_____

Exploring Mathematics Achievement Goals Using Kolb's Learning Style Model

Avelino G. Ignacio Jr. [1], Joseph D. Reyes [2]
PhD Math Education, College of Graduate Studies & Teacher Education
Research, Philippine Normal University, Manila, Philippines
bilyignacio@yahoo.com [1], joseph_reyes2012@yahoo.com[2]

Abstract – This research work is an exploration of causality connection of learning styles to mathematics achievement goals. The objectives of the study are as follows: (1) to identify the mathematics achievement goal of students when grouped according to preferred learning style (2) to identify the learning style of students when grouped according to preferred mathematics achievement goal and (3) to determine if there is a significant difference in each mathematics achievement goal when grouped according to learning style. The researcher used explanatory cross-sectional design. The Revised Achievement Goal Questionnaire and Kolb's Learning Style Inventory 3.1 were utilized to collect data. Results show that respondents hold mastery-approach achievement goals regardless of learning styles. Also, students with approach type of mathematics achievement goals hold assimilative learning style which operates on reflective observation and abstract conceptualization; and students with avoidance type of mathematics achievement goals hold accommodative learning style which operates on active experimentation and concrete experimentation. Furthermore, findings show that there is no significant difference in the mathematics achievement goals based on learning style. Exploratory research is recommended to understand why students with approach type of mathematics achievement goals hold assimilative learning style and why students with avoidance type of mathematics achievement goals hold accommodative learning style.

Keywords: achievement goals, learning style, mathematics

INTRODUCTION

Mathematics is seen as a culture of formal thinking, as a kind of mental activity, so much that it requires the ability to manipulate abstract ideas [1][2]. Consequently, Green [3] argued that there are many ways to learn mathematics. But though there are many aspects in order to learn mathematics, as time goes by, learning and improving the level of students in mathematics has been one of the issues that teachers and administrators are facing. Many studies have been conducted on the effective teaching of mathematics but despite of many innovations and developments, there are still great numbers of students who fail in this endeavor. As a result, there is a need to study other explanations like students' learning styles and appropriate motivational construct such as achievement goals in mathematics setting [4],[5].

Goal can be defined as a cognitive representation linking certain actions with desired outcomes [6], as well as a motive that influences actions to engage in particular favorable achievement outcomes [7]-[10]. Each person adopts and accepts goals which give meaning, purpose and direction to their action [11]. But with regards to the information being provided by the achievement goal theories alone, it does not directly know if learning style affects each achievement goal adoptions. An analysis on the

learning styles and achievement goals may provide future researchers a good baseline for understanding mathematics scenario for students. In line with this, the present researcher is interested in determining whether learning styles affect each mathematics achievement goal adoptions. The results of this study will surely give sufficient initial evidences on classroom scenarios most especially on understanding achievement goals through student's learning styles.

One of the widely known motivational construct is the 2 x 2 achievement goal theory that emerged as a very useful construct for understanding how people develop, attain or demonstrate competence in learning and performance [12][9]. The 2 x 2 achievement goal framework hypothesized four types of achievement goals namely mastery-approach goal, mastery-avoidance goal, performance-approach goal and performance-avoidance goal. The *mastery-approach goal* involves striving to learn all what there is to learn; the *mastery-avoidance goal* involves avoiding failing to learn what there is to learn; the *performance-approach goal* involves seeking to perform better than others; and the *performance-avoidance goal* involves avoiding poor performance relative to others [13][14]. But despite of many enhancements of this psychological construct throughout the years to explain mathematics experiences of students, some inconsistent

findings still occur on the area of its relationship to mathematics performance such as whether the approach or avoidance form of achievement goal; or mastery or performance better provides favorable mathematics performance explanations [4]. In line with this, the researcher became interested in studying what makes mathematics achievement goals inconsistent with the literatures.

Learning style is the way in which individuals begin to concentrate, process, internalize, and retain new and difficult academic information, moreover, these are different approaches students use in perceiving and processing information [15][16]. Consequently, students do not just differ significantly in how they learn but many instructors do not realize that students differ in the way they process and understand information despite the fact that attention to learning styles and learner diversity has been shown to increase student motivation to learn [17][18]. Learning is best regarded as a process, not in terms of outcomes [19]. Kolb's learning style model [15][19][20] combined perceiving, which is the vertical line, with processing, which is the horizontal line, and by assigning the axes within a circle, four distinct learning modes were created: concrete experience, reflective observation, abstract conceptualization, and active experimentation. *Concrete Experience* focuses on being involved in experiences and dealing with immediate human situations in a personal way. It emphasizes feeling more than thinking; concern with the uniqueness and complexity of present reality over theories and generalizations. *Reflective Observation* focuses on understanding the meaning of ideas and situations by carefully observing and describing them. It emphasizes reflection and understanding over action and practical application; concern with what is true or how things happen over what will work. *Abstract Conceptualization* focuses on using logic, ideas, and concepts. It emphasizes thinking rather than feeling; concern with building general theories rather than intuitively understanding unique and specific areas. *Active Experimentation* focuses on actively influencing people and changing situations. It emphasizes practical applications as distinct from reflective understanding; concern with what works rather than with what is absolute truth; an emphasis on doing, more than observing.

