

# Naming Compounds, Writing Formulas, Balancing Equations Abilities And It's Correlates

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**Abstract.** This study focused on the non-cognitive characteristics and their relationship to naming compounds, writing formulas, and balancing equations abilities of all Public Senior High School - Science, Technology, Engineering and Mathematics students in Baler, Aurora, Philippines.

Most of the respondents were 16 years old, more female, most fathers' educational attainments were college graduate while most mothers with units in college, with earnings of ten thousand to twenty thousand nine hundred ninety-nine pesos every month. Students were graduated in public science school and with special science curriculum. They were interest in science especially biology and chemistry.

The students were encountered difficulties in naming, writing, and balancing equations as revealed in low proficient and nearly proficient rating.

Naming compounds skilled was related to students' curriculum graduated while all non-cognitive characteristics were related to writing formulas, and only sex and age were related to balancing equations abilities.

Naming compounds, writing formulas, and balancing equations abilities were interrelated.

## I. INTRODUCTION

The K-12 curriculum in the Philippines started during the school year 2012-2013. Science, Technology, Engineering and Mathematics (STEM) is one of the specific strands under the Academic Track program in Senior High School level. STEM strand gives hope for the prosperity and growth of economy, hence, students' who inspire to be part of it will expect to take specialized subjects like Chemistry 1 and Chemistry 2. Analyzing the system of K-12 system, teachers found the difficulties in teaching chemistry in spiral curriculum in Grade 7 to Grade 10. The study was found out that the focus is very minimal, lacks depth, and lacks concentration, which is not aligned with what spiral progression should be (Orbe et al., 2018). Hence, the study was formulated to find out if the non-cognitive characteristics of students such as sex, age, parents educational attainment, family monthly income, school and curriculum were they graduated, interest in science, and favorite science area, as well as, their self-efficacy in chemistry are factors related in naming compounds, writing formulas, and balancing equations. It seems that one of the most difficult elements in learning chemistry is writing and balancing equations of chemical reactions.

Into some research (Bilek et al., 2019, Schurmeier, et al., 2011, De, Dula 2018) it found out that there is a difficulty in junior high school and senior high school students in naming, writing, and balancing equations in chemistry. There are several reasons of difficulties in writing and balancing formula according to Bilek et al., (2019). The number of subsequent elementary activities in which students need to perform correctly to write and balance the chemical reaction equation. The second one are the hindrances that blocked the students to acquires abilities in writing and balacing chemical equations. It is supported by Schurmier et al., (2011) who explains that there are three topics found to be the reasons on difficulties of students in writing and balancing chemical equations. These are particulate matter, molecular image problem, and mole concept.

Chemical formula is defined as a combination of elemental symbols and subscript numbers that is used to show the composition of a compound. It is a shorthand method for representing a chemical compound. On the other hand, A chemical formula is consists of a collection of chemical symbols, telling the kinds and numbers of atoms present in the compound. Today the rules for writing chemical formulae are set by the Nomenclature Committee of the International Union of Pure and Applied Chemistry (IUPAC) and chemical formulae that follow the rules of this committee are said to follow IUPAC nomenclature.

The science curriculum under K-12 system of education is arranged spirally into four years from Grade 7 to Grade 10. One quarter per grade level is devoted to teaching chemistry instead of compressing all the chemistry lessons in one school year. Spiral curriculum created a great problem to the science teachers like the researcher that is why the study was realized. This study explored the relationship of different factors and chemistry self-efficacy to the most difficult elements for students in chemistry – naming, writing, and balancing equations of chemical reactions.

## II. OBJECTIVES

The study aims to determine the non-cognitive characteristics related to naming compounds, writing formulas and balancing equations abilities. of Senior High School (SHS) Science and Technology, Engineering and Mathematics (STEM) students. Specifically, it sought to answer the following questions:

1. How may the non-cognitive characteristics of the respondents be described in terms of: sex, age, parents' educational attainment, family monthly income, junior high school graduated, high school curriculum graduated, interest in science subjects, and favorite science area?
2. How may the naming compounds, writing formulas and balancing equations abilities of the respondents be described?
3. Is there a significant relationship between non-cognitive characteristics and naming compounds, writing formulas and balancing equations abilities?
4. Is there a significant relationship among naming compounds, writing formulas and balancing equations abilities?

