A STUDY ON THE LEVEL OF THE KNOWLEDGE OF ADVANCED LEVEL STUDENTS RELATED TO DOMESTIC APPLICATION IN CHEMISTRY.

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ABSTRACT

Chemistry is an important part of life. Human beings are also chemical in nature. To understand how we work as well as the universe that we are part of chemistry is needed. Chemistry helps us to understand the world around us. It is in food we eat, cloths we wear, water we drink, medicine we take etc. Therefore chemistry is considered as one of the major subjects in science streams at secondary senior students (grade 12 and 13) in Sri Lanka. In Sri Lankan Advance level curriculum (secondary senior level) chemistry is a compulsory subject for students in physical and bioscience stream. Although the facts, patterns and principals of chemistry were broadly discussed in the syllabus it is observed that the knowledge of the chemicals used in day to day life is not sufficient. This research was done with the intention of identifying the level of knowledge of A/L students in household chemistry, perusing subject content related to household chemistry in other countries and recommending subject content that should be included in A/L syllabus related to household chemistry . To achieve the objectives following methodology was used. First a diagnosis test was administered to identify the knowledge of students regarding the household chemistry. Another questionnaire was used to check the ideas of teachers regarding the level of students as well as the subject content that should be included to the syllabus. Relevant topics were identified referring to the syllabus of other countries. Including facts regarding household chemistry was accepted in the discussion with University lectures and Lectures of NIE (National Institute of Education). The results of diagnosis test proved deficiency in knowledge of A/L students regarding household chemistry. It is strongly proved when analyzing the questionnaire given to teachers. According to the research following subject matters were identified to be included in the A/L syllabus. Chemical in food, chemistry of some important pharmaceutical, chemistry of cleaning agent, chemistry of paints, chemistry of cosmetic can be recommended to include in A/L syllabus. Chemistry can be made an interesting subject for student by realizing them regarding application of chemistry in the real life situations.

Keywords: Chemistry, Chemistry curriculum, household Chemistry, Chemicals

INTRODUTION

Chemistry is a vital and dynamic science. It is of fundamental importance not only to all the other sciences and modern technology but also to any explanation of the material things around us.

A reasonable short definition of the scope of chemistry can be given as "Chemistry is the integrated study of the preparation, properties, structures and reactions of the chemical elements and their compounds and of the systems which they form."

Chemistry plays a major role in all works in our lives. Our daily needs of food, clothing, shelter, water, soaps, detergents, medicines etc. are in one or the other manner connected with chemical compounds. According to the American Chemical Society, a non-profit organization, “Everything you hear, see, smell, taste, and touch involves chemistry.” Chemistry helps explain things like why leaves change color in the fall, why baking bread smells so delicious, and why some people are allergic to things like peanuts. Everything that has matter breaks down into chemical building blocks. (Soken-Huberty E. 2023)

Chemistry is considered universally as an important subject in school curriculum. Chemistry education is necessary because of its immense value for the students' individual lives as well as for the society. In chemistry learning, students are expected to understand chemistry concepts in order to solve problems through building their individual knowledge (Taber, 2002; Koballa Jr. et al., 2000).

In Sri Lankan advance level curriculum, chemistry is one of the major subjects that a student follows. It is considered as a compulsory subject for students in the physical science stream and Bio Science steam.

GCE (A/L) Chemistry curriculum has been designed with the aim of providing the basic background knowledge in chemistry which is essential not only to proceed for higher studies, but for various other fields.

By reviewing the present A/L chemistry syllabus various fact, patterns and principles can be observed. But there is a lack of day to day applications of these fact, patterns and principles. A comparison of the central valued activities of the field of chemistry with the curricula presented in introductory texts reveals lack of connection between what is taught in school and what the field actually encompasses. (Journal of chemical Education published by American chemical society 2006-April)

