Journal Homepage: - www.journalijar.com
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)
Article DOI:10.21474/IJAR01/4413
DOI URL: http://dx.doi.org/10.21474/IJAR01/4413
ISSN NO. 2320-5407

RESEARCH ARTICLE

A STUDY OF LITERATURE ON THE ROLE OF NON-FORMAL RESOURCES IN SCIENCE EDUCATION.

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Manuscript Info

Manuscript History

Received: 07 April 2017
Final Accepted: 09 May 2017
Published: June 2017

Key words:-
Non-formal learning, science education

Abstract

Non- Formal resources in this paper means all forms of direct and indirect experiences gained in a particular setting which helps in better learning of concepts in science. These resources may include any place selected for field visits, excursion, or any such tour for extended learning in science like the national science center, zoos, science museums, the Exploratorium and several other such places. In this paper, the author tries to report the researches done on non-formal resources and their findings in the context of science education trying to explore how these resources help learning in and about science, learning of science concepts vis-à-vis science process skills among young learners in school.

Background:-

In the recent years, students' achievements in the sciences have received ongoing attention over the past decade as demonstrated by international large-scale standardized efforts (Gonzales, Williams, Jocelyn, Roey, Kastberg, & Brenwald, 2008; OECD, 2014). The decreasing interest in science among youth in both primary and secondary educational systems has been widely reported and documented. Many students think science is too hard, uninteresting, and irrelevant (Aschbacher, Ing & Tsai, 2013). As a result, the number of young people choosing to study sciences at universities and colleges is dropping. Students' science identities and goals have been influenced by their science experiences and expectations at home and in school (Aschbacher, Li & Roth, 2010).

In the Indian context too this decline is reported (Srivastava, 2010). The reasons behind this trend could be a large number of students educated in schools which are overcrowded, ill-equipped, and under-staffed (Beena, 2013). There are very few schools providing demonstrations (Though science is truly experiment-based). Science has just become a chalk talk routine like other subjects with emphasis being more on rote learning to pass exams and giving less or no scope for innovation in science learning. Such unindulging and non-provoking environments in science classroom take away the thrill and curiosity of doing science which results in lesser students opting for science.

Locating the Field:-

There are researches which substantiate the need of research in this area viz. - Gardner (1993a) says "schools have become increasingly anachronistic, while museums have retained the potential to engage students, to teach them, to stimulate their understanding and to help them assume responsibility for their own learning". Hofstein and Rosenfeld (1996) who have importantly recommended that "future research in science education should focus on how to effectively blend informal and formal learning experiences in order to significantly enhance the learning of

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science" (p. 107). This indicates the complementary nature of both settings for a holistic understanding of science among learners.

Non-formal science education resources have been found to provide not only prerequisite experiences which make schooling more effective, but also increased opportunities for science learning by exposing students to various science education programs. These programs include demonstrations, science fairs, science seminars, nature trails, computer simulated programmes, sky observation, vacation workshops, environment related programmes.

In addition, these resources bring coordination, coherence and consistency to the improvement of the national science education which occurs through the non-formal resources, recognizes that youth with diverse backgrounds, learning styles and interest levels construct understanding about scientific concepts differently. This leads to the understanding that science can be understood in multiple ways and is contextualized. Non-formal resources all over the world have been striving to fill the gap created by various science curriculums, boards, etc. by developing educational modules to supplement science education in schools and also meeting local educational needs (Kumar, 2013).

In the words of Walker (1994) as reported in Beena (2013) the formal science programs encompass the science curriculum mandated and transacted in schools, whereas the informal science programs include science museums, zoos, technology centers, and aquariums, where learning is less directed, but non- formal science programs include "organized, systematic teaching and learning carried on outside the formal school system with leadership from an adult or volunteer. It appears that in the case of non-formal learning which is an organized activity has the potential to educate students with fun and engaging.

In most countries, there are serious gaps in educational infrastructure which are limiting the level of scientific literacy. Whereas, in the recent years, there is more emphasis laid on improving scientific literacy of a nation and the onus is on school education, but alone formal setting of science learning will not suffice rather it is also important to recognize and embrace the non-formal resources like-the media, science centers and museums, industry-education programs, out-of school student programs and other non-formal science learning outlets as valuable parts of a nation's science education infrastructure.

However, researches reveal that non-formal resources present phenomena in the form of exhibits that are interactive and manipulative, learning in such places is contextualized which provide concrete experience for students to understand scientific concepts. There are researches which prove the effectiveness of these programs in better understanding of scientific concepts- Javlekar (1989) found that students who visited the exhibits out-performed the control group in the understanding of scientific concepts that underlined the exhibits. He also found that interactive techniques are the best approach to achieve a better understanding of concepts underlying the exhibits in the science center.

There are researches which consider non-formal resources as the centres for 'free choice' learning. The study done by John Falk and Mark Needham (2011) focused on the California science centers and offered profound support for the values of such institutions. They support this argument that people get most of their knowledge about science from someplace other than school. The debate is not new but the progression of the thoughts begins to arise quite early and also Kimche (1978) described the learning potential of science centers, citing the interaction between "the predispositions on the part of visitors to be receptive to the museum's message and the capability of museum to transmit the message in a multidisciplinary and yet authentic manner". In the words of Howard Gardner "Imagine an educational environments in which youngsters at the age of seven or eight…have the opportunity to enroll in a children's museum, or some kind of discovery center or the Exploratorium." These statements are explanation and proven facts for the importance of these resources.