## III. REVIEW OF RELATED LITERATURE

### Non-cognitive Characteristics of the Students

Napoles (2018) revealed that there were more female respondents in Grade 12 than male, having age average of 18, their father and mother education were high school graduates and below and few attained college or higher educational degrees, and belonged to low family income.

There was a significant difference between the gender of student and performance in chemistry achievement test. Boys performed significantly higher than girls did except for the descriptive ability test. Girls need to be given special attention while being taught mathematical and spatial ability aspects of chemistry (Akala, 2010).

Ekber and Polat (2013) claimed that students' parents with higher education perform academically as compare to the uneducated parents.

Baah and Krueger (2012) concluded that students from less-endowed schools have much difficulty in writing chemical formula than students from well-endowed schools.

Dela Cruz (2012) reported that Filipino students sometimes top international science competitions, but usually they came from science high schools with special programs.

Tsabari and Yarden (2011) stated that girls increasingly interested in biology and boys more interested in physics and technology.

Overman, et al., (2014) claimed that one of the problems in chemistry is the lack of interest and application to "real world setting."

## Naming Compounds, Writing Formulas and Balancing Equations Abilities

Bilek et al., (2019) identified the several reasons why students have problems in balancing equations: “the number of elementary steps with a typical double replacement reaction is too difficult for many students” and “difficult to make connections between what they observe in the world of particles, atoms and subatomic units.

Schurmeier et al., (2011) claimed that the roots of problem regarding ability to write and balance chemical reactions were the particulate nature of matter, molecular image problems, and mole concept.

De, Dula (2018) claimed that without mastery of the concepts in chemistry, it is difficult for the students to find higher levels of study in chemistry specially, the use of chemical symbols, formulae, writing chemical equations, and calculations involving moles.

Naah (2012) stated that chemistry students have difficulty interpreting the difference between subscripts and coefficients and struggle to understand the proper use of each of them.

The study of Hafsah et al., (2014) concluded the students need to have the conceptual understanding of the problem, give name to elements and compound, can translate the worded problems into a suitable chemical and mathematical equation, used the correct formula to calculate the mole, before they can solve the problem.

Baah and Krueger (2012) studied the difficulties in writing chemical formulae of inorganic compounds: Students do not understand the meaning of Roman numerals that are put in brackets of IUPAC names, problem with what valences and correct formula of radicals and ions, correct names.

## IV. METHODOLOGY

The researchers utilized the correlational survey method, to assess the non-cognitive characteristics related to naming compounds, writing formulas and balancing equations abilities. The respondents were all Senior High School – Science, Technology, Engineering and Mathematics (SHS-STEM) students in Aurora State College of Technology and Aurora National Science High School, Baler, Aurora, Philippines during the School Year 2019-2020. The data gathered were organized classified, tabulated, analyzed and interpreted using the frequency distribution, percentage, weighted mean and test of correlation.

## V. RESULTS

Table 1. Non-cognitive characteristics of the Respondents (N=147)

NON-COGNITIVE CHARACTERISTICS	FREQUENCY	PERCENT
<b>Sex</b>		
Male	69	46.9
Female	78	53.1
<b>Age</b>		
15	2	1.4
16	90	61.2
17	49	33.3
18	6	4.1
<b>Father Education</b>		
Elementary Units	6	4.1
Elementary Graduate	2	1.4
High School Units	4	2.7
High School Graduate	33	22.4
College Units	24	16.3
College Graduate	61	41.5
Post graduate	17	11.6
<b>Mother Education</b>		
Elementary Units	8	5.4