The student who has completed the present A/L syllabus has gained a broad knowledge of complex concepts of chemistry. But they are not aware of chemistry that is needed for real world application. Chemical education at school needs both to help students understand and use basic chemical concepts but also to relate these concepts to real-world issues and show how chemistry helps in understanding and dealing with the many science-related issues that arise in everyday life. (Peter E. etal.2015) A Subject becomes more attractive when it is identified with the real world. It helps the student learn with interest. Then students are able to relate examples from day to day life with the subject. Students will learn new concepts and link them to their prior knowledge. At present chemistry is divided into several categories like organic chemistry, physical chemistry is divided into several categories like organic chemistry, physical chemistry, inorganic chemistry and general chemistry. This is considered as a traditional method of teaching. The attraction of students can be drawn to a subject if it is familiar to them. Then they will understand that the concepts they learn are useful for them as well as the society in which they live. Any curriculum should be changed in accordance with the rapid changing world. Most of the countries have added these changes to their school curriculum. The knowledge related to the subject of chemistry has undergone tremendous changes during the past one decade. Many new areas like synthetic materials, bio molecules, natural resources, consumer chemistry, Industrial chemistry are coming In a big way and deserve to be an integral part of the chemistry syllabus at senior secondary stage. (Teaching of Chemistry M.S. Yadav)

When compare with other syllabi, there is a lack of applications of household consumer products in the syllabus of Sri Lankan A/L chemistry. India has already included a unit on “chemistry in everyday life" to their advance level syllabus. The studies of educational Psychologists, connective scientists and class room experimentation have shown that the pedagogy of long standing is not the most effective for producing learning. Traditional topics have often been modified at the expense of correctness in order to incorporate them in the introductory course. There is overwhelming evidence that students learn best by interactive collaborative methods of instruction. (Journal of Chemical Education publish by American Chemical Society - 2006)

It is a tragedy that a student with a wider knowledge of chemistry does not have a knowledge about the chemistry of active ingredients of the medicine he/she takes for a headache. He/she does not know how to remove a patch on his/her dress, He/she is not aware of the suitability of the chemicals that have been added to various foods. Then the objective of applying things that they learn is not achieved successfully with the content of the present

A/L syllabus. The syllabus places emphasis on a clear grasp of chemical principles, current issues relevant to chemistry, the impact of recent developments and their application of the needs of the society. (Teaching school chemistry UNESCO)

When discussed with the students it was revealed that they have gained a considerable amount of knowledge of organic chemistry, but it was not useful to their day to day life.

When reviewing the answer scripts of term tests as well as A/L examination it is found that the students did not have sufficient knowledge of applications of chemistry in day to day life. Although they are well equipped with theories, principles, and laws, the majority have minimum knowledge of application of chemical compounds and elements.

The chemistry of the products used in day to day life is studied under chemistry of elements in periodic table, Industrial chemistry and environmental chemistry unit of the present A/L chemistry syllabus. But those units discuss very little amount of day-to-day application of chemistry at home.

In accordance with above information it is clearly evidenced that the chemistry curriculum, which is used in Sri Lanka, lacks application of chemistry in household products. If students are aware about the chemicals they use in day-to-day life in medicine, washing agents, cosmetics, food additives, it will be helpful for their family members as well. The society will gain an awareness through them.

For instance there are favorable effects as well as harmful effects from food additives that are added abundantly. As public are not aware of them, they consume these food regularly. It causes many diseases. In addition to that when students get the knowledge of what they consume it will make the subject more interesting to them.

By considering all those facts it is expected to achieve following objectives from this study.

1. Identifying the level of knowledge of A/L students in household chemistry.
2. Perusing subject content related to household chemistry in syllabi of other countries.
3. Recommending subject content that should be included in A/L syllabus related to household chemistry.

METHODOLOGY

This research was conducted to identify the level of the knowledge of advanced level students related to domestic application in chemistry. In order to achieve the objectives of the research various research tools and research methods have been used.

Educational research tools

1. Diagnosis test paper for the two samples of students.
2. Questionnaire for the two samples of teachers.
3. Present Sri Lankan Advance Level chemistry syllabus.
4. Advanced Level Chemistry syllabi used in India and United Kingdom.
5. Interview with resource persons.
6. Text books and web sites of Chemistry.

