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Development of Performance Task Activity in Teaching Systems of Linear Equation

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The researchers design a lesson using the Understanding by Design framework on the topic Systems of Linear Equations, the lesson was developed based from Department of Education standards and embedded assessment throughout the learning task. The designed lesson engaged the students in investigating the essential question "How do we make decision?". In this activity students take the role as a team of entrepreneur in planning a business. Students explore on a mathematical model to describe the relationship the number of days of selling and the amount of sales. Students report their findings thru multimedia presentation. Students use checklist and rubric to monitor their own progress and provide feedback to their classmates. Most groups have a very satisfactory rating on their presentation. There is a significant increase on their posttest scores when compared to their pretest scores. There is no significant difference between male and female student in terms of their posttest scores. Results also show that there is a positive linear relationship between motivation scores and performance in Mathematics.

Since performance task activity helped students to improved their Mathematics performance, the researchers recommend to encourage teachers to design Mathematics activities that enable students to monitor their own progress, create products and develop problem solving skills.

INTRODUCTION

According to Macmillan (2008), assessment of students is critical because effective decision-making is based to some extent on the ability of teachers to understand their students and match actions with accurate assessments. Teachers need to think of variety of assessment to gauge learning of the students.

Part of the educational reform in the Philippines is structuring the curriculum using the Understanding by Design Framework. The framework guides teachers on designing student – centered activities through the following steps (1) identifying desired results (2) determine assessment evidence and (3) create learning plan. In determining assessment evidence, teachers need to think of performance task and other evidence of understanding using varied assessment methods.

Performance based assessment could be used at the end of the instructional unit to find out what students know and whether they use the skills that were taught to make sense in real-life situation. Teachers design tasks that match specific learning goals and standards.

The researcher designs a lesson using the UbD framework on systems of linear functions, the lesson was developed based from DepEd standards and embedded assessment throughout the learning task. In this line, the researcher investigated the achievement gains of the student using performance task in mathematics classroom. In addition, the researcher also investigated the gender differences in achievement scores.

REVIEW OF RELATED LITERATURE

Fan and Zhu (2008) investigated the effects of integrating performance assessment into regular school mathematics teaching and learning. The results in the normal school exams showed that the changes in students' performance across three continuous school semester tests were significantly preferable in the experimental classes. Moreover, the changes occurred after the intervention program had been implemented about one school year, where the experimental class completed 7 interventions, and maintained till the interventions ended. Although it is hard to attribute the positive result solely to students‟ experience with performance tasks, it appears clear that the students from the experimental classes did benefit from being exposed to performance tasks.

Mendoza (2005) reported on the use of authentic and open ended tasks, he stressed the value of performance tasks in helping develop concepts and problem solving skills, it provide a basis to help students see the value of mathematics in the real world. Performance-Based Assessment implies that the measure encourages students to perform, create, and produce solutions while using contextualized problem solving and higher level thinking (Hatfield, Edwards, Bitter, & Morrow, 2005).

Bezzina (2010) investigated the gender differences in mathematics performance and in self-regulated learning (SRL) in Malta. He found out that girls performed significantly better than boys. While all SRL components identified by factor analysis (self-efficacy, intrinsic value, test anxiety and SRL strategy use) produced a significant main effect on performance, girls reported greater use of SRL strategies, boys claimed to be more self-efficacious and intrinsically motivated while no significant gender difference was reported for test anxiety.. This empirical study confirms that gender differences constitute a potentially important source of variation in students' mathematics performance and in their SRL. The issue of increasing the students' use of SRL strategies emerges as a possible strategy aimed at combating gender differences in mathematics performance as well as the underachievement of students, particularly that of the low-achieving boys in Maltese secondary schools.

RESEARCH QUESTIONS

This study focuses on the effects of using performance tasks in mathematics instruction on students. The study was intended to address the following research questions:
There is a significant increase on their posttest scores when compared to their pretest scores. Results also shows that there is a significant difference between male and female student in terms of their achievement scores.

