STUDENTS' SCIENCE RELATED EXPERIENCES, INTEREST IN SCIENCE TOPICS AND THEIR INTERRELATION SOME IMPLICATIONS

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There are mounting evidences of decline in the interest of young people in pursuing science. The policy report of ninth meeting of Global Science Forum (2003) found that there is steady decline in the number of students in science and technology. In India also, there is a similar trend of decline in interest to pursue study of science interest. National Science Survey (Shukla, 2005) has shown that interest in science as well as satisfaction with the quality of Science teaching declined as the age increased. One cannot take the decline in interest in science lightly. Surveys across the globe suggest that lack of interest in science is mainly due to science being less intrinsically motivating (Global Science Forum, 2003; National Science Survey, Shukla, 2005), nature of science being cut off from real world and its content being overloaded with matters unrelated to the life of students (Hill and Wheeler, 1991; Osborne and Collins, 2001). One way of making science relevant is to base science on experiences in which pupils are interested and those that can find applications in real life.

Recent studies on interest in science in India show that there is a shift away from science at the plus-two and under-graduate level (Patil, 2003). As interest in science develops quite early in life (Gardner, 1975), decline in interest in science in later years of life can be tackled to a certain extent by providing all the factors conducive to the development of interest in science interest from quite early years itself. Exploration in the field of influence of out-of-school science experiences on interest in science is not substantial in India.

Present article is based on a study conducted by the authors on 1473 students in 14 upper primary school students in Kozhikode district of Kerala.

Attemptwas made to know the science-related activities that children themselves choose without any external suggestion and the resultant influence these activities have on interest in the topics that they learn in their scienceclasses. The following are the broad findings, conclusions and the implications derived from the study.

Extent and Nature of Science Related Experiences that Pupil Bring into Classroom

The extent of out-of-school science experiences of upper primary school pupils is moderate in nature. Pupils havemore out-of-school experiences in biology compared to those in physics and chemistry. This can be attributed to many a reasons. Biology experiences are quite evident and are quick to arouse curiosity of young children. In addition, experiences related to health and hygiene is a part of one's daily life. In biology, maximum experience is through collection. Most children collect leaves, feathers etc. for aesthetic purpose. It is quite strange that pupil derive least experience through observation. Theoretically, one can get lots of biological experience through observation. Nevertheless, active nature of young children maynot let them remain satisfied with observation alone, which is a passive process.

Out-of-school chemistry experiences are comparatively less among children. Thismay be because these experiences (e.g. different types of taste and odour) are so common and so implicit that children more often do not give special attention to them. That is, they experience them but they do not consider them as on 'experience'. Observations and activities are comparatively more in chemistry. This is quite natural as rapid changes in the colour of things, domestic activities like mixing liquid blue in water, making pickles etc. are easily available to all. The extent of experimentation iscomparatively low. Observations like removing paint using kerosene removing nail polish, making transparencies or printing of are rarely associated with applications of chemistry.

The extent of out-of-school experiences related to concepts of physics lie in between that of biology and chemistry. Physics experiences are mainly through observations. Children observe the sky, weather, shadows, etc rarely out of curiosity or for their aesthetic impact and often do not count it as an experience related to science. The least amount of experience is from experimentation. This is again strange, as experiences like melting of ice, changes in length of shadow etc. are quite popular among young children. One reason for this could be that we rarely understand or project science as activity of human beings as an attempt to understand nature and natural phenomena. It may be that children derive more experience fromvicarious sources than from direct ones.

Boys have more out-of-school experiences in physics while girls have them in chemistry

The extent and nature of out-of-school science experiences differ among boys and girls. Boys usually have more experiencesthan girls.It may be that boys get more opportunities for out-door activities. The difference is mainly due to the advantage of boys in relation to out-of-school

