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Learning Portfolio in Mathematics: Its Effects on the 21st Century Learning Skills of the Grade 8 Learners

Jonathan M. Cabatuan; Zita I. Dales, PhD

Abstract:- The study probed on the effects of integrating learning portfolios in Mathematics on the 21st-century learning skills of Grade 8 learners. It was conducted in Pangantucan National High School, Pangantucan Bukidnon during the second grading period of the school year 2018-2019. A quasi-experimental pretest-posttest research design was used with two-intact classes. The participants of this study were sixty (60) Grade 8 learners. Thirty (30) learners from the experimental group were matched with thirty (30) learners from the control group, based on their first grading performance in math, and gender. Four research instruments were used in the study. The Critical Thinking Skills Test, Collaboration Survey Questionnaire, and Mathematical Creativity Skills were researcher-made tests that measured critical thinking skills, collaboration skills, and creative problem-solving skills, respectively. The Written Communication Rubric for Mathematics, adopted from Quasar Mathematics General Rubrics, was used to measure written mathematical communication skills. The data were treated with One-way Analysis of Covariance (ANCOVA) at 0.05 significance level.

The study revealed that there were significant differences in the performance of grade 8 mathematics learners on critical thinking, communication, collaboration, and creativity when taught using learning portfolio and conventional forms of teaching strategies in favor of the experimental group. Therefore, the use of a learning portfolio in mathematics is effective in enhancing the 21st-century learning skills of grade 8 learners.

I. INTRODUCTION

The 21st-century is regarded as the information age with the rise of computer technology that aids multifarious human activities. Information has become a service that is quickly and broadly distributed, and easily available mainly through the use of computer technology. Although advancements in computer technology revolutionizes data analysis, computers cannot do all the work for us. Employees who can analyze and interpret data in ways that inspire actionable decisions are tremendously valued (Silverstein, 2016).

Human resources are indispensable in the 21st-century workplace. This is also the era where employees are the most valuable assets. The employees' talents, skills, and distinctive abilities are what distinguish the most innovative and trendsetting companies (Sturt et al. 2016). The workforce of today is in demand of leaders and employees who are critical thinkers and good problem solvers; effective communicators; excellent collaborators and team players; and creative and innovative.

For this reason, learners deserve an education that would prepare them for future jobs. These skills are known as 21st-century learning skills, also known as the four Cs, which include critical thinking, communication, collaboration, and creativity (Partnership for 21st Century Learning, 2019).

These relevant skills need to be learned, enhanced, and mastered by the young generation of learners. Shortly, they would take the lead in different areas; may it be in politics, economy, health, social work, education, etc. They will be the backbone of the country. Educators play a big role in building a strong society by creating a pool of able and potential youths.

Hence, the education sector should invest so much on the learners' skills, particularly in mathematical abilities to prepare them for the challenges they may face. The implementation of the K to 12 curriculum paves the way for integrating the 21st-century learning skills in the curriculum for life-long learning (DepEd, 2013).

The problem roots from the learners' beliefs about mathematics and mathematical problem-solving. Many of the Filipino students believe that all word problems can be solved by a simple step by step procedure, and word problems are not important according to the study of Sangcap (2010). This implicates learners' limited outlook on creativity and innovation in mathematical problem-solving.

The setbacks on the basic mathematical concepts in the lower grade levels, if unattended, would probably lead to a more complex problems as the learners take courses in higher mathematics. Herrera & Dio (2016) revealed that Grade 10 learners are moderately ready for SHS' General Mathematics. Solving word problems, particularly on simple interest, are among the least mastered skills. This links to the learners' poor mastery of the basic concepts and unfamiliarity of the processes of problem-solving, which may impede in the analysis and solution of higher order problems.

Under the K-to-12 curriculum, learning assessments come in two folds; formative and summative. The formative assessments are assessments meant to improve learning. This form of assessment enables the teacher to modify teaching strategies and techniques, as well as improve teaching-learning materials to suit the learners' needs and learning styles. The learner's modules contain a bulk of learning activities that aid in mastering the concepts undertaken.

