serious future concern.

As the economic and national development of our country greatly depends on the quality of education, we provide to our future scientists.

The study deals with the low cost teaching aids and its importance to teach science concepts in the present situation at primary level. Since most of the primary schools are situated in rural areas, they are not able to procure the needed equipments. Another factor is secondary schools suffer for want of adequate funds to procure teaching aids. Teachers should realize the present situation and they must encourage the children to utilize the resources available in the immediate environment to prepare the teaching aids. If the science concepts are taught with the help of teaching aids children remember these concepts for a long time (Hope, 2004; Khitab, Zaman, Ghaffar, & Jan, 2015).

Science is the subject which is commonly used in our daily life. By reviewing the literature it is observed that several studies are conducted by the researchers of other countries to find out relationship between the instructional aids and students achievement at different levels, but less researches has been carried out to find out the effectiveness of low cost instructional material in the subject of science specifically at Pakistan. Therefore the purpose of this study is to find out the effectiveness of low cost material to teach sciences students at primary level.

Operational Definition of Term Science

According to Memon (2007). “Science is a cumulative and endless series of empirical observations which result in the formation of concepts and theories, with both concepts and theories being subject to modification in the light of further empirical observations. Science is both a body of knowledge and the process of acquiring it”

Problem statement

Science is the subject which is commonly used in our daily life but it has been observed, that teachers are not using effective ways to teach science. Teacher don't teach students with different methods that can help students to think out of a box, and that helps them to spark new ideas and bring out the creativity in student's thinking. The resources are not available in the government school so science teacher make low cost material to teach science for the better understanding of the student and make their learning long lasting

Research Objectives

The objectives of the study were.

1. To orient the teachers about the importance or use of low cost material to teach science.
2. To find out the effectiveness of low cost material on the students' performance.

3. To compare the performance of students before and after the intervention.

Research Questions

The research questions of the study were.

- i. Is low cost teaching material make teaching of science interesting?
- ii. How low cost materials are used to teach science?
- iii. What is the performance of student's before and after the interventions?

Delimitations

Following were the delimitations of this study:

- i: The study was performed in only one Government school.
- ii: At primary level only grade 4th was consider for this study.
- iii: The subject science and concept sound was considered for this study.

Significance of the study

This study helps the teacher to teach science to the students more effectively by using low cost material. An effective learning can also be done by using low cost material in the classroom. Activities have a huge significance in the learning process. It engages students helping them to develop important skills understand the process and develop broad understanding of concepts. Students will take interest in understanding science concepts through low cost material. The outcomes of this research develop the importance of low cost material to teach science at primary level. It is very difficult to establish science laboratories and demonstration rooms due to financial constraints and lack of resources. Many science equipment for several experiments can be produced under their low cost variety.

Research Methodology

This study was based on quantitative research to check the effectiveness of low cost material to teach science at primary level which were measured through pre and post-test. Qualitative research is based on by collecting a numerical data.

Research design

The study was Quasi experimental and this type of study does allow conclusion to be drawn about before and after the interventions. Experimental research is the best way to investigate the effect of low cost material to teach science at grade 4th. Lesson plans with effective strategies and activities were designed to complete the study. Activities are designed according to the mental level of student. Pre-test post-test control group design was used. Researcher developed a lesson plan of science subject on the topic Introduction of Sound which was executed in grade 4th.

Population

The population of the study was the students of 4th grade studying general science at primary level in Government school of Rawalpindi.

Sample and sample techniques

The sample was taken from defined population i.e. students. As a sample there are 50 students in the class. The class was divided into two sections and each section had 25 students. Section A is control group and Section B is experimental group. Every group held 25 students. Total 50 students are involved. As a researcher taught science to both the groups; control group with traditional method and experimental group with low cost no cost material. The study was experimental and require one school with one class.

Statistical analysis

For the analysis of data Statistical Package for the Social Sciences (SPSS) software was used the t-test were applied for the analysis of Pretest and post-test.

Instruments of the study

A close ended pre-test and post-test type test was used as a tool of the study . which is constructing on the basis of student’s mental level

Pre-test

Pre-test is used to check the previous knowledge of the students on the limited concepts. I was used a pre-test in this study to check the previous knowledge of students of 4th class about science (Introduction of Sound). The total marks of test were 20.

