Vol. 29 · July 2017
Print ISSN 2012-3981 • Online ISSN 2244-0445
DOI: https://doi.org/10.7719/jpair.v29i1.517
Journal Impact: H Index = 3 from Publish or Perish

JPAIR Multidisciplinary Research is produced
by PAIR, an ISO 9001:2008 QMS certified
by AJA Registrars, Inc.

Infusion of the Critical Thinking in Chemistry through Selected Teaching Strategies

ELEANOR C. REYES
http://orcid.org 0000-0002-1457-0341
mecreyes@ceu.edu.ph
Centro Escolar University Graduate School
Manila, Philippines

ABSTRACT

Critical thinking is one of the 21st Century skills involved in education and is required of students nowadays. The study investigated the critical thinking skills of Junior high school students from three selected public schools in Region 3, Luzon, Philippines. Infusion of the critical thinking in Chemistry through selected teaching strategies of inquiry-based, problem solving, collaborative, and lecture methods. CEU-Lopez Critical Thinking Skills Test (2012) with a reliability test value of 0.87 was used to measure the students' critical thinking skill levels. Triangulation of inquiry-based teaching, problem solving, and collaborative teaching methods was used as an intervention to determine the enhancement of the respondents' critical thinking skills and academic performance. Gathered data were processed statistically through descriptive and inferential tests. Results revealed that there is a significant difference in the critical thinking skill levels of Junior high school students in Chemistry. The critical thinking skill levels of the student respondents were highly comparable with respect on their academic performance in Chemistry. The students demonstrated good knowledge, attitude and performance in Chemistry after the infusion of the critical thinking approach in the intervention. The different teaching strategies utilized in the research were

applicable in the enhancement of the critical thinking skills of the Junior high school students in Chemistry.

Keywords **—** Pedagogy, triangulation, critical thinking, infusion, inquiry-based teaching, problem solving, collaborative method, Philippines

INTRODUCTION

Gaps in the learning abilities of the Junior high school students in Chemistry should be determined through experential learning. In any classroom activities, critical thinking should be taught to the students. Alwehaibi (2011), defined critical thinking as a philosophical and practical logical perception, knowledge, precision, and decision to value an idea or theory. Critical thinking skills could be developed and enhanced by the infusion of critical thinking through different teaching strategies. The study involved the exploitation of the inquiry-based, problem solving, collaborative, and lecture teaching strategies in the infusion of the critical thinking. The researcher chose the study to determine the implications of the infusion of the critical thinking into the concepts of Chemistry.

In science education, students are taught to think critically, to know the different skills, and learn how to adapt and survive in the academic environment. Alwehaibi (2011) recognized that critical thinking is an essential competency that plays a significant role in shaping the way students learn and think in the new information age.

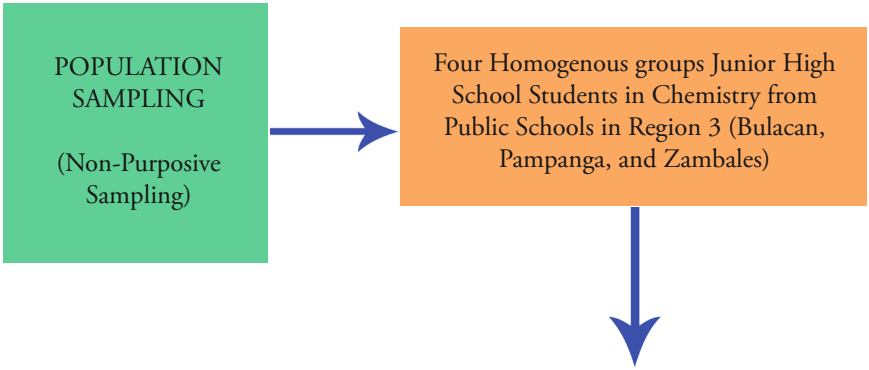
According to Fleming (2010), to become a critical thinker, one must develop a few skills: recognize assumptions, process information honestly, recognize a generalization, evaluate old information and ideas, produce new ideas, analyze a problem, use precise vocabulary, manage emotions, and judge sources.

