Learning Graph Construction: A motivational tool in monitoring the learning performance of students in college algebra

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This study intended to determine the effects of graph construction on the academic performance of students taking the College Algebra. Results show that there is a significant difference in the pretest and posttest scores of the students in all topics using the learning graph construction. Data revealed that more than 90% of the total respondents agree with most of the items in the perception questionnaire indicating that the Learning Graph Construction as a strategy to develop metacognition is generally acceptable.

Key words: Learning graph construction, individual learning graph, achievement test, assessment tools, plus-and-minus notebook

Introduction

Background of the Study

It has been a problem for the past years among nursing students as to how to survive College Algebra. Every year, students are having difficulty in passing, not including those who already have a strong background of the subject which is very rare in Manila Tytana Colleges (*formerly Manila Doctors College*). Records from the Registrar's Office reveal the vast number of failed students in College Algebra. In the School Year 2007 – 2008 alone, it was reported that 8.03% (99 out of 1232) did not pass the subject which was very alarming to the administration.

The present curriculum being used by the institution was influenced by that of previous years wherein the teachers did most of the talking with minimal participation of the students. This does not motivate the students to strive harder to obtain a higher degree of competency in College Algebra.

Statement of the Problem

This study intended to determine the effects of graph construction on the academic performance of students taking the College Algebra Intervention Program.

Specifically, this study seeks to answer the following questions:

1. What is the result of the learning graph construction of the students taking the College Algebra Intervention Program?
2. How did the students assess their performance using the learning graph construction as reflected in their learning journals?
3. Are there significant differences in the pre-tests and post-tests results of the students taking the College Algebra Intervention Program?
4. Are there significant differences in the pre-tests and post-tests results of the students not enrolled in the College Algebra Intervention Program?

5. How different are the results of the inferential analyses between the two groups of students in terms of the differences between the pretests and posttests?
6. What is the perception of the students of the learning graph construction activity?

Scope and Delimitation of the Study

The respondents were first year Bachelor of Science in Nursing (BSN) students who took the College Algebra subject for the first semester SY 2009 - 2010. There were two groups of students: those who were under the intervention program and those who were not under the program. Those who were not under the program were taught using the traditional method of teaching College Algebra. The data gathered and the generalizations done were based on the responses of students from two intact heterogeneous classes.

Students' achievements on the subject were determined using the learning graph construction wherein the levels of entry for each point were given descriptions representing their proficiency of scores such as follows:

I'm sure – 81% to 100% proficiency
I'm competent – 61% to 80% proficiency
I know – 41% to 60% proficiency
I think I know – 21% to 40% proficiency
I do not know – 0 to 20% proficiency

This study covered topics from the real number system to rational expressions. Students' learning was assessed through pre and post tests given on each topic. There were a total of 27 quizzes and 9 unit tests. From the gathered results, revisions on the course syllabus take place only if needed. The scopes of the revisions done were not found on the strategies from the course syllabus.

Significance of the Study

The researcher believed that through this study, the curriculum/syllabus in College Algebra will be enhanced wherein the students will be motivated to study harder and at the same time, enjoy the topics in the subject.

Theoretical and Conceptual Framework

Constructivist's Theory of Learning

Largo (2005) states that the Constructivist Theory of Learning claims that learners come to class with initial concepts in their minds. They also bring to the classroom not only their ideas or beliefs around the world, but also their own way of interpreting their sense perceptions or observations and their own ideas about what constitute adequate explanations. A constructivist's approach to learning was described as a process of constructing meaning which is greatly influenced by the learners' previously accumulated experiences and understandings.

Assessment

Tan (2003) in Largo (2005) claims that in an effective learning environment, assessment and instruction are inevitably linked. A fair assessment is one in which students are given equitable opportunities to demonstrate what they know and can do. In return, teachers are intrinsically motivated when students visibly produce performance evidences of understanding the subject matter. This implies that both the student and teacher can benefit from the result of the assessment given. Thus, assessment should be

integrated with students' day-to-day learning experience rather than as a series of an end-of-course test.

