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ATTITUDES AND VIEWS OF CHEMICAL ENGINEERING STUDENTS TOWARDS
SCHOOL EXPERIENCE AND CHEMISTRY LESSONS IN INDIAN EDUCATION
SYSTEM

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ABSTRACT

Chemistry is the backbone for the chemical engineering students. Basic chemistry learnt in schools till 12th standard makes framework for chemical engineering, hence their understanding of chemistry during school education is important. In present paper, the data of 64 students of Chemical Engineering have been collected and analyzed with respect to their school experience of 10th and 12th standard of school and chemistry lessons learnt during that period.

KEYWORDS: higher secondary education, chemistry, chemical engineering, analysis.

INTRODUCTION

Chemical Engineering uses fundamental laws of natural science, mathematics, information science and economics to develop efficient commercial process for the efficient production of chemicals. The output, productivity and quality of product are the important criteria in chemical engineering. Chemical Engineers apply the basic knowledge of chemical engineering to design the necessary systems and equipment to achieve required products in a cost effective manner.

Chemical engineers have the most diverse, interdisciplinary educational background of all engineers, with strong foundations in mathematics, physics, chemistry, and increasingly in the life sciences. The large number of industries has placed the chemical engineer in great demand. In addition to traditional examples such as the chemical, energy and oil industries, opportunities in biotechnology, pharmaceuticals, electronic device fabrication, and environmental engineering are increasing. The unique training of the chemical engineer becomes essential in these areas whenever processes involve the chemical or physical transformation of matter. For example, chemical engineers working in the chemical industry investigate the creation of new polymeric materials with important electrical, optical or mechanical properties. This requires attention not only to the synthesis of the polymer, but also to the flow and forming processes necessary to create a final product. In biotechnology, chemical engineers

have responsibilities in the design of production facilities to use microorganisms and enzymes to synthesize new drugs. Problems in environmental engineering that engage chemical engineers include the development of processes (catalytic converters, effluent treatment facilities) to minimize the release of or to deactivate toxic materials. To carry out these activities, the chemical engineer requires understanding of both the engineering and scientific principles. This is reflected in the curriculum of the chemical engineering which includes the study of applied mathematics, material and energy balances, thermodynamics, fluid mechanics, heat and mass transfer, separations technologies, chemical reaction kinetics and reactor design, and process design. These courses are built on a foundation in the sciences of chemistry, physics, and biology.

Chemistry is the backbone of chemical engineering. In present paper the attitude and views have been explored for the final year chemical engineering students towards their school experience and chemistry lessons in Indian education system.

METHODOLOGY

In order to obtain students' views and attitudes, a questionnaire was designed and distributed to the third year students of four year chemical engineering bachelor of technology students (Batch: 2009-13) of Visvesvaraya National Institute of Technology Nagpur India, thus generating detailed

Name(optional)		Semester			
Enrollment no(optional)		DOB			
Domicile City/state		Area: Rural / Urban			
10 th score/percentage		12 th score/percentage			
10 th City / State		12 th City / State			
CGPA	1 st yr.	2 nd yr.	3 rd yr.		
School experience up to 10th:					
	Very poor	poor	Average	Good	Excellent
How would you rate your school experience in all aspects?					
How would you rate your school experience in teaching?					
How would you rate your school experience in cultural activities?					
How would you rate your school experience in technical activities?					
How would you rate your school experience in sports?					
Did you find good support from the staff in all aspects?					
Did your school provide you basic scientific and practical knowledge?					
What about your interest in going to school?					
What did you feel about the classes?(boring or interesting)					
Have you really enjoyed your school life and school education?					
Did you like your school teachers?					
Did you find your school lessons easy?					
Do you think that the school lessons are very interesting?					
What do you feel about the examination system in school?					
Do you think that you obtained a lot of new skills during your school life?					
Higher school experience 11th and 12th:					
	Very poor	poor	Average	Good	excellent
How would you rate your higher school in all aspects?					
Did you like the teaching style?					
Did you like the courses in your higher school education?					
Did you feel the lessons were very complicated?					
Do you think the courses were very interesting?					
Do you think that the assessment methods are good?					
Your comments about the practical methods?					
How would you rate the examination system in your higher school?					
Have you really enjoyed your school and the education system?					
Do you think that you obtained a lot of skills along with the course studies?					
Do you think that you got enough knowledge for higher studies?					
Have you ever applied your course contents to your real life?					
Attitude towards chemistry lessons					
	Very poor	poor	average	good	excellent
Love for chemistry					
If you really like or are really interested in chemistry, what made you interested in this subject?					
How about the teaching style of the corresponding faculty?					
Had your basic concepts in chemistry cleared?					
Attitude towards school chemistry lessons					
Attitude towards higher school chemistry lessons					
Does the labs aid well in your understanding of chemistry?					
Do you want to pursue chemistry?					
Do you think that if you study 10 th and 12 th chemistry again (clearing your basics completely) it would be easier for you at this level to study chemistry?					
Have you ever thought of continuing your higher studies with chemistry or in chemical field?					
Can you correlate your 10 th and 12 th chemistry with the any year chemistry in your graduation?					
What did you like the most in chemistry ?					
1) studying the theory					
2) doing practical work					
3) solving everyday problems					
Do you find chemistry more of a learning subject or an understanding one?					
Which subtopic you like the most? (Organic , inorganic ,physical)					
Apply chemistry in daily life?					
Where do you see chemistry as a profession in India?					

