UTILIZING PATH-TURN STRATEGY TO ENHANCE MATHEMATICAL PERFORMANCE AMONG GRADE 11 STUDENTS: A MULTI-METHOD RESEARCH

JOAN J. POSTRADO, Ph.D.[1] CHRISTOPHER E. OLIPAS, Ph.D.[2, 3, 4, 5]
https://orcid.org/0000-0002-8814-0870
joan.postrado@deped.gov.ph[1], ceolipas@up.edu.ph[2]
[1]Lawang Bato National High School, Schools Division Office-Valenzuela City
[2] OLM Institute and Skills Training Center for Allied Courses, Inc., Baliuag, Bulacan
[3] Pamantasan ng Lungsod ng Maynila, Intramuros, Manila
[4] Bulacan State University, City of Malolos, Bulacan, Philippines
[5] Adamson University, San Marcelino Ermita, Manila, Philippines

ABSTRACT

Path-turn strategy is anchored from the concept of Scaffolding where teacher initially gives path to solve the problem followed by student's turn to do the task. It is a gradual transition from grounded learning to independent knowledge among students. Correspondingly, it is used in teaching and learning process as it stimulates student's enthusiasm in learning. This study investigated Grade 11 students of Lawang Bato National High School who took up Business Mathematics subject on 1st semester, School Year 2020-2021. A total of sixty (60) conveniently selected respondents from two different heterogeneous sections handled by the researchers served as the subject of this quasi-experimental research design. This design indicates that one group gets the treatment while the other does not. It assessed the difference of path-turn strategy on the mean, percentage, and score of students. Before the conduct of the study, pretest was personally administered to determine if two groups were on the same achievement level. The researchers used content validated researchers-made posttest with Table of Specifications (TOS) and item analysis as well as a research instrument which is validated by experts in terms of content, structure, and grammar. In the same vein, structured interview guide questions were used to narrate for qualitative analysis from five (5) purposively selected participants. Through t-test paired sample mean, the computed t-value of 5.62, which is higher than the critical value of 1.70 at 5% level of significance, revealed that use of path-turn strategy enhanced the mathematical performance of Grade 11 students. Using Tesch's method and thematic analysis, qualitative findings from interviews merged into three themes in terms of knowledge acquisition, applicability, and satisfaction. Students perceived that the use of pthe ath-turn strategy help them easily understand the lesson, increase interest to solve problems, and sense of fulfillment in learning the subject.

Keywords: buying and selling, path-turn strategy, Tesch's method, thematic analysis, and quasi-experimental research design

INTRODUCTION

The researchers observed that the K to 12 Basic Education curriculum of Senior High School specialized subject in Business Mathematics includes mostly new topics for students. The content on mark-on, mark-down, mark-up, discount, profit, and loss are not thoroughly included in K to 12 Mathematics curriculum guide of Junior High. In the initial interview, 9 out of 10

students perceived that 2/3 of the topics are new to them. Based on the test results on buying and selling, data revealed to have deteriorating learning process. The mean, percentage, score (MPS) of two different classes are as follows: 54% and 48%, respectively. It means that the below par figure needs to be addressed accordingly pursuant with Section 27 of DepEd Order 42 series of 2016 which emphasizes the importance of teachers' capacity to choose from variety of instructional models and their corresponding strategies and methods. The decreasing Mathematical performance on mean, percentage, score of Senior High School students in Business Mathematics needs an immediate action. The researchers are more than willing to propose a strategy that may be helpful to improve Mathematical performance of students in learning business mathematics. The concept of improved performance depends on how students grasp the lesson and how the teacher facilitates the learning. If development of instruction is visible in each classroom, then it may inspire students to gain better understanding and competent to the demands brought by time. Thus, this study is a response to the resounding call of RA 10533 in making ways and means to be empowered individuals who have gained excellent learning and competence in engaging to productive activities.

The use of path-turn strategy in improving the Mathematical performance may encourage the students to actively participate in written exercises and give them motivation to continue the journey in learning key concepts. The researchers recommended to use this strategy to figure out if this pattern is effective and can improve the performance level in business mathematics of senior high school students. Frederick (2014) used scaffolding by group and found out to be helpful in finding solution to a middle school mathematical problem. The researchers used path-turn strategy for senior high school students through individual written exercises.

