Research Papers

Influence of Out-of-School Experiences on Interest in Science of Secondary School Students in Kerala

Dr K. Abdul Gafoor* and Smt. Jaithra, V.S.**

Abstract

Influence of out-of-school experiences on interest in science and such experiences which are significantly contributive to interest are studied on a representative sample of grades 8-9 students of Kozhikode district. Locale but not gender difference exists in extent of interest. Over 40 per cent variance in science interest is attributable to out-of-school experiences. Observation and visits influence interest in science above collection and activity. Influence of common place life experiences among rural students and of structured, organised and planned experiences among urban students were evidenced. Among rural students influence from physical science related experiences is stronger. In urban sample, influence of visits and collections is more and that of activity mainly of physical sciences is less. Experimental experiences were found inconsequential on student interest. Implications for science curricula, instruction, textbooks and support facilities, teacher preparation, assessment and research are added.

Introduction

India and the world need scientists in adequate number, a population and workforce able to think scientifically, and, a citizenry able to understand and approach science and technology related questions with positive attitudes. There is an increase in the number of students in higher education, and in science and technology too. But, the proportion of science and technology students to the total students

* *Reader*, Department of Education, University of Calicut, Calicut University, PO; Kerala

** *Junior Research Fellow*, Department of Education, University of Calicut, Calicut University, PO; Kerala

has been decreasing during the last two decades (Organisation for Economic Co-operation and Development [OECD], 2006). In India too, students' interest in science was found to decline as they climb educational ladder from middle school classes to tertiary level. Students are not pursuing science because they have no interest in science (Shukla, 2005). Guiding force that determines the choices that one formulates is one's own interests. So students' interest in science should enhance. Lack of interest in science is due to lack of confidence in science, stemming from insecurity in understanding science. Science teaching is less intrinsically motivating. While nearly two–thirds of students in Classes VI to VIII are satisfied with the quality of science teaching, this falls to just 40 per cent in senior secondary classes (Shukla, 2005). In other countries too, science curriculum is overloaded with content unrelated to life (Osborne and Collins, 2001).

One way to develop interest in science is to relate science topics with students' experiences. Learning based on experiences generates interest. Connections between students' lives and what they learn in their science courses increase student interest in science (Hulleman and Harackiewicz, 2009). Learning becomes fruitful when past experiences of learner interact meaningfully with present ones. The idea that past experiences of individual interacts with present situation to form new experiences (Dewey, 1938) is old enough. Experiences lead to further inquiry, enjoyment and a sense of what is being leant as personally relevant. If materials presented are familiar, students develop a desire for further learning. Thus, experiences have major role in developing interest.

Relevance of Out-of-School Experience in Science Education

Formal and informal experiences of students may affect interest in science. Children are naturally curious to learn about the things they experience. If these experiences satisfy them, they get interested. Out-of-school visits, collections, making models, watching science-programmes, voluntary work, and the like give students relief from classroom routine, and make the learning interesting and fruitful. Experiences, thought and actions are interrelated. Watching, listening and doing are the ways to spark interest. Strengthening the exposure to science through hands-on activities will result in a more positive perception of these subjects among teens (Lemelson-MIT Invention Index, 2010). Hands-on school science programmes help to increase the number of students entering and maintaining science

careers (Roberts and Wassersug, 2009) also. Since every experience that has gone before influences the quality of further learning, out-of-school experiences have evident long-term effects, too.

Many psychologists and educationists (Dewey, 1925; Lewin, 1936; Piaget, 1951; Kolb, 1984; Melnick, 1991; Wilson, 2005) have established a strong and inseparable link between informal experiential basis and the development of children. The formal external influences are just acting upon this experiential foundation to enhance learning. These experiences can be direct, indirect or vicarious (Kellert, 2005). Out-of-school experiences require social participation that offers students with social support, whereas, school-based experiences do not (Melnick, 1991). Allowing social interaction creates real interest in the topic and a desire to learn, besides the cognitive gains (Koosimile, 2004; Jarman, 2005). In contrast, alienation of school science from the society results in its decontextualisation (Ebenzer and Zoller, 1993).

Out-of-school experiences are effectively used in science lessons to develop interest in science. Science educators, therefore, have begun to pay greater attention to the potential interactions between formal and informal science learning. Though some teachers make extensive use of student-experiences in science lessons; majority of teachers use real-life contexts barely for classroom activities. One reason behind this is that the use of students' out-of-school experiences in science education has not been systematically studied (Cajas, 1998).