1) What are the steps in developing a performance based task?
2) Is there a significant difference between pretest and posttest scores?
3) Is there a significant difference between male and female students in terms of posttest scores?
4) Is there a relationship between posttest scores and motivation scores?

It is hoped that the study can provide research-based evidence on the potential influences of using performance tasks activity in Mathematics classroom, learning so as to help school teachers better align assessment practice with the desired educational goals and hence improve the quality of teaching and learning.

Sample

A total of 98 fourth year high school students in IIligan City East High School participated in this research. Three heterogeneous groupings were considered in this study.

Instruments

Systems of Linear equations portfolio composed of lesson guide, achievement test, assessment tools and student samples. Pretest and posttest was created to measure achievement scores of the students.

The researchers also utilized self -report Intrinsic Motivation Inventory to assess students' subjective experience related to their performance task activity.

Procedure

The researchers developed the lesson guide using the UbD framework and also created support tools in implementing the activity. The lesson guide was presented to the teacher and modified some tools and process for classroom implementation. To gauge students' needs the pretest was done. Teacher followed the procedure written in the lesson guide. Students' outputs during the performance task were rated using the rubric. Posttest and intrinsic motivation inventory were given after the showcasing of their outputs.

Analysis

To determine the significance difference between the male and female performances, t-test for independent samples was utilized.

To determine the relationship between the achievement scores and level of motivation towards the performance task, Pearson's' r correlation was utilized.

RESULTS AND DISCUSSION

Development of the Lesson

The researchers developed a lesson that engage student's interest in Mathematics. The researchers followed the three stages on Understanding by Design Framework starting with the desired results, assessment evidence and learning plan.

<table>
<tr><th colspan="2">STAGE 1 – DESIRED RESULTS</th></tr>
<tr><td colspan="2">Unit Title: Let us Plan a Business
General Standard: (From 2010 SEC)
The learner demonstrates understanding of key concepts and principles of number and number sense as applied to equations and inequalities, communicating mathematically and solving problems in real life.

Content Standard
The learner demonstrates understanding of key concepts of systems of linear equations and inequalities in two variables.

Performance Standard
The learner creates situations/ problems in real-life involving systems of linear equations and inequalities in two variables, and solves these by applying a variety of strategies</td></tr>
<tr><td>Understandings: Students will understand that…
• Unknown numbers in certain real-life problems may be derived from solving systems of linear equations and inequalities in two variables.</td><td>Essential Questions:

How will I make decisions?

Unit Question
• How is knowledge of systems of linear equations and inequalities in two variables used to solve real life problems?

Content Questions:
What is systems of linear equations?
What is a solutions set of systems of linear equations?</td></tr>
<tr><td colspan="2">Learning Objectives (How will you emphasize the six facets of understanding?)</td></tr>
<tr><td>Students will know:

Systems of linear equations and its applications on real world</td><td>Students will be able to:
• 1. Define systems of linear equations in two variables
2. Solve systems of linear equations using graphical method
3. Solve systems of linear equations using algebraic solution
4. Explain the solution of systems of linear equations.
5. Interpret systems of linear equations
5. Use systems of linear equations to model real world problems.
6. Formulate implications on the linear equation models.
7. Make decision on the real –world problems involving systems of linear equations.</td></tr>
</table>

Figure 1. Stage 1 Identifying Desired Results

In Stage 1, the researchers created curriculum-framing questions that were aligned to the standards. The questions served as a guide on developing learning objectives of the lesson.

STAGE 2 – ASSESSMENT EVIDENCE
(How will you monitor, assess, and evaluate the extent to which students know, do, and understand your Stage One results?)