Figure 1: Sample questionnaire.

perspectives on attitudes held, and views. The abstract of sample questionnaire is given in **Figure 1**, which contained the following topics:

- Demographics data includes students' age, gender, domicile state, percentages in 10th and 12th along with the CGPAs in all the semesters, AIR (All India Rank) rank in AIEEE (All India Engineering Entrance Exam) exam, 10th city and 12th city and whether the institutions in which they have studied are located in rural areas or urban areas.

- Overall school experience in all aspects.
- Overall higher secondary school experience in all aspects.

Attitude towards chemistry lessons. Over all 64 students from a class took part in the survey study. The questionnaire helps to understand about the student attitudes and preferences

RESULTS AND DISCUSSION

The results of this detailed study provide an insight into students' attitudes and self-perceptions of learning and teaching. All results are grouped together and are shown in percentages. All the students are in the age group of 19-22. Almost all the students entered the college just after the completion of their higher school education.

School experience up to 10th

Examining students' overall school experience (**Figure 2**), it can be seen that 84.4% students have positive attitude and 10% students have neutral attitude towards their school experience in all aspects. On the other hand, 5.6% had a poor school experience. Most of the students (72.3%) liked the way of teaching in their schools, 18% students have neutral attitude and the rest (9%) have poor attitude. The reasons for poor experience and attitude were probed, the results have shown that they are either from rural places or their faculty might not supported in all aspects like cultural, technical, sports etc. or even that the students did not get adequate learning chances.

The students rating their school experience to be good by most of the urban students. They might be from superior schools with good (if not excellent) faculty and encouraged in all aspects by their teachers and parents. There is a difference between urban and rural students not in terms of brain or development but their initial environment, skills, learning ability, availability of infrastructure, and access to different facilities. One more reason could be the type of school; some of the students might be from private schools and some may be from public schools (schools authorized by the government). Private school education could be the better quality education than the public school education in all aspects. The reason behind this could be that the private schools are well organized as compared to the government schools [1-2].

The people living in rural areas have understood the importance of education now-a-days and they know that education can only get rid of poverty. But due to lack of money or low income of family, they are not able to send their children to good schools.

Some government schools in rural India are overly packed with students, leading to a distorted teacher-student ratio. In such a situation it is impossible for teachers to pay full attention towards each and every student, even if they are willing to help. In addition to this, most textbooks are in English and since people in rural areas either speaks in their native language or Hindi, but not English that defeats the purpose. This

results in lack of interest in studies. Though some of the students from villages are really brilliant, as they have a wealth of knowledge and know how to survive even in very harsh conditions of life, difficulty in understanding their textbooks, lack of facilities and their poverty is a hurdle in their education. These are some of the reasons for them not to have any scientific practical knowledge. But this is not the case with all rural area schools.