Methods

1. Testing the level of students' knowledge regarding the household Chemistry.

A diagnosis test was administered in order to identify the knowledge of students regarding the household Chemistry. The questions were based on chemistry of food additives, cleaning agents, paints, cosmetics, drugs and pharmaceuticals which directly or indirectly related to the present Advance Level Chemistry curriculum. The question paper consists of three parts. First part includes ten binary choice questions which students would find

very easy and readily like to respond. Students had to mark right or wrong in the relevant cage given against the question. Second part includes another ten multiple choice questions. Students had to underline the correct choice for each question. First and second part included closed end questions. But the third part consisted open end questions. It consists five structured essay type questions. This was purposely included to get an idea of the knowledge of the students.

Two student samples were selected using simple random sampling method.

Sample 1 – forty students were selected from grade 13 who were preparing for their Advance Level examination. They were students of Thakshila Central College, a national school from Horana Educational Zone, Western province in Sri Lanka.. They had completed 11 units of their Chemistry syllabus at that time.

Sample 2 - forty students were selected from the same school that had faced their Advanced Level examination.

The responses to questions and the total marks of test paper were too analysed qualitatively and quantitatively to identify the knowledge of the students regarding the day to day application of chemistry.

2. Giving the Questionnaire for the teachers.

The printed questionnaire in Sinhala consisted of two printed pages.

This was like an attitude test. It consisted three types of questions based on their attitudes on knowledge of students, present Chemistry syllabus and the proposed content.

The teachers sample was selected using simple random sampling. Eight Chemistry teachers from Thakshila Central College Horana in Sri Lanka and twelve Chemistry teachers who were following the MSc in Science Education at Post Graduate Institution of University of Peradeniya in Sri Lanka.

Responses were analyzed by using qualitative and quantitative methods to identify the attitude, proposals and the comments of teachers.

3. Referring the Advanced Level chemistry syllabi of India and United Kingdom

4. Interviewing resource persons.

Interviews were made directly with senior chemistry teachers, NIE officers and University lecturers.

5. Collecting the subject content through the text books and internet.

DATA AND DATA ANALYSIS

Analysis of students test paper,

Sample 1 – Forty students were preparing for Advanced Level examination.

Sample 2 – Forty students had faced Advanced Level examination.

Number of students given correct answers was used to calculate the facility index.

Table 1 Facility index of each question

	Facility Index		
Question Number	**Sample 1**	**Sample 2**	**Both sample as a 1 sample**
1) 1	0.90	0.90	0.900
2	0.40	0.70	0.650
3	0.40	0.55	0.475
4	0.25	0.70	0.475
5	0.50	0.70	0.600
6	0.20	0.40	0.300
7	0.15	0.15	0.150
8	0.90	0.90	0.900
9	0.85	0.85	0.850
10	0.80	0.80	0.825

2)	1	0.50	0.50	0.500
	2	0.25	0.60	0.425
	3	0.80	0.80	0.800
	4	0.15	0.40	0.275
	5	0.65	0.75	0.700
	6	0.85	0.65	0.750
	7	0.25	0.55	0.400
	8	0.65	0.65	0.650
	9	0.35	0.65	0.500
	10	0.40	0.55	0.475
3)	1	0.00	0.00	0.000
	2	0.00	0.85	0.425
	3	0.50	0.85	0.675
	4	0.00	0.75	0.375
	5	0.30	0.40	0.350

Weak areas of answering were identified from the facility index.

Table 2 Weak areas of answering

Question Number	Facility Index	Areas
3)1	0.00	Chemistry of cleaning
1)7	0.15	Chemicals in food
2)4	0.275	Chemistry of paints
1)6	0.30	Chemistry of pharmaceuticals
3)5	0.35	Chemistry of kitchen ware

The mean Values of the marks of each sample were calculated using the frequency distribution of marks.

Table 3 Mean values of marks

Sample	Mean value
Sample 1	36.5
Sample 2	53.5
Both	45.0

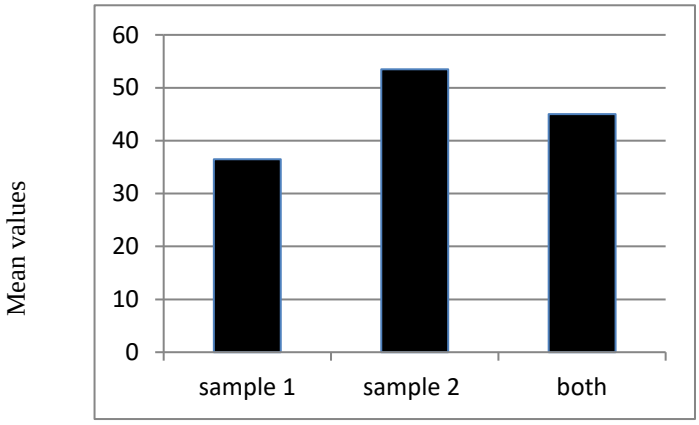

Figure 1 Mean values of the Marks

Analysis of Teachers' Questionnaire

Through analyzing teacher's questionnaire following subject areas were identified as important.