Factors Influencing Out-of-School Experience, Science Interest and their Interrelation

Many factors interplay the influence of science related experience on the development of interest in science among students. So, teachers need to promote a congruent relationship between out-of-school science experiences and formal science learning (Mayoh and Knutton, 1997; Lindemann and Matthies, 2006). Age affects experiential foundation (Bottomley and Omerod, 1981; Coley et al., 2005) and there exist gender differences in science related activities (Gardner, 1975; Bottomley and Omerod, 1981; Hadden and Johnstone, 1982; Farenga and Joyce, 1997). Studies suggest that there are urban-rural differences in experiential basis (Coley et al., 2005; Gafoor and Smitha, 2010) and that these differences have differing impacts on learning (Brown, 2007).

For interest in science too, social variables such as ethnic origin (Taylor, 1993) and parental education (Miller, 1988) are important. Kahle (2004) who reported more interest for boys (13+ age group) and Singh (1999) who reported more interests for girls (18+ age group) have reached almost opposing conclusions on gender difference in interest. Gender difference in science interest (Feldhusen and Williard-Holt, 1993) is due more to gender role socialisation (Jones and Kirk, 1990) and is more qualitative than quantitative (Qualter, 1993; Dawson, 2000; Tsabari and Yarden, 2005; Trumper, 2006). Greenfield (1997) further observed a reversal of interest patterns of boys and girls as they move from primary to secondary school. Significant correlation exists between science interest and science experiences (Johnson, 1987 and Uitto et al., 2006; Zoldosova and Prokop, 2006).

In Kerala context, upper primary girls showed more interest in science than boys though out-of-school science experiences were more for boys than girls (Gafoor and Smitha, 2010). Surveys also revealed that more urban pupils than rural pupils preferred science for higher education. Vani (1997) reported urban-rural difference in student interest in science. Interest in science is found to be decreasing with increase in age (Shukla, 2005) and according to this study urban student than rural student tend to prefer scientific jobs.

Significance of this Study

It is accepted that teachers can bring changes in students' interest (Kelly, 1988; Cooper and McIntyre, 1996) and for this out-of-school experiences are effective doorways. Linking science with students' out-of-school experiences require further studies on new world of children (Cajas, 1998). Contextualising science instruction involves utilising children's prior knowledge and everyday experience as a catalyst to understand the challenging concepts in science (Osborne and Collins, 2001; Rivet and Krajcik, 2008). Carefully planned and designed out-of-school experiential programmes have the potential to broaden students experiences of science and are helpful to bridge the gap between the school science with student experience (Luehmann, 2009). Those who engage in more hands-on activities achieve high (Stohr.Hunt and Patricia, 1996) too.

Students, of course, have innumerable likings and preferences. Student interests are fairly settled dispositions which teachers have to notice, to pay attention to, and to engage in some appropriate activity with certain sorts of things rather than others - as evidenced

from time to time by student inclinations. In order for teachers to efficiently incorporate out-of-school experiences in their plan for teaching and thus to enhance students interest and achievement in science, it will be highly helpful if experiences that are the most significant in developing student interest are identified.

Objective of the Study

This study looks at the influence of out-of-school experiences on interest in science in terms of predictive efficiency and thus, tries to pinpoint such experiences which are significantly contributive to the interest in science among secondary school students. Further, it examines whether interest in science among secondary school students significantly differ based on their gender and locale of their school, and if so, to locate such experiences which are significantly contributive to the interest in science among the subsamples based on gender and locale, too.

Method

Sample

Sample used is 1000 students drawn from 8th and 9th grades of 14 secondary schools belonging to government, aided, unaided categories in Kozhikode revenue district of Kerala by means of proportionate stratified random sampling. There were 714 rural and 286 urban school students, and 501 boys and 499 girls.

Measures

Scale of Interest in Science

One hundred topics in the secondary school science curriculum covering three fields i.e., Physics, Chemistry and Biology were finalised after analysing the contents in the science textbooks of standards 8-12 of schools following Kerala state curriculum. Pilot run of draft items and conventional item analysis procedure for ensuring discrimination power were done. For each topic, students indicated extend of interest on a 3-point likert scale, sum of which indicated the total score. Test re-test reliability coefficient is 0.97 (N=40).

