Student Attribute Correlates of Academic Achievement in High School Chemistry between Grade 9 & 10 Students

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Abstract
This study examined three student attributes namely; level of mathematics anxiety, learning style, and attitude toward Chemistry that generated information on their effect on student achievement in Chemistry.
The study employed the causal-comparative descriptive research method. Instruments used included an achievement test to measure performance involving mathematical concepts in Chemistry, level of mathematics anxiety scale to measure anxiety levels, attitude toward Chemistry scale, and learning style reference. A total of 108 Grade 9 and 10 students from the Institute of Teaching and Learning (ITL) at the Philippine Normal University were involved as respondents. The result of the study revealed that the respondents taken as a whole, performed fairly in the achievement test in Chemistry particularly in the multiple choice and poorly in the open-ended part of the achievement test. Their anxiety in mathematics was positively correlated with their performance in Chemistry involving mathematics.
The respondents, taken separately by grade level showed that grade 9 performed better than grade 10 in multiple choice and open ended tests. Both groups have favourable attitude toward chemistry. Grade 9 has less anxiety level than grade 10 respondents.
The study recommends that teachers should employ an effective approach on how to lessen the students' level of anxiety in mathematics for them to improve their performance in Chemistry. Further, the study recommends teachers to find best ways to get their students interested in Chemistry topics which involve mathematics.

Keywords: Student Attitude, Mathematics Anxiety, Academic Achievement, Learning Style, Chemistry

Introduction

Basic mathematical skills are important in everyday life, yet many students feel anxious when they are faced with the prospect of solving mathematical problems. Students recall having traumatic experience involving mathematics, such as being ridiculed by their classmates if they did not solve a problem correctly or belittled by the teacher.

More than just memorizing formulas and concepts, Mathematics requires high-ordered thinking skills such as analytical reasoning, problem solving, and critical thinking because mathematics are abstract and spiral in nature. Similarly, learning Chemistry is also a challenge because students are not only introduced to science concepts but also required to apply skills in mathematics. Students tend to have a negative attitude toward learning Chemistry, as both require similar skills and a thorough understanding of problems that they have to solve. Mathematical anxiety, characterized by feelings of tension, apprehension, and fear about performing math, hinders the students' progress and competence in learning and understanding the concepts of mathematics, more so when mathematics skills are needed in learning Chemistry concepts. In effect, students' uneasiness of the discipline affects how they take the examination, their attitude toward the subject, and their behavior in the classroom, hindering their capacity to learn not only courses in Mathematics but also scientific in disciplines like Chemistry.

Mathematics is used as the language of science especially Chemistry. Mathematics difficulty is associated with disinterest in learning chemistry, understanding, and solving problems. Student's fear in mathematics affects their ability to endure and perceive concepts encountered in studying chemistry. It has been observed that so many students fear chemistry and such fear is characterized by mass disenchantment among the students toward the subject. The relationship of the student's mathematics anxiety and their attitude toward chemistry greatly affects their performance in the subject.

The increasing learners' individual interest has led to the shifting of traditional to progressive mode of education, showing a new paradigm as a student-centered learning. The individuals' interaction process is very important to determine their method of learning that is most effective to take place in terms of their learning styles (Zywno, 2002). The study of Ikitde and Edet (2013) indicated that students' attention is being focused on how they can meet challenges in an increased diversity inside the classroom. It is their interest how they demonstrate mastery in the completion of a subject that depends on their way in absorbing the lessons and the teaching methods. Pashler, McDaniel, Rohrer and Bjork (2008) conclude that learning styles can have little evidence with the students' learning style on how they match instructions to produce superior learning.

Students' attitude can be influenced by their achievement which gives an important role in selecting their professional carriers. According to Bennet, Lubben, and Hogarth (2003), students' understanding of science ideas is helpful in science education. These science ideas are referred to the student's views in developing science as the result of experiences in different environments in the field of Science education.

Restrepo and Villaveces (2012) noted that Mathematics and Chemistry are closely related. The close relationship was evidently observed in the emerging subdiscipline known as mathematical chemistry.

Mathematics has an essential use in chemistry. Basic knowledge of mathematics can be used in chemistry to deal with concepts and theories. Mathematical skills are extremely necessary to explore chemistry in its most important concept using some basic mathematics skills and with these calculations, chemistry itself will be extremely difficult (Shodor, 2008).

This study sought to determine and correlate the students' mathematics anxiety, students' learning style, and attitude toward chemistry to their achievement in chemistry.