This proposed path-turn strategy is a gradual transition from grounded learning to independent knowledge among students. This strategy can be used in teaching and learning process as it stimulates student's enthusiasm in learning precalculus. In this study, with path-turn strategy, students are expected to improve their performance level in learning business mathematics. This study is related to the concept of how scaffolding strategy of van Driel (2018), and Anwar (2016) improved the language development and mathematical thinking skills of students, respectively. Path-turn strategy can be shown when teacher gives examples on each subtopic so that students will be guided on the entire lesson. A teacher leads the students to the main goal of the lesson through series of samples to be filled out by students. Undeniably, most of students really had tough time to comprehend the magical ideas of Mathematics. In conventional strategy, the example given by the teacher does not give a similar procedure in finding the solution. The problem given is not linguistically the same with the examples provided. This strategy addresses the least mastered competencies of buying and selling. Thus, it may help students to cope up with the challenges that they encounter in learning the subject because the teacher provides samples that may lead them to accurate answer. In this manner, Mathematical performance of students may gradually increase.

OBJECTIVES OF THE STUDY

The study aimed to investigate the use of path-turn strategy to enhance the Mathematical performance of Grade 11 students. Specifically, it sought to determine the Mathematical performance of students who used path-turn strategy and students who used conventional strategy, determine the significant difference in the Mathematical performance of students who used path-turn strategy and those who used conventional strategy, and students' perceived use of path-turn strategy in terms of knowledge acquisition, applicability, satisfaction.

METHODOLOGY

Grade 11 students of Lawang Bato National High School who took up Business Mathematics were conveniently selected for the study. A total of 60 respondents from two different heterogeneous sections handled by the researchers served as the subject of this quasi-

experimental research design to describe and explore the whether the concept of scaffolding is efficient and effective in teaching and learning process as it stimulates student's enthusiasm in learning Business Mathematics.

This design indicates that one group received the treatment while the other group is the comparison group and did not get the treatment. It assessed the difference of path-turn strategy on the mean, percentage, and score of students. After administering posttest, the same respondents were purposively chosen for interview, but only five of them were selected; three from the first top scorers and two students who got low scores. Before the conduct of the study, the researchers secured a letter, together with the research proposal, address to the school principal asking for permission. Stating that selected students at the school served as the subject for the study as well as the class session. Upon its approval, the researchers asked three experts in terms of content, structure, and grammar to validate the research instruments used in this study.

The pretest/posttest has content standard on key concepts of buying and selling. Also, TOS and item analysis were constructed for its content validity. The 30-item multiple choice test is ranged to 20 hours of delivering the lesson. The item analysis used has frequency of error from upper (27%), middle (46%) and lower (27%). It also includes difficulty level and discrimination power which gives an understanding level description of each item. It intends to measure whether the test confirms with the content used by the teacher in delivering the lesson during the conduct of the study. For qualitative procedure, structured interview guide questions were also validated by the same experts. It consists of three parts. First part refers to participant's personal circumstance, second part deals with soliciting point of view of the participant, and last part discusses the participant's lived experience. The first two parts defines the personal background of the participant. The last part, which consists of three questions, is the main concept of the interview. The responses elicit the perception of students in the use of path-turn strategy to enhance their Mathematical performance in class in terms of knowledge acquisition, applicability, and satisfaction. The researchers personally administered the pretest and posttest, but of different order, to respondents. Result of these tests made use of statistical tool for interpretation. One group was taught using the conventional teaching strategy (comparison group) and the other group used path-turn strategy (treatment group) in teaching precalculus. After posttest, the structured interview guide questions were voluntarily answered by the participants. Path-turn strategy was implemented for the entire first quarter of 1st semester of School Year 2020-2021, on a regular class session. The Mathematical performance of students from two different sections on a separate teaching strategy was presented, analyzed, and interpreted through mean. The quantitative data analysis on t-test paired two sample means was determine if the use of path-turn strategy improves the Mathematical performance on mean, percentage, and score of Grade 11 students. To augment the strength of the findings, the researchers conducted a qualitative investigation through thematic analysis and examine qualitative data through Tesch's method. Observation during the use of the strategy was noted by the researchers and interview guide questions for the informants were put into consideration. This study made use of coding to categorize each response to form a theme.