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Once the learners are ready for evaluation based on formative assessment results, the learner may proceed to summative assessments which are now the basis for grading. In this form of assessment, the mathematics curriculum specifies that 40% of the learner's performance is allocated for written outputs, 40% for performance task, and the remaining 20% is allocated for the learner's performance in the final exams (DepEd, 2015). With this figure, a bulk of paper works are expected from the learners as partial evidences of learning.

Unfortunately, many of the learners do not keep their outputs after tests. Most of those papers are lost, or perhaps misplaced because of poor organization of used materials. Instead of just letting the learners dump those accomplished papers into trash, a creative and innovative learning facilitator can help them can turn those into something worthwhile. Learning is a progressive and continuous process; it does not end after examinations/tests.

As the celebrated line states "experience is the best teacher." A lot of learning experiences are embroidered on these papers that are waiting to be uncovered. The learners may further learn from their successful attempts, and from their mistakes on a test as well by reflecting upon them, making some refinements or revisions to correct erroneous problem-solving processes. These papers can be compiled and organized systematically in a container called a learning portfolio. Integrating a learning portfolio in teaching mathematics is a strategy, and an opportunity worth venturing in.

A Portfolio is a systematic collection of student work which shows effort, progress and performance in one or more areas. The collection must include student involvement regarding content, selection criteria and evaluation criteria and it must show student self-reflection. (Paulsson et al., 1991).

Portfolios are classified according to their purpose. Scully et al. (2018) identified three types of a portfolio, namely: assessment portfolio, showcase portfolio, and learning portfolio. A learning portfolio as a type of portfolio which may include drafts and unpolished work, with the focus broadened to include the process of compiling the portfolio, as well as the finished product.

Unfortunately, the use of portfolio in teaching mathematics is among the least used strategies, particularly in the division of Bukidnon (Gagarani, 2013). This substantiates the review of related literature which show a dearth of studies directly relating the effects of a learning portfolio in the 21st-century skills. Moreover, the Department of Education cited the use of portfolio as a priority area for research (DepEd, 2016).

With these, the researcher decided to study the extent to which the use of a learning portfolio in mathematics affected the grade 8 learners' 21st-century learning skills.

II. STATEMENT OF THE PROBLEM

This study investigated the effects of learning portfolio in mathematics in the performance of Grade 8 learners on their 21st-century learning skills. This was conducted at Pangantucan National High School, Schools Division of Bukidnon during the school year 2018-2019.

Specifically, this study answered the following problems:

1. How do the performances in critical thinking skills of Grade 8 mathematics learners compare when taught using learning portfolio and conventional methods of teaching strategies?
2. How do the communication skills of Grade 8 mathematics learners compare when taught using learning portfolio and conventional methods of teaching strategies?
3. Is there a significant difference between the collaboration skills of the Grade 8 mathematics learners who were taught with learning portfolio in mathematics and those who were taught with conventional methods of teaching strategies?
4. Is there a significant difference in the performances of the Grade 8 mathematics learners in terms of the creativity skills when taught using learning portfolio and conventional methods of teaching strategies?

III. METHODOLOGY

A. Research Design

The study used a quasi-experimental pretest-posttest research design. In this design, two intact classes were utilized: the experimental group and the control group. The experimental group was taught using learning portfolio, while the control group was taught using the conventional forms of teaching strategies. Both groups took the pretest and posttest before the start of, and after the conduct of the experiment, respectively.

Both groups were taught using the K-to-12 learner's module in mathematics 8 covering the topics in the second quarter which include key concepts in functions and linear functions. The same activities were administered on individual and group work with the exception that the experimental group was taught with learning portfolio.

For the experimental group, all outputs produced during the experimentation were compiled in a learning portfolio. Assessments of learners' outputs were done instantaneously for the purpose of reinforcing learning. The progression of learners' outcomes from drafts to its final output was based on this assessment. All the participants' outputs were recorded under the formative assessment in the subject.