Conclusions

In light of the findings, the following conclusions on mathematics anxiety, learning style, achievement and attitude of students toward chemistry were made:

1. Students today are very anxious to learn topics involving mathematics. The respondents are visual learners therefore the students are achieved by using visual stimuli rather than auditory and kinaesthetic. The students have a positive attitude toward chemistry thus their performance is not affected towards the subject and the students still has a mastery in the topics of chemistry.
2. It shows that anxiety in mathematics has a marked effect in their learning chemistry than learning style and attitude in chemistry.
3. From the grades 9 and 10 students, Grade 9 students still has a retention of the topics in chemistry because they are currently taking the subject while the Grade 10 students are currently taking different branch of science therefore some of the topics are forgotten.
4. Students' attitude toward chemistry and learning style doesn't affect their achievement in dealing with chemistry concepts involving math skills.

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References

Aiken, L.R. (1970). Attitudes towards mathematics. Review of Educational Research, 40(4), 551-596.

Allport, G.W (1935). Attitudes in C. Murchison (Ed.), handbook of social psychology. Worcester, Mass: Clark University Press

Allport, G.W (1954). The historical background of modern social psychology. In G. Lindzey (Ed.), Handbook of social psychology (Vol. 1, pp. 3-56) Cambridge, MA: Addison-Wesley

Arcavi, A.(1994). 'Symbol Sense: Informal Sense Making in Formal Mathematics', For the learning of Mathematics, vol 14(3), 24-35.

Ballado, R. S. (2014). Mathematics Anxiety and Academic Achievement of Junior pre-service Teacher Education Students . *WEI International Academic Conference Proceedings*.

Balog lu, M. & Koçak, R. (2006). A multivariate investigation of the differences in mathematics anxiety. Personality & Individual Differences, 40(7), 1325–1335.

Bandura, A. (1989). Human agency in social cognitive theory. American Psychologist, 44, 1175–1184.

Bem, D.J. (1970). Beliefs, attitudes, and human affairs. Belmont, CA: Brooks/Cole

Bennett, J., Lubben, F. and Hogarth, S. (2003) A systematic review of the effects of context-based and Science Technology-Society (STS) approaches to the teaching of secondary science. Research Evidence in Education Library [REEL].

Burris, C. C., Heubert, J. P., & Levin, H. M. (2004). Math acceleration for all. Improving Achievement in Math and Science, 61(5), 68-71.

Campbell, D.T. (1950). The indirect assessment of social attitudes. Psychological Bulletin, 47, 15-38.

Carbonel, L. G. (2013). Learning styles, Study Habits, And Academic Performance Of College Students At Kalinga-Apayao State College, Philippines. *International Journal of Advanced Research in Management and Social Sciences* , *2*(8), 245-258.

Coleman, B. (2009). From home to school: The relationship between parental involvement, student motivaion, and academic achievement. Honors Thesis, The University of Southern Mississippi, Department of Curriculum, Instruction, and Special Education.

Collinson, E. (2000). A survey of elementary students' learning style preferences and academic success. Contemporary Education, 71(4), 42-48. Retrieved from EBSCO host database.

Cuaresma, J. (2008). Learning style preferences and academic performance of PHEM majors at the University of the Cordilleras. Unpublished Undergraduate Thesis. University of the Cordilleras, Baguio City.

Di Martino, P. & Zan, R. (2002). 'An attempt to describe a 'negative' attitude towards mathematics', in Di Martino, P. (Ed.) Proc. MAVI-XI European Workshop, 22-29.

Eagly, A. H., & Chaiken, S. (1993). The psychology of attitudes. Fort Worth, TX: Harcourt Brace Jovanovich.

Eggleton, P. (n.d.). Motivation: A key to effective teaching. The Mathematics, 3(2).

Elenchothy, D., 2007. Kebimbangan matematik dan hubungannya dengan pencapaian pelajar tingkatan empat di daerah Klang. [Mathematics anxiety and their relationship with achievement among Form Four students]. Master Thesis, Universiti Putra Malaysia.

Ellis, A. K. (2010). Teaching and learning elementary social studies (Vol. 9). Boston, Massachusetts: Pearson Education Inc.

Evans, J. & Hannula, M. & Philippou, G. & Zan, R. (2004). 'Affect and Mathematical Thinking –Introduction to Thematic Working Group 2' in Mariotti, M.A. (Ed.) Proc. CERME 3, Bellaria (Italy), 28 February-3 March 2003. Edizioni Plus, Pisa.
Felder, R.M. (1993). "Reaching the Second Tier: Learning and Teaching Styles in College Science Education," J. Coll. Sci. Teaching, 23(5), 286--290 (1993)

Felder, R.M. (1996). "Matters of Styles". ASEE Prism, 6(4), 18-23.