Scale of Out-of-school Science Experiences

A total of 160 direct, indirect or vicarious experiences related with three main branches of school science viz., Physics, Chemistry and Biology that the children have from their surroundings and

which they choose to have without any external compulsion are put under five categories viz., observation, visits, collection, activity and experimentation. The experiences included were decided after informal interviews, pilot run of draft items, and conventional item analysis procedure for ensuring discrimination power among children of the pertinent age. For each item, students indicated extend of experience on a 3-point likert scale. Test re-test coefficient of correlation of the total scale was 0.96 (N=40).

Results

Influence of Out-of-School Science Experiences on Interest in Science

Distributions of interest in science scores (M= 122.54, median=124, mode=118, SD=37.41, skewness=-.30, kurtosis= -.17) and out-of-school science experience (total) scores (M= 172.18, median=171, mode=164, SD= 45.67, skewness=0, kurtosis=0.23) are near normal. Multiple regression analysis was conducted to examine the influence of out-of school science experience on interest in science of secondary school students (Table 1).

Table 1

Results of Multiple Regression Analysis for Interest in Science of Secondary School Students in the Total Sample

Predictors	R	R^2x100	F	B	t	SE	β	r	βxr
Photos of astronauts[3]	0.35	12.1	25.44*	6.86	3.78	1.82	0.130	0.338	0.439
Parasitic animals[1]	0.44	19.7		6.78	4.31	1.57	0.137	0.330	0.0452
Darkening of Silver Ornaments[1]	0.49	24.9		5.65	3.45	1.64	0.110	0.286	0.0315
Primary health centre[2]	0.53	27.9		4.99	3.27	1.53	0.105	0.285	0.299
NPK Fertilizers[1]	0.55	30.3		5.00	2.97	1.68	0.098	0.297	0.0291
Photos of Scientists[3]	0.56	31.8		4.67	2.43	1.92	0.086	0.331	0.0285
Making Electric current from tomato[5]	0.58	33.2		5.58	3.95	1.41	0.120	0.157	0.0188
Plant-growth[1]	0.59	34.2		4.94	2.74	1.80	0.084	0.230	0.0193
Loosening of electric line during summer[1]	0.59	35.0		3.69	2.32	1.59	0.074	0.277	0.0205

Making thick Jaggery[4]	0.59	35.7		4.4.5	3.07	1.45	0.095	0.209	0.0199
Soap Factory[2]	0.60	36.3		3.73	2.47	1.51	0.078	0.102	0.0079
Battery cells[3]	0.61	37.0		4.37	2.83	1.54	0.090	0.231	0.0208
Mammals[1]	0.61	37.5		4.01	2.49	1.61	0.080	0.241	0.0192
Aquaculture (Fish) farm[2]	0.62	38.0		4.03	2.72	1.48	0.087	0.113	0.0098
Pictures of the living[3]	0.62	38.5		4.72	2.26	2.09	0.073	0.278	0.0203
Ferns[1]	0.62	39.0		3.79	2.64	1.44	0.083	0.091	0.0076
Thorny Plants[1]	0.63	39.5		3.71	2.17	1.71	0.068	0.230	0.0156
Difficulty in closing doors during rainy season[1]	0.63	39.9		3.84	2.17	1.77	0.067	0.244	0.0163
Science books[3]	0.63	40.2		3.36	2.06	1.63	0.068	0.266	0.0181

Note: p<.01 (19,718) df
#1,2,3,4 and 5 indicates experiences categorised under observation, visit, collection, activity and experimentation respectively.

In the total sample, 19 out-of-school science experiences together significantly predict 40.2 per cent variance of interest in science [R = 0.63, F = 25.44 for (19,718 df), p<.01]. In order to understand the extent of influence of each significant out-of-school experience on interest, for each experience βr x 100, percentage influence of experience on interest (efficiency of the predictor), were estimated. These 19 significant predictor experiences in the order of their percentage influence (in parentheses) on interest in science are: Observation of parasitic animals (4.52), Collection of photos of astronauts (4.39), Observation of darkening of silver ornaments (3.15), Visit to primary health centre (2.99), Observation of NPK fertilisers (2.91), Collection of photos of scientists (2.85), Collection of battery cells (2.08), Observation of loosening of electric lines during summer (2.05), Collection of pictures of the living (2.03), Making thick jaggery (1.99), Observation of plant growth (1.93), Observation of mammals (1.92), Making electric current from tomato (1.88), Collection of science books (1.81), Observation of difficulty in closing doors during rainy season (1.63), Observation of thorny

plants (1.56), Visit to aquaculture (fish) farm (0.98), Visit to soap factory (0.79), and Observation of ferns (0.76).