1. Chemical in food
2. Chemistry of some important pharmaceutical
3. Chemistry of cleaning agent
4. Chemistry of paints
5. Chemistry of cosmetic

The extend of the content of each area that should be included in syllabus is as follows,

1. Name of the chemical
2. Usage
3. Ill effects
4. Chemical reaction
5. Structure of the chemicals

Relevant topics in India and United Kingdom syllabi

Chemicals and healthcare

Analgesics, tranquillizers, antiseptics, disinfectants, antimicrobials, anti-fertility drugs, antihistamines, antibiotics and antacids.

Dyes – Classification with examples

Indigo, methyl orange, aniline yellow, alizarin, malachite

Advanced materials – Carbon fibers, Ceramics, micro alloys

Chemicals in food – Preservatives, artificial sweetening agents, antioxidants and edible colours

Detergents – Classification, some important examples

RESULTS AND DISCUSSION

A large number of results were obtained by analyzing the data collected by performing a Diagnosis test for the students.

According to table 2, it was revealed that while the facility index of certain questions was high, the facility index of some other questions was either at low or medium level.

Comparatively, facility index of marks obtained by sample two students was high. For few questions the facility index was equal for sample one and two. These results depict that after completion of the G.C.E (A/L) syllabus the students gain a fair knowledge about the usage of chemicals in day to day life. But related to table 3 the knowledge of student in certain areas was low. They are chemistry of cleaning agents, chemicals in food, Chemistry of pharmaceutical, Chemistry of paints and Chemistry of kitchenware. Being unable to discuss them broadly in the syllabus can be cited as the reason.

For example neither of the both student samples were able to present a domestic usage of ammonia (NH_3) though a broad knowledge is given to the student about chemistry of ammonia through the present A/L chemistry syllabus, he/she was not made knowledgeable about a domestic usage of NH_3.

A very limited number of students were aware of the compound used in iodized salt. The facility index of those questions in both the samples was very low. Student who studies chemistry as a subject was not aware about a compound used in iodized salt used for domestic purposes daily, reveals a lack of connection between the concepts taught in G.C.E.(A/L) chemistry syllabus and the application of them in day to day lives.

The knowledge of the students on question No 4 in section 2 regarding the compound used in obtaining white color in paint production was very low.

Students have not been made aware about the chemicals in paint though they use paints in their day to day lives.

They are also not aware about chemical compound contained in Aspirin. Despite the fact that students learn at a broader level about various organic compounds in under organic chemistry, it was revealed that they didn't have a fair knowledge about compound such as Aspirin.

When comparing the responses given by the students who had completed and had not completed the syllabus, those completed had a comparatively fair knowledge, but those who had not completed seemed to have inadequate knowledge. Their knowledge about pharmaceuticals, food additives, cleaning agents and paint was insufficient. Less attention paid on such sections in the present syllabus can be cited as a reason.

The mean value of the marks obtained for the question paper by student was calculated (Table 3). It was proved that the mean value of the marks of student who completed the syllabus was high. But that mean value was not sufficient.

When mean value was calculated considering both samples as one it was low. It was below fifty. It is shown that the knowledge of students regarding household chemistry is relatively insufficient.

Depending on the above results, the fact that a considerable amount of attention to be paid on making students knowledgeable about household chemistry for domestic purposes must be emphasized.

Teachers have unanimously accepted including more subject content of household chemistry in to the syllabus when analyzed their questionnaire.

In accordance with the questionnaire for teacher the priority order of the subject matter to be presented as fallows.