Elementary Graduate	2	1.4
High School Units	17	11.6
High School Graduate	21	14.3
College Units	68	46.3
College Graduate	31	21.1
Post graduate	8	5.4
<b>Family Monthly Income</b>		
Below P10,000.00	25	17.0
P10,000.00 – P20, 999.00	54	36.7
P21,000.00 – P29, 999.00	26	17.7
P31,000.00 - P39, 999.00	22	15.0
P41,000.00 – P49, 999.00	3	2.0
P50,000.00 above	17	11.6
<b>Junior High School Graduated</b>		
Science HS	93	63.3
Regular Public HS	42	28.6
Integrated HS	1	.7
Private HS	11	7.5
<b>Junior High School Curriculum</b>		
Special Science Program	102	69.39
General HS Program	45	30.61
<b>Interest in Science</b>		
Very Interested	44	29.9
Interested	103	70.1
<b>Favorite Science Area</b>		
Biology	55	37.4
Chemistry	42	28.6
Physics	20	13.6
Earth Science	30	20.4
<b>TOTAL</b>	<b>147</b>	<b>100</b>

Table 2. Naming Compounds, Writing Formulas and Balancing Equations Abilities

NAMING COMPOUNDS ABILITY	FREQUENCY	PERCENT
Highly Proficient	5	3.4
Proficient	1	0.7
Nearly Proficient	59	40.1
Low Proficient	68	46.3
Not Proficient	14	9.5
Mean	14.68	
SD	2.67	
<b>WRITING FORMULAS ABILITY</b>		
Highly Proficient	2	1.4
Proficient	46	31.3
Nearly Proficient	58	39.5
Low Proficient	21	14.3
Not Proficient	20	13.6
Mean	11.05	
SD	4.36	
<b>BALANCING EQUATIONS ABILITY</b>		
Highly Proficient	2	1.4

Proficient	17	11.6
Nearly Proficient	29	19.7
Low Proficient	99	67.3
Mean	7.95	
SD	3.04	

Table 3. Summary of the Relationship between Non-Cognitive Characteristics and Naming Compounds, Writing Formulas and Balancing Equations Abilities

PROFILE	NAMING COMPOUNDS		WRITING FORMULAS		BALANCING EQUATIONS	
	r	Sig.	r	Sig.	R	Sig.
Sex	-.103	.214	-.171*	.039	-.192*	.020
Age	.070	.402	.321*	.000	.237*	.004
Father Education	-.029	.724	-.317*	.000	.058	.485
Mother Education	-.108	.191	-.456*	.000	-.105	.206
Family Monthly Income	-.053	.523	-.247*	.003	.117	.162
Junior HS Graduated	.075	.369	.175*	.034	.008	.922
Curriculum Graduated	.169*	.041	.367*	.000	-.910	.020
Interest in Science	-.029	.730	.010*	.002	.125	.132
Favorite Science Area	-.063	.452	.345*	.000	-.014	.863

Table 4. Relationships among Naming compounds, Writing Formulas and Balancing Equations Abilities

ABILITIES	r	SIG.
Naming Compounds and Writing Formulas	.441*	.000
Naming Compounds and Balancing Equations	.169*	.041
Writing Formulas and Balancing Equations	.168*	.041

## VI. DISCUSSION

### Non-cognitive characteristics of the Respondents

Table 1 shows the non-cognitive characteristics of the respondents. It shows that females outnumbered males, this finding supported the study of Napoles (2018). The age mean implies that students were on their right age to their grade level. More than 50% of the fathers were degree holders while 79 % of the mothers earned college units to elementary units. Results signified that more than half (53.7%) of the respondents were from below average family income based on 2018 survey of Philippine Statistics Authority (PSA) amounting to P24,474.00 pesos per month. More than half of the respondents were in their right track in choosing

Science, Technology, Engineering and Mathematics as their strands. Students graduated in the special science program in their Junior High School were willing to become scientists, technologists, engineers, and mathematicians evident that they enrolled in the STEM class in their senior high school. Respondents were interested in science that is why they enrolled in the STEM strand in senior high school. The respondents were interested in the study of plants and animals. The same findings obtained by Tsabari and Yarden (2011) that girls were interested in biology, hence female respondents outnumbered, while the boys were interested in physics.

