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Full Length Research Paper

Factors in students' ability to connect school science with community and real-world life

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The ability to relate school and home science as a way of enhancing students' performance in chemistry prompted this investigation. 200 high school chemistry students drawn from an urban center in Ondo State, Nigeria constituted the sample. They were made to respond to validated structured questionnaire that sought to discover the ability of students to relate chemistry concepts they learned in school with those that could be observed or inferred from the activities they carry out daily at home and the effect of socio-economic background of the parents on students' ability to relate the two experiences. The results presented in tables as well as hypotheses tested with chi-square revealed that the students could not establish a helpful relationship between school and home science in spite of daily exposure to both experiences. Students from low socio-economic background, where there are no house helpers, and are involved in regular household chores struck a better relationship than their counterparts from high socio-economic background. Also, chemistry teachers do not cite these home experiences in their teaching. The study is useful for the science teachers, authors of textbooks, teachers' trainers and curriculum planners in improving the learning environment of chemistry students.

Key words: Chemistry concepts, home activities, socio-economic status and achievement**.**

INTRODUCTION

Chemistry is one of the most important branches of science. Careers in science and science based disciplines like engineering and medicine require that students who enroll in such disciplines must not only be good in chemistry but must pass the subject at least at credit level in the Senior Secondary School Examination (SSCE). Besides, chemistry enables learners to understand what happens around them. It helps them to solve simple problems they encounter daily. Fahmy (2000) states that the most interesting aspect of chemistry is that it apply to our daily lives. In order words, chemistry is a real life science subject.

Chemistry deals generally with change, structure and properties of matter. Many of the topics are generally difficult for students to understand because of this. The difficulties arise from several sources. These include, as revealed in the work of some scholars, the abstract nature of concepts (Taber, 2002); curriculum demand (Swhan, 2002); overload of students working memory space (Baddclay, 1999); and language and communication (Cassel and Johnstones, 1985; Gabal, 1999; Johnstone, 1984; Johnstones and Salepeng, 2001). The list of difficult chemistry concepts reported in the literature due to their abstract nature is a long one. The list includes atomic structure (Harrison and Treagust, 1996; Zoller, 1990); chemical bonding (Peterson and Treagust, 1989; Taber, 2002; Taber and Coll, 2003) and kinetic theory (Abraham et al., 1992; Stavy, 1995; Taylor and Coll, 1989).

Of the many factors responsible for the difficulty, there is one that is worthy of being investigated. This is the inability of students to relate chemistry concepts learnt in

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school to daily home activities, or better still, the inability of teachers to cite relevant home examples and illustrations while teaching. It may have been taken for granted that teachers and students would consolidate concepts taught and learnt in schools with home activities such as cooking in the kitchen, boiling water and mixing things. A few research evidences have revealed the opposite of this situation which have been taken for granted.

Learning is known to be culture dependent (Mwannwenda, 1996). Children who do not have the opportunity to engage in home activities, like cooking, may not have the first hand experiences through which they can acquire science concepts associated with such home activities. Hence, the gulf that exists between Science lessons in the school and home activities become wider. This gap, if not bridged by proper teaching, might hinder the ability of such students to relate these supporting experiences at home to school learning. As a result, many students see science as a discipline devoid of real life experiences. The main focus of this paper is to examine the influence of cultural backgrounds of students on their ability to relate chemistry concepts taught or learnt in school to home activities.

Literature review

A substantial number of researches have acknowledged the importance of parents, teachers and peers in the achievement of students in schools (Bugental and Johnston, 2000; Chang et al., 2001; Roehlkepartain, 2007; Jegede and Okebukola, 1989; Wolfram, 2005; Koul and Fisher, 2005). Cultural background and parental socioe-conomic status have been shown to have profound influence on school achievement. They are a major predictor of cognitive achievement (Bugental and Johnston, 2000; Chang et al., 2001; Roehlkepartain, 2007), they exert a very strong effect on students and determine their learning outcomes (Jegede and Okebukola, 1989; Wolfram, 2005). They also influence students' perception of teachers' interpersonal behaviour and classroom learning environment (Koul and Fisher, 2005). Wolfam (2005) established strong relationships between high socioe-conomic status of parents and better performance in students. On the other hand, Roehlkepartain (2007) and Rogoff (1995) observed a high risk of drop out of students in home disadvantaged environments and that low socioe-conomic status is negatively linked to a wide range of indicators of child and adolescent well-being.