Post-test

Post-test is used to check the effects of the treatment on specific group. Researcher checked the effects of low cost material on the students learning. After taking pre-test, researcher taught science (Introduction of Sound) both control and experimental group. For the control group of the study reading method was used and on the other hand, the study was experimental in nature.Pre-test and post-test were used for data collection. Data was analyzed on statistical basis by using paired-sample t-test. SPSS (Statistical Package of Social Sciences) was used to compare the performance of two groups. The next chapter will reflect upon the means and standard deviations of pre-test and post-

Data Analysis

The experimental group taught by low cost material. validation of tool For the validation, pre-test and post-test were given to three teachers for the improvement and feedback. Teacher guided to re-arrange the sequence of pre-test and post-test for the better understanding of the students.

Pilot testing

Self-made pre-test and post-test were used for data collection. For the reliability and validity purpose, the test was pilot tested to make sure the reliability and validity of it. It was pilot tested for the improving of test items. The basic aim of pilot testing was the judgment off research tool (test). It also done in Govt. Millia Islamia boy’s high school in which further research was conducted. Four expert science teachers checked test validity including two science teacher from school and two teachers from university level. They gave their comments for improving the test items, so that to make the test more understandable and reliable for the student of fourth grade.

Test for data analysis

Test and the results of paired sample *t*- test with description.

Mean and standard deviation of pre-test and post-tests marks were calculated to analyze the data. For paired sample *t*-test was applied to check the significant difference between means of pre-test and post-test marks.

The study was conduct to evaluate the effectiveness of low cost material to teach science at grade 4th. The pre-test and post-test were conducted and employed on both groups which were control and experimental group. Data were analyzed by using SPSS. Control and Experimental group were compared by applying *t*-test.

- Firstly, the researcher analyzed the mean difference of pre-test of control group and experimental group.
- The researcher analyzed the mean difference of pre-test and post-test of experimental group and mean difference of pre-test and post-test of control group.
- T-test was applied on the post-test of both control group and experimental group.

Table I
Statistics mean difference of pre-test scores of control group and experimental group.

	Pre-Test Control Group	Pre-Test Experimental Group
N	25	25
Mean	7.00	7.12
Minimum	3	3
Maximum	10	11

Table I represents the mean difference of pre-test scores of both groups. The mean difference shows that the scores of the students of both groups were same before intervention.

Table II
Mean difference of pre-test and post-test of experimental groups

	Pre-Test Experimental Group	Post-Test Experimental Group
N	25	25
Mean	7.96	18.24
Minimum	3	16
Maximum	12	20

Table II shows significant difference between mean scores of pre-test and post-test of experimental group after intervention. This result shows an obvious positive variation in mean score of pre-test and post-test of experimental group. Which means that learning enhanced three times when students were taught science through low cost material.

Table III
Mean difference of pre-test and post-test of control group

	Pre-test con	Post-test con
N	25	25
Mean	6.88	10.52
Minimum	3	8
Maximum	10	13

The above mentioned table shows significant difference between mean scores of pre-test and post-test of control group. The mean test scores of pre-test of control group was 6.88 and mean test score of post-test of control group was 10.52. This result shows an obvious positive variation in both mean scores which means that some learning has occurred when students were taught science through traditional method.

Table IV
Paired samples statistics

	N	Std. Deviation	Std. Error Mean
pair 1 Post Test Control Group	25	1.417	.283
Post Test Experimental Group	25	.881	.176

There is significant increase in mean score of post-test of experimental group i.e., 18.23 as compared to mean of post-test of control group i.e., 10.56, This result shows that the students who were taught through low cost material effectively as compared to the other group.

Table V
Mean, standard deviation, and *t*-Value for male and female wisdom level (*N* = 300)

		Paired Differences					<i>t</i>	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Post Test Control Group – Post Test Experimental Group	-7.560	1.710	.342	-8.266	-6.854	-22.108	24	.000

The calculated value *t* = -22.108 which is less than the table value i.e. 1.699 fixing alpha at 0.05 with *df* = 24. (-5.514 < 1.699 < 0.05). Hence we reject our null hypothesis and our research hypothesis is accepted which states that use of low cost material to teach science at primary level has significant positive effect on learning science concepts at primary level.

Discussion and Conclusion

Purpose of the study was to check the use of low cost material to teach science at primary. The focused of this study was to use low cost material for teaching science at primary level. In science, the researcher teach and chose the Chapter “Introduction of Sound” at grade 4th. The finding were analyzed according to research questions of the study. The research questions were as:

- Is low cost teaching material making teaching of science interesting?

- How low cost materials are used to teach science?
- What is the performance of the student before and after the intervention?

The limitations of the study, implications and recommendation for future research possibilities are also discussed in detail below. Data were collected through pre-test and post-test. The quantitative analyses of the data and findings are presented below.