relating to physics experiences. This finding is similar to those from other parts of the world (Farenga and Joyce, 1997; Sjoberg, 2000; Christidou, 2006). Boys, world over, get more involved in hands-on physical activities like repairing things and opening up toys or other things to know the parts, activities typically considered as male-stereotype ones. It is a part of the sex-role expectations of the society (Johnson, 1987; Farenga and Joyce, 1997). Girls usually have more chemistry related out-of-school observations and activity than the boys. Domestic surroundings give easy access to chemistry related experiences like making of pickles observing, changing in colour of fruits and vegetables, say, apples. Compared to girls, boys indulge more in biology related activities like listening to the sound of birds, maintaining aquarium, rearing animals. Agriculture, fishing and similar other activities are typical male dominated activities in developing countries (Sjoberg, 2000). Biological activities also include those related to health and hygiene. Due to the increased interest in fitness in present times, boys indulge more in health care. Compared to boys, girls indulge more in collecting items like leaves and feathers, which can be for aesthetic purpose. Generally, boys, compared to girls, indulge more in active tasks while girls, compared to boys, indulge more in passive tasks like collection. Science is doing; hence, boys who indulge more in active tasks will naturally have higher extent of experiences in science.

Urban pupils excel rural pupils in out-of-school science experiences

Urban and rural pupils differ in their out-of-school science experiences with urban pupils having more experiences than rural pupils especially in Biology and Physics. The reason can be the difference in opportunities. Rural pupils get opportunities for nature-related direct experiences. Even though this is less for urban pupils, they receive indirect experiences through a visit to parks, zoological gardens, planetarium etc. Urban pupils have the added benefit of getting more vicarious experiences through computers and internet that can compensate for the lack of direct experiences.

Pupils in aided schools lag behind those in government and unaided schools in out-of-school science experiences

Type of management also influences the extent and nature of out-of-school science experiences. Government school pupils have more experience especially in observations related to biology besides physics, biology and chemistry related activities as compared to children from both aided and unaided schools. Biological activities are nature-related which are accessible to all but physics related activities require mechanical and technological facilities, which are comparatively available more to pupils in unaided schools. They have more opportunity to be familiar with television programmes, computers and internet mainly due to their more affluent background. Among the three groups, pupils from aided schools are likely to have the least experiences, They may not be as familiar with technological activities in comparison to pupil from unaided schools, due to the difference in the domestic and school environment. Nevertheless, they may not be getting as much freedom as children in

government schools get to explore their surroundings, due to the protective and restrictive nature in middle class families in third world countries. Further, research is required to explore how out-of-school experiences vary for pupils in different types of schools.

Interest in Science Topics among Upper Primary Pupils

The extent of interest in science of upper primary pupils is relatively high, which is a good indication, as science is an inevitable raw material of technology. Pupils have comparatively more interest in biology and physics. Interest in biology is due to pupils' desire to know about themselves and other living forms in their surroundings. Physics can never remain behind in modern world, as it is the basis for many popular professional courses like Engineering and Computer applications. Moreover, origin of universe, space explorations etc. have always been a challenge to man, and to young curious minds. Study conducted elsewhere (Borrows, 2004) also shows lesser preference for chemistry among pupils. The reason cited is that pupils consider chemistry as something that happens in the laboratories. Topics like acids, recycling of wastes, fertilisers, etc. may give the idea that these are 'jobs' to be done in factories alone thereby reducing their appeal.

Girls are more interested in biology and chemistry while boys are more interested in physics

The extent of interest in science is more for girls, owing mainly due to their higher interest in biology and chemistry. Increased interest of girls in biology is similar to the findings in previous researches (Gardner, 1975; Sjoberg, 2000; Uitto *et al*, 2006). The reason cited is that girls are more interested in people and life oriented aspects of science like biology (Miller *et al*, 2006). The same reason is applicable to the increased interest in chemistry as topics like production of cooking gas, food preservation, preparation of medicine etc. deal with chemistry that influences lives of people. Boys are more interested in physics. This finding also has support of previous researches (Tsabari and Yarden, 2005; Christidou, 2006). Physics topics deal with abstract concepts that appeal girls less (Tsabari and Yarden, 2005). Moreover, boys have more experiences in physics; experiences have an influence on interest (Johnson, 1987; Sjoberg, 2000).

Urban pupils have more interest in science

Urban pupils are more interested in all the three fields of science than the rural pupils. This suggests societal influence on interest in science. Urban pupils receive latest information through media, computers and internet at home. Further, schools and computer institutes in urban locality help them develop better understanding about scientific concepts. Better understanding can increase interest in science. Lave and Wenger's (1991) observation of learning as contextualised and shaped by physical, social and political landscape in which it occurs to development of interest can be applied to development of interest in science as well.

