CHALLENGES FACED BY FIRST GENERATION LEARNERS IN CHEMISTRY LEARNING AT LOWER SECONDARY LEVEL IN INDIA: ANALYSIS THROUGH CASE STUDY AND FINDING A POSSIBLE SOLUTION THROUGH NATURAL SCIENCE TEACHING

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ABSTRACT

Chemistry is a very basic and popular area of science and there are so many articles in all possible areas of chemistry teaching and research. But very few articles are published on how to make the process of learning of chemistry easy for a first-generation learners belonging to the underprivileged socio-economic background in India. Traditional chemistry teaching methods like lecture methods or laboratory methods may not be useful for them. The present work focused on case studies of several students to understand their difficulty level and then to go the topic in a phenomenography (partly) approach by choosing acid-base as the lesson. A possible solution is also proposed for the conceptual advancement of the students in light of natural science teaching.

Keywords : *First generation learner, Case study method, Lower secondary, phenomenography.*

Introduction

In the recent past, much research on Chemistry education has made a clean sweep of all vital fields of chemistry teaching and practice. It includes the skill development of teachers (Boz et. al. 2006, Bryan et. al. 2008) introduction of new methods and technology, innovative ideas for teaching a particular chapter, analysis of textbook difficulty, and so on (Alpaslan 2015). But very few articles are published on how to make the process of learning of chemistry easy for a first-generation learner, belonging to under privileged socio-economic backgrounds. One reason may be that almost every researcher contributing to this field of chemistry education belongs to first-world countries and focused on the problems of their own education system. But the job of making science familiar to the first-generation learners (FGL) of so-called third-world countries may be a fascinating area of science education and research. Now let's have a look at the present scenario of the first FGL in the education profile of India. The term 'First Generation

Learners' (FGL) here refers to the pupil who is the first one in their entire generation to go to school or whose parents have attended the formal education system up till the primary level of schooling. These children face a multitude of academic, psychological, socio-economic, and cultural challenges. When it comes to the point of chemistry learning, the hurdles become uncrossable to them. Traditional chemistry teaching methods like lecture methods or laboratory methods may not be useful for them.

This is because they often stumble over the terms used in lectures or laboratories. Another key reason is that they are ignorant about the materials used in practical classes as they cannot relate them to their observations of daily life. Hence they lack confidence and gradually lose interest in learning. The present article is an attempt to find out a solution to the problems by providing them with lessons with natural examples with which they are familiar. It is

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focused on case studies of several students to understand their difficulty level and then to go the topic partly in phenomenography approach by choosing acid-base as the lesson.

Theoretical Framework

A thorough literature survey provides two very useful full theoretical frames for the present study. The study is partly based on the Phenomenography approach proposed by Ference Marton (1981). Phenomenography is a qualitative research approach aimed at studying the variation of ways people experience, conceptualize, perceive, and understand phenomena in the world (Marton 2006).

Preparation for case study method

After having a thorough study of the textbook difficulties faced by FGL, a case study method was carried out to understand their problem and for their improvement in understanding basic chemistry. The 1st author himself obtained the permission from a school authority to conduct an interview. The authors explained the purpose of their visit to the students. Four students were chosen. A chapter acid base was selected for the interview, based on the student's choice. A set of questions were asked face to face to probe their conception.

Procedure

Students were interviewed by authors who also designed the interview protocol. Each student was interviewed for 10-12 minutes. During the interview, the interviewer carefully listened to the student's response. Follow-up questions focused on students' conceptualization of the meaning of words they had just said, rather than an assessment of students' answers. Most of the students responded in their mother tongue (Bengali). The interviewer translated their version into English. The 1st round of interviews was followed by data analysis, then conducting some practical classes to meet the problems faced by the students and finally, 2nd round of interviews to understand their development.

Results

In light of the phenomenography method, the first attempt was not to categorise the students according to their efficiency of response in the interview. The students are given a code name.

Interview Round - I

Interviewer (In) : Do you know, what is an acid?

RK : It is sour in test.

In : Anything more about acid?

RK : Long pause....It reacts with base.

In : So define a base.

RK : Base is like soap water, it is slippery.

In : Give example of acids and bases (two each)

RK : acids are lemon, tamarind and bases are soap water and washing soda.

In : What are the key characteristics of acids?

RK : They taste sour and...(Silence), causes skin irritation.

In : And what are the key characteristics of bases?

RK : They are slippery and hazy solution.

In : Can you define an indicator?

RK : Yes, they changes colour.

In : Give two examples of indicator.

RK : Yes, Litmus paper and..... silence, no reply then.

Student II (BM)

Interviewer (In) : Can you define an acid?

BM : Acids are sour in taste.

In : Anything else about acids?

BM : No reply

In : Define a base.

BM : Bases are washing soap

In : Give example of acids and bases (two each)

BM : Apples and lemons are acids, soaps and detergents are bases.

In : What are the key characteristics of acids?

BM : They taste sour

In : Anything more?

BM : Silence....no answer afterwards.