The axes also create four quadrants of learners with different learning style types: divergers, assimilators, convergers and accommodators. *Divergers* learn by reflecting on concrete experiences to create a learning style that can view concrete situations from different outlooks. Individuals are interested in people, tend to be imaginative and emotional, specialize in the arts; and prefer working in groups while listening with open mind. *Assimilators* learn by reflecting on abstract concepts and putting the information in logical form. Individuals find it more important that a theory have logical soundness than practical value, specialize in the science; and prefer

readings, lectures exploring theoretical models, and having time to think things through. *Convergers* take abstract ideas and active experiment to find practical uses for the information by finding solutions to problems. Individuals prefer to deal with technical tasks and problems rather than with social issues and interpersonal issues, specialize in technology related careers; and prefer to experiment with new ideas like laboratory assignments, and practical applications. *Accommodators* take concrete experiences mixed with active experimentation in a hands-on experience. Individuals rely more heavily on people for information than on their own technical analysis, specialized in action-oriented careers such as marketing or sales; and prefer to work with others to get assignments and projects done.
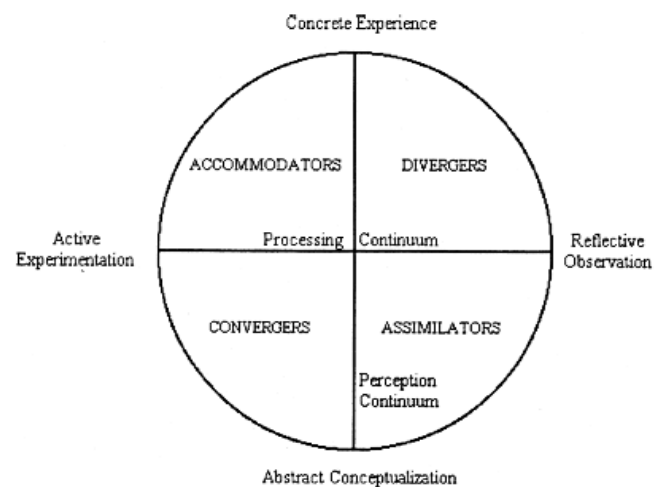
OBJECTIVES OF THE STUDY

The general objective of this study was to explore causality of learning styles of high school students in one Secondary High School located in Sta. Ana, Pampanga, Philippines who enrolled during School Year 2016–2017 to mathematics achievement goals through analysis of variance.

Specifically, it sought to determine the mathematics achievement goal of students when grouped according to preferred learning style; to determine the learning style of student when grouped according to preferred mathematics achievement goal; and to test whether there is a significant difference in each mathematics achievement goal of students when grouped according to learning style.

Hypothesis

On the basis of the study framework presented and the preceding review of related literature, the hypothesis is formulated:

There is no significant difference in each mathematics achievement goal of students when grouped according to learning style.

METHOD

This study used explanatory cross-sectional design [21]. This is a non-experimental quantitative design used to test a theory about a phenomenon which data are collected at one point in time. Data were collected at a single time point and analyzed for the purpose of testing hypothesis.

This study limits its sample size to one hundred eighty seven (187). Five (5) sections, specifically, one section each from grade levels 7, 8, 9, 10, and 11 at Telesforo Natividad High School located in Sta. Ana, Pampanga who were enrolled on the school year 2016 – 2017 were chosen as respondents of the study. From a population of five hundred forty three (543), the researcher applied cluster sampling that produced one hundred eighty seven (187) samples. Instead of taking all the sixteen (16) sections of high school students, the researcher chose only five (5) sections, one from each grade level. The section per grade level was selected through lottery method. Moreover, the researcher explained to all respondents that the survey will only be used for research purposes and confidentiality of the information will be observed.