However, a startling revelation was made by Pedrosa et al. (2006) of 'education resilience'. According to the authors, students coming from disadvantage back-grounds, in both educational and socioe-conomic aspects have a higher relative performance than their comple-mentary group. This observation is startling because one would think that a disadvantaged background would hinder performance and the subsequent advancement and enrollment for higher studies. Can it be there is something in such detractive environments that facilitates learning and achievement?

Characteristically, high socioe-conomic background has enhanced indices such as high standard living, educational attainment, high income and the ability to hire and pay for services such as cooking, cleaning and gardening, (Ainley and Long, 1995; Gwatkin et al., 2000; Vyas and Kumaranayake, 2006). Students from such homes are thus, left to face their studies in schools or at homes without distraction. The situation is not so in the lower income group. With meager income, many parents cannot afford the luxury of hiring helpers. They have to combine the household chores with the daily paid jobs. The children are not only involved in these domestic activities, in some cases, as it is in the third world, they contribute substantially to the family income either by selling in the market or working in the garden after school or at week ends. Deprived, as these environments may be of modern facilities, they could be rich in and promote indigenous and cultural activities through which children could learn meaningful science concepts.

Obviously learning takes place everywhere. Decades ago the cognitive scientists discovered and stressed the importance of environments in problem solving in learn-ing. The study by Okebukola and Jegede (1991) revealed the negative influence of African traditional cosmology, beliefs and superstitions on students' acquisition of observational skill. However, those of Dansen (1984, 1988; Ohunche and Otaala (1981) and Mwamwenda and Mwamwenda (1989) made known the facilitating effects of domestic activities (selling, buying, gardening) on African children development of conservation ability, numeracy, concept formation and skill development. Generally females are known to possess better finger dexterity (Baenninger and Newcombe, 1995; Poole et al., 2005), perhaps due to their daily engagements in manipulative activities and household chores, while males develop better spatial orientation (Baenninger and Newcombe, 1989; Stumpf, 1998) and concepts due to their activities in gardens. Siggraph (2004) affirmed 'that simple scientific experiments can be conducted in the comfortable confines of the kitchen and the final result may be edible'. What an approach to science! However because students learn in a pleasant and comforting atmosphere, learning in the kitchen is not considered fashionable as the book approach to learning science. Difficult chemistry concepts such as radiation, convec-tion, conduction, energy and chemistry of carbohydrates may seem overwhelming to many students, yet to explore and appreciate these scientific concepts during prepara-tion of food may actually be a fun and exciting adventure. A list of some home activities that could promote the development of skills and formulation of scientific concepts is presented in Table 1. It is important that children engage in these household chores, for 'the chores may serve both the immediate goal of helping parents with

Table 1. Home activities that could promote the development of skills and formulation of scientific concepts.

Home environment	Home activities	Skills developed	Concept formulated
Kitchen	Lighting stove, burning of fuel	Measuring, observing noting observable change	Chemical change, physical change, compound, combustion, incomplete combustion, hydrocarbon, gases, liquids and solids
	Boiling of water	Measuring, , inferring, , predicting	Change of state, boiling, boiling point, evaporation, vapour pressure, atmospheric pressure etc
	Freezing and melting	Estimating size, observing	Freezing and melting points, solidification, contraction
	Dissolution of salts, sugar, oil etc in solvents	Measuring, observing, classifying	Solute, solvent, solution, mixture, residue, precipitate, suspension, colloidal solution, saturated and unsaturated solution, miscible and immiscible liquids, gels,
	Spraying insecticides	Estimating distance, predicting	Diffusion, gas volume and molecules, intermolecular space and force of attraction, entropy, compressibility, density
	Drying	Observing, measuring, classifying	Evaporation, surface area, volume-surface area, rate of reaction, radiation, heat energy,
	Grinding and pounding	Observing, measuring,	Increasing surface area, reducing particle size, solid, paste,
Living room	Operating electrical appliances fans, pressing iron	Observing, counting, estimating time, communicating, reporting	Conversion, conservation of energy, revolution, rotation, potential and kinetic energies, oscillation
Garden	Measuring, planting, harvesting, applying fertilizers etc	Estimating planting time and distance, calculating, hypothesizing, controlling and manipulating variable les	Storage organs, corms, rhizomes, photosynthesis, translocation, irrigation, organic and inorganic compounds and solvents

Source: Ahiakwo (2007) and Oloruntegbe (2004) inaugural lecture and research article.

busy schedules to run the household, as well as the long-term goal of teaching children about family relationships and obligations and about planning and coordinating schedules and activities' (Goodnow, 1988). If the experiences are properly related so that one could consolidate the other, there is much a chemistry student can learn from home activities.

