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A Comparative Study of Misconceptions in the Subject of Chemistry among the Students of O-Level Curriculum of University of Cambridge UK and SSC Level, Pakistani National Curriculum 2006

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Abstract

The study was intended to identify and compare the misconceptions in the subject of Chemistry among the students of O-level and SSC. Researchers also seek to explain how student's demographic and educational diversity effects to their conceptual understanding. The population was comprised of 16 schools of ICT (Islamabad Capital territory) offering O-level with Cambridge University's curriculum and 34 public schools of ICT, offering Pakistani National curriculum (2006) for their SSC classes. Researcher selected 25% educational institutions as sample of the study through simple random sampling (02 boys +02 girls=04' schools for O-Level, 05 boys +05 girl's =10 schools for SSC). 100 % students these classes from selected schools were respondents of the study. Content based standardized instrument of TIMMS (2008), revalidated in local context, was used. The hypotheses were tested statistically by using T-test through SPSS. In the light of findings it was concluded that there is significant difference between in misconception of the learner of SSC&O-level regarding the all ten common content areas. It was also concluded that O-level students have less misconceptions in some content areas but the overall the comparison shows that SSC students have less misconception as compared to O-level students.

***Keywords**: Curriculum, Misconceptions, Chemistry, SSC, O-Level*

Introduction

Education is the most significant aspect in attaining speedy economics growth and scientific development. Quality of education is integrally linked with curriculum, educational outcomes and learner's performance. Teacher plays a key role in the development of the whole educational system. The academic

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qualification, professional qualification, and teaching style of teachers have a direct impact on quality of education (Rehman, 2006). Curriculum facilitates the learners to understand the key concepts about any area of study or subject. Usually content or textual material and teacher's personal understanding about any concept misleads the leaner about that specific concept. The content standard provide the description that of what student should know, understand and able to do in specific content area. (Govt. of Pakistan, 2006, p.7)

Benchmarks for SSC classes in National Curriculum 2006

National Curriculum 2006 has stated our national benchmarks (Govt; of Pakistan, 2006, pp.9-11) as follows. After completing the lessons the students will: (i) Produce the scientific inquiry about the world on the based on examination (ii) Plan and perform scientific examination and inquiry. Secondary education (ix-x) is chief sub-segment of the whole formal education system. However it supply middle level workers for the financial system and secondly it acts as a foundations for the advanced stages of education. The worth of higher education, which is probable to generate high quality, specialized and skilled in different fields of public, financial and political life of the country, are directly related to the quality of secondary education. This stage of education consequently needs to be planned in such a way that it should produce young generation for their higher education, as well as to face the challenges of their practical lives significantly (Ayesha, 2010, p44). It comprises of two categories

i. Lower Secondary Level (9^{th} -10^{th} or SSC)

ii. Higher Secondary Level (11^{th}-12^{th} OR HSSC).

The objectives of secondary education should be to provide such general education as to equip to student with basic knowledge in all subjects and skills in some fields to enable them to pursue life their own. The knowledge and skill thus acquired should be potent enough to act as a preparation and stimulate for the student to pressure higher academic or technical courses. Secondary education is an extremely important phase of a student's life. It is a point when a student stepped in to teenage years which are extremely essential phase of life (Govt. of Pakistan, 1998, p.32).

The O-Level (Ordinary Level) System

The "General Certificate of Education 'Ordinary' Level Examination", also known as the O Level is the examination organized by University of Cambridge, United Kingdom, for the countries or regions linked with the British curriculum. It purposes as to establish the principles and standards of middle-secondary students. This includes students of Grade 8 to Grade 10 (Sameen, 2008, p.45). The General Certificate of Secondary Education (GCSE) was started in 1988. So the first final O-level examinations were taken in 1987. The curriculum for the new system was set up in 1986. Now the O level is used in many Commonwealth countries, such as Bangladesh, Brunei, Malaysia, Malta, Mauritius, Pakistan, Singapore, and Sri Lanka. In June 2005, 12 million candidates from more than 200 countries registered for O-level examinations across the world (Shah, 2013). Secondary School Certificate (SSC), a local Pakistani system of qualification and certification requires only two years where as O-Level is a three years school certificate programme. However O-Level accesses the students on the bases of Bloom taxonomy which internationally acceptable .Although it is also recommended for SSC exams but has not been followed (Ayesha, 2010, p.47).

Science and technology are the important branches of education. These have influenced every characteristic of life and have reformed the human civilization. It is a renowned fact that current societies are obligated its sustainability and existence to science and can be called a scientific evolution. It is universally acknowledged that the harmonious continued existence of a nation in the 21st century depends mainly upon the scientific growth and expansion (Siddique, 2010).

