WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

LEARNING MATERIALS FOR MODULAR DISTANCE LEARNING ON ACADEMICALLY-CHALLENGED LEARNERS' SCIENCE PROCESS SKILLS AND CONCEPTUAL UNDERSTANDING OF MATTER

A Thesis Presented to the

Faculty of the Graduate School

College of Education

West Visayas State University

Iloilo City

In Partial Fulfillment

Of the Requirements for the Degree

Master of Arts in Education

(Physical Science)

by

Alfredo C. Ga, Jr.

June 2021

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

APPROVAL SHEET

A Thesis for the Degree

Master of Arts in Education

(Physical Science)

by

Alfredo C. Ga, Jr.

Approved by the Research Committee:

EMELLIE G. PALOMO, PhD, Chair

RICKY M. MAGMO, PhD, Member

KAREN S. SUMADIC, PhD, Outside Expert

IGNACIO S, TIBAJARES, JR., PhD, Adviser

RICKY M. MAGNO, LPT, PhD
Dean

July 2021

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

Ga, Alfredo Jr., C. "*Learning Materials for Modular Distance Learning on Academically-Challenged Learners' Science Process Skills and Conceptual Understanding of Matter.* "Unpublished Master of Arts Education (Physical Science) Thesis. West Visayas State University, Iloilo City, 2021.

Abstract

Face-to-face learning engagement of learners and teachers within the school has been suspended due to the Coronavirus Infectious Disease (COVID-19) pandemic. This pandemic has paved the way to the implementation of Modular Distance Learning as an urgent response to ensure continuity of education. The Philippines is in the process of adapting to the new normal form of education at present, and continuous innovations of educators and active involvement of other stakeholders are the driving force for its success. This comparative research pre-test-post-test design determined the effectiveness of learning materials for modular distance learning on academically-challenged learners' science process skills and conceptual understanding of matter. It used two data-gathering instruments: Science Process Skills Test for Academically-Challenged Learners (SPSTACL) and Test on Conceptual Understanding (TCUM) in Science 8 specifically in Matter domain. The subjects of this research were the seventy (70) Grade 8 learners coming from two lower sections of Trinidad V. Canja-Sta. Teresa National High School in the Schools Division of Guimaras. The descriptive statistical tools used were means and standard deviations, while the inferential statistical tools were the *t-test* for independent samples, *t-test* for dependent samples, and Pearson's Product Moment of Correlation. Significance level was set at.05. The qualitative data analysis utilized thematic analysis, as proposed by Braun and Clarke (2006), which involves the

deductive approach and employed thematic map as a tool to clearly examine the data to identify common themes—topics, ideas, and patterns of meanings that come up repeatedly to reveal the perceptions, triumphs, and travails of the academically-challenged Grade 8 learners exposed to ADM Module (ADMM) and Learning Activity Sheet (LAS). The researcher followed the six phases, as introduced by Braun and Clarke (2006). Phase 1. Familiarizing the Data, Phase 2: Generating Initial Codes, Phase 3: Searching for Themes, Phase 4: Reviewing Themes, Phase 5: Defining and Naming Themes, and Phase 6: Producing the Report. The results showed that before exposure to ADM Module (ADMM), the group had "developing" science process skills and "beginning" conceptual understanding of matter. Similarly, those who were assigned under the Learning Activity Sheet (LAS) possessed "developing" and "beginning" conceptual understanding of Matter. However, the results revealed that after exposure to the intervention, those learners who were exposed to ADMM "developed" science process skills and "developing conceptual understanding of matter. Likewise, those who were exposed to the LAS "developed" science process skills and "developing" conceptual understanding of matter. The results further showed also that the mean gain scores of the learners exposed to ADMM in science process skills and conceptual understanding were slightly higher than those of the learners exposed to LAS in science process skills and conceptual understanding of Matter. Moreover, the positive mean gain scores revealed that the science process skills and conceptual understanding of Matter of learners has improved. The inferential analysis revealed that there were no significant