Influence of Out-of-School Science Experiences on Interest in Science in the Subsamples

Mean difference analysis was done to examine the difference in interest in science between boy-girl and urban-rural sub samples (Table 2).

Table 2

Result of Test of Significance of Difference between the Mean Scores of Interest in Science of Subsamples Based on Gender and Locale

Subsamples based on	Groups	N	Mean	SD	Critical ratio
Gender	Boys	501	122.13	38.22	0.35
	Girls	499	122.96	36.60	
Locale	Rural	714	125.39	38.17	3.84**
	Urban	286	115.41	34.46	

*Note: **p<.01*

There exists no significant difference between boys and girls in the extent of interest in science (p>.05), but there exists significant difference between the rural and urban school students in the extent of interest in science (p<.01). Hence, experiences which are significantly contributive to the interest in science among rural and urban samples are identified separately, while no such analysis was done on boy-girl subsamples.

In the rural sample

Result of multiple regression analysis to examine the influence of out-of-school experience on interest in science among rural secondary school students is in Table 3.

Table 3

Results of Step-wise Multiple Regression Analysis for Interest in Science of Secondary School Students in the Rural Sample

Predictors	R	R^2x100	F	B	t	SE	b	r	βxr
Parasitic animals[1]	0.36	12.8	23.62*	8.83	4.82	1.83	0.176	0.247	0.0435
Photos of scientists[3]	0.48	22.6		7.98	3.68	2.17	0.141	0.275	0.0388

Darkening of silver ornaments[1]	0.53	27.7		8.93	4.71	1.89	0.168	0.204	0.0343
Primary health centre[2]	0.57	32.0		7.23	4.24	1.70	0.147	0.202	0.0297
Making electric current from tomato[5]	0.59	35.1		6.51	4.07	1.60	0.138	0.024	0.0033
Attracting iron onto a magnet[5]	0.61	36.9		7.06	3.48	2.03	0.127	0.119	0.0151
Backward movement of roadside plants while we travel[1]	0.62	37.9		7.46	2.95	2.53	0.102	0.222	0.0226
Making loud noise in hall[4]	0.62	38.9		7.80	4.17	1.87	0.151	0.185	0.0279
Sprouting the seeds[1]	0.63	40.0		6.32	2.96	2.13	0.106	0.200	0.0212
Science books[3]	0.64	41.1		5.24	2.92	1.79	0.105	0.208	0.0218
Connecting electric switches[4]	0.65	41.8		4.93	2.97	1.66	0.108	0.125	0.0135
Thorny plants[1]	0.65	42.5		5.13	2.60	1.98	0.089	0.149	0.0133
Computer games[4]	0.66	43.2		5.25	2.47	2.13	0.088	0.156	-0.137
Photos of astronauts[3]	0.66	43.8		5.04	2.41	2.09	0.091	0.305	0.0278
Colour wheel[4]	0.67	44.3		4.43	2.38	1.86	0.087	0.172	0.0149
Parasitic plants[1]	0.67	44.8		4.83	2.39	2.02	0.090	0.234	0.0211
Pendulum movement in clock[1]	0.67	45.2		4.32	2.06	2.09	0.072	0.240	0.0173
Making thick Jaggery[4]	0.68	45.6		3.3.2	2.09	1.59	0.071	0.257	0.0182
Feathers[3]	0.68	46.0		4.64	2.00	2.32	0.071	0.229	-0.163

**p<0.01 (19,526) df*
1,2,3,4 and 5 indicates experiences categorised under observation, visit, collection, activity and experimentation respectively