Some schools are providing quality education. 98.5% students liked their school teachers. This shows that teachers had good interaction with students and helped them in most of the aspects. 98.5% students found that the school lessons are easy and 1.5% students felt the school lessons were hard. The reason for this can be that these students (1.5%) did not understand lessons properly and they had to mug up the things. The others might have understood the lessons theoretically and practically.

Higher school experience

Largely, the results show that (**Figure 3**) 86% students had positive attitude towards their higher school experience in all aspects. In India, people from villages go to urban areas to study their higher school. They get proper knowledge (practical & theoretical) in all the topics than what they would have got in rural areas. Moreover, the other reason to be noted for the same can be the high competition in urban areas. This also comes along with the fact that the exposure itself is a great teacher. Teachers with lot of knowledge in the subject in which they teach prefer to teach in urban areas as they get good salaries and they can interact with the people who have more knowledge in that particular subject and other great people so that they get well versed in their subject.

Nowadays, students complete their higher studies along with coaching for competitive examinations. As a plus point to this, there are numerous coaching centers that provide coaching for all competitive examinations along with state board syllabus, however by and large concentrated more towards the teachings of the competitive examinations. Most of the students who participated in answering the questionnaire have completed their higher school education in these types of Institutes, conclusively; the students have obtained many new skills during their higher school life. However, these types of studies helped the students to obtain required knowledge and skills for their higher studies.

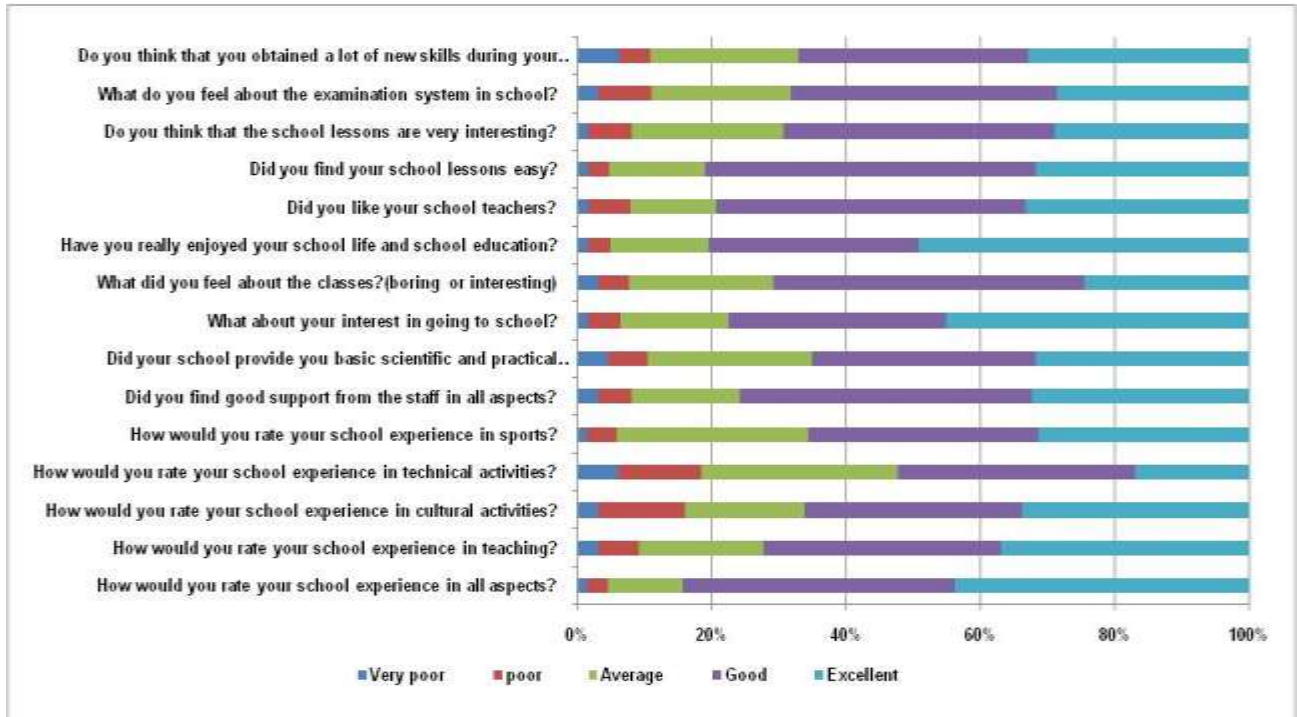


Figure 2: Students' perceptions on school experience up to 10th standard.