The research involved the enhancement of the critical thinking skills and academic performance of the Junior high school students in Chemistry though inquiry-based, problem solving, collaborative, and lecture method. The study assumed first that there is a significant difference in the critical thinking skill levels of the Junior high school students in Chemistry. Second, that there is a significant difference on the effect of the infusion of the critical thinking using the inquiry-based, problem solving, collaborative, and lecture teaching methods as teaching strategies utilized in the concepts of Chemistry.

Triangulation method of the inquiry-based, problem solving, and collaborative teaching strategies was used to infuse the critical thinking into the

concepts of Chemistry.

Questionnaires on the Inquiry-based, Problem solving, Collaborative, and Lecture Instructional Models were validated by three (3) critical thinking experts, five (5) science educators, and ten (10) high school students who are not involved in the research. This validation of the instrument determined the content validity of the instructional materials used in the study. Instructional materials were used in the teaching strategies to determine the effects of the infusion of the critical thinking into the concepts of Chemistry.



Group Respondents	Teaching Method
X, O1- A,B,C (X1, X2, X3)	Type of school where the Instructional Material Model 1, 2, and three were used as the teaching strategies.
Y, 01-A, B, C (X4)	Type of school where the Lecture Method Model 4 was used as the teaching strategy.

Figure 1. Population Sampling Diagram

Non- purposive population sampling was used in the population sampling were:

f %
Class 1- Inquiry-based Method X,01 AX1, X,01 BX1, X,01 CX1 69 17.51
Class 2- Problem-solving Method X,01 AX2, X,01 BX2, X,01 CX2 99 25.13
Class 3- Collaborative Method X,01 AX3, X,01 BX3, X,01 CX3 115 29.19
Class 4- Lecture Method Y,01 AX4, Y,01 BX4, Y,01 CX4 111 28.17
Total 394 100.00

There are almost equal in the percentage value of the abovementioned classes (1-4) of the respondents. The data signify that the participants are comparable when grouped according to classes. In the Classes of 1-4, inquiry-based, problem solving, collaborative, and lecture methods were used in the intervention. Triangulation of the aforementioned teaching strategies was applied in the infusion of the critical thinking into the concepts of Chemistry.

OBJECTIVE OF THE STUDY

The study aimed to determine the effects of the infusion of critical thinking in Chemistry through inquiry-based, problem solving, collaborative, and lecture teaching methods. Critical thinking skills and academic performance of the Junior high school students in the selected schools of Region 3, Philippines were evaluated. The implication of the infusion of the critical thinking to science education is established by knowing the learning gaps of the Junior high school students in Chemistry.

METHODOLOGY

The study is a quasi-experimental design which focused on the infusion of critical thinking into the concepts of Chemistry by using inquiry-based teaching, problem solving, collaborative, and lecture method as the teaching approaches. Three hundred ninety-four (394) student respondents from the selected public high school of Bulacan, Pampanga, and Zambales were used to determine the effects of the infusion of the critical thinking using the aforementioned teaching strategies. Validated instrument for the respondents' perception on the criteria of meeting the standard of a good teaching strategy is administered. The critical thinking skills levels of the students were investigated using the CEU-Lopez Critical Thinking Skills Test (2012) in which the "Pre-Test" was determined.

The students were exposed using the inquiry-based, problem solving, collaborative, and lecture teaching method in which the critical thinking is infused into the concepts of Chemistry. Thus, after the intervention, "Post Test" was administered to determine the effects of the infusion of the critical thinking into the concepts of Chemistry. The validated questionnaires with a reliabilty test-Chronbach alpha value of 0.78 were used to evaluate the content validity of the instructional models of inquiry-based, problem solving, collaborative, and lecture teaching methods. Concept 1 (Boyle's Law) and concept 2 (Colligative

Properties of Water Solutions) in Chemistry were used in the process of the intervention. The criteria of a good teaching strategy and content validity of the instructional models employed in this study were evaluated. This undertaking consists of Informed Consent and Clearance from the Ethics review Board of the CEU Institutional Ethics and Review Committee (IERC) as approved by the Committee dated September 7, 2015.