Science education is a very important School discipline and field. It is the branch which deals with distribution of science contents and procedure with persons not conventionally measured as ingredient of the scientific society. At Secondary School stage the flux of information, concepts, knowledge and understanding of the subject matter provides the basis for learning new ideas in next higher classes. If concepts are not understood by the students at this level then misconceptions are generated at lateral stage (Tudge**,** 2008). The study of student's unusual commencement and abstract thoughts has been dynamic and attractive field for science instructors for more than two decades. Science educationists, who are concerned in conceptual expansion and growth, have used a diversity of expressions

to explain the circumstances in which students' thoughts disagree from those of scientists about a particular conception. Some mention it as student's mistaken belief or misunderstandings, and some quote it as preconceptions, or immature conceptions, naive assumption, alternative or substitute conceptions (Margrete, 2000).

Barrass (1984) quoted it as blunders, faults, mistaken beliefs, ambiguous ideas, misunderstandings or misconceptions of facts, saying that educators and brilliant students can accurate faults and errors. Hancock (1940, p.28) identified a misconception as, any groundless faith that does not symbolize the component of terror or horror, good luck, faith, or supernatural involvement. He also deliberates mistaken beliefs to come up from faulty reasoning. Ausubel (1968) argued that Ideas expressed that do not have the status of generalized understandings that are characteristic of conceptual knowledge. These are actually preconceived notion or a conceptual misunderstanding. These are cases in which something a person knows and believes does not match what is known to be scientifically correct. Chemistry is a branch of science, which deals with the study of matter and energy and relationship between them. Chemistry is a fundamental science; its principles underline much of technology which is human kinds mean of solving their problems. It is very useful for all field of life. There are many uses of chemistry in daily life. While studying chemistry, there is a point that is very meaningful and it creates, many problems for the students are "Misconception" as chemistry is a considered very difficult and composite science subject. It is even complex from both the research on problem solving and misconceptions and even from personal understanding Students have misconceptions because not only chemistry is considered as difficult science, but also because of the style of pedagogy and strategies by which, the concepts are taught. Investigations on students 'conceptions has proliferated in the last twenty years. It gives us awareness and understanding about the notion, misconceptions, preconception and unusual conceptions that students carry with them to the classroom (Chaman, 2010). Now, it is well accepted that unusual conceptions and misconceptions are very frequent among students and that these hinder against successive learning and are challenging to conceptual change. Defeating misconception is very critical to student knowledge. So a study of student' misconceptions in the subject of Chemistry, performed at secondary

school stage has great importance and significance.

Statement of the Problem

The wide application of Chemistry in different realms of life necessitates studying misconceptions of curriculum in Pakistan, thus need is felt to compare the two parallel systems being practiced at O-Levels and Secondary School Certificates (SSC) level. The study was aimed at comparing misconception in the subject of chemistry among the students of the two parallel systems of education offered at Secondary Level in Pakistan i.e. O- Level and Secondary School Certificate (SSC)

Objective of the Study

Objectives of the study were:

i. To study the misconception in the subject of Chemistry among the students of O-levels

ii. To study the misconception in the subject of Chemistry among the students of SSC

iii. To compare the misconception of Chemistry at O-levels and SSC

Hypothesis

Hypotheses of the study were:

H_{01}: There is no significance difference between the misconceptions of students of SSC & O-level regarding basic techniques in laboratory work.

H_{02}: There is no significance difference between the misconceptions of students of SSC & O-level classes regarding identification of a substance.

H_{03}: There is no significance difference between the misconceptions of students of SSC & O-level classes regarding gases, liquid and solid.

H_{04}: There is no significance difference between the misconceptions of students of SSC & O-level classes regarding mixture.

H_{05}: There is no significance difference between the misconceptions of students of SSC & O-level classes regarding filtration, evaporation and distillation process. H_{06}: There is no significance difference between the misconceptions of students of SSC & O-level classes regarding movements of the articles.

H_{07}: There is no significance difference between the misconceptions of students of SSC & O-level classes regarding gases.

H_{08}: There is no significance difference between the misconceptions of students of SSC & O-level classes regarding composition and chemical formula of the substances.

H_{09}:There is no significance difference between the misconceptions of students of

SSC & O-level classes regarding acid, bases and salt.

$H_{10:}$ There is no significance difference between the misconceptions of students of SSC & O-level classes regarding the content of solution.

H_{O11}: There is no significance difference between the misconceptions of students of SSC & O-level classes.

Delimitations of the Study

Due to the time and economic limitation the study was delimited to the area of Islamabad Capital Terrritory (ICT) and for the ten common content areas of both the curriculum in the subject of chemistry only.