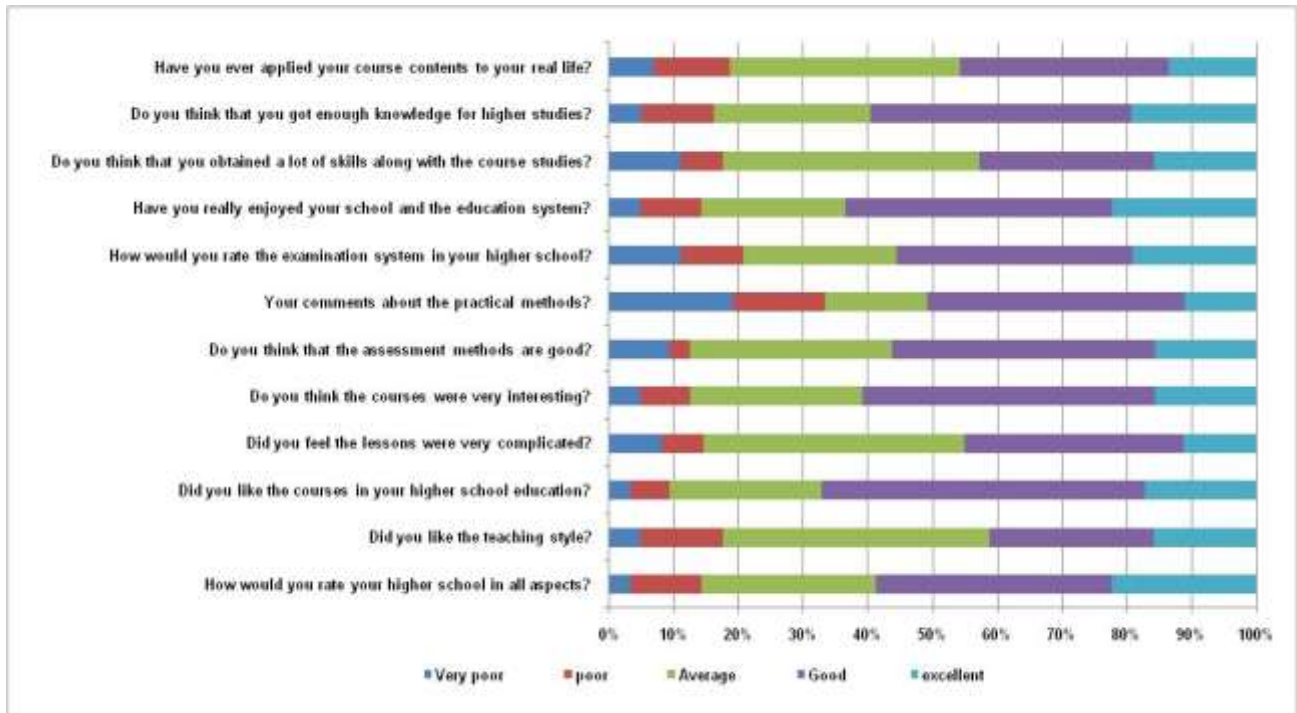


Figure 3: Students' perceptions on higher school experience.

This age (16-21), being the prime youth age, the students become good at thinking and imagining while studying. Ample time to study accompanied with proficient teachers who teach them imaginative learning, make students learn and grow efficiently. Hence it can be easily concluded that most of the students liked their higher school education and find their courses more interesting (the same was observed as per survey).

Some schools have given good knowledge about all the things as they are not concerned about any competitive exams but all other aspects. So, the students who came from these types of schools have answered that they obtained a lot of skills during the education and that their practical methods are good. Students who studied in coaching centers have shown poor attitude towards the same question. 20% students did not like the examination system, 24% students have neutral attitude towards this and 56% students have positive attitude towards this. Some students' feel that examinations are there to know to what extent you have learned and understood the course. Some students concluded that examinations give the chance to use our knowledge about the course to give answers to the questions and to solve problems.