RESULTS AND DISCUSSION

Junior High School Respondents' Profile According to Age

The results showed that the most number of the student respondents are between the ages of 17 and 18 with a percentage value of 41.37 % and 49.49 %, respectively. The highest frequency of the respondents is from the age of 18 while the second highest is at the age of 17. Junior high school students of the selected schools in Region 3 were at the ages of 17 and 18, but there are some at ages 16, 19, 20 and 20 above.

This implies that most number of the Junior high school students in selected areas of Bulacan, Pampanga, and Zambales is between the ages of 17 and 18. At the age of 19, there are 24 respondents with a 6.09 % value. The ages 16, 20, and 20 above are with the least number of frequency and with a % value of 1.78, 0.76, and 0.51 respectively. There is no significant difference before and after the infusion of the critical thinking of Junior high school students in Chemistry when grouped according to age.

Junior High School Respondents' Profile According to Gender

The results revealed that there are more female than male of the respondents in this study. Two hundred forty-three (243) or 61.68% are female as compared with one hundred fifty-one (151), or 38.32 % are male. This implies that female is almost two-thirds of the total respondents. It was found out that the Junior high school students used as participants of this study are comparable when grouped according to gender. Tamayo, Tayao, Lopez and Mangalile (2014) concluded in their study that there is no significant difference in the sexual category of the freshmen, sophomore, junior, and senior students of CMT CEU Malolos.

The profile of the Junior high school students when grouped according to classes is needed to determine the number of the participants in each class where the exploitation of the different teaching strategy is used. For Class 1, 2, 3, and 4 pseudosononyms is used to identify the different teaching strategies of inquiry-based, problem-solving, collaborative, and lecture method.

Table 1. Junior High School Participants' Critical Thinking Skill Levels Utilizing (Inquiry-based Teaching, Problem-solving Method, Collaborative, and Lecture Method)

Type of Classes	Score Level of Critical Thinking	% Value		% Value	Interpretation
X,01-Class 1	(Pre-Test)		(Post-Test)		
AX1, BX1, CX1	0	0	0	0	Master Thinker
	3	3	4	5	Advanced Thinker
Inquiry-based Method	0	0	0	0	Practicing Thinker
	20	23	21	24	Beginning Thinker
	40	46	46	53	Challenged Thinker
	24	28	16	18	Unreflective Thinker
TOTAL	87	100	87	100	
X,01-Class 2					
AX2, BX2, CX2	1	1	1	1	Master Thinker
	32	32	34	34	Advanced Thinker
Problem solving	0	0	1	1	Practicing Thinker
Method	33	33	31	31	Beginning Thinker
	32	32	21	21	Challenged Thinker
	2	2	10	10	Unreflective Thinker
TOTAL	100	100	100	100	
X,01-Class 3					
AX3, BX3, CX3	0	0	0	0	Master Thinker
	29	2	38	26	Advanced Thinker
Collaborative Method	0	0	0	0	Practicing Thinker
	50	34	45	31	Beginning Thinker
	33	23	29	2	Challenged Thinker
	33	23	33	23	Unreflective Thinker
TOTAL	145	82	145	82	
AX4, BX4, CX4	21	19	16	14	Master Thinker
	36	32	36	32	Advanced Thinker
Lecture Method	28	25	34	31	Practicing Thinker
	13	12	0	0	Beginning Thinker
	13	12	10	9	Challenged Thinker
	0	0	15	14	Unreflective Thinker
TOTAL	111	100	111	100	

The results reveal that there is an increase in the number of the advanced thinker and challenged thinker after the infusion was done by using the inquiry-based teaching method. However, the data from Table 6 for X,01 AX1; X,01 AX2; and X,01 AX3 with a t-test value of 2, -1, and -1 respectively. This implies that there is no significant difference in the level of the critical thinking skills of the respondents after the infusion using the inquiry-based teaching method. Jones (2013) confirmed that by stimulating a student's reasoning abilities through the inquiry-based learning, where the students were motivated by the teachers to discover, define a specific concept, acquire knowledge, and make significant observations based on the interpretation of the relevant data and information. However, Cottrell (2011) asserted "giving difficult messages in a way other people could accept an important aspect of critical evaluation.

