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COMPARATIVE ANALYSIS IN THE PERFORMANCE OF STUDENTS IN CHEMISTRY

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ABSTRACT--*Chemistry is a subject that is usually found difficult by students, along with physics and some other areas of science. Aside from these, they find it not interesting and not useful. This study dealt about the difficulties of students in understanding Chemistry as a subject. It also dealt with finding out the difference in their cognitive performance when students are grouped according to select profile variables. The respondents in this study, 244 students participated and they come from both public and private High Schools in Cagayan. This study is descriptive and used the person product correlation technique. Data were gathered using an adapted questionnaire. Results revealed that most of the students find difficulty in answering higher order questions which resulted to their low cognitive performance in Chemistry. Their performance is also not affected by their profile. The researcher recommends that teachers may apply the difficult concepts and skills of cognition to achieve better learning process. If necessary, teachers may also give remedial teaching to poor learners in Chemistry.*

KEYWORDS-- *comparative analysis in the performance of students in chemistry*

I. INTRODUCTION

The third millennium is a witness to the relative advancement of science and technology and has introduced enormous changes in our socioeconomic environment. In order to cope with the tremendous changes of age, science education must be made relevant to cope with these challenges. It is the teacher's task to make science learning an attractive and enjoyable experience for every student.

According to Ople (1993) "…in a periodic test given to 14 -year old student in the field of Science and Mathematics, the Filipino student always rank the lowest". Various studies had pointed out students' low or even dismal achievement in Science at all levels of education. Studies have also shown that many pass their science subject without acquiring proper understanding of the concepts and theories that the course intends to teach. (Ferrido, 1995). Problems of these type have been identified in different areas of science including Chemistry.

Chemistry is considered a difficult subject even among science majors because the fundamentals behind the world of atoms and molecules are abstract. Most undergraduate students consider chemistry at the college level as neither interesting nor important with the exception of the potential chemistry majors. Most general chemistry students simply dislike the subject or exhibit fear of it. This negative attitude toward the subject maybe due to several factors: the abstract nature of chemistry, the passive nature od students who just listen and take down notes rather than participate in class discussions, or the very nature of classroom instruction (Enriquez, 1994).

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Many researches have shown that students find difficulty to relate Chemistry concepts at the submicroscopic level. For example, the replicated study conducted by Sawrey (1990) and Lee (1993) showed that most students were more capable to answer questions that used symbols and numbers in the traditional test questions than to answer conceptual questions involving particles. Another study by Lythcott (1990) revealed that many students were not able to draw the meaning of their balanced chemical equation I terms of atoms and molecules.

However, problems are really inevitable when it comes to learning science subjects. As what Taylor (1984) pointed out that the general problem in all science courses is the introduction to learning how to learn. Traditional school subjects utilize the process of memorization in the collection of important facts and solutions t problems. On the contrary, science education requires the skills of critical inquiring and understanding concepts.

Many students were found to experience difficulties in problem solving even though they had the necessary level of knowledge. Bar and Travis (1991) revealed that students find difficulties in applying abstraction and they were frequently misled where a choice of possible correct answer. These findings showed the need to emphasize the importance of explaining specific situations and experiences using clear and relevant models to suit the discussion.

These, among others contributed to the conceptualization of this paper to compare the performances of students in Chemistry via their profile.

Statement of the Problem

This aimed to assess the difficulty and cognitive performance of students in Chemistry according to select profile variables. Specifically, it sought to answer the following questions:

1. What is the profile of respondents in terms of
a. Parents' educational attainment
b. Parnets' occupation
c. Type of school graduated
2. What
3. of performance of the respondents in Chemistry?
4. How comparable Chemistry topics do students find difficult?
5. What is the level is the level of performance of the respondents when grouped according to profile variables?

II. METHODOLOGY

Research Design

This study made use of the descriptive-correlational design. It described the performance of the respondents in Chemistry. It is correlational since it also determined the relationship performance in chemistry and some profile variables. Frequency, percentage, mean and standard deviation were used to analyze the personal variables. The Pearson Product Correlation techniques was used to determine the relationship between students' profile and performance in chemistry.

Respondents and Sampling Procedure

The respondents of this study are the first year students of selected tertiary schools in Cagayan. The selected respondents comprised only one section and were chosen using random sampling. Complete enumeration was used in some selected sections.