Learning Graph Construction

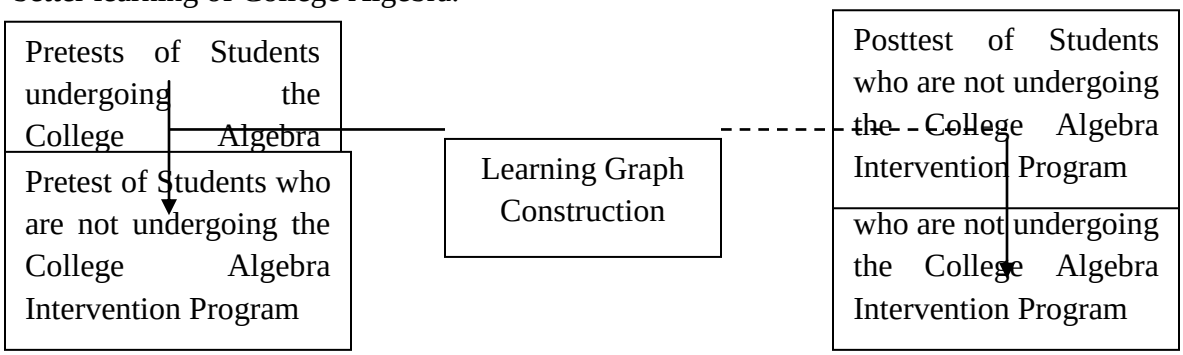
Serin (1999) in Largo (2005) utilized the use of graph in analyzing learning outcomes when he plotted students' confidence levels on a line graph to determine how closely their confidence levels paralleled their competency levels within each standard. Surprisingly, the data reflect a level of over confidence among students that is most evident in the Earth Science and Biology standards and its probable cause is an incomplete or superficial understanding of the objectives. The model provides educators with one way of identifying progress toward achieving science standards. It is not intended to be the only way of appraising a student's science knowledge.

For students to achieve lifelong learning, functional literacy must be met. Teachers should make effective use of assessment tools (i.e. quizzes and unit tests) to motivate students to be more engaged in the learning process. To provide them with opportunities for self-reflection, journal writing is required. This skill is essential in evaluating their performance in the classroom which is initially needed to be able to plan for effective ways of improving academic achievement in College Algebra.

The cited studies provided the conceptual framework for the present study. This conceptual framework is presented in the research paradigm which follows:

Conceptual Paradigm

The study was based on the premise that self-monitoring by students of their progress in their learning could enhance their metacognitive skills and thus promote their better learning of College Algebra.



Methodology

Research Design

This is a descriptive experimental study utilizing the pretest – posttest design. It seeks to discover the possibility of improving academic achievement by introducing a metacognitive tool called a learning graph.

Population and Sample

The study involved two heterogeneous sections of first year Bachelor of Science in Nursing students at Manila Tytana Colleges for the first semester of the School Year 2009 – 2010.

A total of 90 students (45 from each group) were used for the study. One group consisted of 45 students enrolled in the College Algebra Intervention Program while the other one consisted of 45 students who were taught using the traditional method of teaching College Algebra.

The study was facilitated by one full – time faculty member in the Mathematics Department. She handled both sections. Students were chosen based on the result of the entrance examination and upon reviewing their academic background as data were provided by the office of the guidance counselor. The performance of the students as witnessed by the researcher was treated with utmost confidentiality.

The Research Instruments and Techniques

Several instruments were used for this study. These are the Achievement Test, Assessment Tools, Individual Learning Graph (ILG), and a personal diary known as the plus and minus notebook.

Achievement Test (Pre and Post Tests)

The achievement test was a multiple choice type exam covering the nine unit tests used as an evaluation of students' learning during the course of the study. Test questions are of varied types developed by the researcher. At the end of the learning stage for a particular lesson, a quiz was given. The number of items (or points) for every quiz vary.

The scores in the quizzes were the bases of the students' entry in their learning graphs for points B, C and D. For the final entry (Point E), a unit test covering all the topics was given. The time when such assessment was given depended on how long a specific learning task was completed and varied from lesson to lesson.

