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Theme: Learning by doing Sub theme: Innovative use of low cost/no cost teaching learning materials

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ABSTRACT: *It is in this context that the Science teaching and learning, use of environment and local resources has been recognised as one of the basic areas of school curriculum in many developing countries including India. Keeping in view the significance and importance of 'learning by doing' this study has analysed the studies of national and International level. The nature of this conference paper is survey type. It consists of three parts. The first part explains the importance of Science teaching, learning by doing, adoption of Inquiry based approach and Aims and objectives of Science teaching. The second part explains the necessity of preparation of 'low cost no cost science material', its importance and utilisation in science teaching, especially in developing countries at grassroots level. The third part discusses the findings of selected research study and put forth the suggestions for effective implementation of ' learning by doing ' with the help of concreting teaching in Science, TLM and low cost/no cost material. It also recommended fixing of well organised Monitoring mechanism for the betterment of science teaching at Elementary school level.*

Keywords: *Science Education, Learning by doing, low cost/no cost material, Inquiry based approach.*

I. Introduction

Introduction Indian education commission (1964-66) defined the Education ought to be related to the life, need and aspirations of the people and thereby made powerful instrument of social economic and cultural transformation. Teacher is a very important part of education. Teacher is the custodian and architect of students' future. The future of every country is in the hand of teacher. Teachers play a vital role in fostering the intellectual and social development of children during their formative years. The education that teachers impart plays a key role in determining the future prospects of their students, whether in pre-schools or high schools or in private or public schools, teachers provide the tools and the environment for their students to develop into responsible adults.

Teachers act as facilitators or coaches, using classroom presentations or individual instruction to help students learn and apply concepts in subjects such as science, mathematics, or English. They plan, evaluate, and assign lessons; prepare, administer, and grade tests; listen to oral presentations; and maintain classroom discipline. Teachers observe and evaluate students' performance and potential and increasingly are asked to use new assessment methods. For example, teachers may examine a portfolio of a student's artwork or writing in order to judge the student's overall progress. They then can provide additional assistance in areas in which a student needs help. Teachers also grade papers, prepare report cards, and meet with parents and school staff to discuss a student's academic progress or personal problems. Many teachers use a "hands-on" approach that uses "props" or "manipulative" to help children understand abstract concepts solve problems, and develop critical thought processes. For example, they teach the concepts of numbers or of addition and subtraction by playing board games. As the children get older, teachers use more sophisticated materials, such as science apparatus, cameras, or computers. They also encourage collaboration in solving problems by having students work in groups to discuss and solve problems together. To be prepared for success later in life, students must be able to interact with others, adapt to new technology, and think through problems logically. It is the teacher, who has the privilege of shaping and mouldings the habits, interests, attitudes, sentiments, behaviour, and character of pupil.

Elementary Education Elementary education in India means eight years of schooling from the age of six. The government has made elementary education compulsory and free. Through "Sarva shiksha Abhiyan" (S.S.A) primary schools are upgraded and they named as elementary schools. Elementary schools provide education from class 1st to class 8th. The children in these classes are generally aged between five to fourteen. The major goal of elementary education are achieving basic literacy and numeracy amongst all pupils, as well as establishing foundations in science, geography, history, and other social sciences.

Science plays an ever increasing role in the modern civilization. It is our primary duty to see that every individual should have at least an elementary knowledge of the scientific principles involved in everyday life. Teaching of science is not mere transaction of science based knowledge so as to load students' mind with facts and figures. At elementary level, science is taught through theory as well as practical. All though, at higher education a part of science tends towards more abstract and theoretical, but at lower stage, experimentation and demonstrations are essential components for explaining many of the concepts. So often we say 'Science is doing' because it is highly desirable to incorporate activities, supporting the theoretical teaching so as to leave a permanent impression of understanding. While teaching the topic, if the phenomenon is explained by doing an actual experiment makes teaching more effective. Science has played a tremendous role in our lives during the last century and it now changing our entire existence in such important aspects of health/ communication, transformation power. To visualize what science has done for man, it is simply necessary to sit in a modern room and look around. Science is universal and so can be its benefits. Its material benefits are immense and far reaching industrialization of agriculture and release of nuclear energy, mention two examples- but even more profound is its contribution to culture.

II. Importance of learning by doing

Learning by doing helps students perform better in science. Students who physically experience scientific concepts understand them more deeply and score better on science tests, according to a new U Chicago-led study.