For instance, in boiling of water in a tin container in the kitchen, students would be made to know that water molecules are energetic and mobile, hence it can be poured.

$$H_2O\ (l) \longrightarrow H_2O\ (g)$$

As the container is being heated on kerosene stove or electric/pressure cooker, the water molecules gain more energy such that molecules with high enough energy will escape from the liquid phase into the gaseous phase. A vapour pressure will be built up. As more molecules move into the vapour phase (small volume) the vapour pressure increases (this can be inferred). The pressure would tend to force the lid of the container open to allow them to escape into a larger volume if not tightly closed (this can be observed from outside). At a time when the saturated vapour pressure inside is equal to the atmospheric pressure acting on the lid, the particles move freely to the gaseous phase and the water is said to boil (this can be inferred as well as observed). This is the point when the water is fit to make eba – cassava powdered meal (any eba made before this time will not be good). If the temperature is taken at this time it is likely to read 100°C (this can be observed). This temperature is called the boiling point of water.

If the container is tightly closed to prevent particles from escaping (closed system – this may not be achieved in the kitchen), on getting to the colder part under the lid the vapour will condense and drop back as liquid to the container (can be observed). The processes of boiling and condensation will continue until when equilibrium is established between water and vapour.

$$H_2O\ (l) \rightleftharpoons H_2O\ (g)$$

Look at the number of concepts that can be observed and inferred during the process of boiling water to make eba.

Further questions can be asked by the teachers to establish more links:

1. Why do liquid particles move and that of solid do not?
2. What causes the lid of water boiling container to move?
3. Why does water boil at different times but at the same temperature?
4. Would you expect the boiling water to completely dry up if heating continues?
5. How can you achieve a dynamic equilibrium between liquid and gaseous particles?

Questions of this sort could provoke more thinking in the students.

The list and the example provided above are not exhaustive. However, whether or not the experiences can be adequately related depends on the involvement of students in them, the ability of the parents to offer the necessary assistance and the teachers' competence and readiness in establishing a relation and making them strong. Parents' inculcation of cultural values is passed to the next generation through socialization (Rogoff, 1990; Bandura, 1997; Bussey and Bandura, 1999), how parents engage their children in science-related activities (Crowley and Callanan, 1998) and the language of discussion of conceptual questions and scientific vocabularies (Tenenbaum and Leaper, 2003) at home go a long way to determine children's ability to relate school science and home activities. Tenenbaum and Leaper submitted that causal explanations provide a cause-effect description of an event. Specifically the authors view few of them as eco-cultural factors. This investigation is on the influence of the factors on students' ability to relate school science and home activities.

Problem of the study

The main focus of this investigation is seeking a way of improving the learning environment of students in chemistry and enhancing their performance in skills and cognitive achievement through consolidated home activities. Students' interest in science could also be enhanced. This will forestall the dwindling enrollment of students into science and science based disciplines in universities and polytechnics. Lewis (1987) had long observed that young ones are turning away from science; while Djallo (2004) and Duyilemi (2006) also raised alarm that science education is in danger of low patronage. Whereas graduates of social and management sciences get lucrative employment just like sportsmen and women, those in sciences are not so favoured. According to Djallo (2004), young people today are less interested in studying science and technology subjects than before. That they are opting for fields that pay better salaries and require less hard work. This is in spite of the current global race for science and technological advancement. At a time when the demand for scientific advances and innovation are needed, the number of graduates in science and technology has fallen (Djallo, 2004). One factor that seems to have facilitated the trend observed above is the tension created inadvertently between school and home science. Students no longer see science as a real life experience. The inability to relate these two complementary experiences makes chemistry to be difficult for students to understand, hence the need to arrest the students' dwindling interest in chemistry. This has inspired the current investigation into the influence of cultural background on students' ability to relate home experiences to the learning of chemistry.

Research questions

The research questions raised in the study are:

1. Is there any difference in the overall number of students that can relate chemistry concepts learnt in school to home activities and those who cannot?
2. Is there any difference in the number of students from low socio-economic families and high socio-economic ones who could relate chemistry concepts learnt in school to home activities?
3. Is there any difference in the number of students from low socio-economic families and high socio-economic ones who could not relate chemistry concepts learnt in school to home activities?
4. Do chemistry teachers cite relevant home examples and illustrations in their teaching?