1. Chemical in food
2. Chemistry of some important pharmaceutical
3. Chemistry of cleaning agent
4. Chemistry of paints
5. Chemistry of cosmetic

When studying the chemistry syllabi for the students of senior secondary level in India and United Kingdom it was seen that they have specifically discussed about application of domestic chemicals in their syllabi. Therefore it proves that many countries have paid attention on the above fact.

Many scholars such as NIE officers, University professors and lectures have acknowledged the fact that the above subject matters should be included into the syllabus. Some professors and lectures had a view that those subject matters need not to be added as separate unit or a sub unit, but to emphasis the applications of those chemical in relevant lessons. Chemistry of paints can be included in the unit of Industrial chemistry was one of the example. In the study of compounds in organic chemistry, application also should be emphasized.

CONCLUSION AND SUGGESTIONS

This research was done with the intention of studying the level of the knowledge of advanced level students related to domestic application in chemistry and recommending Household Chemistry as a new unit in the G.C.E (A/L) Chemistry Syllabus.

Although the facts and principles of Chemistry were broadly discussed in the present G.C.E (A/L) Chemistry Syllabus there was a deficiency in discussing domestic applications related in Chemistry.

The student who obtains wider knowledge about deep concepts of chemistry doesn't know about the chemistry of active ingredients of the medicine he/she takes for a headache.

In the analysis of the marks obtained for the question paper given to student samples it proves that their knowledge about household Chemical is poor.

Analysis of the responses given by teachers for the questionnaire it is further proved and the need and the necessity of inclusion of facts related to household Chemistry was emphasized.

Including facts regarding household chemistry was accepted in the discussion with University lectures and project officers of NIE.

When Studying the Chemistry Syllabi of other countries inclusion of these facts into syllabuses can be witnessed.

Depending on above facts subject content suitable to enhance the knowledge of household chemistry is recommended to include in the G.C.E (A/L) Chemistry Syllabus.

Subject content that should be included under each area

1. **Chemical in food**

- Food additives
- Antioxidants
- Sweeteners
- Preservatives
- Flavors
- Coloring agents
- Flavor enhancers
- Leavening agent
- Surface active agent
- Enrichment

2. Chemistry of some important pharmaceutical

- Analgesics (pain killers)
    - Aspirin
    - Paracetomol
- Antacids
- Balm
- Germicide
    - Antiseptic
    - Disinfectants

3.Chemistry of cleaning agent

- Detergents
    - Soap
    - Non Soapy Detergents
- Cleaning action of detergent
- Stain removers

4. Chemistry of paints

- Paint pigments
- Binder (The nonvolatile vehicle)
- Carrier (The volatile vehicle)

5. Chemistry of cosmetic

- Perfumes
- Dyes and Bleach
- Deodorants
- Lipstick
- Talcum powder
- Cream

When these subject matters are related to their life experiences, it will help to make Chemistry an interesting subject for the students. Their knowledge will be penetrated to the society as well.

Student can be motivated by giving them a chance to explore in household Chemistry through practical sessions. Project method can be used to enhance their capability in this subject content.

Based on this research anyone interested in this research area can make it a point to further study and propose the subject content related to household Chemistry.

REFERANCES

[1] Hill, G. C. and Holman (1995). *Chemistry in Context*, 4th edn .ELBS.

[2] Matthews, P. S. E. (1995). Advanced Chemistry, 1st edn, Cambridge University press, Cambridge. Yadav, M. S. (2005). Teaching of chemistry

[3] Michael and Clugston (2000). Advanced Chemistry, Oxford University press, Oxford.

[4] Peter E. Childs, Sarah M Hayes and Ann O'Dwyer, (2015) Chemistry and Everyday life relating secondary school chemistry to the current and future lives of students: Relevant Chemistry Education, Brill

[5] Robert, A. (1983). How to write and published a scientific paper, Day Vikas publishing house, New Delhi.

[6] Ryan, L.(1996). Chemistry for you, Stanly Thrones publishers LTD.

[7] Soken-Huberty E. 2023, 10 Reasons Why Chemistry Is Important Available at https://theimportantsite.com/10-reasons-why-chemistry-is-important

[8] Taber, K. (2002). Alternative conceptions in chemistry: prevention, diagnosis and cure. London: Royal Society of Chemistry