Individual Learning Graph (ILG)

Each student was provided initially with a sample of the Individual Learning Graph (ILG). For the succeeding lessons, the students themselves prepared a learning graph similar to the given sample and attached them to their journal notebooks. One learning graph was accomplished by the student for every lesson and was inspected by the teacher at the end of every learning activity to monitor the student's entry. There were eight ILGs per student corresponding to the eight lessons covered.

The five (A, B, C, D and E) entries in the learning graph correspond to these five stages:

Stage A – before the lesson is discussed (based on prior knowledge)
Stage B – after completing an individual or group activity (Quiz No. 1 is given)
Stage C – after the lesson was partially discussed (Quiz No. 2 is given)
Stage D – after discussion of the lesson was completed (Quiz. No. 3 is given)
Stage E – after generalization of the entire lesson was made (Unit Test is given)

The levels of entry for each point in the learning graph were given descriptions representing their achievement (proficiency of scores) as follows:

I'm sure – 81% to 100% proficiency
I'm competent – 61% to 80% proficiency
I know – 41% to 60% proficiency
I think I know – 21% to 40% proficiency
I do not know – 0 to 20% proficiency

The distribution of proficiency indicated above was determined by the researcher. The lowest level of proficiency (0 – 20%) used for this study labeled as *I do not know* corresponds to the baseline grade a student can get. The midpoint in the graph labeled as *I know* corresponding to an average proficiency of 50% was an indication of student's critical level serving as a boundary for failing (levels below) and passing (levels above) proficiency values. The fourth level above, *I believe*, has 70% average proficiency value that is considered passing. The peak of the graph or the *I'm sure* level with an average

proficiency value of 90% corresponds to the student's mastery level. The researcher believes that setting a criterion at this level constitute adequate competency in College Algebra.

Learning graph construction was done by the students individually and was utilized by the teacher to monitor their achievement as the learning process progresses. Students' achievement, in this study, referred only to their scores on the written assessments given by the teacher in the form of quizzes and unit tests.

The Plus and Minus Notebook

This is similar to a personal diary where students jot down the happenings for the day. The notebook was kept by the student and was inspected by the teacher at the end of every lesson. Things that are written in the diary may or may not be directly related to the lesson. Entries included incidents in and out of the school including physical and emotional aspects which may have interfered in their studies. Reflections about their constructed learning graph were written in the plus and minus notebook. Students were guided by these questions when writing their reflection on the learning graph.

1. *Did you achieve your goal for this particular lesson?*
2. *Do you feel satisfied with the result of your graph?*
3. *What events took place during the period when the lesson was taken?*
4. *Do you think those events have a bearing on your performance? If the effect is positive write PLUS and if the effect is negative write MINUS?*
5. *Would you permit the same incident/s to happen again?*
6. *What are your plans to improve your performance in the next lessons?*

Data Collection Procedure

The study was done in three phases. Phase I included preliminaries to actual instruction. A pretest was given and the scores of the respondents under each group were recorded. The mean score for each group was computed.

Phase II includes the actual instruction. During this period, the students have constructed an individual learning graph representing their scores in the assessments given after each learning experience. The teacher was guided by lesson plans to determine at what stage of the lesson the assignments will be given and when the entry for each point in the learning graph be completed. Students wrote reflections on the events that took place and analyzed how those events affected their performance in class. The plus and minus notebook where they wrote their reflection about their learning graph was inspected by the teacher after every lesson was completed.

Phase III of the study includes the administration of the Posttest in which individual scores were obtained. The mean score of students under the same group and the mean gain score were computed.

The Study Design

Phase	*Activities*	*Output*
I	Administration of Pretest	Pretest Scores
II	Actual Instruction	Quiz/Test Scores
	Completion of the Learning Graph	ILG Patterns
	Preparation of PLUS and MINUS Notebook	Reflections on ILGs
III	Administration of Posttest	Posttest Scores

Data Analysis Procedure

The gathered data was analyzed both quantitatively and qualitatively. Under Phase I in the data gathering procedure, the students' individual scores in the pretest were obtained. At this early stage, an analysis was done comparing the pretest scores of individual students in the same group and with the students in the other group. The mean score for each group was computed.