differences in the levels of science process skills before and after exposure to ADMM and LAS but there were a significant differences in the levels of conceptual understanding before and after exposure to ADMM and LAS. Likewise, there was a significant difference in science process skills and conceptual understanding of the subjects before and after exposure to ADMM and LAS. Moreover, there was no significant difference in the mean gains of the ADMM and LAS groups in science process skills. It can be taken to mean that, in terms of developing the science process skills of learners, ADMM is comparable with LAS group. However, the mean gain score in conceptual understanding of the subjects exposed to ADMM was significantly higher than that of the subjects exposed to LAS. The results also revealed that ADMM is effective in improving conceptual understanding in science 8 specifically in matter domain. Finally, results revealed that the science process skills and conceptual understanding of the subjects exposed to ADMM and LAS were not significantly correlated. In conclusion, the utilization of learning materials (ADMM and LAS) engaged learners to think and put meaning to their answers which helped them develop their science process skills and conceptual understanding of Matter. The importance and relevance of the ADM Module and Learning Activity Sheet as instructional materials for modular distance learning cannot be discounted because both materials have positive effects on the science process skills and conceptual understanding of academically-challenged learners. Learners' firm grasp of the concepts does not necessarily translate their ability to do scientific work that requires the application of their science process. Policy and curriculum makers may attempt to develop programs that address the need to develop learning materials such as ADMM

and LAS for academically-challenged learners. They must align their planning towards those that could address low performance in science. Module and LAS writers are encouraged to make necessary improvements on the instructional materials to better grasp expectations for every lesson. They may also provide learning activities that are timely and relevant for the 21st century learners. Teachers, being catalysts of change should be resourceful and creative in all aspects of delivering instructions to learners. They may utilize the ADM Modules used by the researcher in this study as samples. They could also be a means of reaching out to learners who are most likely to be left behind. Collaboration among teachers must be practiced in school. It is recommended that one of the sessions during Learning Action Cell (LAC) be allotted for mentoring and sharing best practices in delivering lessons with the use of learning materials. The result of this study may serve as springboard for the future improvements of the schools' existing programs and guidelines on the implementation of modular distance learning.

WEST VISAYAS STATE UNIVERSITY
COLLEGE OF EDUCATION
GRADUATE SCHOOL
Iloilo City

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

References

Abungu, H. E., Okere, M.I.O., & Wachanga, S.W. (2014). The effect of science process skills teaching approach on secondary school students' achievement in chemistry in Nyando District, Kenya. *Journal of Educational and Social Research, 4*(6), 359-371. doi:10.5901/jesr.2014.v4n6p359, Accessed on 07/19/2018 @ 4:38 PM.

Adesoji F. A. and Raimi S. M. (2004*). Effects of Enhanced Laboratory Instructional Technique on Senior Secondary Students' Attitude towards Chemistry in Oyo Township, Oyo State, Nigeria. School Science Education and Technology.*http:www.yahoo.com, Accessed on 10/09/2018 @ 10 PM.

Agahito, A. G. et al. (2007). *Science and Life*, revised edition, Salesiana Books by Don Bosco. Makati City.

Agogo, P.O., & Onda, M.O. (2014). *Identification of students' perceived difficult concepts in senior secondary school chemistry in Oju local area government area in Benue State, Nigeri*a. Global Educational Research Journal. 2(4). 44-49. Retrieved from http://www.springjournal.net/full articles/springjournals.netglobalarticlessogbu -agogo.pdf?view=online, Accessed on 03/28/2019 @ 8:37 PM.

Aktamo, H., & Ergin, O. (2008). *The effect of scientific process skills education on students scientific creativity, science attitudes and academic achievements.* Paper presented at Asia-Pacific Forum on Science Learning and teaching. June 2008.

Ali, et al. (2010). *The Effectiveness of Using CSAA Module on Students Academic Performance.* Paper presented at 1st International Conference on World-Class Education (ICWED) on 5-6th, Dec, University of Malaya, Kuala Lumpur, Accessed 06/14/2021@ 6:47 PM.

Ango, M. L. (2002). *Mastery of Science Process Skills and Their Effective Use in the Teaching of Science: An Educology of Science Education in the Nigerian Context.* University of Jos, Plateau State, Nigeria International Journal of Educology, 2002, Vol 16, No 1 Available: www.google.com, Accessed on 05/17/2020 @ 9:55 PM.

Ardales, V. (2008). *Basic concepts and methods in research* (3rd ed.). Educational Publishing House, Manila, Philippines. ISBN #978-971-513-245-9.

Arthur, D. (2004). *The effect of inquiry-based instruction on students' participation and attitudes in third grade science classroom.* Master's thesis. University of Central Florida, Orlando, Florida, 2005.