Research hypotheses

Three hypotheses were formulated based on the questions raised above. They are:

1. There is no significant difference in the overall number of students that can relate chemistry concepts learnt in school with home activities and those that cannot? 2. There is no significant difference in the ability of students from high and low socio-economic status to relate chemistry concepts learnt in school with home activities.
3. There is no significant difference in the number of chemistry teachers as perceived by the students who

Table 2. Ability of students to relate chemistry concept to home activities.

Chemistry concepts	(1) Melting point	(2) Boiling point	(3) Filtration	(4) Decantation	(5) Saturated vapour pressure	(6) Evaporation	(7) Rusting
Able	*56*	47	68	41	43	27	19
Unable	144	153	132	159	157	173	181
	(8) Corrosion	**(9) Alloy**	**(10) Oxidation**	**(11) Reduction**	**(12) Condensation**	**(13) Change of state**	
Able	*45*	43	10	12	54	61	
Unable	155	157	190	188	146	139	

utilize home illustrations and examples in their teaching and those who do not.

METHODS

The research design employed in this study is survey research design. This is because only a very small proportion of the entire chemistry students' population was covered. 200 senior secondary school two (SSII) (Senior High School) students randomly selected from 10 senior secondary schools in Akure, Ondo State, Nigeria constituted the sample. They were gotten through simple random sampling using the class register.

Instrument, validation, data collection and analysis

A self-constructed validated structured questionnaire was used for data collection. The questionnaire consisted of four sections. The first section deals with the socio-economic status and home background of the students. Responses were sought on traditional variables, (Vyas and Kumaranayake, 2006), such as: father's income, mother's income, occupation of the father/mother, status of the father/mother on their jobs and the education of the father/mother. Other specifics range from asset ownership – piped borne water, electricity to whether parents have cooks, gardeners and cleaners at home or they carry out the household chores on their own. Respondents were also asked to indicate whether or not they join their parents in carrying out some of the household chores. The second section deals with what activities the students carry out when at home. Activities listed to be ticked by respondents include cooking which in turn involves boiling water; melting and freezing; evaporating; drying; making solution, laundry-drying, ironing, gardening and so on. In the third section, students were asked to indicate which of the 13 chemistry concepts presented they could relate with specific home activities. The concepts presented are melting point, boiling point, filteration, decantation, saturated vapour pressure, evaporation, rusting, corrosion, alloy, oxidation, reduction, condensation and change of state. It is the belief of the authors that the concepts listed here and the home activities listed in the second section are somehow related and that science students should be able to establish such relationship. In the fourth section, students were to indicate the home examples and illustrations they perceived that their teachers often referred to while teaching in chemistry classes. The instrument was validated using a team of science educators in the the Faculty of Education of Adekunle Ajasin University, Akungba-Akoko. They went through the drafts and gave suggestions necessary for the preparation of the final draft. The final draft was subjected to a test–retest method in order to determine the coefficient of reliability. The coefficient was put at 0.74.

Data collected are presented in contingency tables and histogram. Chi-square was used to test the null hypotheses.

RESULTS

The responses of the students on the chemistry concepts they could relate to home activities are presented in Table 2. The evidences here and in other parts of the report are based on what the students reported they could do. No test instrument was designed and administered to test the actual ability of the students. The data in Table 2 clearly shows that the number of students who could not relate each concept with home activities was fewer than those who could relate the concept with home activities.

The socio-economic status of the parents of students who could relate the chemistry concepts with home activities is presented in Table 3. The data in Table 3 reveal that more students from low socio-economic home than from high socio-economic homes could relate each chemistry concept with home activities.

The socio-economic status of the parents of students who could not relate each concept with home activities is presented in Table 4. The data in Table 4 clearly show that for each chemistry concept, more students from high socio-economic homes, than from low socioeconomic ones could not relate the concept to home activities.

Chi-square statistic was used to analyze the data in Tables 2, 3 and 4 to test the first two null hypotheses. The analysis is presented in Table 5.

The analysis reveals that, for each dependent variable considered in the study, the value of chi square analysis is statistically significant. With respect to dependent variable 1, (shown in Table 5), the number of students who could relate chemistry concepts with home activities was significantly less (x^2 = 125.83 when compared with table value of 21.0 at degree of freedom (df) = 12 and $\propto$ = 0.05) than the number of students who could not. With respect to the influence of the socioeconomic status of parents on the ability of students to relate chemistry concepts with home activities, the number of students who could relate concepts with home activities was significantly higher (x^2 = 112.78 when compared with

Table 3. Socio economic status of students who could relate concepts with home activities.