Interest in science of rural school students can be significantly predicted [R=0.68, F = 23.62 for (19,526df), p<.01] using 19 predictors out-of-school experiences. These 19 significant predictor variables in the order of their predictive efficiency, in terms of percentage influence (in parentheses) on interest in science of rural secondary school students are: Observation of parasitic animals (4.35), Collection of photos of scientists (3.88), Observation of darkening of silver ornaments (3.43), Visit to primary health centre (2.97), Making loud noise in hall (2.79), Collection of photos of astronauts (2.78), Observation of backward movement of roadside plants while we travel (2.26), Collection of science books (2.18), Sprouting the seeds (2.12), Observation of parasitic plants (2.11), Making thick jaggery (1.82), Observation of pendulum movement in clock (1.73), Collection of feathers (1.63), Attracting iron on to a magnet (1.51), Making colour wheel (1.49), Doing computer game (1.37), Connecting electric switches (1.35), Observation of thorny plants (1.33), and, Making electric current from tomato (0.33). The percentage influence of the 19 predictors out-of-school experiences together on interest in science of rural secondary school students is 46.0

In the urban sample

Result of multiple regression analysis to examine the influence of out-of-school experiences on interest in science among urban secondary school students is in Table 4.

Table 4

Results of Step-wise Multiple Regression Analysis for Interest in Science of Secondary School Students in the Urban Sample

Predictors	R	R^2x100	F	B	t	SE	b	r	βxr
Pictures of the living[3]	0.40	16.2	14.29*	12.87	3.78	3.40	0.228	0.245	0.0559
Lichens[1]	0.49	24.5		8.63	2.99	2.89	0.176	0.227	0.0399
Photos of astronauts[3]	0.56	30.8		10.16	3.54	2.88	0.216	0.341	0.0737
NPK fertilizers[1]	0.59	34.8		9.17	3.09	2.96	0.181	0.282	0.0510
Loosening of electric lines during summer[1]	0.61	37.3		8.84	3.39	2.61	0.198	0.251	0.0497
Animal movements[1]	0.63	39.1		8.29	2.68	3.09	0.161	0.255	0.0411

Rubber/sandal factory[2]	0.64	40.6		-8.98	3.31	2.71	0.201	0.122	0.0245
Flower show[2]	0.65	42.4		8.45	3.00	2.82	0.190	0.113	0.0215
Horticulture[4]	0.67	44.3		-8.09	2.94	2.76	0.170	0.263	0.0447
Using thermo utensils[4]	0.68	46.1		6.80	2.79	2.44	0.154	0.119	0.0183
Aquarium Fish exhibition[2]	0.69	47.5		-7.45	2.51	2.97	0.159	0.121	0.0192
Agriculture research centres[2]	0.69	48.9		6.47	2.26	2.80	0.136	0.182	0.0248

*Note: *p<0.01(12,179)df*
#1,2,3,4 and 5 indicates experiences categorised under observation, visit, collection, activity and experimentation respectively.

Interest in science of urban school students can be significantly predicted [R = 0.69, F = 14.29 for (12,179df), p<.01] using 12 predictors out-of-school experiences. These 12 significant predictor experiences in the order of their predictive efficiency, in terms of percentage influence (in parentheses), on interest in science of urban secondary school students are the following: Collection of photos of astronauts (7.37), Collection of pictures of the living (5.59), Observation of NPK fertilizers (5.10), Observation of loosening of electric lines during summer (4.97), Doing horticulture (4.47), Observation of animal movements (4.11), Observation of lichens (3.99), Visit to agriculture research centre (2.48), Visit to rubber/ sandal factory (2.45), Visit to flower show (2.15), Visit to aquarium/ fish exhibition (1.92), and, Using thermo-utensils (1.83). The percentage influence of the 12 predictor out-of-school experiences together on interest in science of urban school students is 48.90.

Categories and Fields of Out-of-School Experiences Influencing Interest in Science More

In order to know the relative influence of observation, visits, collection, activity and experimentation related to biological and physical sciences on interest in science of the students, percentage influence if the relevant experiences under those categories were added together, and are presented in Table 5.