In problem solving method as shown in Table 1, there is an increase in the number of the advanced thinkers and master thinkers. However, results in Table 4 imply that there is no significant difference in the level of the critical thinking skills of the Junior high school students since the t-test value is 1, 1.7, and 0.9 for X,01 BX1; X,01 BX2; and X,01 BX3 respectively using the aforementioned teaching method. Through this, critical thinking encompasses a set of skills including the ability to analyze problems, set information that probes into relevant evidence and figures out fallacious arguments in educational settings as confirms by Birjandi and Bagherkazemi (2012). The results imply that problem solving method was a good teaching strategy to be used in the infusion of the critical thinking in Chemistry. Paul and Elder (2010) cited that a well cultivated critical thinker, raises vital questions and problems, gathers and assesses relevant information, uses abstract ideas, and draws conclusions from a valid data. The assumptions, implications, and practical assesments are needed to find solutions to complex problems.

The result exposed that there is an increase in the number of the advanced thinkers in the infusion of the critical thinking where the collaborative method was exploited. Data from Table 3 shows that t-test value of 2.1, -3 and 2.4 for X,01 AX3; X,01 BX3; and X,01 CX3 respectively. This means that there is a significant difference in the level of the critical thinking skills of the respondents using the collaborative method. The result confirms to the study of L. Snyder and M. Snyder, (2008) that collaborative learning and activities could also develop the student critical thinking skills. The intellectual challenge of the students with the assessment techniques could enhance the critical thinking skills of the students. This implies that collaborative method is one of the different good teaching

strategies that could be utilized in the infusion of the critical thinking. The findings confirm from the study of Sabiru, Dahir Yusuf (2014) that the students where the collaborative teaching method was exploited significantly enhanced the critical thinking skills and the anxiety was found to be low as compared with the lecture method. Based on the findings, the recommendations were given that teachers should always use collaborative teaching method in Chemistry concepts

The result shows that there is an increase in the number of the practicing thinker after the intervention and the infusion of the critical thinking in which the lecture method was used. However, the results show that the t-test value for Y,01 AX4; Y,01 BX4; and Y,01 CX4 is 1, 0, and 0.7 respectively. This means that there is no significant difference in the critical thinking skill levels of Junior high school students using the lecture teaching method. The results implied that lecture method is not the appropriate teaching method to be used in the infusion of the critical thinking in Chemistry. Snodgrass, (2011) on the other hand, revealed that it is important to have a curriculum with new classroom activities involving the infusion of the critical thinking into the concepts of Chemistry.

Table 2. Comparison Between the Critical Thinking Skill Levels of the Junior High School Participants and the Teaching Strategy

Teaching Strategy (Collaborative)	**X/SD**	**Pre-Test**	**Post Test**	***t-test***	**V.I.**
X,01 AX3	X	17	20	2.1	**Sig.-** ***Ho*** **(*****Rejected*****)**
	SD	7	6.9		
X,01 BX3	X	26	24	-3	**Sig.-*****Ho (Rejected)***
	SD	4.7	4.2		
X,01 CX3	X	24	27	2.4	**Sig. *****Ho (Rejected)***
	SD	3.9	5.6		

@ 0.05 Level of Significance Critical value = 2.021

The finding implies that inquiry-based, problem-solving and the lecture method have no effect on the enhancement of the critical thinking skills after the infusion and intervention were done. Moreover, in the classes of X,01 AX3; X,01 BX3; and X,01 CX3 exemplified that in the t-test value of 2.1, -3, and 2.4 respectively, there were significant differences between the critical thinking skill levels in the collaborative teaching method. The collaborative teaching strategy exploited in the research study was applicable in the infusion of the critical thinking skills of the Junior high school students in Chemistry. It could

be effective teaching strategy to be employed to enhance the critical thinking skills of the Junior high school students into the concepts of Chemistry. From the study of Sabiru (2014), it confirms that there is a significant difference found when chemistry students were exposed to collaborative teaching method as compared with performance of chemistry students taught with lecture method of instruction. Those students taught using collaborative learning tend to achieve significantly higher as compared with those taught using lecture method.