The pattern in the Individual Learning Graphs (ILG) constructed by the students in the same group was compared and the commonalities or differences were identified. Comparison of the ILG pattern of the students in the same group and with the other group was done. Reflections written in the PLUS and MINUS notebook were transcribed and summarized to determine how many students had achieved their goals for each lesson, their feeling about their ILG pattern, the factors associated with their achievement or non-achievement and their plans to improve learning.

The individual scores in the posttest were compared with the students' pretest scores and the individual gain score was determined. Mean scores were computed and compared with the pretest mean scores to determine the gain. The significance of both the gain in individual score and the mean score was determined by a t-test.

Results and Discussion

Students' Constructed Learning Graphs

Scores of students in the assessments given determine the point entry in the graph. This section presents the different learning graph patterns created by the students.

The pattern shown by the graph indicates how much knowledge was acquired by a student during the five stages of instruction. Each level in the graph corresponds to the proficiency level of the scores obtained ranging from 0 to 100% proficiency (Largo, 2005).

Generally, it was observed that learning graph patterns of students are different from each other. Graphs with an increasing trend from point A, which is based on personal assessment of prior knowledge, indicate improvement in the performance during the tests while a decreasing trend suggests failure to improve performance. Also, points reaching levels of proficiency (B, C, D and E) higher than the levels of proficiency for point A are a positive indication of additional knowledge acquired from the lessons provided by the instructor.

On the other hand, a level for these points lower than what is plotted at point A indicates failure of the student to improve his/her performance in the series of tests given. However, it does not actually indicate failure to acquire additional knowledge since the classroom activities provided by the instructor and the concepts taken varies for every stage of learning corresponding to points C to E in the graph (Largo, 2005).

Other graphs indicate improvement in performance at certain stages of the lesson but declines at some particular stages.

Entries in the Learning Journal

Data were obtained from the students' learning journal, called the plus and minus notebook, included reflection on their performance as shown by the learning graph for each lesson which included achievement of target and level of satisfaction, events that took place when the lessons were taken including other factors such as skills and attitudes

towards studies, realizations on the significance of the learning graph activity and their plans to improve performance.

Students' Reflections on their Learning Graphs

Students' awareness of the passing proficiency level, which is 75% in all subject areas including College Algebra, serves as a basis for their achievement goal.

Of the seventeen who achieved their goal for unit 1, three are at the *I'm sure* level (81 – 100% proficiency), nine are at the *I'm competent* level (61 – 80% proficiency) and six are at the *I know* level (41 – 60% proficiency). For unit 2, six achieved their target at *I'm sure* level, eight at *I'm competent* believe level and two at *I know* level. For unit 3, six achieved their target at *I'm sure* level, eleven at *I'm competent* level and four at *I know* level. For unit 4, six achieved *I'm sure* level, eleven achieved *I'm competent* level and two at *I know* level. For unit 5, only two achieved *I'm sure* level, one achieved *I'm competent* level and three achieved *I know* level. For unit 6, four achieved *I'm sure* level, twelve achieved *I'm competent* level and five achieved *I know* level. For unit 7, on the topic on special products, four achieved *I'm sure* level, six achieved *I'm competent* level and seven achieved *I know* level. For the same unit but on the topic on factoring, two achieved *I'm sure* level, seven achieved *I'm competent* level and six achieved *I know* level. For unit 8, on the topic on rational expressions, one achieved the *I'm sure* level, fifteen achieved *I'm competent* level and six achieved *I know* level.

Students' Level of Satisfaction

Not all who have reached the *I'm sure* level, felt satisfied with their performance although they admitted they achieved their target.

Plus/Minus Events

During the time when the lessons were taken, students listed the events that took place. They include happenings both in and out of the school. Those events were classified by the students as plus (+), which means the effect on their performance is positive, and minus (-) when the effect is negative.

The events that were considered are the activities relevant to the lesson discussed in class whether individually or in groups. Their involvement in these activities improved their learning and added interest to the topic delivered to them. Some also considered group tutoring helpful because of obtaining other ways of solving the problem.

School-related happenings are the most common cause identified by the nursing students to have affected their performance in College Algebra class. Their involvement in these happenings greatly influenced their study habits and the pressure of being able to finish all the other requirements in the different subjects to lessen their concentration on the lessons being discussed in College Algebra class.