Artun, H., & Costu, B. (2012). Effect of the 5E model on prospective teachers' conceptual understanding of diffusion and osmosis. *Journal of Science Education and Technology, 22*, 1-10. doi:10.1007/s10956-012-9371-2, Accessed on 05/25/2020 @ 7:43 PM.

Barsalou, et al. (2003).The effects of inquiry-based learning on elementary students' conceptual understanding of matter, scientific process skills, and science attitudes. *Procedia–Social and Behavioral Sciences, 2*(2), 1190-1194. Retrieved from http://www.sciencedirect.com/science/article/pii/S1877042810002107#, . Accessed on 03/07/2021 @ 9:16 AM.

Becta, S. (2003). Science-based occupations and the science curriculum: Concepts of evidence. Retrieved from: http://www.Interscience.wiley.com. Accessed on 03/26/2020 @ 7:56 PM.

Bennet, F. (2001). The influence of attitude on science teaching and learning. *School Science and Mathematics, 85*(3), 222-232. http://dx.doi.org/10.1111/j.1949-8594.1985.tb09615.x, Accessed on 06/18/2019 @ 8: 34 PM.

Bernardo, J. (2020, July 30). *Modular Learning most paents preferred: DepEd.* ABS-CBN News. https://news.abs-cbn.com/news/07/30/20/modular-learning-most-preferred-by-parents-deped, Accessed on 07/30/2020 @ 11:40 PM.

Biray, E. T. (2005). *Teaching performance of college language teachers as influenced by stress : The Aklan experience.* Unpublished master's thesis. West Visayas State University, La Paz. Iloilo City.

Brotherton, J & Preece, T. (1995). Developing a of a science process skills test for secondary students: validity and reliability study. *Educational sciences: Theory and Practice, 12*(3), 1899-1906, *Published by Sciedu Press* 21 *ISSN 1925-0746 E-ISSN 1925-0754*, Accessed on 02/13/2020 @ 2 PM.

Brown, S. (2009). Skill acquisition process skills. Accessed on 06/16/2020 @ 8:51 PM Available: http://www.itjoblog.co.uk/2009/04/skill – acquisition process.html, Accessed on 04/10/2020 @ 7:51 PM.

Cabrera, A. F. (2002).Classroom Teaching Practices: Ten Lessons Learned. WISCAPE Sr. Research Associate Department of Educational Administration University of Wisconsin at Madison 1025 West Johnson St. Madison, WI 53706. Available:http://www.education.umd.edu/EDPA/faculty/cabrera/Classroom%2 Teaching., Accessed on 05/16/2021 @ 6:58 PM.

Chase, A. M., Clancy (2017). Improving critical thinking via authenticity: The Caspie research experience in a military academy chemistry course. *Chemistry Education Research and Practice, 18* (1), 55-63.

Chiu, J. L. & Linn, M. C. (2014). Supporting knowledge integration in chemistry with a visualization-enhanced inquiry unit. *Journal of Science Education and Technology*, 23, 37-58. doi:10.1007/s10956-013-9449-5.

Darling, P. L. (2000). *A case study of Urban student and teacher experiences surrounding an outdoor environmental Science Field Trip.* Retrieved May 3, 2020, from ProQuest Education: http://search.proquest.com/docview/304926497/13675FA6E6959EA3CF9/5?acco untid=42518.

Dara , A. O. (2008). Motivating the Interest of Students In Science Subjects by linking Their Concepts to Real Life. A conference paper presented at the 8th National Conference of the School of Social Science, AIFCE, Owerri.

Department of Education. (2012). *K to 12 curriculum guide*: Science. Philippines: Author

Dreyfus, M. (2008). *Issues in inquiry-based science education seen through Dewey's theory of inquiry.* Retrieved April 1, 2012, from Ideals Illinois: http://www.ideals.illinois.edu/bitstream/handle/2142/14574/Won_Mihye.pdf, Accessed on 6/12/2020 @ 3:30 PM.

Edward, C. N., Asirvatham, D., & Johar, M. G. M. (2019). The impact of teaching oriental music using blended learning approach. *Malaysian Journal of Learning and Instruction, 16*(1), 81-103. Retrieved from http://mjli.uum.edu.my/images/vol.16no.1/81-103.pdf, Accessed on 05/16/2021 @ 6:58 PM.