Brain scans showed that students who took a hands-on approach to learning had activation in sensory and motor-related parts of the brain when they later thought about concepts such as angular momentum and torque. Activation of these brain areas was associated with better quiz performance by college physics students who participated in the research.

"This gives new meaning to the idea of learning," said Beilock. "When we're thinking about math or physics, getting students to actually physically experience some of the concepts they're learning about changes how they process the information, which could lead to better performance on a test."

"In many situations, when we allow our bodies to become part of the learning process, we understand better," Beilock said. "Reading about a concept in a textbook or even seeing a demonstration in class is not the same as physically experiencing what you are learning about. We need to rethink how we are teaching math and science because our actions matter for how and what we learn."

The key to combating young people's declining interest in science is the adoption of a inquiry-based, 'learning-by-doing' approach, argues an expert group:

The expert group established by the Commission to find policy recommendations to improve science teaching in European primary and secondary schools delivered its report on 12 June 2007.

The major conclusion of the report entitled 'Science education NOW: A renewed pedagogy for the future of Europe' is the need "to change the way in which teachers are working and convince them to change their pedagogical methods", explained Csermely. This change implies a shift from the traditional, mainly deductive science-teaching pedagogy to **inquiry-based methods** ('learning by doing method') to combat young people's waning interest in science.

Aims and Objectives of Science Teaching:

The general aim of science education is to helping development of well defined abilities in cognitive and affective domains, besides enhancing psychomotor skills. It helps to faster an uninhibited spirit in inquiry, characterized by creative, innovative and objective approaches.

Educational programs are designed to help unravel the mysteries of the inter relationship between science and day to day life, health, agriculture, industry, and indeed, the individual and universe.

The emphasis on science education can be observed in the educational policies of the developing countries. In India, through the effect of national council of educational research (NCERT), science has been made a compulsory throughout the school stage.

Scholarly Research Journal for Interdisciplinary Studies / Mehatab; & Dhanwinder, (90-99) Teaching aids provide a stimulus for exploration and thinking. With the added input of verbal, personal communication with an adult interaction and discussion arise…. And these are crucial to real, activity based learning. Adults and older children, help younger ones to interpret sensory and language experiences to clarify them and relate them to their previous understandings. Children that learn by blending language with experiences, they learn to think.

For maximum mental growth and personality development, a child's life needs to be filled with stimulating, encouraging experiences. Appropriate learning materials (teaching aids) help children to develop their innate abilities.

About 98% of all incoming information to the brain comes through the senses. Add to that the fact that over 87% of the learners in the classroom prefer to learn by visual and tactile means and you have a recipe for failure if the primary methods of teaching are auditory. In Growing up Digital (1998), Don Tap Scott said that this generation prefers to be active participants in all that they do.

Low-cost / No-cost teaching material there is a paradigm shift in classroom pedagogies used by teachers around the world.

Objectives of this paper:

The main objectives of this conference paper are:

1. To know the importance of science teaching through' learning by doing.'
2. To know the research studies on status of Utilisation of low cost no cost teaching material at grassroots level.
3. To give appropriate suggestions for effective utilisation of low cost and no cost material for science teaching.

In the micro innovations article published this week (MI | Learning Phonics on Mobile Phones) , we featured Sadaf, an elementary school teacher, who used her cell phone as a multimedia device to teach Phonics to students in a low-income school. Very often, when we say "innovative teaching aids" people begin to think of technology and devices. It's because technology has helped bring a whole bunch of innovative teaching aids to schools that can help change the teaching and learning experience for the better. But, the reality is that a large, very large percentage of schools across the world may still not be able to afford technology-driven solutions. Thus, students enrolled in such schools often miss out on the benefits of "innovative teaching aids", until a person like Sadaf comes along, who devises an innovative idea while operating in a highly-constrained environment.

In this article we share resources that explain how teachers can build low-cost teaching aids and create an engaging and immersive learning experience for their students. These resources are simple, use every day material, and can be easily used by teachers across all schools.

Conventional teaching-learning methodologies are fast giving way to newer, innovative and efficient pedagogies. Chalk-and-talk though not fully redundant, has become somewhat obsolete and is considered pitiably inadequate in the contemporary educational scene. All over the world teachers are innovating new teaching aids to make teaching-learning processes more interesting and effective. Learning takes place when the environment is exciting and active. Making and using teaching and learning materials is an important part of teaching in many parts of the developing world there are few manufactured teaching materials for purchase and if they are available tend to be very expensive.