Methodology

It was a descriptive type research and survey method was used to gather the data from the students of O-Level and SSC. The population was comprised of 16 schools of ICT (Islamabad Capital territory) offering O-level with Cambridge University's curriculum and 34 public schools of ICT, offering Pakistani National curriculum (2006) for their SSC classes. Researcher selected 25% educational institutions as sample of the study through simple random sampling (02 boys +02 girls=04' schools for O-Level, 05 boys +05 girl's =10 schools for SSC). 100 % students these classes from selected schools were respondents of the study. The enrollment of SSC boy's schools was 40-45 students, in each class and 35-40 students in female schools. The enrollment of each O-Level class for boy's schools was 35-40 boys and 30-35 girls. .

A structured content based instrument, consisted of thirty test items was selected .Those 30 test items were selected from TIMMS (2000), which belongs to ten common content areas of both curriculum. All thirty test item were with four options in which one was the correct key and remaining three were distracter. For its validation and reliability in local context a pilot study was conducted with 40 (30 SSC and 20 O-Level students). The reliability coefficient of study was determined by applying Cronbach alpha reliability method and its calculated value was $\propto = 0.811$. So on the bases of statistics it is concluded that test is valid and reliable. The Instrument was administered to the respondents personally because the researcher visited different schools. All concerned persons of schools cooperated with researcher very well.

Analysis of data and Results

The data were analyzed trough SPSS. .A coding scheme was prepared and data were tabulated separately.

Table 1 *Age of the students of O-Level and SSC*

Class	Ages	Percentage
SSC	Below 16 years	19.5
	16-17 years	68.3
	Above 17 years	12.2
	Total	100.0
O-level	Below 16 years	28.2
	16-17 years	59.0
	Above 17 years	12.8
	Total	100.0

The table 1 reveals that most of the students were in the age of 16 to 17 years.

Table 2 *Gender of the students of O-Level and SSC*

Class	Gender	Percentage
SSC	Male	50
	Female	50
	Total	100.0
O-level	Male	57
	Female	43
	Total	100.0

Table 2 shows that in case of SSC both the genders participated equally and for O-Level males were 57% and females were 43%.

H_{01}: There is no significance difference between the misconceptions of students of SSC& O-level classes regarding basic techniques in laboratory work.

Table 3 *Misconceptions of students of SSC& O-level regarding basic laboratory techniques*

Grouping variable	N	Mean	Std. Deviation	Std. Error Mean	df.	t-value	p-value
SSC	300	1.8780	.71397	.11150	418	2.806	.006
O-Level	120	1.3590	.93153	.14916			

Table 3 indicates that as the p-value < 0.05 so the null hypothesis is rejected and found that there is significant difference between the misconceptions of SSC & O-level students. The greater mean 1.8 shows that SSC students have less misconception in basic techniques of laboratory work.

H_{02}: There is no significance difference between the misconceptions of students of SSC& O-level classes regarding identification of a substance.

Table 4: *Misconceptions of students of SSC & O-level regarding identification of a substance*

Grouping variable	N	Mean	Std. Deviation	Std. Error Mean	df	t-value	p-value
SSC	300	1.6098	.91864	.14347	418	2.271	.026
O-level	120	1.1538	.87475	.14007			

Table 4 shows that as the p-value < 0.05 so the null hypothesis is rejected and found that there is significant difference between the misconceptions of SSC & O-level students. The greater mean 1.6 shows that SSC students have less misconception for the content of Identification of substances.

H_{03}: There is no significance difference between the misconceptions of students of SSC& O-level classes regarding gases, liquid and solid.

Table 5 *Misconceptions of students of SSC& O-level regarding gases, liquid and solid*

Grouping variable	N	Mean	Std. Deviation	Std. Error Mean	df	t-value	p-value
SSC	300	1.2439	.79939	.12484	418	.198	.844
O-level	120	1.2051	.95089	.15226			

Table 5 reveals that as the p-value >0.05 so the null hypothesis is accepted and found that there is significant difference between the misconceptions of SSC & O-level students. The greater mean 1.24 shows that SSC students have less misconception for the content of gases, liquid and solid.

H_{04}: There is no significance difference between the misconceptions of students of SSC& O-level classes regarding mixture.

Table 6 *Misconceptions of students of SSC& O-level regarding mixture*

Grouping variable	N	Mean	Std. Deviation	Std. Error Mean	df	t-value	p-value
SSC	300	1.5122	.86954	.13580	418	2.671	.009
O-level	120	.9744	.93153	.14916			

Table 6 reveals that as the p-value <0.05 so the null hypothesis is rejected and found that there is significant difference between the misconceptions of SSC & O-level students. The greater mean 1.51 shows that SSC students have less misconception for the

content of Mixture.