Eggleston, H. (2007). *Chapter 7: Constructivism and the Nature of Science.* Retrieved November 7, 2019, from SpringerLink: http://www.springerlink.com/content/ur28h01608032674/fulltext.pdf

Escalona, L. P. (2010).*Attitudes towards Chemistry and Chemistry Performance. A Correlational Study.* Available:http://www.jblcf bacolod.edu.ph/escalona.php .www.yahoo.com, Accessed on 07/24/202018 @ 6:58 PM.

Ferguson, R. L. (2007). Constructivism and social constructivism. In G. M. Bodner & M. Orgill (Eds.), *Theoretical frameworks for research in chemistry and science education.* Upper Saddle River, NJ, United States: Pearson Education (US).

FlipScience. (2020, October 5). *'Tagapagdaloy': How Filipino parents can help ensure successful modular distance learning*. FlipScience - Top Philippine Science News and Features for the Inquisitive Filipino. https://www.flipscience.ph/news/features-news/tagapagdaloy-modular-distance-learning/, Accessed on 02/16/2019 @ 3:27 PM.

Frazer, et al. (2010). *Issues in Inquiry-based science education seen through Dewey's theory of inquiry.* Retrieved April 1, 2019, from Ideals Illinois:http://www.ideals.illinois.edu/bitstream/handle/2142/14574/Won_Mihye.pdf.

Gaton, D. D. (1999). *Process skills and practical knowledge in science: Their influence on science and technology* . Unpublished master's thesis. West Visayas State University. Lapaz, Iloilo City.

Gee, K. A., & Wong, K. K. (2012). A cross national examination of inquiry and its relationship to student performance in science: Evidence from the program for International Student Assessment (PISA) 2006. *International Journal of Education Research, 53*, 303-318. Retrieved from http://www.sciencedirect.com/science/article/pii/S0883035512000365?np=y, Accessed on 08/11/2021 @ 10:45 AM.

Gerlovich, T. (1994). *Science Instruction in the Middle and Secondary Schools* (5th ed*).* Upper Saddle River, NJ: Merrill Prentice Hall.

Gilbert, J. K. (2010). The role of visual representations in the learning and teaching of science: An introduction. *Asia-Pacific forum on science Learning and teaching*, 1 (1), 2-5. Retrieved from https://www.researchgate.net/profile/John_Gilbert7/publication/45459, Accessed on 03/15/2021 @ 12:10 PM.

Goldhaber, C., & Anthony, D. (2003). Classroom management and inquiry-based learning: Finding the balance. *Science Scope, 32 (9),* 18-21. (EJ850038). Retrieved fromhttp://vnweb.hwwilsonweb.com.ezproxy.brooklyn.cuny.edu:2048/hww/results/external_link_maincontentframe.jhtml?_DARGS=/hww/results/results_common.jhtml.43, Accessed on 02/13/2019.

Green, J. (2003). The direct teaching of critical thinking in grades four through six. *Journal of Research in Science Teaching, 1 (4).* Retrieved from ERIC. http://www.eric.ed.gov.ez-proxy.brooklyn.cuny.edu:2048/PDFS/ED011239.pdf, Accessed on 04/25/2020 @ 3:56 PM.

Gupta, T., Burke, K. A., Mehta, A., & Greenbowe, T. J. (2015). Impact of guided-inquiry based instruction with a writing and reflection emphasis on chemistry students' critical thinking abilities. *Journal of Chemical Education, 92*(1), 32-38.

Harlen, W., & Allende, J. E. (2009). *Teacher professional development in pre-secondary school inquiry-based science education.* Santiago Chile: Fundacion para Estudios Biomedicos Avanzados de la Facultad de Medicina. Retrieved from http://www.interacademies.net/File.aspx?id=9348, Accessed on 11/21/2020 @ 2:18 PM.

Hashim, H. (1999). Teaching and learning cycles in a constructivist approach to instruction. *Journal Teaching and Teacher Education*, 24: 1613-1634, Accessed 06/16/2020 @ 4:54 PM.

Hawk, S. (1985). Examining reflective thinking: A study of changes in methods students' conceptions and understandings of inquiry teaching. *International Journal of Science and Mathematics Education.* **1-21**. Retrieved from EBSCO. http://ejournals.ebsco.com/direct.asp?ArticleID=4F6CBAE4E3BBD1F0DC2A, Accessed 06/08/2020 @ 6:10 PM.

Huppert, J., Lomask, S. M., & Lazarowitz, R. (2002). Computer simulations in the high school: Students' cognitive stages, science process skills and academic achievement in microbiology. International Journal of Science Education, 24(8), 803-821. http://dx.doi.org/10.1080/09500690110049150 (retrieved: 02/11/2017 @ 7:53 PM).