Table 3. Comparison between the Teaching Strategies and Academic Performance of the Junior High School Participants

Teaching Strategies	**Mean Value**		**SD**		**t-test Value**	**V.I.**
	(Pre-test)	***(Post Test)***	***(Pre-test)***	***(Post Test)***		
Inquiry- based (X,01-X1)						
X,01 AX1	88.5	90.8	2.638	3.300	-3.302	**S**
1st Group				0.685		
				2.263		
X,01 BX1	91.1	92.2	1.324	1.704	2.726	**S**
2nd Group				0.423		
				1.154		
X,01 CX1	80.9	86.05	4.090	3.457	6.212	**VS**
3rd Group				0.836		
				5.195		
Problem Solving (X,01-X2)						
X,01 AX2	77.5	78.4	3.553	3.858	0.795	**NS**
1st Group				1.094		
				0.870		
X,01 BX2	87.5	89.8	2.451	2.386	-3.970	**S**
				0.596		
2nd Group				2.363		
X,01 CX2	80.8	85.2	2.056	2.710	8.264	**VS**
3rd Group				0.531		
				4.390		
Collaborative (X,01-X3)						
X,01 AX3	77.0	78.4	2.987	3.477	1.584	**NS**

1st Group				0.899		
				1.423		
X,01 BX3	92.9	94.1	1.766	2.181	2.704	**S**
2nd Group				0.444		
				-1.2		
X,01 CX3	87.5	89.8	2.451	2.386	-4.145	**S**
3rd Group				0.570		
				2.363		
Lecture Method (X,01-X4)						
Y,01 AX4	76.7	78	2.453	3.055	1.524	**NS**
1st Group				0.835		
				1.273		
Y,01 BX4	82.8	82.9	2.784	4.064	0.263	**NS**
2nd Group				0.799		
				0.210		
Y,01 CX4	80.0	83.2	4.164	4.463	2.994	**S**
3rd Group				1.062		
				3.181		
TOTAL						

*@ 0.05 level of Significance Critical Value = 2.021**

Legend:

1st Group – First Public School (Bulacan)

2nd Group- Second Public School (Pampanga)

3rd Group- Third Public School (Zambales)

The results reveal that there is a very significant difference in the academic performance of the 3rd group of the participants employing the inquiry-based and problem-solving teaching methods. However, there is a significant difference in the academic performance utilizing the inquiry-based teaching method for the 1st and 2nd groups; problem-solving method for the 2nd group; collaborative method for the 2nd and 3rd groups; and lecture method for the 3rd group. There is no significant difference in the academic performance using the problem solving and collaborative method for the 1st group; and lecture method for the 1st and 2nd groups @ 0.05 level of significance.

Findings show that the infusion of the critical thinking into the concepts of Chemistry could enhance the critical thinking skill levels and increase the

academic performance of the Junior high school students. Moreover, according to Snyder *et al.* (2008), rote memorization and lecture method could not be used in teaching the critical thinking to the students. Other strategies in teaching such as focusing instruction and assessment techniques could be used to teach the student learners to think critically.

The study of Adalikwu, and Lorkpilgh (2013) revealed that students taught with instructional materials performed significantly high in their academic performance as compared with those educated without the instructional materials. The use of the instructional materials improved the students' understanding of the concepts resulting to a high academic performance. The use of the instructional materials is highly recommended for the teachers to be used in teaching-learning Chemistry.