Table 1. Distribution of students by school

Respondent Schools	**Sample**
CSU- Aparri Campus	23
International School of Asia and the Pacific	40
Lyceum of Aparri	16
Florencio Vargas College	33
CSU- Andrews Campus	47
CSU- Lallo Campus	49
CSU- Sanchez Mira Campus	36
Total	**244**

Locale of the Study

The study was conducted in the tertiary schools in Cagayan. These are CSU- Aparri Campus, CSU Andrews Campus, CSU Lallo Campus and CSU Sanchez Mira campus. These are state universities in Cagayan. Three private colleges also participate, namely, the International school of Asia and the Pacific, Lyceum of Aparri, and Florencio Vargas College.

Research Instrument

The principal instrument used in this study was a structured questionnaire adapted from the study of Villaflor (1987) which was modified by the researcher based on the following concepts: Kinetic Molecular, Gas Laws, Formula Writing, Chemical Reaction, Periodic Table and Periodicity, Particles of Matter, Orbitals and Levels of Energy, Bonding, Acids and Bases, Redox and Stoichiometry. The questionnaire consisted of three parts. Part I dealt with the students' personal variables including Chemistry performance. Part II of the instrument was used to elicit answers regarding difficult topics in Chemistry. The respondents were instructed to indicate the extent of truthfulness to each statement by rating and encircling the number of the given options. The scoring of the positively oriented statements is as follows: (G) Generally true of me, 3; (M) Moderately true of me, 2; (N) Not true of me, For negatively oriented statements, the scoring was reversed.

Data Gathering Procedure

Permission to conduct the research was sought from the school heads of the different respondent schools. A request letter was prepared by the researcher to this effect after which, they were personally delivered by the researcher for approval. Upon having the request granted, she personally administered and retrieved the questionnaire from the respondents. This gave the researcher a chance to guide the respondents in accomplishing the questionnaire. The researcher also conducted an informal interview with some of the respondents to gather additional data needed in the study.

Statistical Tools and Analysis

The scale below was used in describing the weighted grade average or performance of respondents in Chemistry

Scale Value	**Category**
1.00 – 2.38	High
2.39 – 2.88	Average
2.89 – 3.00	Low

III. RESULTS AND DISCUSSION

A. Students Personal Variables

Table 2. Academic performance of respondents in Chemistry

Academic Performance	**Chemistry**	
	f	%
High	9	3.69
Average	125	51.23
Low	110	45.08
Total	**244**	**100.00**

The table above shows the distribution of respondents according to their academic performances in Chemistry. It was noted that majority of the respondents, 125 or 51.23 percent obtained the average performance in this subject.

Table 3. Frequency and percentage distribution or respondents according to parents' educational attainment

Educational attainment	Father		Mother	
	f	***p***	***f***	***P***
Did not finish elementary	22	9.02	18	7.38
Elementary graduate	37	15.16	46	18.85
Did not finish high school	37	15.16	28	11.48
High school graduate	48	19.67	58	23.77
Did not finish college	44	18.03	39	15.98
College graduate	52	21.31	50	20.49

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Masters graduate	4	1.64	4	1.64
Ph D graduate	0	0	1	0.41
TOTAL	**244**	**100.00**	**244**	**100.00**

Table 2 shows that out of 244 respondents, 52 or 21.31 percent are fathers who graduated in college, while 58 or 23.77 percent have mothers who are high school graduate. This finding simply implies that majority of the respondents' fathers have higher degree of educational attainment. On the other hand, the respondents' mothers are mostly high school graduate.

Table 3. Frequency and percentage distribution of respondents according to parents' occupation

Parents' Occupation	***Frequency***	***Percentage***
Father		
Farmer/Fisherman	126	51.64
Laborer	24	9.84
Carpenter	11	4.51
Overseas worker	5	4.51
Military/Fireman	10	2.05
Security Guard	3	1.23
Teacher	7	2.87
Office worker	13	5.33
Businessman	9	3.69
Driver	25	10.25
Pastor/Minister	2	0.82
Deceased	9	3.69
Total	244	100.00
Mother		
Housewife	172	70.49
Office worker	15	6.15
Overseas worker	11	4.51
Market vendor	16	6.56
Teacher	15	6.15
Dressmaker	5	2.05
Businesswoman	8	3.28
Nurse	1	0.41
Deceased	1	0.41
Total	244	100.00

As to parents' occupation, Table 3 revealed that 126 or 53.62 percent of the fathers are farmers and 172 or 70.78 percent of the respondents' mothers are plain housewives. Most of the respondents' parents have non-fixed source of living such as fisherman/farmer, laborer, carpenter driver market vendor and dressmaker. Only few have fixed-income such as teacher, office worker, overseas worker, military, security guards, nurse and church minister.