Table 5

Influence of Observation, Visits, Collection, Activity and Experimentation Related to Biological and Physical Sciences on Interest in Science of Secondary School Students

Group	Experience related to the field of	Percentage influence on interest in science of					
		Category of experience					
		Obser-vation	Visits	Collect-ion	Activity	Experi-mental	Total*
Total Sample	Biological science	10.69	3.97	2.03	0	0	16.69
	Physical science	10.09	0.79	6.47	1.99	1.88	20.04
	Science (total)	20.78	4.06	13.161	1.99	1.88	*
Rural	Biological science	9.90	2.97	1.63	0	0	14.50
	Physical science	7.42	0	2.78	8.82	1.84	20.85
	Science (total)	17.32	2.97	10.022	8.82	1.84	*
Urban	Biological science	8.10	6.55	5.59	4.47	0	24.71
	Physical science	10.07	2.45	7.37	1.83	0	21.72
	Science (total)	18.17	9.00	12.96	6.30	0	*

** Total may not add up to the value of $R^2 \times 100$ as some experiences are classifiable under neither of the fields of science; 1 and 2 indicate that respectively 4.66 and 6.06 per cent were added as percentage influence of collection of books and photos of scientists.*

Percentage influence of physical science related experiences on interest in science is 20.24 in total sample, 20.85 among rural school students and 21.72 among urban school students. Percentage influence of biological science related experiences on interest in science is 16.69 in total sample, 14.50 among rural school students and 24.71 among urban school students. In the total sample the experiential influence on interest in science is the highest from observation (10.69%) and is true in rural (17.32%) and urban (18.17%) samples also. Visits and collections especially to places and objects of biological interests are manifestly more in urban sample. In the rural sample, influence of visits related to physical

science on interest in science is nil, while percentage influence of visits to places of biological interest on interest in science is 2.97. The influence of collections related to both physical science and biological science on interest in science are more in urban sample than in rural sample. Influence of activity experiences on interest in science is comparatively less in urban sample (6.30 per cent). In the rural sample, though influence of activities related to biological-science on interest in science is nil, influence of activities related to physical science is 8.82 per cent. In total as well as rural and urban samples, influence of experimentations on interest in science is very feeble. Influence of biological science related experimentations in total, rural and urban samples are nil, whereas that of physical science related experimentations are 1.88 per cent for total, 1.84 per cent for rural and zero per cent in urban students.

Conclusions

In essence this study found that locale but not gender difference is noteworthy in interest in school science in Kerala, that interest in science is decidedly influenced by out-of-school experiences, and that locale difference exists in the influence of out-of-school science experiences on interest in science. Around 40 per cent variance of interest in science is attributable to out-of-school experiences among secondary school students, while such influence is 46 per cent among rural school students and 48.9 per cent among urban school students. Thus, nearly half the variance in interest in science is attributable to variance in experience. Observational experiences influence interest in science more than collection, activity, and experimentation. Experimental experiences derived by students are not found effective enough to arouse their interest in science.

This study could not reveal gender-difference in the extent of interest in science among secondary school students. While samples other than from Kerala indicated gender-based difference in interest in science (Feldhusen and Williard-Holt, 1993; Farenga and Joyce, 1997) a previous study on Kerala upper primary school sample revealed that the difference is qualitative than quantitative (Gafoor and Smitha, 2010), and the present finding is similar to the latter. Significant difference exists between interest in science of rural and urban school students with the former having markedly higher interest than the latter, confirming the previous similar findings from India (Vani, 1997; Shukla, 2005).

Interest in science of rural students is better influenced by experiences from easily available materials and day to day life

activities, whereas for the urban school students experience from structured, organised and planned settings are found more influential. Interest in science is influenced more by physical science related experiences, especially among rural school students. Influence of organised experiences such as visits and collections on interest in science is more in urban than rural sample. Influence of activity on interest in science, mainly those related to physical sciences, is less in urban sample.

Educational Implications of the Study

Linking science with students out-of-school science experiences to enhance student interest in science requires re-examination of traditional school science in terms of contents, instructional practices, textbooks and support facilities, teacher preparation, and assessment and further research.

Science learning at least in the early years needs to be an expansion of children's natural activities of observation and exploration. Exploring the living and non-living things and playfully interacting with their environment help children learn. Constructive science experiences are found in playful exploration of their immediate environments. Mountain, sky, sea, valleys, parks, and zoo might be distant, but stimulating environments. Teachers can suggest situations that encourage collecting information about primary qualities like location, dimension, mass, number and secondary qualities like colour, smell or sound.

Observation is found influential on student interest. But, teaching until the high school was not able to use this primary tendency to trigger students' science activities and experimentation. This is evident from less than expected influence these latter categories have on student interest. Careful expression of what one observes is important in prompting students' science activities and experimentation. Children require time to talk about what they observe and to compare their observations one another. Mutual descriptions and discussions of the observations encourage one to compare experiences and to "check what you think against what you see".