Chemistry concepts	(1) Melting point	(2) Boiling point	(3) Filtration	(4) Decantation	(5) Saturated vapour pressure	(6) Evaporation	(7) Rusting
HSES	19	20	30	17	12	11	9
LSES	37	27	38	24	31	16	10

Chemistry concepts	(8) Corrosion	(9) Alloy	(10) Oxidation	(11) Reduction	(12) Condensation	(13) Change of state
HSES	13	21	2	1	22	11
LSES	32	22	8	11	32	50

Table 4. Socio economic status of parents of students who could not relate chemistry concepts with home activities.

Chemistry concepts	(1) Melting point	(2) Boiling point	(3) Filtration	(4) Decantation	(5) Saturated vapour pressure	(6) Evaporation	(7) Rusting
HSES	108	134	130	125	135	153	132
LSES	36	19	2	34	22	20	49

Chemistry concepts	(8) Corrosion	(9) Alloy	(10) Oxidation	(11) Reduction	(12) Condensation	(13) Change of state
HSES	109	142	151	143	134	119
LSES	46	15	39	45	12	20

Table 5. Chi square analysis on variables considered.

Variables considered	Degree of freedom	Calculated value	Table value	Remark
Ability or inability of students to relate chemistry concepts with home activities	12	125.83	21.0	*
Socio economic status of students who could relate concepts with home activities	12	112.78	21.0	*
Socio economic status of students who could not relate concepts with home activities	12	126.82	21.0	*

*Significant at P < 0.05.

table value of 21.0 at df = 12 and ∝ = 0.05) in low socioeconomic homes than those in high socioeconomic homes. Hypotheses 1 and 2 were rejected.

The response of the students on the ability of their teachers to refer to familiar home activities while teaching chemistry concepts is presented in Table 6. The data in Table 6 reveal that greater number of students indicated that their teachers were unable to make use of home activities in teaching chemistry concepts in the school. The chi-square analysis is significant, (x^2 = 5.99). This means that the difference in the number of students who indicated that their teachers often utilized activities in students' homes in teaching chemistry concepts in school is significantly less than those who indicated otherwise. The hypothesis 3 was rejected.

DISCUSSION

The finding that the bulk of the students reported they could not relate science concepts learnt in schools to home activities may be due to the wide gap that usually exists between the two family settings, homes where students participated in household chores and others where these activities are never engaged in by the students. Banu (1985) and Watanambe et al. (2007) once observed this trend. Both authors described as 'cultural mismatch' any comparison between home activities and school learning. Azmitia et al. (1994) highlighted the inability of chemistry teachers to cite home experiences in their teaching. This evidence is also revealed on Table 6 as many students claimed that their teachers do not

Table 6. Students' perception of teachers' use of home examples and illustrations in chemistry teaching.

Variables	Yes	No	Chi square analysis			
			Calculated value	Table value	Degree of freedom	Remark
Use of home activities	68	132				
Use familiar illustration	56	144	16.67	5.99	2	*
Use familiar language	87	113				

*Significant at $P < 0.05$.

cite relevant home experiences as examples and illustrations in teaching chemistry concepts.

There are more students from parents of high socio-economic level than those from low socio-economic homes who could not relate school and home science. This may be due to lack of involvement in household chores by the children whose parents prefer to hire house helps to do the job rather than allow the children to take part. However it need be noted that the performance of students may not follow this pattern, as the ability to relate these experiences are complementary and not a total factor of school achievement.

Conclusion and recommendations

In conclusion a substantial number of chemistry students could not establish a helpful relationship between school and home science in spite of daily exposure to both experiences. Also students from low socio-economic background, where there are no house helpers and are exposed to household chores struck a better relationship than their counterparts from high socio-economic background. This is not to say that their performance is better, but rather they could gain more especially if the teachers could cite these concepts related home activities in their teaching. Incidentally many chemistry teachers, as perceived by the students in the study, do not cite these home experiences in their teaching.

Socio-economic variables are very much beyond what the school management can manipulate. More attention is paid to the teachers' variable. Enhanced teaching strategies are advocated for meaningful learning through good school-home linkage practices. Teachers and students alike will do well to bring out salient chemistry – related home concepts in teaching and learning as illustrated in the example of boiling water in the literature review section.

This study has implication for science teachers, authors of textbooks, teachers' trainers and curriculum planners. Home activities can provide a veritable source of meaningful teaching and learning of science concepts. Parents must not see it out of place to engage their children in household chores; instead they should assist the children to learn from them. Teachers too must use students' home experiences to consolidate learning in school.

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