Table 4. Junior High School Participants' Perception of the Extent of Meeting the Criteria of a Good Teaching Strategy for Concept 1 and Concept 2

		Mean	Std. Deviation	t-value	V.I.
Inquiry-based Method *(X,01-X1)*	***Concept 1***	3.318	.348	-7.115	**VS**
	Concept 2	3.384	.314		
Problem Solving Method	***Concept 1***	3.399	.314	-3.786	**VS**
(X,01-X2)	***Concept 2***	3.450	.284		
Collaborative Method	***Concept 1***	3.374	.298	-2.051	**S**
(X,01-X3)	***Concept 2***	3.408	.293		
Lecture Method *(X,01-X4)*	***Concept 1***	3.291	.375	-2.616	**S**
	Concept 2	3.319	.322		

Table 4 shows that the t-test value of -7.115 and -3.786 @ 0.01 level of significance for the inquiry-based and problem solving teaching method that there is a very significant difference before and after the infusion of the critical thinking into the concepts of Chemistry. Moreover, the t-test value of -2.051 and -2.616 @ 0.05 level of significance for the collaborative and lecture method imply that there is a significant difference after the intervention. Smith and Szymanski,

(2013) confirm that the establishment of professional learning communities allows educators to think critically about the methods they are using to teach, and is a good starting point for ideas about inclusion of critical thinking skills in the classroom. The results imply that the aforementioned teaching strategies used in the infusion of the critical thinking perceived by the student respondents could be the best to exploit in the intervention. Inquiry-based teaching and problem solving methods could be the best teaching strategies to use in the infusion of the critical thinking into the concepts of Chemistry.

Table 5. Junior High School Participants' Perception of the Extent of Meeting the Criteria for the Content Validity of Teaching Strategies for Concept 1 and 2

Aspects of Critical Thinking	**Pre-test**			**Post test**		
	Mean	**S.D.**	**V.I.**	**Mean**	**S.D.**	**V.I.**
Analyzing	3.35	.417	Strongly Agree	3.38	.397	Strongly Agree
Applying Standards	3.28	.398	Strongly Agree	3.29	.397	Strongly Agree
Discriminating	2.94	.582	Strongly Agree	***3.01***	.522	Agree
Information Setting	3.38	.405	Strongly Agree	3.38	.404	Strongly Agree
Logical Reasoning	3.29	.426	Strongly Agree	3.32	.414	Strongly Agree
Predicting	3.21	.497	Agree	3.24	.467	Agree
Transforming Knowledge	3.35	.451	Strongly Agree	3.35	.351	Strongly Agree
	3.26	.308	Strongly Agree	3.28	.276	Strongly Agree

Table 5 shows that Junior high school students strongly agree with respect on analyzing, applying standards, information setting, logical reasoning, and transforming knowledge and agree on discriminating, and predicting aspects for Concept 1 (Boyle's Law) and Concept 2 (Colligative Properties of Water Solutions) exploited in the infusion of critical thinking. This signify that the teaching strategies used in the intervention could enhance the critical thinking skills of the students. Inquiry-based teaching, problem solving, collaborative, and lecture method that utilized in the infusion of the critical thinking into the concepts of Chemistry met the criteria of a good standard teaching strategy. Halvorsen, (2005) posited that the most experienced teachers recognize that

the more information about the personal interests of the students, the more appropriate and engaging the classes will become.

Table 9 shows that Junior high school students strongly agree that the two concepts in Chemistry exploited in the infusion of critical thinking with respect on analyzing, applying standards, discriminating, information.

VanTassel-Baska, Bracken, Feng, and Brown (2009), McCollister and Sayler (2010), and Tsai, Chen, H. Chang and W. Chang (2013) confirms that critical thinking could be infused in lessons throughout all disciplines by exploiting in-depth questioning and evaluation of data and information. These types of activities could be done in any educational setting with the alternative styles of assessment.

CONCLUSIONS

Science educators have adequate teaching abilities and experiences that could help the Junior high school students in some selected public schools in Region 3 to enhance their critical thinking skills in Chemistry. The learning gaps of the Junior high school students should be assessed by the teachers to develop their critical thinking skills and improve their academic performance. The learning through experience of the students is the basis for the infusion of the critical thinking into the concepts of Chemistry. Through this, science educators could determine the effects of the critical thinking and its implications to science education.

