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Strengths of Formative Assessments (Daily Time-pressured Quiz, Homework and Portfolio) on Students' Summative Assessment Performance in Integral Calculus

DENNIS B. ROBLE
ORCID NO. 0000-0001-8322-7064
dennisroble@gmail.com

CHARITA A. LUNA
ORCID NO. 0000-0002-9026-2121
charita_luna@yahoo.com

Department of Mathematics Education
College of Science and Technology Education
University of Science and Technology of Southern Philippines
Lapasan Highway, Cagayan de Oro City, Philippines

ABSTRACT

This study reports the impact of varied formative assessments on students' summative assessment performance. Formative assessments are used by teachers to gauge how effective are the instructions done to get feedback, improve instructional strategies and plan for future innovations. This study used thirty-two Electronics and Communications engineering students taking up Integral Calculus during the school year 2016-2017 at the University of Science and Technology of Southern Philippines, Cagayan de Oro City. These students were subjected with daily time-pressured quizzes, homework and once-in-a-week portfolio. The researchers tried to determine which of the formative assessments have high influence on the summative assessment which is the departmental examination in Integral Calculus. Using regression analysis, results revealed that the best predictor of the formative assessments is the daily time-pressured quiz. The researchers recommend to teachers to give students' daily time-pressured quizzes in their mathematics classes to be ready for high stake examination.

***Keywords*:** Formative assessment, Summative assessment, Daily time-pressured quiz

INTRODUCTION

Learning is an outcome of instruction. However, instruction need assessment to determine its effectiveness. Researches have shown that formative assessment can improve students' learning more than most instructional practices (Hattie, 2012). Empirical evidence also revealed that implementation of well-crafted formative assessment increase students' scores, narrow achievement gaps between low achieving students and others (Black & William, 1998). But which formative assessment can best impact summative assessments?

Inevitably, formative assessment is associated with summative assessment (Fernandes, 2017), since formative assessment have important purposes if taken on regular basis. It gathers information about students' assimilation of concepts discussed in class, provide important feedback about students' understanding, guides teachers for future instructional innovation for higher mathematical thinking and measures students' achievement. In addition, the long term effect of formative assessment evidence in the summative assessment are used by the school system at the end of the school year for students' promotion. Moreover, when students seek admission in universities, they are subjected with assessments to determine their capability for university mental rigors. Fortunately, the ideas and concepts that are left in the students' minds are the long-term effect of the instruction which made them ready for any high-stake examination (Johnson & Kiviniemi, 2009).

FRAMEWORK

Formative assessments as used by teachers come in many forms during instruction to gauge their students' learning against learning objectives (Clark, 2013). The purpose is to refine instruction based on feedback (Cauley & McMillan, 2010). It is also function as indicator of students' progress to address intervention and reform for higher performance. To reach a higher performance in Mathematics, some scaffoldings need to be done through formative assessment. These scaffoldings are daily time-pressured quiz, homework and portfolio which are often used by classroom teachers at present.

Daily Time-pressured Quiz

Daily time-pressured quiz as one of the formative assessment used by teachers goes beyond evaluating students' learning and daily feedback for improvement of instruction but it is also used to hone students for future national and international assessments. It is a fact that all government examination like board examination, entrance to a university, scholarship and others are under time pressure, and examinee needs focus, concentration, and familiarity. Siadat, (2010) believed that fluid intelligence which is needed in any examination can be acquired through training. Fluid intelligence is an ability of a person to possess flexibility and fluency in the use of all his stored knowledge, ability and skills with ease in any situation and circumstances. He further said that battery of daily time-pressured quiz can develop mind focus and concentration which are important for problem solving, critical thinking, creativity, connection and relationship of ideas. If the mind is simulated to take time-pressured daily quiz, the students' mind is conditioned to focus and concentrate to analyse the tasks at hand similar to (Thorndike, 1898) classical conditioning theory. This daily time-pressured quiz is one of the scaffolding that help support the students' preparation for high stake examination in the future for higher achievement.