RESULTS AND DISCUSSION

The results of the study in utilizing path-turn strategy that may enhance the Mathematical performance of Grade 11 students were organized into tabular form for better understanding.

1. Mathematical Performance of Students who used Path-turn Strategy and Students who used Conventional Strategy

Table 1
Results on Mathematical Performance of Students

Strategy	Mean
Path-turn Strategy	22.16
Conventional Strategy	18.67

The result on the Mathematical performance of students was shown in Table 1. The data revealed that the mean in the use of path-turn strategy is 22.16 which is greater than the mean of conventional strategy, which is 18.67. This implies that the obtained values were the average performance of students on a separate use of teaching strategies. The Mathematical performance of students who used path-turn strategy revealed a better result than the performance of students who used conventional strategy.

The findings support the study of Frederick (2014) where students learned to find a solution to a mathematical problem by scaffolding.

2. Difference of Mathematical Performance among students who used Path-turn Strategy and students who used Conventional Strategy

Table 2
Comparison of two Strategies used in Teaching Precalculus

Strategy	Mean	Diff	Comp t	CV (α=5%)	Decision	Remark
Path-turn Strategy	22.16	3.49	5.62	1.70	Reject Ho	Significant
Conventional Strategy	18.67					

The researchers hypothesized that path-turn strategy was more effective the than conventional strategy. Table 2 presents the comparison of two strategies used in teaching Business Mathematics through posttest. Based on the table, a difference of 3.49 between the average mathematical performance of students who used path-turn strategy ($\bar{x}$ =22.16) and students who used conventional strategy ($\bar{x}$ =18.67) is proven statistically significant since the computed t-value of 5.62 is greater than the critical value of 1.70 at 5% level of significance. Thus, there is robust evidence that on average, there is a significant difference between the mathematical performances of students who used path-turn strategy and students who used the conventional strategy. With the results, it is implied that the use of path-turn strategy is more effective than conventional strategy in teaching business mathematics. The yielded data supports the findings of Anwar (2016) that mathematical thinking skills of students were improved with scaffolding.

3. Perception of Students in the Use of Path-turn Strategy in terms of Knowledge Acquisition

This study requested five purposively chosen informants to participate; three from first top scorers and two students who got low scores in posttest. The interview identified the perception of students in the use of path-turn strategy in terms of knowledge acquisition, applicability, and satisfaction. The researchers arranged a short virtual meeting with the participants. They requested to answer questions in writing so that they would have more time to formulate their answers and review them before finalization. Prepared guide questions were used in the interview. Responses were arranged according to the questions stated in the guide and themes were emerged based on their answers.

Road to Understand

How do you define the learning in mathematics if the discussion is done through path-turn strategy?

The interview revealed that learning mathematics tend to become easy to understand with the help of path-turn strategy. The transcribed data deals on how students perceive the use of path-turn strategy in terms of knowledge acquisition. Considering that the subject associates to one of the most difficult subjects in the academe, participants showed the following responses: A participants said that topic becomes understandable using path-turn strategy.

"I found it easy to understand the discussion if it is done through path-turn strategy. Since it makes the students to stay focus on what the teacher doing, the students can understand it

*detailed and do it themselves."(*Student 5: lines 019-056) (I found it easy to understand the discussion if it is done through path-turn strategy. It makes the students stay on the focus that will lead them to understand the lesson in details.)

Student 3 also shared her experience on how she understands the lesson.

"*The path-turn strategy helps me to better understand my difficult mathematical topics and broadens my prior knowledge on this subject."* (Student 3: lines 019-038) (The path-turn strategy helps me to better comprehend difficult mathematical concepts and broaden my knowledge on this matter.)

Another participant added he felt at ease on the subject.

"*We students find it easier to understand Mathematics because the way the topic/problem should be solved has been shown first by the teacher before making the students try and solve it by themselves."(*Student 4: lines 019-051) (We find it easier to understand the way the lesson is delivered as well as the steps were shown accordingly so that we can have guide to solve it by ourselves.)