In this undertaking, it was found out that there is no significant difference between the critical thinking skills and the respondents' profile: age and gender before and after the interventions were done. The research found out that through collaborative teaching method, critical thinking skills of the student participants were significantly enhanced. Moreover, there is a significant difference between the critical thinking skill levels and the academic performance of the Junior high school students in Chemistry in some public schools in Bulacan, Pampanga, and Zambales of Region 3, Philippines. The study determined the implications of the infusion of the critical thinking in Chemistry through the appropriate teaching strategies. Infusion of the critical thinking is one of the important activities in the teaching-learning components of education.

TRANSLATIONAL RESEARCH

The critical thinking should be infused into the different classroom activities to enhance the level of the critical thinking skills of the students. Critical thinking skills of the students could be enhanced using other teaching strategies and methodologies. The research could be a basis for a proposed instructional model that could be utilize in the infusion of critical thinking in teaching Chemistry concepts.

ACKNOWLEDGEMENT

A sincerest gratitude to Dr. Erna V. Yabut and Dr. Marcos V. Lopez, for the CEU-Lopez Critical Thinking Skill Test (2012) Instrument tool. To Dir. Malcolm S. Garma, CESO V, Officer-In -Charge of DepEd.Region 3, for the approval and endorsement of this undertaking to the school heads. To the Principals and teachers of the selected high schools in Bulacan, Pampanga, and Zambales, for the appropriate schedule of the classes during the intervention. To Junior high school students, for participating in the infusion of the critical thinking into the concepts of Chemistry. Finally, to Dr. Zenaida B. Los Banos, Dr. Edna Liza M. Victoria, Dr. Avelina Raqueno, Dr. Elmar Malvar, and Prof. Erlina Mendoza, for sharing their expertise in the completion of this research.

LITERATURE CITED

Adalikwu, S. A., & Iorkpilgh, I. T. (2013). The Influence of Instructional Materials on Academic Performance of Senior Secondary School Students in Chemistry in Cross River State. *Global Journal of Educational Research*, *12*(1), 39. Retrieved from https://search.proquest.com/openview/bcc0a2e0178d197fa8e39ccc5c1f1bb3/1?pq-origsite=gscholar&cbl=105791

Alwehaibi, H. (2011). The Effect of a Critical Thinking Program on Developing College Students'critical Thinking Skills. In *EDULEARN11 Proceedings* (pp. 6386-6397). IATED. Retrieved from https://scholar.google.com.ph/scholar?hl=en&as_sdt=0%2C5&q=Alwehaibi%2C+H.+%282011%29.+The+Effect+of+a+Critical+Thinking+Program+on+Developing+College++++Students%27critical+Thinking+Skills&btnG=

Birjandi, P., & Bagherkazemi, M. (2010). The relationship between Iranian EFL teachers' critical thinking ability and their professional success. *English language teaching*, *3*(2), 135. Retrieved from http://www.ccsenet.org/journal/index.php/elt/article/view/6255

Cottrell, S. (2011). *Critical thinking skills: Developing effective analysis and argument*. Palgrave Macmillan. Retrieved from https://scholar.google.com.ph/scholar?hl=en&as_sdt=0%2C5&q=Cottrell%2C+S.+%282011%29.+Critical+thinking+skills%3A+Developing+effective+analysis+and+argument&btnG=

Fleming G. (2010). Introduction Critical Thinking. Retrieved on January 5, 2015 from https://www.thoughtco.com/introduction-to-critical-thinking-1857079

Halvorsen, A. (2005). Incorporating critical thinking skills development into ESL/EFL courses. *The internet TESL journal*, *11*(3), 1-5. Retrieved from http://iteslj.org/Techniques/Halvorsen-CriticalThinking

Jones, R. C. (2013). The instructor's challenge: moving students beyond opinions to critical thinking. Retrieved from *https://scholar.google.com.ph/scholar?hl=en&as_sdt=0%2C5&q=Jones%2C+R.+C.+%282013%29.+The+instructor%E2%80%99s+challenge%3A+moving+students+beyond+opinions+to+critical+thinking&btnG=*