Freiberg, M. (2005). Math – that four-letter word! Academic Exchange Quarterly, 9(3), 7-11.

Furner, J., & Berman, B. (2003). Math anxiety: Overcoming a major obstacle to the improvement of student math performance. Childhood Education, 79(3), 170–174.

Fuson, W.M. (1942). Attitudes: A note on the concept and its research consequences. American Sociological Review, 7, 856-857
Gwet, K. L. (2010). Handbook of Inter-Rater Reliability (2nd Edition), Advanced Analytics, LLC. Maryland, USA.

Gwet, K. L. (2011a). The Practical Guide to Statistics, Advanced Analytics, LLC. Maryland, USA.

Honey, P. & Mumford, A. (1982) Manual of Learning Styles London: P Honey

Hopko, D.R. (2003). Confirmatory factor analysis of the Math Anxiety Rating Scale - Revised.
Educational and Psychological Measurement, 63, 336–351.

Horney, K. (1937). The Neurotic Personality of our Time. New York: Norton

Horney, K. (1950). Neurosis and human growth: The struggle toward self-realization. New York: Norton.

Hunt, T., Clark-Carter, D., Sheffield D. (2011) The Development and Part Validation of a U.K. Scale for Mathematics Anxiety

Ikitde, G. A., & Edet, U. B. (2013). Influence Of Learning Styles And Teaching Strategies On Students' Achievement In Biology. *Voice Of Research*, *1*(4), 1-13.

Jain, S., & Dowson, M. (2009). Mathematics anxiety as a function of multidimensional self-regulation and self-efficacy. Contemporary Educational Psychology, 34(3), 240–249.

Jennison, M., & Beswick, K. (2009). Students' perceptions of the impacts of parents, teachers, and teaching upon their anxiety about the learning of fractions. In R. Hunter, B. Bicknell & T. Burgess (Eds.), Crossing divides (Proceedings of the 32nd Annual Conference of the Mathematics Education Research Group of Australasia, Vol. 1, pp. 265-272). Palmerston North: MERGA

Jung, C.G. (1921/1971). Psychological types. In collected works (vol. 6)

Kelly, G. A. (1955). The Psychology of Personal Constructs (Vols 1 and 2). New York: Norton.

Kieran, K. (1990). 'Cognitive Processes involved in Learning School Algebra', in Nesher P. & Kilpatrik, J. (Ed.): Mathematics and Cognition, ICMI Study Series, Cambridge University Press, 96-112.

Kieran, K.: 1992, 'The Learning and Theaching of School Algebra', in Grouws D.A., (Ed.) Handbook of Research of Mathematics Teaching and Learning, Macmillan, NY, 390-419.

Kolb, A. Y., & Kolb, D. A. (2005). Learning Styles and Learning Spaces: Enhancing Experiential Learning in Higher Education. Academy of Management Learning & Education, 4(2), 193-212.

Kolb, D.A. (1984) 'Experiential Learning experience as a source of learning and development', New Jersey: Prentice Hall

Krech, D., & Crutchfield, R.S. (1948). Theory and problems of social psychology. New York: MacGraw-Hill.

Lee, J. (2009). Universals and specifics of math self-concept, math self-efficacy, and math anxiety across 41 PISA 2003 participating countries. Learning and Individual Differences, 19(3), 355-365.

Ma, X. (2003). Effect of early acceleration of students in mathematics on attitude toward mathematics and mathematics anxiety. Teachers College Record, 105(3), 438-464.

Malinsky, M., Ross, A., Pannells, T., & McJunkin, M. (2006). Math anxiety in pre-service elementary school teachers. Education, 127(2), 274–279.

Marchini, C.:2002, 'Instruments to detect variabiles in primary school', Proc. CERME 2, Part I, 47-57

Marchini, C. & Kaslova, M. (2003). "Substitutions and variables in primary school, a comparative study on preconceptions', Proc. Semt 01, 113-117

Martinez, F. (2005). Multiple Intelligences of College Chemistry Students, Their Relationship to Chemistry Achievement and Program of Study.

Mc Leod, D.B. (1992). 'Research on Affect in Mathematics Education: a Reconceptualization', in Grouws, D.A. (Ed.) Handbook of Research of Mathematics Teaching and Learning, Macmillan, NY, 575-596.

Middleton, J. A., & Jansen, A. (2011). Motivation matters, and interest counts: Fostering engagement in mathematics. Reston, VA: National Council of Teachers of Mathematics.

Miller, H., & Bichsel, J. (2004). Anxiety, working memory, gender, and math performance. Personality and Individual Differences, 37(3), 591-606.