True science requires abilities that exceed observation. For elder students, observations are to provide basis for explanations, beyond mere descriptions and discussions. Observation ought to work as springboard for refined questions, beyond what, how, when, and why of things, to evaluate "what counts" as scientific knowledge. Findings

reveal that students' experiences from experiments have feeble effect on their interest in science. Repetition of past experiments is not the best way of exciting the spirit of science. Science learning activities should challenge, but not overly frustrate. Teachers have to find ways to keep children's natural yearning for learning burning by engaging them in motivating activities, by not forcing them to do. Genuine student involvement is the key to the stimulation of interest and intellectual development.

Arranged but less formal experiences have impact on student interests. Effect of visits on urban school students' interest in science is noticeable. Opportunity for rural students too for field-visits is to be thought upon. Structured activities and experiences are integral to an instruction for the development of interest in science. Influence of indirect experiences from books and computers on interest in science of students is evident in findings of this study. Bridging classrooms with media is one way to relate science teaching with the world outside. Movies, television, magazines, newspapers, books, and computer can bring in a lot of experiences into the classroom and thus, generate interest in science. Development of a school museum devoted to science will help students to structure the experience from collection better.

Impact of out-of-school experiences on science learning must be borne in mind while imparting instruction. For every unit, decide the major concepts and identify corresponding experiences from out-of-school. For achieving the affective goals of education the most appropriate, responsive, relevant, and reliable curriculum is a local one. At the start of every unit, relating the topic to the world outside the classroom works as a catalyst for setting the mind and body to really involve in learning. Before they begin a new topic, related materials be made available for students to get an opportunity to explore freely and prompt questions related to the topic. Linking out-of school experiences and systematic instruction is but a way of integrating right brain and left brain functioning, and thus of integrating achievement with attitudes.

Schools cannot ignore the urban-rural disparity in out-of-school experiences, as out-of-school experiences are highly influential on interest in science. Providing more computers and better lab facilities supplemented with frequent educational excursions to places of scientific interest might be one-step for rural children to get more experience and to further their interest in science. Interest in science can be enhanced through intervention that make use of

out-of-school experiences as symposia, science centres, puzzles, field based scientific investigations, summer science programmes, visits to space stations, field trips and garden based activities.

What students learn from textbooks be an extension of and be reinforced by out-of-school experiences. Science text books should be sources of interesting ideas, references and activities, rather than words to be memorised. Suggested activities should not be directed and "cookbook" in nature. On topics that can't be studied in depth or for which a hands-on approach is not possible, chapter need be useful to read as summaries. And teacher has to seek out activities and local examples to complement and to keep students interested in the subject.

Though observational skills are basic to science, guidelines to differentiate between the observations, say, of a first grader from those of an eighth grader are vague. The age-appropriateness of concrete learning strategies is ambiguous. Hence, teacher-incorporated activities tend to stress lower level skills such as information gathering, remembering, and organising rather than higher level skills classifying, inferring, theorising, generalising, hypothesising, and predicting. Further, research is needed to tune activity-based learning to the age of learner.

How teachers assess and what they assess has a major impact on the implemented curriculum. Assessment focuses learning activities in science classrooms. Educators are to develop better means of measuring kinds of understanding students acquire through activities. Evaluation of experience-based-learning has to be informal, majorly via unobtrusive observations. Teacher's observations should be recorded in writing, and if possible in detail. This can serve in planning further instruction, as a record of progress and attainment.

Beyond sheer possession of appropriate conceptual framework of the subject, teachers need to enrich their experiential repertoire through reading, observation, discussion with colleagues, and the like. Recognition of the aspects of science that students enjoy will help teachers to elicit and address student ideas, and to personalise students' learning experiences. Teachers having inadequate understanding of out-of-school experiences may discourage further discussion of student ideas. Teachers have to share their science interests and seize the ensuing teachable moments. Sharing teacher's hobbies such as keeping an aquarium or pets, or fixing electric circuits, create excitement that is contagious. Science

learning begins hands-on which stir students' mind-on to make their heads-on. Classroom science has to become a way of observing, a way of thinking about the experiences, a way of sharing these thoughts to others, and, a way of verifying what one think against what one see and share, in order to improve students' understanding of the world.

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