### **Naming Compounds, Writing Formulas and Balancing Equations Abilities**

**Naming Compounds.** The mean of 3.57 and SD of .810 signified that students obtained homogenously, nearly proficient rating. Correct names of some radicals are a problem to students resulting to difficulties in writing formulas. Baah and Krueger (2013). Students have difficulty interpreting the difference between subscripts and coefficients and struggle to understand the proper use of each of them. Naah (2012) (Table 2)

**Writing Formulas.** Results revealed that the respondents scores were “homogenously”, “nearly proficient”, and majority got low scores as evident by it’s mean and SD. This result implied that writing formulas was slight easily to remembered by the respondents. In contrary, Baah and Krueger (2012) found out that senior high school students encountered difficulties in writing chemical formulae of inorganic compounds.

**Balancing Equations.** More than half of the respondents (67.3%) have low proficient rating in balancing equations. The mean and SD implied that majority of the students homogeneously got low scores. The poor performance of the students in balancing equations were related to the low performance in terms of naming compounds. Students could not balance the equation unless he/she can name and write the formula of the compounds. Naah and Sanger (2012) identified student misconceptions in writing balanced equations for ionic compounds dissolved in water: simple student mistakes, memory lapses on the part of the student (incorrect charges for the ions).

### **Relationship between Non-Cognitive Characteristics and Naming Compounds, Writing Formulas and Balancing Equations Abilities**

Students graduated in the science curriculum obtained higher scores in naming compounds than from general HS curriculum. Students graduated in science high school performed better in chemistry than those graduated in national high schools (Adamos, 2011).

In writing formulas, all the non-cognitive characteristics were significantly related. Students who obtained higher scores were female, older students, from lower the parents’ education and monthly income of the family, graduated in science school with Special Science curriculum, very much interested in science and whose favorite subjects are biology and chemistry.

Only sex and age found significantly related to proficiency in balancing equations. Male performed better than female in balancing equations. Males outperformed females on the stoichiometry questions. (Hudson, 2012). Old students can balance the equation well as compare to young students. The higher the age of the students’ they tend to be more observant and has the ability to conduct experiments procedurally and their level of science process ABILITIES in observing (Gal, 2018).

### **Relationships among Naming Compounds, Writing Formulas and Balancing Equations Abilities**

There is significant relationship among naming compounds, writing formulas and balancing equation abilities. Students who obtained high scores in naming compounds, obtained also high scores in writing formulas compounds and balancing equations.

## **VII. CONCLUSIONS AND RECOMMENDATIONS**

### **Conclusions**

The non-cognitive characteristics of respondents are factors that can be considered to determine the pathways in achieving student’s abilities in naming compounds, writing formulas and balancing equations.

Students find difficulty in naming compounds, writing formulas, and balancing equations.

Naming compounds influence the students' curriculum graduated while all non-cognitive characteristics were related to writing formulas, and only sex, age and balancing equations were related.

There are interrelationships among naming compounds, writing formulas, and balancing equations abilities.

## Recommendations

The school needs to address the non - cognitive characteristics of their students to encourage them to like chemistry subject. Career guidance may aid to assess career pathways of students to link in science related courses.

The teachers, instructor, and mentors need to strategize concept on chemical formulas and equations specifically in naming, writing, and balancing equations.

Since, this study found out that in some ways non – cognitive characteristics are not significantly related in balancing compounds only the age and sex found to be significant. Also, curriculum in which respondents graduated found to be significant in naming compound. On the other hand, all non-cognitive characteristics found to be significant in balancing equations. Hence, it is recommended a deep research in finding how non-cognitive characteristics of students may influence their abilities to deal in chemical formulas and equations.

In teaching chemistry, teachers should focus first in naming compounds and writing formulas before introducing the concepts of balancing equations. The use of different strategies in teaching naming compounds and writing formulas must be strengthened – like the use of the computers and programmes. Prerequisite knowledge (bonding and sharing of electrons, valence, use of periodic table, etc.) in writing and naming compounds be given emphasis and mastery in teaching chemistry.

Further studies are highly recommended: Relationship of naming compounds, writing formulas, and balancing equations in academic performance of students; Remediation on naming, writing, and balancing using traditional ways and computer assisted interaction; Innovation in teaching chemistry in junior and senior high school.

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