Hermida, H. C. (2004). *Perceived teacher characteristics, level of teaching effectiveness, and level of academic performance among high school students.* Unpublished master's thesis. West Visayas State University.La Paz, Iloilo City

Halpern, D. F. (2016). *Manual: Halpern critical thinking assessment* Retrieved from https://drive.google.com/file/d/0BzUoP_pmwy1gdEpCR05PeW9qUzA/view Accessed on 09/25/2020 @ 8:31 PM.

Jackson, R, *et al.* (2001). A glimpse at current teaching practices with preliminary survey results. National Center for Assessing the General Curriculum.

Kennedy, A. (2010). *Theory and Practice.* Retrieved April 23, 2020, from Inquiry Based Approaches to Science education: http://www.brynmawr.edu/biology/franklin/InquiryBasedScience.html, Accessed

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential and inquiry-based teaching. *Educational Psychologist, 41*(2), 75-86. http://dx.doi.org/10.1207/s15326985ep4102_1 (retrieved: 02/17/2018 @ 6:45 PM).

Koniceck-Moran, R., & Keeley, P. (2015). *Teaching for conceptual understanding in science.* NSTA Press: Arlington.

Lederman, N.G. (1992). Students' and Teachers' Conceptions of the Nature of Science: A Review of the Research. *Journal of Research in Science Teaching*, Vol. 29, No.4,pp331-259.Liberko, C. A. (1998).Study Tips For Students. Available:http://people.cornellcollege.edu/cliberko/studytips.htm, Accessed on 04/02/2021 @ 1:40 PM.

Malefyane, T., Hofman, A., Winnips, K., & Beetsma, Y. (2014). The impact of interactive engagement methods on students' academic achievement. *Higher Education* Research and Development, 33(5), 1020-1034. doi: 10.1080/07294360.2014.890571.

Marmolejo, M. N. (2000). *The relationship between attitude and achievement in chemistry of third year high school students.* Unpublished Master's Thesis. University of Iloilo. Iloilo City.

Marshall, J. A., (2000). Inquiry experiences as a lecture supplement for preservice elementary teachers and general education students. *American Association of Physics Teachers, 68.* Retrieved from http://ejournals.ebsco.com/direct.asp?ArticleID=E7VEHHT4H1RP07MNC39C, Accessed on 7/25/2020 @ 3: 45 PM.

Matchete, E. M. (2001).*Performance of third year high school students in chemistry, An assessment.* Unpublished master's thesis. Eulogio " Amang " Rodriguez Institute of Science and Technology, Nagtanan, Sampaloc Manila

Mayer, et al. (2001). *Blending Physical and Virtual Manipulatives: An Effort to Improve* Student's Conceptual understanding through Science Laboratory Experimentation. Retrieved April 5, 2020, from Science Education: http://onlinelibrary.wiley.com/doi/10.1002/sce.20463/pdf.

Mcullough, A. (2002). *Effects of project, inquiry, and lecture-demonstration teaching methods on senior secondary students' achievement in separation of mixtures practical test.* Retrieved March 14, 2018, from Educational Research and Review: academicjournal.org/err/PDF/pdf%202007/Jun/sola%20and%20ojo.pdf

Meling, K.R. and Oliver, D.L. 1983. *Handbook I: Science teaches basic skills.* Washington, D.C.: National Science Teachers Association *http://ejse.southwestern.edu/article/view/7589/5356,* Accessed on 04/18/2021 @ 9:20 AM.

Mei, G.T. (2007). Promoting Science Process Skills and the Relevance of Science through Science Alive Programme. Clemente Town Secondary School.Singapore Available: www. Google .com, Accessed on 05/3/2021 @ 8:15 PM.

Meyers, B .et al (2004). *Assessing Agriculture Teachers' Capacity for Teaching Science Integrated Process Skills.* University of Florida. Journal of Southern Agricultural Education Research Volume 54, Available: www.yahoo.com, Accessed on 05/17/2021 @ 7:18 PM.

Monica, K .M. (2005). Development and validation of a test of integrated science process skills for further education and training learners. University of Pretoria, Africa. Available: www.goggle.com, Accessed on 02/22/2021 @ 11:56 AM.