Table 4. Frequency and percentage distribution of respondents according to type of school graduated from

Type of School Graduated	***F***	***P***
Public General	133	54.51
Newly Nationalized HS	15	6.15
Public Vocational	38	15.57
Private High School	58	23.77
TOTAL	**244**	**100**

Table 4 reveals that out of 244 respondents, more than one half, that is, 133 or 54,51 percent graduated in public general school. This trend is due to the fact that majority of the parents of the students do not have parents whose income is fixed, thus they seek for schools such as the public general school which have lower fees.

Table 5. Frequency and percentage distribution of respondents according to level of cognitive performance

Achievement Interval	***F***	***P***
1-8	3	1.23
9-16	128	52.46
17-24	101	41.39
25-32	9	3.69
33-40	3	1.23
TOTAL	**244**	**100.00**

One hundred twenty- eight or 52.46 percent of the respondents had a fairly satisfactory performance in the cognitive test in Chemistry. One hundred one or 41.39 percent got satisfactory performance. This implies that students find difficulty in chemistry concepts. Comparing the ideal mean (25) and actual mean (16.02), ideal mean is much higher than the actual mean, which further implies that the test is difficult. The coefficient of variation has a value of 0.28. This means also that the test is a poor discriminator. This is due to the fact that the students have poor retention of concepts and skills in Chemistry since the test was given second semester, but they took the subject first semester.

Table 6. Difficult Chemistry concepts/skills encountered by students

Topic/Skills	**Item Number**		
	Difficult	**Easy**	**Total**
Gas Laws Application	33		2

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Comprehension	24		
Formula writing			
Application	35		1
Bonding			
Knowledge	15	12	3
Comprehension	13		
Molecular Orbital			
Analysis	11		1
Stoichiometry			
Application	19	37 22	3
Substances			
Comprehension	30	32	3
Knowledge		27	
Periodic Table			
Comprehension		4	3
Knowledge		5,18	
Redox			
Comprehension		40	1
Atomic Particles			
Application		10	1

Table 6 presents the difficult and easy concepts and skills on the responses of the respondents in the 40-itm cognitive test. The findings show that questions which belong to the lower category of Bloom's Taxonomy of Objectives were more often answered correctly than those in the higher category. Thus, simple recall type of common terms and specific facts were answered correctly by the majority than those that require comprehension, application and analysis. Questions on the more advanced concepts were also often not answered correctly by the respondents.

As revealed in the table, the most difficult concept was about gas law, item no. 33, with a percentage of 19.67. It was noted that most of the respondents chose letter b, but the correct answer is a. This might be due to the lack of understanding the relationship of volume and temperature, which is directly proportional, not inversed.

The second difficult concept to the respondents was calculation of oxidation number given the formula. In number 35, the correct oxidation is 7. The error on the respondents' answer may be due lack of knowledge about oxidation no. of common ions and the concept that all atoms in a formula have oxidation numbers algebraically equal to zero.

It was not at all expected that number 15 which is supposed to be a very simple question was considered difficult to the respondents. The synonym of ionic bond is electrovalent bond, but not the favorite option Van de Waals Forces. Respective teachers of the respondents might have failed to introduce the other term for ionic bond.

In item numbers 11, 24.18 percent only got the correct answer. Respondents were not aware of the orbital formed when atoms combine to form compounds.

Problem number 19 requires mathematical understanding on mole concept. The correct answer is a, 0.25 mol. It should be emphasized that the students be made familiar with the atomic mass of every common element like C,O, and N. It could also be that respondents had insufficient understanding of the mole concept important for stoichiometry which is chemical calculation based on chemical relationships.

One can intelligently guess to answer item no. 30. The correct answer is c, 273 k. Lack of knowledge in the inter-conversion of matter might have been the reason for not answering the problem correctly.

In items 13 and 24, knowledge of electronic configuration and the nature of atoms, so with the type of bonding presupposed familiarity of the atomic number and position of the elements in the periodic table. Only 27.46 percent got the correct answer, which is CO2 for no. 13, and 27.05 percent only got the correct answer Ga3+ in number 24.

Understanding physical properties and periodicity of elements in the periodic table should enable the respondents to give the reason why Flourine is the most electronegative element. Seventy five or 30.74 percent answered item number 4 correctly.