III. Importance of low cost/no cost teaching materials:

Import of teaching material from other countries at a given level is a heavy financial burden for a developing country like India. Low-cost teaching material is that which produced by the factories of local areas of the country. Its spare parts are also easily approachable and its cost is always low than imported equipments from other countries. Low - cost teaching aids involve minimal or nil input costs as they are made from household waste and discarded items or from materials readily available in our immediate surroundings and natural environments.

Sometimes the standard teaching aids may remain out of reach – may be due to any reason. Look around, quit possible one gets something from the surrounding, which may serve as a better teaching aid for the topic. A step further, perhaps he who is innovative, may prepare such an aid for the available materials from here and there, low cost-no cost teaching material is the term that refers to an offhand construction of a teaching aid with simple available materials costing little or nil. No-cost teaching material is mater is that which a teacher can use by carrying it from local sources. It may waist things which a teacher can use as a teaching aid. Low-cost teaching aids can be used in nursery, primary, middle, secondary and senior secondary schools.

Of course, the type as well as number of aids to be used in a given subject would vary from one class to another. But broadly speaking, primary and middle school students can be engaged in making simple items with rudimentary materials such as bits of paper, cardboard and thermocole using scissors, glue etc, whereas senior school students could develop teaching aids using metal, wood, plastic, rubber etc.

The major concerns of developing countries are food supply, livelihood, health, nutrition and growth and economy. At the level of the student and his family, food, health, and livelihood are primary concerns. In developing the need is great for self-reliance in (science) teaching at country level and more importantly at teacher level. The use of Low-cost/No-cost teaching material for science education has certain important advantages in developing countries like India.

Cheapness:-Investments in equipment for all students at a given level are a heavy financial burden for a Developing country. Essential follow-up procedures like teacher training in the pedagogical and technical use of the equipment, provision of maintenance, and replenishment, etc., are sometimes not accomplished because of the lack of funds.

No fear of loss:-There is another risk in connection with the high cost of equipment. It is sometimes safely locked up in the school and not used at all, because the teacher is afraid that he/she or the students might break it and that he/she will have pay for it from his/her own pocket.

Proper use:-The costs of locally produced equipment are often but no always, lower than the imported equipments. When calculating the cost of the equipment some factors should be kept in mind. They are durability of the equipment, additional installation costs, service costs, cost of teacher and technician training. We should also keep in mind that most expensive equipment is that which is never used.

Same principles:-Low cost equipments illustrate the same principles as imported expensive equipments.

Maintenance and repair:

If equipment is simpler in design, teachers, laboratory technicians and local craftsmen are more likely to be able to carry out small **repair.**

Relevance to the curriculum:

In practice, development of low cost equipment is often at the sometime involved in curriculum design.

Higher school content: - Equipment made of parts and material familiar to the students is more likely to help the students.

Self reliance:

It cultivates confidence and expertise to educator in developing country.

Related to real life:-Teacher needs to realize the significance of practical work in science education as well as the use of social resources in laboratory activities.

Helpful for teacher:-Because of overcrowded classroom, teacher cannot provide individual attention to students.

Strength:-Made of paper, wood, metal, string etc such equipments can be treated roughly with no damage. Hence pupils feel more at ease.

Economic:-It is very difficult to establish science laboratories and demonstration rooms due to financial constraints. Much science equipment for several experiments can be produced under their low cost variety.

Active method, Group work, Fun:-Making and using low cost equipment encourage the active method and group work can be great fun, each pupil can make his or her own equipment and even bring it home. It is the active method of learning.

Envisaged changes in the curriculum are sometimes not taken into account in connection with equipment purchase, even if they are supposed to happen in the near future. On the other hand, in practical implementations of the curriculum there is sometimes little or no time allotted for practical work. Another

possibility is that the educational value of the experiments is low because they fail to demonstrate scientific concepts convincingly, or do not illustrate the connection between scientific principles and the real world. The reasons might be use of unfamiliar materials, practical work following 'cookbook recipes' without real understanding of the process, or use of 'black boxes' - unexplained and unfamiliar equipment where input and output do not have any apparent connection.

Low-cost teaching aids can be used for supplementary and illustrative education in the sciences as well as the humanities. However, they are most suitable for subjects like science, geography, mathematics and art and crafts. In a resources-starved economy such as India where the masses need to be educated about how to properly dispose household waste and used items and huge piles of garbage and trash is dumped on roadsides and street corners, low-cost teaching aids made from household waste and trash serve a particularly useful purpose. With a bit of creativity and imagination, scraps of metal, wood, plastic, rubber, paper etc can metamorphose into valuable items, which can be used as effective teaching tools. System-wide use of low-cost teaching aids will not only boost teacher/student creativity and involvement, help institutional budgets go a longer way, but also serve to keep our immediate environments clean. The equipment is not always relevant to the curriculum. In other words, it is designed for experiments that do not suit the curriculum.