Nardo, M. T. B. (2017, October 20). *Modular Instruction Enhances Learner Autonomy.* Sciepub.http://pubs.sciepub.com/education/5/10/3/index.html#:%7E:text=The%20use%20of%20modules%20is,in%20doing%20their%20individual%20tasks.&text=It%20directs%20students%20to%20practice%20or%20rehearse%20information.,-To%20gain%20mastery, Accessed on 04/28/2021 @ 4:45 PM.

National Research Council. (2000). *Inquiry and the National Science Education Standards: A guide for teaching and learning.* Washington D. C.: National Academy Press. Retrieved from http://www.nap.edu/openbook.php?record_id=9596&page=25, Accessed on 04/25/2021 @ 3:40 PM.

Ornstein, A & Levine,D .(2003). Foundations of education 8th edition, Hougarton Nuffin Company, NY

Osborne, R., and Freyberg, P. (1985). Learning in science: The implication of children's science. Auckland: Heinemann Publishers. http://ejse.southwestern.edu/article/view/7589/5356, Accessed on 03/16/2021 @ 5:43 PM.

Ostlund, K .(1992). What the Research Says about Science Process Skills. University of Texas, Austin. http://ejse.southwestern.edu/article/viewArticle/ 7589/5356, Accessed on 08/13/2019 @ 6:37 PM.

Padilla, M. J. (1990). The science process skills. Research matter – to the science teacher. No. 9004.

Pallon, R. (2003). *Science process skills, attitudes, and science and technology achievement of high school students.* Unpublished master's thesis. West Visayas State University. La Paz,Iloilo City

Pallada, G. H. (2002). *Perception about chemistry and teachers' teaching practices to student performance.* Unpublished master's Thesis. University of San Agustine ,Iloilo

Palma, N. H. (2006). *Teaching style, creativity, and performance of social studies teachers in the schools division.* Unpublished master's thesis. West Visayas State *University.* La Paz,Iloilo City

Parreño, N .G . Jr. (2005). *Aptitude and attitude towards science as correlates of science performance.* West Visayas State University. Unpublished master's thesis. La Paz, Iloilo City.

Pedroso, J. P. (2010). *Classroom management and teaching performance of secondary teachers in a private sectarian school.* West Visayas State University. Unpublished master's thesis. La Paz, Iloilo City.

Racela, E. M. (2011).Teaching – learning Processes in the Pre-service Education of General Science Teachers .Mariano Marcos State University emyracela@yahoo.com

Saleh, S. (2011). The effectiveness of the brain-based teaching approach in dealing with problems of four students' conceptual understanding of Newtonian physics. *Asia Pacific journal of Educators and Education*, (26)1, 91-106.

Salome, C. (2013). The impact of students' attitude on the teaching and learning of chemistry in secondary schools in Bureti district, Kenya. Journal of emerging trends in education research and policy studies. 4(4). 618-626. Retrieved from http://jeteraps.scholarlinkresearch.com/articles/The%20Impact%20of%20students.pdf, Accessed on 04/12/2020 @ 2:40 PM.

Sari, P. M., Sudargo, F., & Priyandoko, D. (2018). *Correlation among science process skill, concept comprehension, and scientific attitude on regulation system materials.* Presented at 1st

Sawyer, R. K. (2008). *Optimising learning: Implications of learning science research. Innovating to learn, learning to innovate*. (pp. 45- 65). doi: 10.1787/9789264047983-en

Stephenson, N. S., & Sadler-Mcknight, N. P. (2016). Developing critical thinking skills using the science writing heuristic in the chemistry laboratory. *Chemistry Education Research and Practice, 17*(1), 72-79.

TIMMS (Trends in International Mathematics and Science Study) (2003). *International Science report: Fndings from IEA's trends in International Mathematics and Science study at the fourth and eighth grades*. Retrieved from August 14, 2014 http://www.timmsreport.org/report_eight_fourth_grade/9889/pdf, Accessed on 2/10/2018 @ 9:20 PM.

Viennot, L. (2008). Learning and conceptual understanding: Beyond simplistic ideas, what have we learned? In M. Vincentini, & E. Sassi (Eds.), *Connecting research in physics education with teacher education* (pp. 1-17). International and Pan American Copyright Conventions:

Young J. (1995). Science process skills and attitudes of pre-service elementary teachers. *Journal of Elementary Science Education, 11*(2), 57-64. http://dx.doi.org/10.1007/BF03173838, Accessed on 03/17/2020 @ 6:50 PM.