Item numbers 27, 5, 37, 18, 40, 22, 32, 12 ,and 10 which deal on substances, periodic table, stoichiometry, redox, bonding and particles, were answered correctly by more than 50 percent of the respondents, therefore concepts are considered moderately easy.

The question, Which is used for purifying water?, is the easiest item for the respondents to answer because they are all exposed to the fact theta NAWASA uses chlorine to purify drinking water.

Item numbers 5 and 18 are simple recall on the development of the arrangement of elements in the periodic table. 64.34, 55.74, and 57.79 of the respondents correctly answered items no. 37, 22, and 40, respectively, which implies that these were simple analysis and application of the basic knowledge in mole concept and simple chemical reaction and besides the formula of carbonate was given as a clue to correct in item no. 40.

Item number 32, an unknown solution is homogenous, and it is observed to scatter

Visible light, 53.28 percent answered colloid, which is correct. This suggest that respondents have read the question thoroughly and have understood the meaning of the word “homogenous” which is a strong clue to the question.

There were 51.64 percent of the respondents who got correct answer in no. 12. Respondents are aware of the the geometric shapes of molecules forms when atoms combine forming compounds but find difficulty in the orbital formed as manifested in no.11.

Knowledge and skill on the calculation of particles (neutrons) given the atomic number (no. of electrons) and mass number (number of protons and neutrons) enable half of the respondents’ ability to answer problem no. 10 correctly as 61neutrons.

Table 7. Analysis of variance in the respondents' cognitive performance when grouped according to fathers' educational attainment

Source of Variance	*Sum of Squares*	*Df*	*Mean Squares*	*Compound F-ratio*
Between	65.7	6	11.0	0.58ns
Within	5156.7	237	21.8	
Total	522.4	243		

As revealed in the table, there is no significant difference on the scores of respondents in the cognitive performance with fathers' educational attainment.

Table 8. Analysis of variance in the respondents' cognitive performance when grouped according to mothers' educational attainment

Source of Variance	*Sum of Squares*	*Df*	*Mean Squares*	*Compound F-ratio*
Between	205.0	7	29.3	1.38ns
Within	5017.4	236	243	
Total	522.4	243		

As shown on the table, cognitive performance of respondents is not significantly related to their mothers' educational attainment. This means that performance of students depends on their ability and effort. Students with parents of high educational attainment may be advantageous in a way that they can seek help from their parents on academic matters, but this is not true at all times, more so if parents are so busy in their respective work. On the other hand, students with parents of low educational attainment can be successful if they posses the interest and determination in studying.

Table 9. Comparison in the respondents' cognitive performance when grouped according to variables

Group	*Mean*	*SD*	*Std Error of Difference*	*Computed t-value*

Father's Occupation				
Non-fixed income	16.59	4.70	0.64	0.44ns
Fixed income	16.28	4.20		
Mother's Occupation				
Non-fixed income	16.74	4.74	0.60	1.09ns
Fixed income	15.98	4.19		
School Type				
Private	15.48	3.31	0.36	2.60**
Public	16.95	4.93		

df = 242

** = significant at .01

ns = not significant

The result of the cognitive performance of respondents is significantly related to the type of school graduated in high school. Respondents who come from public schools obtained higher scores in the cognitive test than those who graduated in private schools. This was due to the fact that teachers in public schools have higher qualification than those teachers in the private schools. Furthermore, teachers in public schools are eligible ones and received better quality of education in public schools than in private schools.

Similarly, parents' educational attainment, parents' occupation are not significantly related to respondents' performance in the cognitive tests. This implies that though students' parents are farmers or plain housekeepers, they can still perform well in their Chemistry subject. The findings of this study has a very good implication for the economically disadvantaged students. Students who belong to the lower socio-economic status performed equally as well as those that belong to the middle and high socio-economic status.

A study by Madera gives a similar findings that students with parents with high educational attainment does not necessarily mean that they perform well or high in their cognitive performance.

IV. CONCLUSIONS

Based on the findings of this paper, the following conclusions were drawn:

1. The students found difficulty on the more advance topics and application of higher level of cognitive thinking.
2. The students' level of cognitive performance is not significantly related to parents' educational attainment and occupation, but significantly related to the type of high school they graduated from.

V. RECOMMENDATIONS

The following recommendations are put forward based on the findings:

Chemistry teachers should emphasize the difficult concepts and skills of cognition.

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1. Chemistry teachers should provide remedial teaching to poor learners in Chemistry.

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