Investment in equipment for all students at given level is a heavy financial burden for a developing country like India. Foreign exchange is usually scares, while the equipment is rather expensive, considering the large number of schools. This result is uneven and only practical supply of schools. Developed and produced on campus, they help institutions become self-reliant and reduce costs of education. Incremental and selective use of low-cost teaching aids makes the process of teaching and learning more varied, interesting and effective.

Available equipment is not always relevant to the curriculum. In other words, it may design for experiments that do not suit the curriculum. Envisaged changes in the curriculum are sometimes not taken into account in connection with equipment purchase, even if they are supposed to happen in the near future. On the other hand, in practical implementations of the curriculum there is sometimes little or no time allotted for practical work. Another possibility is that the educational value of the experiments is low because they fail to demonstrate scientific concepts convincingly, or do not illustrate the connection between scientific principles and the real world. The reasons might be use of unfamiliar materials, practical work following 'cookbook recipes' without real understanding of the process, or use of 'black boxes' - unexplained and unfamiliar equipment where input and output do not have any apparent connection.

Significance of the problem Science is the most important subject and it helps to develop the problem solving, reasoning power, creativity of the students. We can say that science prepare a child to life.

Science courses are becoming difficult not only due to conceptually difficult content but also due to our formal and didactic approach of teaching science. This process of teaching and learning of Science doesn't fascinate the students and hence learning of science becomes only a tool to get a decent looking job. To make science understandable perceivable and enjoyable teachers use different techniques. To understand the scientific process of any concept teaching material is very necessary. For developing it very much financial burden to purchase expensive teaching material from other countries. We are going to observe that up to which extent low cost /no cost teaching is used in elementary school. Because at elementary stage concept are not very much complex, they can be understand with the help of easily approachable teaching materials like no cost low cost teaching materials. India is developing country, in India most of the population lives under poverty. Due to the economic problem Govt. can't supply the required expensive teaching material to all schools. Lack of teaching material may create some learning problems.

Findings:

To find out the solution teacher can use low cost / no cost teaching material in teaching of science.

There were so many studies conducted on Science education, importance of teaching material, need of training program to make teaching effective at all stages. Some studies emphasized on preparation of low cost no/cost teaching material at country level in developing countries like India and Pakistan. Etc. but no one study was found which tell as about availability and use of low cost/no cost teaching material in India. Due to constraint of time we were unable to conduct any research at field level. Hence the study entitled *'use of low cost-no cost teaching material by elementary school teachers in teaching of Science.'* By Mehtab Singh & Dhanwinder Kaur (june2012) has been analysed to know the status. This study is important to explore the use of low cost - no cost teaching material at elementary level. So investigator feel tempted to study the availability and usages of low cost no cost teaching material by elementary school teachers in teaching of science. The focus

of this study is on use of low cost- no cost teaching material by the elementary school teachers in teaching of science.

Operational definition of the term used Appropriateness use of available waste materials as low cost-no cost experimental arrangement, model, project or activity lead to development of creative skill and through the creative skills the child acquires the basic objective of learning science-viz. Knowledge, Understanding and Application. It will be achievement for a teacher, if he can bring a situation where he uses low cost- no cost teaching material and his student comes forward with a new idea to create of his own for the next one.

The important findings of the study are as follows:

Results show that 53% of elementary schools have availability of low cost/ no cost teaching material and 47% of elementary schools do not have low cost/ no cost teaching material.

Results shows that 47% teachers involve themselves in preparation of low cost/ no cost teaching material, whereas 53% of teachers do not involve themselves in preparation of low cost/ no cost teaching material.

Results shows that only 49% of elementary school science teachers use low cost/ no cost teaching material, whereas 51% of elementary school science teachers do not use low cost no cost teaching material in teaching of science.

It was founded 88% of science teachers believed that low cost/ no cost teaching material is helpful in changing behaviour of students, whereas 12% of science teachers think that low cost/ no cost teaching material is not helpful in bringing change in students' behaviour.

It is found that there is very less availability of low cost/ no cost teaching material in elementary schools for teaching of science. To some extent there is availability of readymade teaching material, very few teacher buy low cost/ no cost teaching material personally, funds are not much sufficient, only some school has science kits. Availability of science of raw material in not satisfactory.