Pupils in aided schools have lesser extent of interest in science

Pupils in Government and unaided schools have more interest in science than amongst those in Government aided schools. Difference in interest might partially be due to difference in their experiences in day to day life. Apart from this, school facilities including access to internet and libraries, learning environment, teaching style together with the difference in the social background of the three strata influence their interest. Children in unaided schools, by and large, get better learning facilities, in their school as well as at home, while in government schools they get them through the facilities provided by the government. Children from aided schools remain wanting in both these aspects.

Out-of-School Science Experiences Contributes to Interest in Science

The relationship between out-of-school science experiences and interest in science is positive in all fields of science and in all categories of experiences. This also is in agreement with earlier studies (Joyce and Farenga, 1999; Uitto et al, 2006, Zoldozoa, 2006). The relationship is substantial in biology while in physics and chemistry, it is comparatively low. This indicates that influence of experiences on interest is more in biology than in physics and chemistry. This maybe because biology is more life related. Among the categories of experiences, experimentation has more impact on interest. Experimentation is an act of discovery which in turn nurtures interest.

Gender difference exists in relationship between out-of-school experiences and interest in chemistry

Gender difference is evident only in the extent of relationship between out-of-school chemistry experiences and interest in chemistry with boys exhibiting a stronger corelation than the girls. Even though girls have more experience in chemistry than the boys, they do not develop more interest in chemistry. These experiences, received mainly from domestic surroundings, may not be helping girls to find any learning opportunity in them.

Not only urban pupils have more experiences, but these experiences have higher influence on the development of their interest in science.

The extent of relationship between out-of-school science experiences and interest in science shows locality-based differences. The extent of relationship is stronger for urban pupils in all the three fields of science. Urban pupils have more exposure to academic activities through indirect and vicarious means that enrich the science experiences that they get. This also helps them utilise the experiences better to develop stronger interest in science.

Out-of-school science experiences of pupils from unaided schools have better influence on their interest in science.

The extent of relationship between out-of-school science experiences and interest in science is more for children from unaided schools, than from both aided and government schools. Owing to the interventions and guidance from parents

and teachers, students from unaidedschools are more orientated towards academics. They have better facilities at school like computerlab, rich libraries that enrich their experiences and give them an opportunity to develop wider areas of interest.

Educational Implications

The findings bring to focus the fact that the nature and extent of out-of-school science experiences and interest in science vary for different strata of population. The study also validated the person-object theory of interest by establishing relationship between pupil's experience and her/his interest. Further, it was revealed that the extent of relationship between out-of-school science experiences and interest in science differed among subsamples. These findings render useful information that can bring about some reformations in the educational scenario.

1. Know about what pupils bring to classroom

One cannot do much to control out-of-school experiences, but knowing about what pupils bring to the classroom will help for providing better educational circumstances. For a constructivist teacher, knowledge of pupils' out-of-school experiences isinvaluable as the present experiences are building blocks of the future experiences.Knowing students' experiences also assists in providing those experiences that pupil lack. Evidence of pupils' experiential background can help a teacher to choose those experiences that can result in minimal dissonance with existing experiences. In addition, teachers can know how pupils use science in their daily life. Moreover, what people do is more important than what they merely 'know'.

2. Monitor interest from primary classes

Interest develops very early in life.So monitoring of interest should begin from primary school itself. Interest and attitude that one develops in the lowerclasses influence their future choices (Lloyd and Contreras, 1984). Leaving nature of interests and their fields unnoticed in the developing stages of a child is detrimental as, no matter how hard we try in the later stages, it would be quite difficult to make her/him get interested and people to appreciate science. Identifying pupils' diverse interests helps to nurture interestas well as to find innovative means to make those fields of science inwhich they lack interest appealing. This proveshelpful to alleviate transitional problems as they reachsecondary schools with diversified science curriculum.

3. Relate classroom chemistry with child's life

An analysis of the extent of experiences and interest showed that children generally have lesser extent of experience as well asinterest in chemistry. Making children realisethat chemistry is something that is going on all around and within us will helpthem see its significance. Extent of experience and interest in biology is relatively high. Pupils need to see that the very essenceof biology rests on chemical reactions. This would helpthem appreciate the significance

of chemistry in our lives. Once they understand the utility of chemistry, they will get interested, as pupils need to feel the relevance of a concept in their life to develop interest in it (Qualter, 1993).