Attitude towards chemistry lessons

According to the Indian Education System, separate chemistry education starts in Secondary school level (7th to 10th). Very little training is offered about chemistry in the secondary school (like atoms, molecules and their components, their nature and behavior). Discipline based and content oriented courses are introduced in the higher-secondary school level. After completing the 10 years of general education, students opt for chemistry with the purpose of pursuing their career in basic sciences or professional courses like engineering, medicine, and study courses in applied areas of sciences etc. The objective of teaching chemistry at this level is to promote understanding of basic facts and concepts of

chemistry, to expose the students to different processes used in industries and their technological applications, to develop an interest in students to study chemistry as a discipline and to acquaint students with different aspects of chemistry used in daily life.

Chemistry at higher secondary school level mainly has the basics of organic, physical and inorganic chemistry. The main course content of chemistry at higher secondary level [3]: structure of atom, classification of elements and periodicity in properties, chemical bonding and molecular structure, states of matter: gases and liquids, thermodynamics, equilibrium, redox reactions, s-block elements, p-block elements, some basic principles and techniques of organic chemistry, hydrocarbons etc.

The results show that (**Figure 4**) 75.5% people like chemistry and everyone is interested in different fields of chemistry like solid state interactions, physical chemistry, treatment plants, organic chemistry, teaching, process modeling and simulation and organic reactions. Some students said that they like chemistry because of its simplicity. However, many students stated that their basic concepts were not properly cleared. They liked attitude towards the chemistry lessons (school and high school chemistry) because the chemistry lessons are more or less interesting facts in the world. For example in organic chemistry sometimes the product may not be the desired one always. This is because of the interactions between the reactants. Sometimes one kind of forces is dominating and some other times the other kind depending upon the reaction conditions, reactants etc. These things are very interesting while studying and learning in classrooms. Other examples can be a change in color in titrations It is mentioned that it would be easier to study chemistry at this level if they study 10th and 12th chemistry again as all the topics are related with these basic concepts.