Student 2 added that he perceived to understand the lesson easily.

"It's given me more strategy that can I use in my daily life. Also, my teacher makes easier and mas mabilis na way para malaman yung sagot." (Student 2: lines 019-044) (This strategy also teaches me to be strategic in solving the problem as the teacher also shares the easiest way.)

Also, Student 1 also shared his insight.

"*Learnings became easy with that strategy, students tend to understand it more and guided to what should be done because of examples given first."*(Student 1: lines 019041) (Learning the subject seemed to be easy since students tend to understand it through pattern and set of examples given.)

Additionally, one of the responses deals with how the subject becomes easy through path-turn strategy.

"*I found it easy to understand the discussion if it is done through path-turn strategy. Since it makes the students stay focus on what the teacher doing, the students can understand it detail and do it themselves."* (Student 5: lines 019-056) (I find it easy to understand the discussion using path-turn strategy. It also helps the students to stay on focus while the teacher illustrates the example before they do it themselves.)

This resonates with van Driel (2018) whose stand about learning the subject depends on how it was being taught. The use of scaffolding significantly affects the learning development of students.

4. Perception of Students in the Use of Path-turn Strategy in terms of Applicability

The theme of interest to solve emerge as the perception of students in the use of path-turn strategy in terms of applicability.

Interested to Solve

When your teacher used path-turn strategy, how does it increase your interest in learning the subject?

Results of the interview revealed the perception of students in the use of path-turn strategy in terms of applicability. It is the perspective of how they are interested to solve mathematical problems which were articulated in the following responses:

"It gives me more interest to learn the subject because the teacher makes it more easier to understand that ends up giving me more knowledge, and like to know different things that I

can use in future." (Student 4: lines 069-105) (It makes me more interested to learn the subject because the teacher shows the procedure in easier way.)

Student 1 claimed that his interest also increases.

"My interest grew because I easily learn from it, I become more enthusiast with what may be the next to do with the help of teacher solving and showing it first." (Student 1: lines 060-090) (My interest in learning the subject increases because I easily understand it because the teacher shows it first.)

Similarly, another participant affirmed that she tends to be interested to learn.

"When my teacher uses a path-turn strategy every math hour it expands my ability to solve math problems and it gives me an interest to learn more. And because of my teacher's help to explain and teach so much I understood the topics more easily." (Student 3: lines 056-100) (Every time my teacher uses path-turn strategy, it makes me interested to learn more.)

Student 5 also shared her perception towards path-turn strategy.

"Precalculus is a difficult subject in first sight for me but, with the help of path-turn strategy, it makes the subject an easy one. It increase my interest in learning the subject because it was amazing to learn how easy to solve the difficult one in your eyes." (Student 5: lines 074-121) (Initially, precalculus seemed to be difficult subject. However, through path-turn strategy, learning the subject increases my interest and I get amazed whenever I solve a problem.)

Another participant also gets interested in learning the subject.

"Like I said to the number 1 question, my teacher in precalculus do every easier to understand sa lesson and good not for students also the next generation because of that strategy, naging interested ako at meron pa kong natutunan na strategy na magagamit ko pa sa college." (Student 2: lines 063-106) (Because of the way my teacher delivers the lesson, I get interested to learn and I also gained knowledge that I may use in college.)

Analyzing the variable on applicability, participants commented that the use of path-turn strategy provide interest in solving mathematical exercises. These findings are in accordance with the prescription of Zurek (2014) that scaffolding may be recommended as a tool to improve education in early childhood.

5. Perception of Students in the Use of Path-turn Strategy in terms of Satisfaction

The theme focusing on the perception of students in the use of path-turn strategy in terms of satisfaction

Road to Fulfillment

How does path-turn strategy improve your Mathematical performance in a class?

The last aspect raised by the researchers concerns students' perception on the use of path-turn strategy in terms of satisfaction. Teaching mathematics approach involves many hands-on activities characterized by collaboration, communication, and interdependence in a team and this becomes easy to achieve when students are fulfilled with the learning they deserve to achieve. The responses are as follows:

"When I answer correctly and I get a high score I am encouraged to learn a lot and with the help of path-turn strategy I became satisfy of and improved my math performance in class. And as I listen to each lesson taught, I follow the difficult parts of the topic." (Student 3: lines 112-163) (Every time I got high score, I am encouraged to learn more and feel fulfilled with the help of path-turn strategy to improve in mathematics class.)