In addition, daily time-pressured quiz gives more benefit to students because it develops a habit of studying lessons every day to prepare for the test, improve attendance to participate the quiz and help retain the concepts studied for longer period of time (Chump, Burler, & Alex, 2003; Johnson & Kiviniemi, 2009)

Portfolio Assessment

Portfolio is another formative assessment considered by most educators as an alternative assessment. It comes in many forms but in this study, it focused on content mathematics portfolio design to demonstrate mastery of essential skills, explain procedures and communicate conceptual understanding (Fukawa, Connelly et al., 2010). The goal is for the teacher to see how students' thinking in Integral Calculus have illustrated the connections of concepts and theories in solving problem and exercises, so that students can view themselves as mathematicians (Stenmark, 1994. p. 37). Open-ended problems are their tasks in the portfolio to be solved by groups for brighter students in their group to help the slower ones and avail the expertise of consultant as contended by Vygotsky (1978) zone of proximal development (ZPD) for better assimilation, connection and understanding of concepts. Furthermore, Midkiff and Thomasson (1993) said that portfolio assessment can evaluate both product and process which can

be seen in students' written work, since solution required reason and justification by writing the theorems and rules used appropriately. Also, portfolio encourage students to be responsible for their own learning which motivates them to develop skill for life-long learning.

Homework

Homework is always given by the teachers for reinforcement after instruction. It is a task outside of classroom expected to be done at home but students prefer to do it in school to solicit help from their classmates (Cooper, et.al, 2006). There is positive correlation of homework and achievement (Walberg, 1991) that is why many teachers used this scaffolding to help students assimilate concept and process. From homework score, teachers can gauge how far the student understand the topics discussed although they asked the help of classmate. Homework is handwritten, hence their minds are at work while doing the tasks. The task allow students to simulate all the theories appropriate in the topics as well as the processes to come up to a product.

OBJECTIVES OF THE STUDY

This study aimed to determine the strengths of formative assessments namely, daily-time pressured quiz, homework and portfolio in improving students' summative performance in Integral Calculus. Specifically, it sought to (1) determine the levels of performance of the students' on formative assessments (daily time-pressured quizzes, homework and portfolio) and summative test (final departmental examination) in Integral Calculus, (2) determine the strength of these formative assessments on students' summative test performance in Integral Calculus.

METHODOLOGY

This study is descriptive which was done for 9 weeks with a total of 45 hours actual instructional period. The participants of the study composed 32 students of one section of Electronic Communication Engineering (ECE) taking up Integral Calculus in school year 2016-2017. These students were expected to take the board examination conducted by the Professional Regulatory commission (PRC) after graduation.

The Mathematics teacher of this class gave lecture with a daily time-pressured

quiz and a daily homework. The portfolio was given once a week for nine (9) weeks. The portfolio was done by groups with leaders. Each group leader were called by the teacher to check their individual portfolio with a discussion how to give points in the rubrics. The leader took leadership in checking the portfolio of each member. When some students have different solution but with correct answer, the leader consulted the teacher how to give points using the rubric. Varied solutions are encouraged to develop creativity provided no violation of mathematical rule were committed. A week later after nine (9) weeks, the students were given the departmental final examination. The total daily time-pressured quiz, homework, and portfolio scores were considered the formative assessment while the final departmental examination score is the summative assessment.

These data collected were also used as bases of students' grade for the promotion. The same data were used to determine which formative assessment has the best impact on the students' summative assessment which is the departmental examination in Integral Calculus. These data collected were analyzed using mean, standard deviation, and Pearson product measurement correlation and regression analysis.

RESULTS & DISCUSSION

The results of the analysis of the data collected are shown in the following tables:

Table 1. Mean and Standard Deviation (SD) in terms of Scores

Variables	Perfect Score	Mean	Standard Deviation (SD)
Daily Time-pressured Quiz	215	135.81 (63%)	31.73
Homework	167	161.42 (96.6%)	3.42
Portfolio	339	337.29 (99.7%)	1.72
Final Departmental Examination	140	66.84 (66.2%)	22.64

Table 1 shows that the students mean score in the daily time-pressured quiz is only 63% of the total points of 215 which reveal that on the average no one have passed the university standard of 70% passing percentage. The highest score is 196 and the lowest score is 82. This results shows that if the basis for students grades is only the short quizzes, midterm and final examination, very few of the ECE students will pass the course. Furthermore, the standard deviation is very large which means that the scores of the students are widely dispersed and the students are heterogeneous.