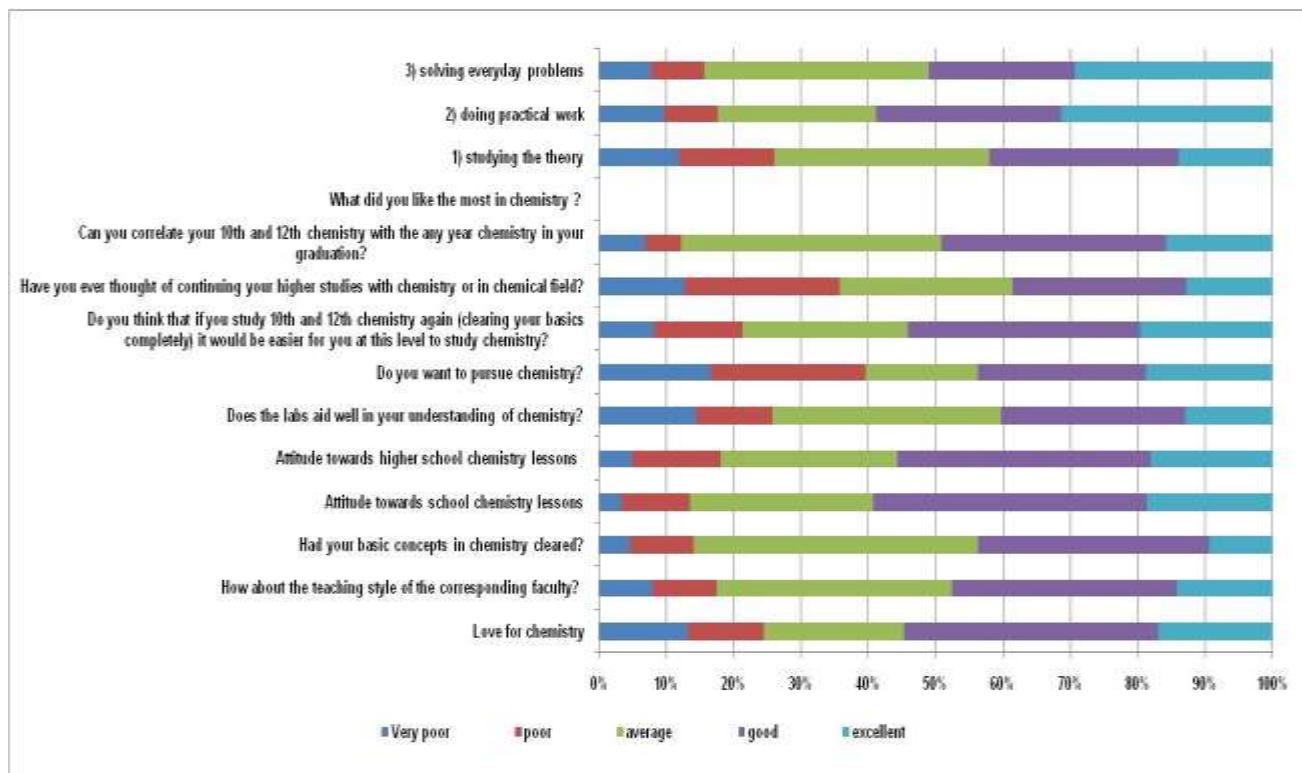


Figure 4: Students' attitudes towards chemistry lessons.

The chemistry in graduation does not deal with the basics. At graduation level, chemistry is confined only to the reaction, reactants and products. One should have basic knowledge about the subject and clarity in that particular subject to understand the chemistry at graduation level. For example the Inorganic Chemical Technology (a core subject in graduation chemistry) deals with the unit operations and processes in several plants like sulphuric acid plant, urea plant etc. The chemistry is involved only in reaction of the reactants to produce product. The other things like the heat transfer, design considerations, optimization of the process etc. are learned by the students at graduation level. But to calculate the heat that has to be supplied, we should know about whether it is endothermic or exothermic, if endothermic how much heat is required for the reaction to occur, if exothermic how much heat has to be removed for the desired product to obtain. So, for all these calculations, chemistry is required. In design of any reactor, we have to choose a material that should not be corroded with the reactant. So the selection of material for design of the reactor involves studying the physical and chemical properties of both reactants and products. To

understand the process, the basic knowledge of the reactions involved in the manufacturing of sulphuric acid, the byproducts produced (if any), the nature of reaction (whether exothermic or endothermic), the nature of the reactants and products (toxic or non toxic, volatility, ease to react with other reactants), the phase of reactants and products and the temperature and pressure conditions involved must be known. The chemistry in 10th and 12th deals with all these basic things. Students had neutral opinion in continuing higher studies in chemical engineering. Students are likely to correlate their 10th and 12th chemistry with the chemistry in graduation. They had neutral opinion for studying the theory. But it is observed that students are interested in doing practical work and solving everyday problems such as arsenic removal and fluorine removal from water and finding alternative methods for utilizing energy released in reactions effectively etc. 60% students have the opinion that chemistry is an understanding subject while 20% students had neutral opinion. The results show that students like physical and organic chemistry more than inorganic chemistry, the reason for this was physical and organic chemistry involve

understanding and imagination whereas, inorganic chemistry involves just mugging up of things.

The application of chemical engineering to day-to-day life is found to be a reason of interest for students like utilizing the waste in effective manner by examining its properties and compositions, how it reacts with other reactants etc, and by separating the important components using separation processes like absorption, adsorption, sedimentation etc. Other example is utilization of waste heat radiated from wood fired stove to simultaneously cook as well as for other heating purposes such as water heating etc. Firewood is a non-renewable source of energy. While cooking on the traditional hearth, which is still prevalent in most houses, nearly 50% of heat was being wasted and it gets unbearably hot near the hearth. It is also very difficult to procure enough supply of firewood, especially for the poor. This is a multipurpose energy efficient utility method which would help to save fuel as well as to prevent wastage of heat.

CONCLUSION

The data of 64 students of final year Bachelor of Technology in Chemical Engineering, four year program were collected with respect to their school experience of 10th and 12th standard of school and chemistry lessons learnt during that period. The collected data were analysed systematically to understand their perspectives and views. Overall the results suggest that students experience for urban students is better than rural students in all aspects and same is observed for chemistry lessons.

In terms of intellectual developments, encouraging students is desirable. Further students have better understanding towards their responsibilities. More specific guidance is required in terms of revising the examination and knowledge system.

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