The first instrument that was used in this study is the revised achievement goal questionnaire by Elliot and Murayama [9]. The researcher was permitted by Professor Andrew J. Elliot of University of Rochester to utilize the AGQ-R. It is a 12-item questionnaire reflecting four achievement goal orientations: mastery-approach goal, mastery-avoidance goal, performance-approach goal and performance-avoidance goal. Each achievement goal orientation includes 3 items. The format of all items is a 7-point Likert - type scale, ranging from 1 (not all true of me) through 7 (very true of me). With regard to its validity, CFA were conducted by the original proponents of AGQ-R.

The second instrument that was used in this study is the Kolb's [19] Learning Style Inventory Version 3.1. This learning style inventory was adopted by the researcher. KLSI 3.1 is based on experiential learning theory [15] and is designed to help individuals identify the way they learn from experience. KLSI 3.1 have 12 items that asks respondents to rank four sentences, per each item, in a force-choice format that correspond to the four learning modes—concrete experience, reflective observation, abstract conceptualization and active experimentation. Dominant learning style can be computed after. Internal reliability and test-retest reliability was established using correlation and factor analysis. External validity includes research on demographics, educational specialization; and concurrent validity with other experiential learning assessment instruments, aptitude test performance, academic performance, experiential learning in teams, and educational applications

The researcher first asks for permission and approval from the Principal of Telesforo Natividad High School in Sta. Ana, Pampanga in order to administer the research instruments to the students. Then, the researcher administered the set of questionnaires, involving two instruments, to the students. The researcher always checked whether no questions were left unanswered. After checking the questionnaire, the researcher immediately encoded the data for the treatments needed. In cases that there are more than one achievement goals due to equal values, all of these will be considered. Likewise, in cases that a student got zero value in KLSI 3.1 after getting the differences of respective learning modes, then this student will not be included for the purpose of the study.

The gathered data were treated by the following statistical tools: Frequency Count and Percentage was used to determine the frequency of the responses in each of the categories necessary in the study; Mean was used to determine the mathematics achievement goals of the respondents; Analysis of Variance was used to test the significant difference of more than two independent variable

RESULTS AND DISCUSSION

Based on data obtained from the research findings, three (3) tables were presented. The results are organized and presented relative to the specific problem posed by the researcher.

Table 1. High School Students' Math Achievement Goal Based on Learning Style

LS	MAp	MAv	PAp	PAv	Conc.
DI	6.281	4.729	5.677	5.021	**MAp**
AC	5.908	4.773	5.454	5.163	**MAp**
CO	6.109	4.647	5.673	5.090	**MAp**
AS	6.119	4.702	5.685	5.137	**MAp**

The table 1 shows the mathematics achievement goal based on learning style of high school students. On mastery-approach goal which states "My aim is to completely master the material presented, to learn as much as possible, and strive to understand the content of the course thoroughly" obtained a weighted mean of 6.281 for divergers and 5.908 for accommodators, 6.109 for convergers and 6.119 for assimilators.

Mastery-avoidance goal, "My aim is to avoid learning less than I possibly could, to avoid learning less than it is possible to learn and an incomplete understanding of the course material" got a weighted mean of 4.729 for divergers and 4.773 for accommodators, 4.647 for convergers and 4.702 for assimilators.

Performance-approach goal, "I am striving to do well compared to others, perform relatively better to others and than others" had a weighted mean of 5.677 for divergers and 5.454 for accommodators, 5.673 for convergers and 5.685 for assimilators.

Performance-avoidance goal, "My goal is to avoid performing poorly and worse than others" got a weighted mean of 5.021 for divergers and 5.163 for accommodators, 5.090 for convergers and 5.137 for assimilators.

This suggests that divergers, accommodators, convergers and assimilators are mastery-approach oriented students. Since the highest mean is mastery-approach, then the respondents' aim is to master, learn, and understand the mathematics subject**.**

Table 2. High School Students' Learning Style Based on Math Achievement Goals

LS	Dive	Acco	Conv	Assi	Conc.
MAp	24	33	36	42	Assi
MAv	3	4	1	3	Acco
PAp	6	10	12	18	Assi
PAv	6	10	10	7	Ac/As

Table 2 shows the learning style based on mathematics achievement goals of high school students. The highest frequency obtained for mastery-approach oriented students is 42, for mastery-avoidance oriented students is 4, for performance-oriented students is 18; and for performance-avoidance students is 10.

This suggests that mastery-approach oriented students hold assimilative learning style, mastery-avoidance oriented students hold accommodative learning style, performance-approach oriented students hold assimilative learning style; and performance-avoidance oriented students hold both accommodative and assimilative. As a result, approach goal oriented students hold assimilative learning style and avoidance goal oriented students hold accommodative learning style.