Student 5 added that it feels like accomplishment learning the subject through the aid of path-turn strategy.

"As a student who once had tough time in the subject mathematics, path-turn strategy is so

helpful to improve my performance in mathematics. It makes me easy to solve it by myself. I can visualize how the teacher had done the steps in solving and apply it to myself. It turns me accomplish person who done the things she thought she could never do."(Student 5: lines 133-196) (I am like any student who has a tough time learning mathematics. But with the help of path-turn strategy, it feels like I accomplish something I thought I could never do.)

The participant also underscored how the path-turn strategy change him for the better.

"For me, it changes me for a better that I can understand it very well even though few examples were given, just watching on how it was solved out. It is more convenient and understandable because I'm able to perform more on it." (Student 1: lines 102-144) (Path-turn strategy changed my perception in mathematics that learning the subject is understandable if it will be only explained strategically.)

Likewise, Student 4 also shared his form of fulfillment through happiness.

"Well because it is easier to understand, it ended up giving me happiness that I didn't have on my past school years in the subject of mathematics and other subject that is included with math." (Student 4: lines 117-152) (Since I understand the lesson easily, I feel the happiness that I did not feel in my previous mathematics subjects.)

One informant expressed his view in path-turn strategy.

"Because of that strategy, gave me more potential and the lessons that hard to learn, nagiging madali or nagbibigay ng lakas sa aming mga students na hindi naman pala mahirap and subject na mathematics." (Student 2: lines 118-151) (This strategy gives me more potential to learn difficult lesson and brings us inspiration that learning mathematics is not as difficult as I think.)

Considering the findings, the context of satisfying with the learning that students achieve connects with the reason of its fulfillment (Vallejo 2018). With researchers' observation that the use of path-turn strategy was effective in the subject, she just wishes to make it possible across discipline. Qualitative findings from interviews with selected Grade 12 students revealed three themes about how they perceive the use of path-turn strategy in terms of knowledge acquisition, applicability, and satisfaction. These are easy to understand, interested to solve, and the road to fulfillment.

The obtained values were the average performance of students on a separate use of teaching strategies. The Mathematical performance of students who used path-turn strategy revealed a better result than the performance of students who used conventional strategy.

Results revealed a difference of 3.49 between the average Mathematical performance of students who used path-turn strategy ($\bar{x}$=22.16) and students who used conventional strategy ($\bar{x}$ =18.67) is proven statistically significant since the computed t-value of 5.62 is greater than the critical value of 1.70 at 5% level of significance. Thus, there is compelling evidence that on average, there is a significant difference between the Mathematical performance of students who used path-turn strategy and students who used conventional strategy. With the results, it is implied that the use of path-turn strategy is more effective than conventional strategy in teaching Business Mathematics. The interview identified the perception of students in the use of path-turn strategy in terms of knowledge acquisition, applicability, and satisfaction. Responses were arranged according to the questions stated in the guide and themes were emerged based on their answers. Qualitative findings from interviews with selected Grade 11 students revealed three themes. These are easy to understand, interested to solve, and road to fulfillment.

Therefore, Mathematical performance of students who used path-turn strategy has statistically proven effective compared with the use of conventional strategy. Also, students perceived that the use of path-turn strategy help them easily understand the lesson, increase interest to solve problems and sense of fulfillment in learning the subject. From the quantitative and

qualitative analyses on the use of path-turn strategy to enhance the Mathematical performance of Grade 11 students, the researchers strongly recommends that it may be used both in formative and authentic assessment. Also, teachers may learn the proper techniques of using path-turn strategy. Furthermore, a similar study involving larger groups of respondents may be undertaken to further affirm the findings of this study.

Acknowledgment

The authors appreciate the students who participated in the study. Special thanks to the school administrator and assigned faculty members for their help in recruiting student participants.