The same table shows the mean of students' homework which were scored using rubrics. The mean is 96.6% of the total points of 167. Their scores are high because they have solicited help from their classmates. The standard deviation is 3.42 which is less dispersed. The scores are more close to each other. The table further shows the portfolio assessment mean score which is 99.7% of the total points 339. The rubric of each item varies. Shorter solutions have lesser points and difficult problems earned bigger points. This means that many students did their tasks and have tried their best. The standard deviation is very small which means that the students were homogeneous because their scores are very close to each other.

However from the same table, the final examination total points of 110 and the mean is only 66.2%, a little higher in percentage than the time-pressured

quizzes scores. This means that the students' ability have improved but still short of the university standard of 70%. Although, there are two students who got perfect but many are below the mean. The standard deviation of 22.64 which revealed that the students' scores in the final departmental examination is widely dispersed.

To determine which among the formative assessments have the best impact on the students departmental examination, further analysis was done.

Table 2. Relationship between Students' Scores in the Formative Test and Final Examination Performance

Variables	Pearson (r) Value	p-value	Conclusion
Daily Time-pressured Quiz	0.626	0.000*	Significant
Homework	-0.078	0.676	Not Significant
Portfolio	0.272	0.138	Not Significant

*significant at p<0.05 alpha level

Table 2 shows the relationship between the students' scores in the formative assessments and the final departmental examination performance. The daily time-pressured quizzes has a highest correlation of 0.626 with the departmental final examination which is considered as the summative assessment followed by the portfolio assessment and the last is the homework. The portfolio assessment might have been the next higher correlation because the tasks given to students were to give reason why they used the theory in answering the open-ended questions and it allowed them to communicate in written form. The homework negatively correlate with summative test because most of the students got high scores in homework but low score in the summative test. Their homework might have been just copied from their classmates without deeper thinking and they did it for compliance. In addition, the nature of doing their homework is procedural although it was done handwritten.

Furthermore, among the three formative assessments, the daily time-pressured quiz showed significant relationship as indicated by the p-value of 0.000. This implies that daily time-pressured quiz possess a strong association on the students summative assessment performance which means that strong performance in the quiz would indicate good score in the final departmental examination. Therefore, students' need to perform well in the daily time-pressured quiz as compared to homework and portfolio which showed no significant relationship.

Table 3. Result of the Regression Analysis of the Formative Assessments and the Departmental Final Examination as the Summative Assessment

Predictors	Coefficient	SD	T-value	p-value
Constant	-228.1	656.2	-5.11	0.277
Daily Time-pressured Quiz	0.4588	0.1018	4.51	0.0001*
Homework	-1.1924	0.9436	-1.26	0.217
Portfolio	2.743	1.855	1.48	0.151
S= 17.31	R-squared = 47.4%		R-square adj. = 41.5%	

*significant at 0.05 alpha level

Table 3 shows the result of the regression analysis of the three formative assessments on the final departmental examination as the summative assessment. The analysis yielded a T-value of 4.51 with a probability value of 0.0001 which means that the daily time-pressured quiz is the best predictor among the three formative assessments. This implies that when the mind has experienced simulation through many activities with deeper thinking and persistence it hones their thoughts to focus and concentrate that yields a better retention of ideas. This results confirmed Siadat (2010) belief that fluid intelligence can be acquired through training.

The table further revealed that the portfolio assessment has partly contributed 41.5% to the summative assessment but it failed to reach the significant level. This contribution is possible since portfolio demonstrates essential skills, explain procedure and communicate conceptual understanding which strengthens retention as contended by Fukawa (2010). This result confirmed also Chump et al. (2003) that the students who have experienced daily quizzes developed a habit of studying every day and help retain concepts for longer period of time.

CONCLUSION

Based on the results of the analysis and findings, the researchers concluded that daily time-pressured quizzes have the strongest impact on students' summative assessment performance in Integral Calculus. Although, homework and portfolio are important classroom reinforcement activities in the learning of mathematical concepts, students need to perform well in the daily time-pressured quizzes to excel in the summative assessment.

RECOMMENDATIONS

1. The researchers recommend that teachers may use daily time-pressured quizzes in their classes because it enhances students summative assessment scores, encourages students to attend classes every meeting, study their lesson every day and prepare students for high stake examinations.

2. This study may be replicated by future researchers by adding more sections not only those taking board examinations after graduation.

3. They may add more formative assessment activities in comparison to daily time-pressured quizzes and try this out also to senior high schools offering Science, Technology, Engineering and Mathematics (STEM) track.

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