Enhanced Metacognitive Learning

Difficulty to memorize easily and distraction from their classmates during the discussion were uniquely identified by the least number of students as the cause of their failure. Some students failed to achieve their target because they felt dissatisfied, accompanied with nervousness about the subject, and failure to remember or understand important terms and formulas. The majority of the students got confused with the lesson which created a negative effect on their performance. However, although this factor is considered to produce a negative effect, it does not totally suppress the gaining of knowledge, just like the other factors enumerated.

Students' Perception of the Learning Graph Activity

Data revealed that more than 90% of the total respondents agree to most of the items in the perception questionnaire indicating that Learning Graph Construction as a strategy to develop metacognition is generally acceptable. From the information above, the most developed metacognitive skills identified include (1) improvement of students' discipline, (2) awareness of the need to be present in class always, (3) realization of the development of performance inside the classroom, (4) graphing and checking the progress in class, (5) improvement of study habits, (6) awareness of learning and the endeavor exerted in learning, (7) eagerness to acquire more knowledge and (8) having the goal of getting high scores in the examinations. Similarly, it is very important to note that almost 100% enjoyed Learning Graph Construction.

On the contrary, there are metacognitive skills less developed by this evaluation and monitoring activity. These include expressing learners' readiness for the learning activity, regularly doing the assigned tasks, paying more attention to the teacher during classroom discussions, initiative to complete the Learning Graph without teacher's supervision and active participation in class. But, it is also significant to note that the percentages of negative responses to the items enumerated are not particularly low which also indicates that the strategy introduced in this study cannot be absolutely considered inadequate in developing these aspects among the respondents. In totality, ILG construction is perceived to be a valuable and important tool to promote self-assessment and observe students' development inside the class and to develop metacognitive skills beneficial in building functionally educated individuals.

Entries of students in the plus and minus notebook after each learning graph proved to be very helpful in conducting a self-assessment of learning. Here, the students were able to evaluate their self-reliance as far as learning for a particular lesson or topic is concerned. They also evaluated the effects of some factors such as events that took place inside the classroom, their enthusiasm on a particular lesson, their eagerness to participate in group activities and classroom discussions and their own personal motivations. The study of Largo (2005) also revealed that writing something about the events of the day and the things they do in the classroom made them sensitive to their progress and helped them in planning what should be done to improve learning. The new findings are in conformity with results of previous studies including those on metacognitive strategies. Based from these findings, it can now be carefully stated that the learning graph construction is an effective tool in developing metacognition.

Conclusions

Considering the findings of the study, the following conclusions are drawn:

1. Learning graph construction promotes learning for the students especially on the topic of ratio and proportion and household measurements.
2. Learning graph is a useful tool in assessing the individual's learning progress.
3. Students find learning graph construction motivating and significant.

Recommendations

Based on the findings and conclusions of the study, the following recommendations are proposed:

1. Make learning graph construction a part of the regular evaluation procedures in order to improve student's achievement.

2. Consider a more comprehensive analysis of the entries in the plus and minus notebooks of the students for the sake of their academic performance.
3. Involve the parents in the monitoring of students' learning development by asking them to make significant comments on the entries in their children's learning journal.
4. Replicate the study in other areas or disciplines or year level to further validate the results of the present study.
5. Monitor the improvement of the recognized metacognitive skills.
6. Conduct similar studies taking into consideration other issues not addressed in the present study such as increasing the sample size.

References

Cizek, G. (1997). *Handbook of classroom assessment: Learning adjustment and achievement.* San Diego CA: Academic Press.

Labnao, M. (2000). *Effectiveness of self-learning kit in teaching mathematics in grade six.*

Largo, M.E. (2005). *Learning graph construction and achievement in physics of students with high and low self-esteem.* Master's Thesis. Technological University of the Philippines,Manila.

Serin, P. (1999). Practical assessment. *The Science Teacher. 2*, 34 – 37.

Tan, M. (2003, month). *Assessment of student learning.* Paper presented at the DepEd Training. Baguio City

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