Findings of the Study

The findings of the analyzed data were organized according to research questions of the study. Findings of the present study are discussed in relevance to the research question. The findings of the study show that the treatment had positive effect on the students' learning. The post-test indicated that the learning of students got better and the interest of students also increased in learning Science through low cost material.

Findings related to first research question

First question of the study was 'Is low cost material make teaching of science interesting? With the help of the students' scores before and after the use of low cost material, it is found that the low cost material is useful for students learning. This study revealed that low cost material helps to develop students' interest in science subject because most of the teachers use lecture and traditional methods which do not attract students towards learning process. Teaching through low cost material engages student in the learning process and instruct them better than traditional learning. It also helps to enhancing their knowledge.

Findings related to second research question

Second question of the study was 'How low cost materials are used to teach science?' The study revealed that low cost material is an innovative and new method for teaching science in government schools because mostly in government schools this subject is used to be taught through lecture methods (Ary et al., 2018; Ford, Hayes, Byford, Edwards, Fletcher, Logan, ... & Ukoumunne, 2019). Teaching science through low cost material has several benefits it has many visuals and colorful activities which attract students towards the learning process. The learning through low cost material is long lasting and students will remember science concepts more effectively.

Findings related to third research question

Third question of the study was 'What is the performance of the student before and after the intervention?' The student's scores before and after the teaching indicated that the low cost material had positive effect on students' learning. The mean scores of post-test indicated that students performed better after the intervention. Before the use of intervention, the score pre-test of the students was low. The mean of the pre-test score was 10.56 (table IV) which shows that students' scored low in the pre-test of control group. On the other hand, after the intervention, scores of the students got increased. The mean of the post-test score of experimental score was 18.12 (table IV) which shows that the students' scored high after the intervention.

Conclusion

The study was conducted to identify the usefulness of low cost material to teach science. The study concluded that the use of low cost material to teach science had positive effect on students' learning. It was helpful for student in the following ways.

- The performance of students was improving by using low cost material.
- Students showed their involvement and they were actively participating in science by using low cost material.
- By using low cost material, the student's concepts were developing and being cleared.
- Use of low cost material is economical. It also helped students to participate in class and share their ideas. Students also learn that how to work in groups with cooperation and collaboration.

Limitations

The study was limited to science teaching at grade 4. The intervention was limited to only one week. The teaching of science during intervention was aligned with the availability of low cost material

Discussion

The study was designed to analysis of using of low cost material to teach science. Findings indicate that low cost material has positive influence on students learning (Farid, Kanwal, Ameer, & Karim, 2021; Khitab et al., 2015). The sample of 25 students was taken from targeted school. Pre-test and post-test was designed for collection of data. With the help of the student's scores before and after the use low cost material, it is found that it is useful for students learning. This study revealed that low cost material helps to develop student's interest in science subject because most of the teachers use traditional methods which do not attract students towards learning process. Teaching through low cost material engages student in the learning process and instruct them better than traditional learning (Yitbarek, 2012) It also helps to enhancing them. Students can experience the science through real-life things. The study revealed that low cost material is an innovative for teaching science in government schools because mostly in government schools this subject is used to be taught through traditional methods. The findings of this research are aligned with that of (Siva, 2014). The findings of this study are also aligned to some extent with that of (Khitab, 2015). The student's scores before and after the teaching indicated that the low cost material had positive effect on students' learning. The mean scores of pre-test and post-test indicated that students performed better after the intervention. Before the use of intervention, the score of the students were low. The mean of the pre-test score was 10.56 table IV which shows that students' scored low in the pre-test of control group. On the other hand, after the intervention scores of the students got increased. The mean of the post-test score was 18.12 table IV which shows that the students' scored high after the intervention.

Recommendations

On the basis of the findings and conclusion of the study, it is recommended that teacher need to make low cost material for students and make the subject interesting and enhance the level of understandable.

- Teacher should be encouraged to make their practical session utilizing the low cost material.
- School should popularize the concept of low cost material in science through organizing science exhibitions and science fairs.
- Held proper workshops for science teachers that specially focused that how to make and how to use low cost material.

Recommendations for future research

The study recommends that : There should be more studies conducted to investigate the variety and usability of "low cost material" for science teaching. It is also recommended to investigate the usability and effectiveness of "low cost material" at higher levels (elementary and secondary). A study could be conducted to check teacher's perceptions, motivation and reflection on utilization of " low cost material in their teaching. The use and effectiveness of "low cost material" can be studied for all subjects other than science.

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