Miller, S. F. (1981). A study of the relationship of mathematics anxiety to grade level. Gender intelligence, and mathematics achievement. Proquest Dissertations and Theses, 52(04) DAI (Publication No. AAT 9127651)

Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2008). Learning styles concepts and evidence. Psychological Science in the Public Interest, On the Effect of Learning Style on Scholastic Achievement 59(3), 105-119.

Restrepo, G., & Villaveces, J. L. (2012). Mathematical Thinking in Chemistry. HYLE--International Journal for Philosophy of Chemistry, 18(1), 3-22.

Richardson, F. C., & Suinn, R. M. (1972). The Mathematics Anxiety Rating Scale: Psychometric data. Journal of Counseling Psychology, 19, 551–554.

Rinaldi, M.G., Marchini, C., Moscucci, M., Piccione, M. & Simoni, S. (2006). Mathematical Discomfort and school drop-out in Italy. Fourth Congress of the European Society for Research in Mathematics Education.

Ryan, R. M., & Stiller, J. (1991). The social contexts of internalization: Parent and teacher
influences on autonomy, motivation and learning. In P. R. Pintrich & M. L. Maehr (Eds.),
Advances in motivation and achievement (Vol. 7, pp. 115–149). Greenwich, CT: JAI Press.

Scarpello, Gary, (2005) The Effect of Mathematics Anxiety on the Course and Career Choice of High School Vocational-Technical Education Students

Sherman, Brian F., and David P. Wither. "Mathematics anxiety and mathematics achievement." *Mathematics Education Research Journal* 15.2 (2003): 138-150.

Silver, A.& Kenney, P.A.: (1997). 'Results from the sixth mathematics assessment of the National Assessment of Educational Progress', Reston, VA : National Council of Teachers of Mathematics.

Singh, K., Granville, M., & Dika, S. (2002). Mathematics and science achievement: Effects of motivation, interest, and academic engagement. The Journal of Educational Research, 95(6), 323-332.

Smith, S. S. (1997). Early Childhood Mathematics. Boston: Allyn & Bacon.

Snyder, R.F. (2000). The Relationship Between Learning Styles/Multiple Intelligences and Academic Achievement of High School Students. High School Journal, 83(2), 11-21.

Sorge, C., Newsom, H.E, and Hagerty, J.J. (2000) Fun is not enough: Attitudes of Hispanic middle school students towards science and scientists, Hispanic Journal of Behavioral Sciences, 22, 332-345

Sullivan, H.S. (1953b). The Interpersonal Theory of Psychiatry. New York: Norton

Tinio, M. F. (2009). Academic engagement scale for grade school students. The Assessment Handbook, 2, 64-75.

Vygotsky, L. S. (1962). *Thought and Language.* Cambridge MA: MIT Press.

Whyte, J. M. (2009). Maths anxiety: The what, where, and how. Unpublished Masterate research report. Palmerston North: Massey University

Zywno, M. S. (2002). Effect of Individual Learning Styles on Students Outcome in Technology-enable Education-Global Journal of Engineering Education 6(1) pp 240-249.

Web References

Achievement test. (n.d.). Defined. Retrieved May 27, 2013, from http://www.alleydog.com/glossary/definition.php?term=Achievement%20test

Acknowledging Math Anxiety. (n.d.).Acknowledging Math Anxiety. Retrieved June 1, 2013, from http://teachers.sduhsd.net/jastorino/Thesis.htm

anxiety. (n.d.). The Free Dictionary. Retrieved June 1, 2013, from http://www.thefreedictionary.com/anxiety

Bai, H., Wang, L., Pan, W., Frey, M. (2009) Measuring mathematics anxiety: psychometric analysis of a bidimensional affective scale The Free Library Retrieved September 1, 2013, from http://www.thefreelibrary.com/Measuring mathematics anxiety: psychometric analysis of a...-a0211235540

Bhatti, R., & Bart, W. M. (2013). On the effect of learning style on scholastic achievement. Current Issues in Education, 16(2). Retrieved from

http://cie.asu.edu/ojs/index.php/cieatasu/article/view/1121

Bluman, A. (n.d.). The Nature and Causes of Math Anxiety Help.Education.com. Retrieved May 1, 2014, from http://www.education.com/study-help/article/pre-algebra-help-part-i-nature-causes/

Conner, M. (n.d.). What is Your Learning Style?. *Marcia Conner What is Your Learning Style Comments*. Retrieved September 18, 2013, from http://marciaconner.com/assess/learningst