H_{05}: There is no significance difference between the misconceptions of students of SSC& O-level classes regarding filtration, evaporation and distillation process.

Table 7 *Misconceptions of students of SSC& O-level regarding laboratory process*

Grouping variable	N	Mean	Std. Deviation	Std. Error Mean	df	t-value	P-value
SSC	300	1.4634	.89715	.14011	418	2.135	.036
O-level	120	1.0513	.82554	.13219			

Table 7shows that as the p-value <0.05 so the null hypothesis is rejected and found that there is significant difference between the misconceptions of SSC & O-level students. The greater mean 1.46 shows that SSC students have less misconception for the content of filtration, evaporation and distillation process.

H_{06}:There is no significance difference between the misconceptions of students of SSC& O-level regarding movements of particles.

Table 8 *Misconceptions of students of SSC& O-level regarding movements of particles*

Grouping variable	N	Mean	Std. Deviation	Std. Error Mean	df	t-value	P-value
SSC	300	1.6029	1.03535	.16169	418	.310	.758
O-level	120	1.6954	.90657	.14517			

Table 8 shows that as the p-value >0.05 so the null hypothesis is accepted and found that there is significant difference between the misconceptions of SSC & O-level students. The greater mean 1.69 shows that O-Level students have less misconception for the content of movements of particles.

H_{07}: There is no significance difference between the misconceptions of students of SSC& O-level classes regarding gases.

Table 9 *Misconceptions of students of SSC& O-level regarding gases*

Grouping variable	N	Mean	Std. Deviation	Std. Error Mean	df	t-value	p-value
SSC	300	1.5122	.86954	.13580	418	3.257	.002
O-level	120	.9231	.73930	.11838			

Table 9 shows that as the p-value <0.05 so the null hypothesis is rejected and found that

there is significant difference between the misconceptions of SSC & O-level students. The greater mean 1.5 shows that SSC students have less misconception for the content of movements of gases.

H_{08}: There is no significance difference between the misconceptions of students of SSC& O-level classes regarding composition and chemical formula of the substances.

Table 10 *Misconceptions of students of SSC& O-level regarding composition and chemical formula*

Grouping variable	N	Mean	Std. Deviation	Std. Error Mean	df	t-value	p-value
SSC	300	1.8049	.78165	.12207	418	1.188	.238
O-level	120	1.5641	1.02070	.16344			

Table10 shows that as the p-value >0.05 so the null hypothesis is accepted and found that there is significant difference between the misconceptions of SSC & O-level students. The greater mean 1.8 shows that SSC students have less misconception for the content of composition and chemical formula of the substances.

H_{09}: There is no significance difference between the misconceptions of students of SSC& O-level regarding acid, bases and salt.

Table 11 Misconceptions of students of SSC& O-level regarding acid, bases and salt

Grouping variable	N	Mean	Std. Deviation	Std. Error Mean	df	t-value	p-value
SSC	300	1.3659	.79863	.12472	418	3.534	.001
O-level	120	.7692	.70567	.11300			

Table 11 indicates that as the p-value <0.05 so the null hypothesis is rejected and found that there is significant difference between the misconceptions of SSC & O-level students. The greater mean 1.3 shows that SSC students have less misconception for the content of Acid, Bases and Salt.

$H_{10:}$ There is no significance difference between the misconceptions of students of SSC& O-level classes regarding solution.

Table 12 *Misconceptions of students of SSC& O-level regarding solution*

Grouping variable	N	Mean	Std. Deviation	Std. Error Mean	df	t-value	p-value

SSC	300	1.0513	.92328	.14419	418	1.977	.052
O-level	120	1.4390	.82554	.13219			

Table 12 indicates that as the p-value >0.05 so the null hypothesis is accepted and found that there is significant difference between the misconceptions of SSC & O-level students. The greater mean 1.4 shows that O-Level students have less misconception for the content of to solution.

H_{O11}: There is no significance difference between the misconceptions of students of SSC& O-level.

Table 13 *Over All Comparison of misconceptions of students of SSC& O-level*

Class	N	Mean	Std. Deviation	Std. Error Mean	Df.	t-value	p-value
SSC	300	15.6341	4.82056	.75285	418	4.022	0.001
O-level	120	11.7436	3.73263	.59770			

Table 13 shows that P-value is less than 0.05 so null hypotheses, there is no significant difference between the misconceptions of students of SSC & O-level is rejected. Hence from the greater mean 15.6 it is concluded that SSC students have significantly less misconception as compared to O-Level students for the subject of chemistry.