While analysing the above study results it is found out that still 50% teachers are not preparing and utilising low cost/no cost teaching material in elementary schools which is a pathetic scenario. Hence the administrators and academicians should take it seriously and formulate education policies accordingly.

IV. Suggestions and Educational implications:

Science education is gaining more attraction throughout the world. It is believed that the development of science education is one of the most important prerequisite for the all round development of any economy in the world. Higher the quality of science education that is provided in the country, higher would be the gains in all walks of life through the development of technology. Although the Mudaliar Commission (1953) the Education commission (1964-66) and the National Policy on Education (1986) stressed the importance of science education, we are not able to reach the expected standards in our science education. The reasons are many.

Most of the pupils do not possess positive attitude towards science and thereby not developing much interest in science education. This in turn makes them to achieve less percentage of marks in science. Without understanding science properly, one cannot develop positive scientific attitudes such as thinking objectively, logical analysis of issues, open minded, curious to know more about the things, does not believe in superstitions and false beliefs, suspended judgement, unbiased and impartial in judgement, seeks the facts etc.,

Since Science teaching cannot be imparted as abstract teaching. It should be taught through concrete teaching. The teaching learning material should be real objects, specimens and working models. Pupils should be taken to field trips in order to give direct experience to interact with the nature. The authorities should realize that the science teachers haven't acquired proper skills in implementing methods like heuristic method, Project method, demonstration method, laboratory method, and experimental method. Hence the teachers should be imparted proper training in the said methods for teaching science effectively. This is the century of brain; the explosion of knowledge has taken place. Life is impossible without science and technology. Hence the time has come to open the doors of laboratories in the schools and follow the maxim of learning by doing. Just designing the text books based on constructivism is not enough. The new paradigm should be shifted towards classroom. The science teachers should spent time in laboratories and give concrete experience by imparting proper guidance in conducting experiments to the students. So that students should explore the truth on their own. The authorities should see that they should fix proper monitoring mechanism and conduct the monitoring and supervision effectively by recruiting dynamic monitoring personnel. They should be given proper comprehension in observing the classroom and school process. The theoretical and paper work should be kept

aside. All the Educational programmes designed by RMSA and SSA should be thoroughly monitored and evaluated by these personnel. The programmes should percolate in grass root level in order to achieve set objectives. The teachers should work with commitment. The authorities should initiate disciplinary action among erratic, sluggish, ignorant and irresponsible teachers and follow-up action should be taken. The monotony and immunity of irresponsible behaviour should be break down immediately. They should be imparted professional ethics and values during training programmes by renowned psychologists.

Sincere and gifted teachers should be suitably rewarded. The interference and influence of teachers unions should be banished from academic matters. In every school Science club should make mandatory. The D.E.O should see that Science forums should be constituted at District, division and mandal level by expert teachers. Every science teacher should have membership and participation in the forums. They should conduct workshops and seminars and come out with innovative teaching strategies by fruitful discussions.

The Urdu medium science teachers also acquire membership and follow the ideas of their Telugu and other media counterparts. The methodology should be imparted in classroom without fail. As we know Science education has undergone paradigm shift at the term of millinium.It is not a passive process but it is an active construction and interpretation of experiences learning is a 'treasure within' and scientific knowledge is being actively built up and constructed by the learners. For constructivists, learning is viewed as an interaction between the learners and learning environment. During this interaction prior knowledge becomes the basis to interpret and construct new understanding. In effect learning is a process in which the learner invents new ideas .Viewed from this context learning science becomes a process of conceptual change and knowledge navigation.

Learning involves the reconstruction of the student's conception and the educators need to appreciate the ideas that children bring to the learning situations. They should also understand the process by which the conceptual change occurs in order to design the learning programs. In a learner centred approach learning is not a passive process but instead active meaning making problem solving process. New learning depends on learners' previous knowledge which may sometimes interfere with the understanding of new information. Thus learning employs the organization of prior conceptual schemes. Science can be thought effectively using the constructivist strategies in which the learner involves actively. Hence the constructivist's innovative strategies for science teaching like PEER TUTORING, SIMULATION, TEAM TEACHING, EXPERIMENTAL LEARNING, and COGNITIVE APPRENTICESHIP. DISCOVERY LEARNING has to be implemented for better achievement of science. In developing countries the preparation and utilisation of low cost/no cost materials is a boon to educational system for effective Science teaching.

Thus the process of Science education should be strengthened and given top priority in our educational system in order to fetch better results for the progress of the country.

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