In : And what are the key characteristics of bases?

BM : They taste soapy bitter. In: Can you define an indicator?

BM : Indicator changes colour.

In : Give two examples of indicator.

BM : long pause..... Litmus paper

In : So, can you tell me the exact function an indicator? Have you ever seen the colour change?

BM : No reply....

Student III (HB):

Interviewer (In) : Can you define an acid?

HB : Yea...Acids produce Hydrogen ions in water.

In : Define a base.

HB : Base ionizes in water to form OH-ions.

In : Give example of acids and bases (two each)

HB : Acids are HCl, H2SO4 and bases are NaOH and KOH.

In : What are the key characteristics of acids?

HB : They taste sour and react with bases to form salts.

In : And what are the key characteristics of bases?

HB : They taste soapy bitter and react with acids to form salts.

In : Can you define an indicator?

HB : Yes, they changes colour in different solution.

In : Give two examples of indicator.

HB : Yea, Litmus paper and Phenolphthalein.

In : So, can you tell me the exact function of an indicator? Have you ever seen the colour change?

HB : Blue litmus turns red.....no clear response then.

Student IV (BB) :

Interviewer (In) : Can you define an acid? BB: Acids are sour in taste.

In : Anything else about acids?

BB : No reply.

In : Define a base.

BB : Bases are detergentIn: Give example of acids and bases two each).

BB : tamarinds and lemons are acids, soaps and detergents are bases.

In : What are the key characteristics of acids?

BB : They taste sour

In : Anything more?

BB : Silence....no answer afterwards.

In : And what are the key characteristics of bases?

BB : They taste bitter.

In : So, can you tell me the exact function an indicator? Have you ever seen the colour change?

BB : No reply....

Discussion

Three categories of descriptions were constructed to demonstrate the variations in the learning of the acid-base concept of FGL of lower secondary standards. It is observed only two FGLs belonging to category A, defined acids and bases as H+ and OH- ion donors in aqueous solution respectively which is the classical definition according to Arrhenius. They have an idea about the opposite behaviour of acid-base pair as they tried to describe as properties. On the other hand, the rest of the students belonging to group B, defined acids as sour substances and bases as bitter ones. They even gave examples of acid bases in terms of natural substances such as apple, tamarind, lemon, soap, detergents etc. As a consequence of the case study, it is to be noted that the majority of the FGL have a limited idea about the classical definition and properties of the acids and bases and indicators as described in their texts under a given syllabus. Rather they picked up the ideas of acid-base from natural phenomena and from natural substances.

Therefore, an attempt was made to improve the conceptualization of the present subject area. Following our observation regarding the weakness of the FGL, we arranged some practical classes and interviewed the students for the second time to monitor their conceptual development (if any). Some common natural colour-changing materials were collected. Lemons and tamarind solutions were taken as acids and soap, detergent solutions were taken as bases. China rose and turmeric extract was taken as indicators.

After that, they were asked instant questions and their answers were recorded as earlier.

Interview Round - II

Category A :

In : What physical properties have you found for acids?

VB : Acid solutions obtained from lemon and tamarind is colourless, got special odour.

HB : Same but lemon is more smelly.

In : Any difference of acid solution with bases you found?

HB : yes, bases produce slippery and hazy solution.

VB : Yes, the same thing I also noticed.

In : Have you noticed any sharp change in colour when you added acid and bases to rose and turmeric extract?

HB : yes, rose extract changes its colour in both the solutions while turmeric solution turned red only in base.

VB : Similar observation I got.

In : now, can you define an indicator?

HB : Pause, Indicators helps to identify acid and bases solution.

VB : Yes, Indicators helps to make sure whether the solution is acidic or basic.

In : And what is the key feature of indicator function?

HB : They have different colour in acid and base solution.

VB : Yes, they change their colour in either solution.

Category B/C :

In : What physical properties have you found for acids?

VB : Acid solutions obtained from lemon and tamarind is colourless, got special odour.

HB : Same but lemon is more smelly

In : Any difference of acid solution with bases you found?

HB : yes, bases produce slippery and hazy solution.

VB : Yes, the same thing I also noticed.

In : Have you noticed any sharp change in colour when you added acid and bases to rose and turmeric extract?

HB : yes, rose extract changes its colour in both the solutions while turmeric solution turned red only in base.

VB : Similar observation I got.

In : now, can you define an indicator?

HB : Pause, Indicators helps to identify acid and bases solution.

VB : Yes,

In : And what is the key feature of indicator function?

HB : They have different colour in acid and base solution.

VB : Yes, they change their colour in either solution.

Conclusion

Since their socio-economic status makes their living a bit hard, they have to be keen observers of the facts happening around them. As a consequence, it helps to grow a realistic attitude in their behaviour instead of making their imagination strong. But being a keen observers, they can explain and analyse natural phenomena to some extent. Therefore the present work established that the best way to teach them chemistry is a through natural science. Furthermore, it may be a helpful teaching pedagogical approach for the teachers dealing with the FGL.

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