B. Participants of the Study

The participants of this study were the grade 8 learners of Pangantucan National High School during the school year 2018-2019. Two intact classes out of the eleven sections, with learners of heterogeneous academic achievements, participated in the study. Of the two groups, one was the experimental group and the other was the control group.

The intact classes considered in this study were composed of an average of 50 learners per section. However, only 30 learners from each section were chosen as participants of the study. Both groups were taught using the learner's module in Mathematics 8 of the K-to-12 curriculum.

The participants from the experimental group were matched with the participants in the control group based on their grades in mathematics 8 during the first quarter, and gender. The number of participants in both groups was proportionate in terms of gender population. The distribution of participants is summarized in table 1.

C. Research Instrument

This study used four research instruments to measure the learners' critical thinking, communication, collaboration and creativity skills in mathematics. These instruments were subjected to reliability and validity tests by experts.

a. Critical Thinking Skills Test

The researcher developed a Critical Thinking Skills Test. It is a 15-item multiple choice test to measure the critical thinking and problem-solving skills of the participants. All of the items included in the test are high order questions ranging from 'Applying' to 'Evaluating' levels based on the revised Bloom's taxonomy. The test covered word problems and non-verbal questions on the key concepts in functions and linear functions. It was subjected to content validation, and construct validation by three experts. The test was tried out on grade 9 learners who have undergone the topics being covered. The reliability test result shows a Cronbach's alpha of 0.82 which implies that the instrument is suitable for the purpose of measuring critical thinking skills.

b. Written Communication Rubric for Mathematics

A Written Communication Rubric for Mathematics was used to measure the mathematical communication skills of the participants. This was adopted from Quasar Mathematics General Rubrics with slight modification to suit with the concern of the present study. The modification includes the rating of 'zero' for items without response by the learners. In this study, communication skills were measured based on the learners' writing ability. The learners explain the processes in solving problems on particular items found in the tests. They were rated based on mathematical correctness, clarity, flow and organization and other general principles of communicating mathematics. This material was subjected to content and construct validation by experts.

c. Collaboration Survey Questionnaire

To measure the collaboration skills of the learners, the researcher developed a Collaboration Survey Questionnaire. This is based on the collective impact model of a collaboration of which collaboration is partitioned into components namely; common agenda, continuous communication, shared measurement system, mutually reinforcing activities and backbone functions. Three situations were presented to gauge each component. This is a self-rating tool where the learners provide information about the observed performance of their group during collaborative learning activities. This instrument was subjected to content and construct validations by experts.

d. Mathematical Creativity Skills Test

The learners' creativity skills were assessed using the Mathematical Creativity Skills Test. It is a researcher-made instrument to measure the creative problem-solving ability of the learners. The learners' products were assessed based on flexibility, fluency, and originality. The learners were given four open-ended questions, or questions with a definite answer but may be solved in different ways. The test was developed following the model by Lee (2003) and Akgul. S., & Kahveci, N. G. (2016) on the development of a Mathematics Creativity Scale. This instrument was subjected to content and construct validity by experts.

IV. SUMMARY, FINDINGS, CONCLUSION AND RECOMMENDATION

A. Summary

This study probed on the effects of learning portfolios in mathematics to the 21st-century learning skills of grade 8 learners.

This was conducted in Pangantucan National High School during the second quarter of the school year 2018-2019. The quasi-experimental pretest-posttest research design was used in the study. Two intact heterogeneous classes comprising of 30 learners for each group were the participants of the study. Participating classes were randomly selected from eleven heterogeneously-grouped sections. The learners from the experimental group were matched with the learners from the control group based on their first quarter grade in mathematics, and demographic profile.

A total of four instruments were used in this research. The instruments are Critical Thinking Skills Test, Written Communication Rubric for Mathematics, Collaboration Survey Questionnaire, and Mathematical Creativity Skills Test. Pretest and posttest were conducted before the start and at the end of the experiment, respectively.