4. Never ignore disparity in out-of-school experiences

The disparity in out-of-school experiences is natural as personal choice and the social, cultural and economic background from which pupils come determine these experiences. Still we cannot ignore the disparity in out-of-school experiences, as a substantial positive correlation exists between out-of-school science experiences and interest in science.

5. Girls have to be more accustomed to physics activities

Girls' lesser extent of experience and interest in physics reveals that irrespective of the vast cultural differences, girls all over the world remain elusive once it comes to physics. The reason cited elsewhere – sex-role socialisation- could be the cause for such gender differences in physics in Kerala also. Even in the modern world, there still exist male and female stereotype activities and preferences. Physics is dominated by hands-on mechanical and technological activities, from which girls shy away or are kept away. Girls have to be more accustomed to physics and made aware of the significance of physics lest they remain far behind in the modern techno-savvy world.

6. Revamp rural schools

In the case of rural pupils, the environmental factors allow them to have nature related experiences but when it comes to technological aspects, they do not get the facilities that the affluent urban locale provides. Rural children come to school with an impoverished experiential background. The situation at school is not different. A visit to rural schools can give us a glimpse of the poor infrastructural facilities that pupils have. Disparity between urban and rural schools can do nothing but contribute to the backwardness of rural pupils. The solution lies in a complete revamping of rural schools. More computers and better laboratory facilities, supplemented with trained teachers with enough motivation, frequent educational excursions to places of scientific interest and availability of other resources might be one-step in this direction.

7. Pay special attention to the needs of pupils in Government aided schools

The lack of experience and interest amongst+ pupils in Government aided schools is a serious issue because in Kerala majority of schools belong to this sector (Department of General Education, Kerala, 2002-03 and 2003-04). Government provides necessary facilities for schools in the public sector whereas unaided schools have the strong support of wealthy managements, trusts and parents. Government aided schools, on the other hand, especially upper primary schools, are wanting in aids from both the government as well as management. This further aggravates the disadvantaged position of pupils in these schools. Therefore, government and management have to pay special attention to the needs of pupils aided schools so that their pupil can be on par with those from government and unaided schools.

8. Personal autonomy is a crucial determiner of interest

The inequality in the magnitude of interest is not a welcome discovery, as over the years, government has been diligently working towards reducing the discrepancy in interest in science between various strata of population. A major landmark in the science education was the introduction of the activity-oriented learning. Nevertheless, there exists a major distinction between out-of-school learning and classroom learning. Most often pupils undertake the activities as part of the curricular requirements. Classroom learning, thus, becomes compulsory and extrinsically motivated. Moreover, all activities are timed and collective. Scope for individual variations is limited. In contrast, out-of-school learning is one of personal choices, giving ample freedom for exploration. The personal autonomy makes out-of-school experiences a crucial determiner of interest, as freedom to make decisions can enhance interest (Hamrahan, 1998). Activity oriented classrooms can be transformed for the better if teachers are willing to accommodate this need of pupils for liberty. Instead of directing them to do exact prescription in the textbook, teacher can enquire about how they would deal with a particular situation. This would not only allow the use of out-of-school experiences but also bring students nearer to diverse ideas that can supplement classroom learning.

9. Using out-of-school experiences individualizes instruction

Out-of-school learning facilitates pupils' inherent nature of individualised way of acquiring information. Using out-of-school experiences in science classrooms thus individualises instruction.

The above discussion on the implications brings on certain recommendations to optimise science learning. Conduct of science enrichment programmes where pupils can implement scientific method under the guidance of resource persons will help create a 'psychological moratorium' – an engaging and psychologically safe chance for learners to experiment with the identity of self as scientist (Erikson, 1968). This not only enhances interest but also gives enriching experiences to students who do not have access to such experiences. Attempt needs to be made to make pupils aware of the task value (Eccles and Wigfield, 1995). Task value indicates the ability of a task to satisfy personal needs, which in turn depends on the interest, importance and utility of the task. Establishing educational guidance cells, especially in rural areas can help to develop awareness about benefits of science thereby nurturing interest in science. As experimental activities are better predicators of interest in science, pupils need more opportunities for experimental activities and club activities.

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