REFERENCES

Anwar A., Yuwoo, I., Edy, B., & As'ari, A.R. (2016). Investigation of contingency patterns of teachers' scaffolding in teaching and learning mathematics. *Journal on Mathematics Education, 8(1), 65-76.*

Creswel, J. W., (2014). Research design: Qualitative, quantitative, and mixed methods approaches. 4th ed. Thousand Oaks, California: SAGE Publications

Deped Order No. 42 S 2016. Policy guidelines on daily lesson preparation for the K to 12 basic education program. http://depedabra.com/index.php/2016/06/20/deped-order-no-42-s-2016-policy-guidelines-daily-lesson-preparation-k-12-basic-education-program/

Frederick, M., Courtney, S.,& Caniglia, J. (2014). With a little help from my friends: scaffolding techniques in problem-solving. *The Research Council on Mathematics Learning, Winter Edition 2014, 7(2).*

Guest, G., MacQueen K., & Namey, E., (2012). Applied thematic analysis. DOI: https://dx.doi.org/10.4135/9781483384436.

Republic of the Philippines. enhanced basic education act of 2013. https://www.officialgazette.gov.ph/2013/05/15/republic-act-no-10533/.

Republic of the Philippines. Policy guidelines on daily lesson preparation for the K to 12 basic education Program. https://www.deped.gov.ph/2016/06/17/do-42-s-2016-policy-guidelines-on-daily-lesson-preparation-for-the-k-to-12-basic-education-program/.

Tesch R., (1990), Qualitative research: Analysis types and software tools. New York, Falmer

Vallejo, N., Vargas, O., & Rodriguez, L. (2018). Effect of motivational scaffolding on e-learning environments: self-efficacy, learning achievement, and cognitive style. *Journal of Educators Online.* 8-10.

van Driel, S., Slot, E., and Bakker, A. (2018). A Primary teacher learning to use scaffolding strategies to support pupil's scientific language development. *European Journal of STEM Education, 3(2), 05.* https://doi.org/10.20897/ejsteme/3115.

Zurek, A., Torquati, J. & Acar, I. (2014). Scaffolding as a tool for environmental education in early childhood. *International Journal of Early Childhood Environmental Education, 2(1), p. 27.*

AUTHORS' PROFILE

Dr. Joan J. Postrado is currently taking up her second-degree program in Doctor of Philosophy in Mathematics Education at Nueva Ecija University of Science and Technology. She completed her degree in Doctor of Philosophy in Educational Management at Bulacan State University. As a graduate of New Era University, she has completed all requirements for the Master of Arts in Education major in Mathematics Education. She finished her undergrad at Davao Oriental State University with a degree of Bachelor of Secondary Education major in Mathematics. She has completed two division classroom-based action research. One is published in DepEd NCR *Manyuskrip* journal and awarded as Best in Abstract. Right now, she is working with her

research study for international publication with her colleagues outside the division. She was recognized as international awardee for the Most Outstanding Demonstration Teacher in Mathematics. She is one of the Self-Learning Module (SLM) writers of Business Mathematics, SLM editor & layout artist, and test writer of the same subject. She is also an SLM validator of Practical Research 1 subject for senior high school. She is also a research instrument validator of Bulacan State University for selected courses. She has been a district resource speaker and invited for speaking engagement inside and outside the division. She is also a licensed legal transcriptionist after completing the NCII of Finishing Course for Legal Transcription.

At present, she is employed as Master Teacher I in Lawang Bato National High School-Senior High Department, designated as group head in Mathematics, Science, and Research; a BAC Chairman in SHS; a school research coordinator, a grade 12 level enrollment chairman.

Dr. Christopher E. Olipas had been a faculty since 2008 and is a nurse and a teacher by profession. His academic preparation include Diploma in Research and Development Management, Doctor of Philosophy major in Educational Management, Master of Arts in Nursing, Continuing Professional Teacher Education, Bachelor of Secondary Education major in Technology and Livelihood Education, and Bachelor of Science in Nursing. He is a recipient of the TESDA National TAGSANAY AWARD in 2018. Currently, he holds an Associate Professorial Lecturer V rank in at Pamantasan ng Lugsod ng Maynila and held different positions and designations both in the industry and in the academe.

COPYRIGHTS