And thus, students with approach type of mathematics achievement goals operate on reflective observation and abstract conceptualization learning modes; and students with avoidance type of mathematics achievement goals operate on concrete experience and active experimentation learning modes. Moreover, students with approach type of mathematics achievement goal learn by reflecting on abstract concepts and putting the information in logical form. On the other hand, students with avoidance type of mathematics achievement goal take concrete experiences mixed with active experimentation in a hands-on experience. Individuals rely more heavily on people for information than on their own technical analysis.

Table 3. Significant Difference in the Math Achievement Goals Based on Learning Style

LS	MAp		MAv		PAp		PAv	
	M	V	M	V	M	V	M	V
DI	5.59	0.36	5.43	0.47	5.58	0.58	5.58	0.30
AC	5.19	0.70	5.12	0.67	5.08	0.76	5.07	0.55
CO	5.60	0.41	5.48	0.46	5.57	0.56	5.55	0.30
AS	5.31	0.92	5.26	0.64	5.24	0.70	5.28	0.60
F.V	0.64		0.14		0.26		0.05	
C.V	2.65		2.65		2.65		2.65	
Dec.	Accept H_O		Accept H_O		Accept H_O		Accept H_O	
Con.	Not Significant		Not Significant		Not Significant		Not Significant	

The mean and variance of the divergers with mastery-approach goal are 5.59 and 0.36 respectively, of the accommodators with mastery-approach goal are 5.19 and 0.70 respectively, of the convergers with mastery-approach goal are 5.60 and 0.41 respectively; and of the assimilators with mastery-approach goal are 5.31 and 0.92 respectively. The F value of mastery-approach goal for divergers, accommodators, convergers and assimilators is 0.64 which does not lie on the critical region and does accept null hypothesis that there is no significant difference in the mastery-approach goal of the students when grouped according to learning style.

The mean and variance of the divergers with mastery-avoidance goal are 5.43 and 0.47 respectively, of the accommodators with mastery-avoidance goal are 5.12 and 0.67 respectively, of the convergers with mastery-avoidance goal are 5.48 and 0.46 respectively; and of the assimilators with mastery-avoidance goal are 5.26 and 0.64 respectively. The F value of mastery-avoidance goal for divergers, accommodators, convergers and assimilators is 0.14 which does not lie on the critical region and does accept null hypothesis that there is no significant difference in the mastery-avoidance goal of the students when grouped according to learning style.

The mean and variance of the divergers with performance-approach goal are 5.58 and 0.58 respectively, of the accommodators with performance-approach goal are 5.08 and 0.76 respectively, of the convergers with performance-approach goal are 5.57 and 0.56 respectively; and of the assimilators with performance-approach goal are 5.24 and 0.70 respectively. The F value of performance-approach goal for divergers, accommodators, convergers and assimilators is 0.26 which does not lie on the critical region and does accept null hypothesis that there is no significant difference in the performance-approach goal of the students when grouped according to learning style.

The mean and variance of the divergers with performance-avoidance goal are 5.58 and 0.30 respectively, of the accommodators with performance-avoidance goal are 5.07 and 0.55 respectively, of the convergers with performance-avoidance goal are 5.55 and 0.30 respectively; and of the assimilators with performance-avoidance goal are 5.28 and 0.60 respectively. The F value of performance-avoidance goal for divergers, accommodators, convergers and assimilators is 0.05 which does not lie on the critical region and does accept null hypothesis that there is no significant difference in the performance-avoidance goal of the students when grouped according to learning style.

This suggests that there is no significant difference in the mathematics achievement goals based on learning style. In this study, learning style was not found to be initial predictor of mathematics achievement goals.

CONCLUSION

Divergers, accommodators, convergers and assimilators are mastery-approach oriented students. Since

the highest mean is mastery-approach, then the respondents' aim is to master, learn, and understand the mathematics subject**.**

Mastery-approach oriented students hold assimilative learning style, mastery-avoidance oriented students hold accommodative learning style, performance-approach oriented students hold assimilative learning style; and performance-avoidance oriented students hold both accommodative and assimilative. As a result, students with approach type of mathematics achievement goals hold assimilative learning style which operates on reflective observation and abstract conceptualization learning modes while students with avoidance type of mathematics achievement goals hold accommodative learning style which operates on concrete experience and active experimentation.

There is no significant difference in the mathematics achievement goals based on learning style. In this study, learning style was not found to be an initial predictor of achievement goals.