Correlation Ratio - Statistics Solutions. (n.d.). *Statistics Solutions*. Retrieved August 17, 2014, from https://www.statisticssolutions.com/directory-of-statistical-analyses-correlation-ratio/

Curtain-Phillips,, M. (n.d.). The Causes and Prevention of Math Anxiety. The Causes and Prevention of Math Anxiety. Retrieved June 17, 2013, from http://www.mathgoodies.com/articles/math_anxiety.html

Escalona, L. P. (2005). Attitude Towards Chemistry And Chemistry Performance: A Correlational Study . *John b. Lacson colleges foundation - bacolod, inc.*. Retrieved October 17, 2014, from http://www.jblcf-bacolod.edu.ph/escalona.php
Felder design model. (n.d.). - EduTech Wiki. Retrieved June 17, 2013, from http://edutechwiki.unige.ch/en/Felder_design_model

Forbes, K. J. (n.d.). Building math self-efficacy : a comparison of interventions designed to increase math/statistics confidence in undergraduate students. Full text of "Building math self-efficacy : a comparison of interventions designed to increase math/statistics confidence in undergraduate students". Retrieved July 19, 2013, from http://archive.org/stream/buildingmathself00forb_djvu.txt

Heick, T. (2013, August 10). The Definition Of Intrinsic Motivation.TeachThought. Retrieved December 10, 2013, from http://www.teachthought.com/learning/the-definition-of-intrinsic-motivation/

Hood, K. (n.d.). Exploring Learning Styles and Instruction. Karen Hood's Paper. Retrieved May 18, 2013, from http://jwilson.coe.uga.edu/emt705/EMT705.Hood.html

Math Anxiety. StudyMode.com. Retrieved June 3, 2013, from http://www.studymode.com/essays /Math-Anxiety-43888717.html

Mobbs, D. R. (n.d.). Honey and Mumford. University of Leicester. Retrieved January 12, 2014, from http://www2.le.ac.uk/departments/gradschool/training/eresources/teaching/theories/honey-mumford

Olufemi. (2014, April 16). Kolb Learning Styles. College Essay. Retrieved April 28, 2014, from http://www.cyberessays.com/Term-Paper-on-Kolb-Learning-Styles/86901/

Professor's talk: Math: the language of science. (n.d.). The Daily. Retrieved April 8, 2013, from http://dailyuw.com/archive/2008/10/15/imported/professors-talk-math-language-science#.UWJB_cqH-ME

Regression Terminology Help - Transtutors. (n.d.). Regression Terminology Help - Transtutors. Retrieved December 29, 2013, from http://www.transtutors.com/homework-help/statistics/bivariate-regression/terminology/

Research Gate. (n.d.). Research Gate. Retrieved May 11, 2013, from http://www.researchgate.net/post/Is_there_a_math_anxiety_scale_that_has_been_validated_for_adolescents

Science Anxiety. (n.d.). Academic Anxiety Resource Center. Retrieved June 17, 2013, from http://academicanxiety.org/?page_id=102

Shan, K. Y., Yong, L. S., Shan, L. Z., Toh, V., & Weng, U. H. (n.d.). Mathematics Anxiety. Scribd. Retrieved August 13, 2013, from http://www.scribd.com/doc/76230575/Mathematics-Anxiety

Shodor (2008) Mathematics in Chemistry. (n.d.).Mathematics in Chemistry. Retrieved April 8, 2013, from http://www.shodor.org/unchem/math/

Strawderman, Ph.D, V. S. (n.d.). Math Anxiety Model.Math Anxiety Model. Retrieved May 30, 2013, from http://www.mathgoodies.com/articles/math_anxiety_model.html

Theories of Cognitive Development: Lev Vygotsky.. (n.d.). Psycho Hawks. Retrieved July 25, 2013, from http://psychohawks.wordpress.com/2010/11/03/theories-of-cognitive-development-lev-vygotsky/

Thompson, S. (2011, July 18). Memletics Accelerated Learning Styles Inventory.eHow. Retrieved May 21, 2013, from http://www.ehow.com/info_8751613_memletics-accelerated-learning-styles-inventory.html

Understand Bandura's Social Learning Theory. (n.d.) About.com Psychology. Retrieved April 30, 2014, from http://psychology.about.com/od/developmentalpsychology/a/sociallearning.htm

Vani29981. (n.d.). Uses of Math.StudyMode. Retrieved October 23, 2013, from http://www.studymode.com/essays/Uses-Of-Math-742324.html

Yunus, S. S. (2011, November 17). Math Anxiety_4. Kurikulum Matematik. Retrieved April 3, 2013, from http://kurikulummatematik.wordpress.com/2011/11/17/math-anxiety_4/

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