The test consists of 15 items multiple choice, and 4-item non-objective test as the part I and Part II of the test, respectively. In part II, the learners are encouraged to produce as many responses as they can for each problem. After which, the learners chose one best answer for each item, and explain thoroughly how those were solved. The learners' creativity skill is assessed on the basis of their output in part II. Communication skills were measured using the written communication rubric for mathematics on the basis of their written explanation of their best answer for each problem in part II.

To answer the problems, the mean and standard deviation were used to describe the performance of the learning groups before and after the experiment. The data extracted from the test were analyzed using the analysis of covariance (ANCOVA) at 0.05 significance level to determine whether a significant difference exists between the performance of the experimental and control groups in terms of each of the 21st-century skills.

B. Findings

At the end of the experiment, the learners who are subjected to a learning portfolio showed better performance in all the 21st-century learning skills than the learners who were taught with conventional strategies. Specifically, the result of the study revealed the following:

1. There is a significant difference in the performances of grade 8 mathematics learners in terms of critical thinking skills when taught using learning portfolio and conventional forms of teaching strategies.
2. There is a significant difference in the communication skills of the Grade 8 mathematics learners when taught using a learning portfolio and conventional forms of teaching strategies.
3. There is a significant difference in the collaboration skills of the Grade 8 mathematics learners who were taught with learning portfolio in mathematics and those who were taught with conventional forms of teaching strategies.
4. There is a significant difference in the performances of the grade 8 mathematics learners in terms of creativity skills when taught using a learning portfolio and conventional forms of teaching strategies.

C. Conclusion

A substantial observation on the findings made this study to conclude that the use of a learning portfolio in mathematics is effective in enhancing the 21st-century learning skills of grade 8 learners.

D. Recommendation

Based on the findings and conclusion, the following are recommended:

1. Mathematics teachers may integrate the use of a learning portfolio in mathematics.
2. The teacher-researchers may conduct further investigations on the use of other forms of a portfolio in mathematics at various grade levels.
3. Administrators may suggest learning action cell (LAC) session in the conduct of in-service training and seminar-workshops on the use of a learning portfolio in mathematics to facilitate and enhance learning and instruction.

REFERENCES

[1]. Akgul. S., & Kahveci, N. G. (2016). A study on the development of a mathematics creativity scale. Eurasian Journal of Educational Research, 62, 57- 76 http://dx.doi.org/10.14689/ejer.2016.62.5

[2]. Department of Education (2013). Curriculum Guide for Mathematics, Philippines.

[3]. Department of Education (2015). Policy Guidelines on Classroom Assessment for K to 12 Basic Education Program. Philippines

[4]. Department of Education (2016). Basic Education Research Agenda. D.O. no. 39, s. 2016. Philippines

[5]. Gagarani, Jean P. (2013). Alternative Assessment in Secondary Mathematics: Are the Teachers Ready? Unpublished Thesis. Bukidnon State University. Philippines.

[6]. Lee, K.S. et. al. (2003). Development of the Test for Mathematical Creative Problem Solving Ability. Dankook University, Hannam-dong, Yongsan-ku, Seoul 140-714, Korea

[7]. Paulsson, F. L. , Paulsson, P. R. & Meyer, C (1991) What makes a portfolio a portfolio? Educational Leadership 48, 5. 60-63.

[8]. Sangcap, A. & Giovanni, P., (2010). Mathematics-related Beliefs of Filipino College Students:Factors Affecting Mathematics and Problem Solving Performance. Procedia Social and Behavioral Sciences https://www.sciencedirect.com/science/article/pii /S1877042810021695 last retrieved: 3/26/2019

[9]. Scully, D., O'Leary, M. & Brown, M. (2018). The Learning Portfolio in Higher Education: A Game of Snakes and Ladders. Dublin: Dublin City University, Centre for Assessment Research, Policy & Practice in Education (CARPE) and National Institute for Digital Learning (NIDL).

[10]. Sturt, David and Nordstrom, Todd (2016). Want To Be A Successful 21st Century Workplace? https://www.forbes.com/sites/davidsturt/2016 /01/22/want-to-be-a- successful- 21st- century-workplace-start-here/#7410 e8062f7d Last retrieved: August 13, 2018