According to Katherine E. Rowan in her book 'Explaining difficult ideas'- an idea may be confusing because it involves- difficult language, difficult pictures or processes and difficult to believe notions like (e.g. Earth is weightless). To overcome these there should be elucidation (to clarify the meaning of the terms), Quasi- science to mentally model complex phenomena and transformation of conceptions to overcome counter intuitive ideas. And in science museums and other non-formal resources there is more emphasis on all these areas, therefore there sources can enable young learners to learn science more effectively. Many museum exhibits offer quasi-scientific explanations: how pulley work, or why the stomach doesn't digest itself. Each helps visitors build and refine their

"mental models" of something that initially looks too complicated or unfamiliar to understand. Furthermore, Hard to believe: ideas about ubiquitous phenomena like-heat, light, color, weight, death, etc. is dealt in by transformative explanations as it helps visitors acquire such concepts. For example, in viewing exhibits on space travel, visitors may find it difficult to believe and thus understand that a four and a half ton satellite or the Earth itself could be weightless. Science educators have found that the best transformative explanations are those that A. state peoples' implicit or lay theory about the phenomenon or ask questions which elicit this theory. B. acknowledge the apparent plausibility of the lay theory. C. reject the lay theory and demonstrate its inadequacy. D. state the more accepted account and state its greater effectiveness.

Many studies refer these resources as the centres where students enjoy out of sense making of the exhibits available in science centres on their own. They consider themselves as discoverers of knowledge just like scientists. They construct their own knowledge without any compulsion of doing it in a 'right' way only and free to do what they wish without any fear of being failed or ridiculed.

However, there are researches which look at the roles of science centres and museums with suspicion with a notion that communication of information is at risk in museums as felt by Baruch Fischhoff. There are other people of the same viewpoint like Shortland et al. have said that exhibits are just source of entertainment and very less to do with education.

There are researches which talk about several ways in which science centres can do a lot of changes along with content to also tackle social issues. According to Dale Baker, Girls IN science are few because we ask them or prepare them to be so. Similarly Barabara N. Flagg considers the visits to be worth learning. According to Stephen the studies are done for the purpose of knowing the gains we make by school field trips few narratives are as follow: While entering fun science gallery; science is a way of looking at reality. Science is a process of questioning. Learning of science becomes exciting when it involves the learner in close interaction with the exhibits that carry a desired message. Here is a unique facility where physics, humor and art are mixed up in the form of hands on interactive exhibits which are challenging and instructive, accessible and inspiring. In this hall of fun science, the curious mind will have enough to explore and gain.

Further, the studies highlight that in the museum visits 'affect' has a major role to play (MIES) and therefore we need to have a proper way of assessing them.

There are various centres and institutions which have further hopes and aspirations of these centres and continuously strive for making it more and more up to date and competent. For example ASTC: innovation in informal science education: it seeks to enhance the ability of its science museum members to foster public understanding of and interest in the principles, practices, and implications of science and technology and to encourage the public to apply that understanding in their daily lives.

STCs can play a unique role in breaking down the barriers that prevent girls from choosing maths and science. Science centres can provide an experience that creates access to role models, enhance self esteem and self concept in maths and science, change parents' attitudes and perceptions, provide access to computers and scientific equipment, and make training and resource materials available to teachers. Success will depend on a number of factors: age, family circumstances and parents' educational background, teacher characteristics, local norms and values and the resources of science tech centres.

According to Roger Miles and Alan Tout: a museum exhibit is traditionally evaluated by three criteria; its power to attract visitors, its power to hold interest, and its power to teach concepts.The emphasis is on making most of the time visitors can remain attentive in any museum.

Also, there are researches which have focused on the nature of school field trips to these centres. According to Stephen Bitgood: while the results of research may help us identify the effectiveness of various methods used in informal educational programmes, they cannot dictate the goals, content, and objectives of such programs. These must be selected by, and sometimes negotiated between school and museum. Experiencing museum objects are often more meaningful to the students than reading about the same objects and concepts in textbooks. In the words of George W. Tressel There is huge role of informal learning in science education in following ways:Schooling is what happens in school; training to provide skills, skills to use in careers, to use in life, skills in preparation for a

lifetime of personal, self-directed informal learning. Because in fact, most people, most of the time, learn most of what they know outside of school, one of the principal roles of formal education is to provide the skills and background that makes this possible.

Why we need informal education: in high school, we are giving most college bound students a couple of years of disciplinary science courses. Most of them have no disciplinary interest at all and will take little or no further science in college. Is that our decision making professional workforce needs? Are a couple of years of high school botany and zoology the right preparation for a decision-maker who is going to decide about Bioengineering?

Conclusion:-

These studies point toward the positive, strong correlation between the visit to science museums or any such places which provide informal learning in science and enhanced understanding in and about the science. The literature also highlights the need of researches to be carried out in this field to gain more insights on how the knowledge creation takes place there. These further might serve to become the basis for formulating a model to guide the successful operation of science programs for effective cooperation between formal and non-formal learning environments based on shared educational goals which may develop understanding about the science concepts along with the development of science process skills and understanding of the nature of science and building scientific attitude among the young learners of science.

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