The results of the study support learner diversity [16], moreover, all patterns discovered in this research are subjected to future research as stated in the recommendation.

RECOMMENDATION

This study explored the connection of mathematics achievement goals and learning style in the light on Kolb's learning style model through the use cross-sectional quantitative research, and thus, further studies using other design involving possible mediators is recommended to fully comprehend connections between the variables, specifically, to discover why students with approach type of achievement goal hold assimilative learning style and why students with avoidance type of achievement goal hold accommodative learning style. On the other hand, due to the limitation of the study due to the use of cross-sectional design, stability analysis on the variables is recommended for confirmation of results.

REFERENCES

[1]   Prediger, S. (2001). Mathe*matics learning is also intercultural learning.* Intercultural Education, 12(2), 163-171.

[2]   Thompson, A. G. (1992). Teacher's beliefs and conceptions: A synthesis of the research. In Douglas A. Grouwes (Eds.), *Handbook of research on mathematics teaching and learning,* New York: Macmillan.

[3]   Greenes, C. (1995). Mathematics learning and knowing: A cognitive process. *Journal of Education, 177*(1), 85-106.

[4]   Ignacio, A. & Policarpio, R. (2016) Achievement Goals and Mathematics Performance: Based on Gender. *International Journal of Current Innovation Research, 2(8)*, 443 – 450

[5]   Botsas, G. &Padeliadu, S. (2003). Goal orientation and reading comprehension strategy use among students with or without reading difficulties. *International Journal of Educational Research, 39*, 477 – 495

[6]   Mustaffic, M. & Freund, A., M. (2012) Developmetrics: Means or Outcomes? Goal orientation predicts process and outcome focus. *European Journal of Developmental Psychology, 9(4),* 493 – 499

[7]   Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. Psychological Review, 95(2), 256–273. doi:10.1037/0033-295X.95.2.256.

[8]   Elliot, A. J. (2005). A Conceptual History of the Achievement Goal Construct. In A. J. Elliot & C. S. Dweck (Eds.), Handbook of competence and motivation (pp. 52–72). New York, NY: Guilford Publications Guilford Publications.

[9]   Elliot, A. J. & Murayama, K. (2008). On the measurement of achievement goals: Critique, illustration and application. *Journal of Educational Psychology, 100*, 613 – 628

[10] O'keefe, P., A., Ben-Eliyahu, A. & Linnenbrink-Garcia, L. (2013). Shaping achievement goal orientations in a mastery-structured environment and concomitant changes in related contingencies of self-worth. *Motiv Emot, 37,*50 – 64. doi 10.1007/s11031-012-9293-6

[11] Soini H., Aro, K. & Niemivirta, M. (2011). Stability and change in achievement goal orientations: A person centered approach. *Contemporary Educational Psychology, 36*, 82 – 100

[12] Akin, A . (2012) Achievement Goal Orientations and Math Attitudes. *Studia Psychologica, 54(3),*237 – 249

[13] Howell, A. J. & Buro, K. (2009). Implicit beliefs, achievement goals and procrastination: A mediational analysis. *Learning and Individual Differences, 19*, 151 – 154

[14] Dickhauser, C. & Buch, S. (2011). Achievement after failure: The role of achievement goals and negative self-related thoughts. *Learning and Instruction, 21*, 152 – 162

[15] Kolb, D. A. (1984). Experiential learning: Experience as the source of learning and development. Englewood Cliffs, NJ: Prentice-Hall.

[16] Dunn, R., Griggs, S., Olson, J., Beasley, M. & Gornan, B. (2004). A Meta-Analytic Validation of the Dunn and Dunn Model of Learning Style Preferences. *Heldref Publications, p.353*

[17] Hein, T.,L. & Budny, D., D. (1999). Teaching to Students' Learning Styles: Approaches That Work, *29th ASEE/IEEE Fontiers in Education Conference.* San Juan, Puerto Rico

[18] Cano, J. (1999). The relationship between learning style, academic major and academic performance of college students. *Journal of Agricultural Education, 40(1)*, 30 – 37

[19] Kolb, A. & Kolb, D. (2005). The Kolb Learning Style Inventory – Version 3.1 2005 Technical Specifications. Boston: Hay Resources Direct

[20] Jones, C., Reichard, C. & Mokhtari, K. (2003). Are Students' Learning Styles Discipline Specific? *Community College Journal of Research and Practice, 27,* 363 – 375

[21] Johnson, B. (2001). Toward a new classification of nonexperimental quantitative research. *Educational Researcher,* 30(2), 3 – 13

COPYRIGHTS