Conclusion

From the data analysis and in the light of findings following conclusions were obtained.

1. It was concluded that SSC students have better concepts in the areas of basic techniques in laboratory, Identification of a substances, regarding to Mixture, filtration, evaporation and distillation process, movement of a particles, gases and acid, bases and salts.
2. It is also conclude that O-Level students have better concepts in the content of composition and chemical formula of the substances and solutions,
3. In the light of findings it was concluded that there is significant difference between in misconception of the students of SSC &O-level regarding to different content areas. It was also concluded that O-level students showed better performance

in some areas of the content but overall the SSC students have less misconception as compared to O-level students.

Recommendations

1. Teacher trainers, Teacher educators, Teacher training institutes may help teachers to become familiar with the variety of strategies for successful delivery of the contents suggested in curriculum. Teacher trainers should more emphasis on training in following areas.

a. Improved teaching investigation skills/Laboratory work.

b. Be aware of new innovations and strategies.

c. Develop ability to conduct action research.

d. Enhance ability to specialize in specific subject.

The work of Policy makers, Curriculum wing, Boards of Intermediate and Secondary Education, National Educational Assessment System and Teacher Training Institutes may be aligned which will give better implementation of curriculum.

2. Future studies for this purpose may be planned with the students from different cultural background such as urban and rural areas, and other areas of Pakistan and also to compare the misconceptions at HSSC level with that of A-Level and for other subjects also.

References

Aufschnaiter, C. and Christian, R. (2010). *Misconceptions or Missing Conceptions.* Giessen: Justus Liebig University Giessen, Germany

Ayesha (2010), *A Comparative Study of Misconception in the Subject of Mathematics Among the Students of O-level and matriculation in Islamabad schools,* Islamabad: Federal College of Education on 07-082013.

Bhatia, P. (1983), *Principles and Practical's of Education,* Shiba Printing Press, India.

Cambridge IGCSE Physics (2006), Harper Collins Publisher, London

Cambridge O Level Chemistry Curriculum code 5054 For examination in June and November 2013, University of Cambridge, 2011, London.

Chaudhri, A. G. (1982*), Some Aspects of Islamic Education,* Lahore: Universal books.

Farooq, R.A. (1994), *Education system in Pakistan, Islamabad;* Asia society for the promotion of innovation and reform in Education. pg# 0-10

Gay, L.R. (2012), *Educational Research,5th Edition.* Islamabad: National Book Foundation.

Govt. of Pakistan (2006), *National Curriculum for General Science Grade 1V-V111,* Islamabad.

Govt. of Pakistan (2006). *National Curriculum for General Science Grades 1X-X,* Islamabad.

Govt. of Pakistan. (1994*), Chemistry curriculum for class (IX-X),* published by National Breury of Curriculum and Text Books, Islamabad: Ministry of Education.

Ken, H. (2012), *Teaching and Researching, Dorling Kindersley* (India) Pvt, New Dehli 110017, India

Khan, A. (1984), *Development Education*, Islamabad, Allama Iqbal Open University.

Martin, R., Sexton, C. and Gerlovich, J. (2002), *Teaching Science for all Children: Methods for Constructing Understanding*. Boston: Allyn and Bacon.

Pathak, R.P. (2011). *Research Methods in Education and Psychology*. New Dehli: Dorling Kindersley (India) Pvt Ltd, 110017

Poham, W. James (1975). *Educational Evaluation* New Jersey: Prentice-Hall, INC.

Ranjit, K. (2005). *Research Methodology*. New Dehli: Dorling Kindersley (India) Pvt Ltd, 110017

Rao, V. R. (2003). *Science Education.* New Dehli: APAAH Publishing Corporation, 110002

Sabir, H. (1998), *Study guide of secondary education,* A.I.O.U, Islamabad.

Shami, P. A. (2005), *Education In Pakistan, Policies and Policy Formation.* http://prr.hec.gov.pk/Chapters/40-1.pdf retrieved on 23rd December at 9:00 pm http://www.aku.edu/ismc/ismc-courses.shtml retrieved on 17th September 2010, 5:23PM

Teresa L. H. (2009), *Using Writing to Confront Student Misconceptions in Physics,* Washington, DC 20016-8058.

Thyme, M. J. (1974). *Principles of Examining* London: University Press.

TIMMS Test Items (2000). *Department of Science Education,* National Institute of Science Education University of Philippines, Quezon City

Vinayak, M. (2006). *Methods of Teaching Physics.* Crescent Publishing Corporation, New Hehli-110002.