Lopez, M. CEU-Lopez, Critical Thinking Skills Instrument Tool (2012). Retrieved from https://www.researchgate.net/publication/319101787_Validation_of_the_CEU-Lopez_Critical_Thinking_Test_Using_Multidimensional_IRT_Model

McCollister, K., & Sayler, M. F. (2010). Lift the Ceiling Increase Rigor with Critical Thinking Skills. *Gifted Child Today*, *33*(1), 41-47. Retrieved from https://scholar.google.com.ph/scholar?hl=en&as_sdt=0%2C5&q=McCollister%2C+K.%2C+%26+Sayler%2C+M.+F.+%282010%29.+Lift+the+Ceiling+Increase+Rigor+with+Critical+Thinking+Skills&btnG=

Sabiru, D. Y. (2014). Effects of collaborative learning on Chemistry students' Academic achievement and anxiety level in balancing chemical Equations in secondary school in Katsina Metropolis, Nigeria. *Journal of Education and Vocational Research*, *5*(2), 43-48. Retrieved from https://scholar.google.com.ph/scholar?hl=en&as_sdt=0%2C5&q=Sabiru%2C+D.+Y.+%282014%29.+Effects+of+collaborative+learning+on+Chemistry+students%E2%80%99+Academic+achievement+and+anxiety+level+in+balancing+chemical+Equations+in+secondary+school+in+Katsina+Metropolis%2C+Nigeria&btnG=

Smith, V. G., & Szymanski, A. (2013). Critical Thinking: More than Test Scores. *International Journal of Educational Leadership Preparation*, *8*(2), 16-25. Retrieved from https://scholar.google.com.ph/scholar?hl=en&as_sdt=0%2C5&q=mith%2C+V.+G.%2C+%26+Szymanski%2C+A.+%282013%29.+Critical+Thinking%3A+More+than+Test+Scores&btnG=

Snodgrass, S. (2011). Wiki activities in blended learning for health professional students: Enhancing critical thinking and clinical reasoning skills. *Australasian Journal of Educational Technology*, *27*(4). Retrieved from https://scholar.google.com.ph/scholar?hl=en&as_sdt=0%2C5&q=Snodgrass%2C+S.+%282011%29.+Wiki+activities+in+blended+learning+for+health+professional+students%3A+Enhancing+critical+thinking+and+clinical+reasoning+skills&btnG=

Snyder, L. G., & Snyder, M. J. (2008). Teaching critical thinking and problem-solving skills. *The Journal of Research in Business Education*, *50*(2), 90. Retrieved from https://scholar.google.com.ph/scholar?hl=en&as_sdt=0%2C5&q=Snyder%2C+L.+G.%2C+%26+Snyder%2C+M.+J.+%282008%29.+Teaching+critical+thinking+and+problem-solving+skills&btnG=

Tamayo, J. D., Tayao, J., Lopez, M. & Mangalile, M. (2014), " A Cross-Sectional Analysis on the Level of critical Thinking Skills of Students in the College of Management and Technology at CEU Malolos". International Journal of Scientific and Research Publications, Volume 4. Retrieved from http://www.ijsrp.org/research-paper-0514/ijsrp-p29124.pdf

Tsai, P. Y., Chen, S., Chang, H. P., & Chang, W. H. (2013). Effects of Prompting Critical Reading of Science News on Seventh Graders'

Cognitive Achievement. *International Journal of Environmental and Science Education*, *8*(1), 85-107. *8*(1), 85-107 doi:, 10.1002/tea.20385.

VanTassel-Baska, J., Bracken, B., Feng, A., & Brown, E. (2009). A longitudinal study of enhancing critical thinking and reading comprehension in Title I classrooms. *Journal for the Education of the Gifted*, *33*(1), 7-37. Retrieved from http://journals.sagepub.com/doi/abs/10.1177/016235320903300102