Performance Tasks Description:	**Other Evidence:**
Goal *Role* *Audience* *Situation* *Product* *Standards*  Let us Start a Business.doc	**Pre test** **Post test** **Peer Feedback** **Self – assess**

Assessment Plan

Before project/task work begins	Students work on projects and complete tasks	After project/task is completed
Pre-test ***Brainstorming***	***Business presentation Checklist*** ***Peer feedback*** ***Journal*** ***Short Quiz*** ***Problem Solving Rubric***	***Rubric for the project*** ***Post test*** ***Journal***

Figure 2. Stage 2. Determining Assessment Evidence

In stage 2, the researchers identified engaging performance task to developed problem solving, collaboration and communication skills of the students. Other assessment evidences of learning were identified. An assessment plan was created ensure successful implementation of assessments to support learning. A performance-task activity was developed using the GRASP framework

Let us Start a Business

Gol

As you do this activity, reflect on the question " How do we make decision?". Your class is task to plan a business(sari-sari store) to be ventured by your student council. You will record details of your sales and use graphs to model your investment and relationship between the days of sellling and the amount of sales. You will use your Mathematics problem solving skill to make decisions on running a business.

Role

You will act as team of entrepreneurs who will plan for a business. Decide within your group who will play the following role and tasks

Role	Tasks
Marketing Manager	You will facilitate the group in making decision on the product to sell.
Cashier	You will keep the money of the group and decide on what amount to be released for marketing product
Accountant	You keep track on the sales and expenses of the operation. Give information to the team on daily operations.
Clerk	You document all the activities and schedule a meeting in discussing the updates of your business

Audience

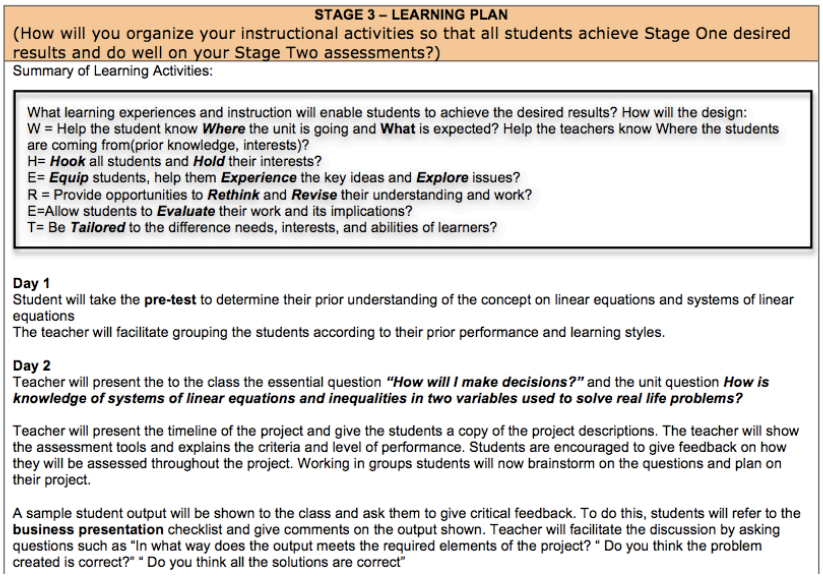
As a team you will present a presentation to the student council on the result of your business venture and recommend product to sell in student council canteen.

Situation

Your team is task to do a business presentation to pursuade student council leaders on the product to sell.

Product

Your team will create a business presentation which includes Mathematics problem using systems of linear equations, interpreation and explaination of the graph depicting the daily sales.



STAGE 3 – LEARNING PLAN

(How will you organize your instructional activities so that all students achieve Stage One desired results and do well on your Stage Two assessments?)

Summary of Learning Activities:

What learning experiences and instruction will enable students to achieve the desired results? How will the design:
W = Help the student know ***Where*** the unit is going and **What** is expected? Help the teachers know Where the students are coming from(prior knowledge, interests)?
H= ***Hook*** all students and ***Hold*** their interests?
E= ***Equip*** students, help them ***Experience*** the key ideas and ***Explore*** issues?
R = Provide opportunities to ***Rethink*** and ***Revise*** their understanding and work?
E=Allow students to ***Evaluate*** their work and its implications?
T= Be ***Tailored*** to the difference needs, interests, and abilities of learners?

Day 1
Student will take the **pre-test** to determine their prior understanding of the concept on linear equations and systems of linear equations
The teacher will facilitate grouping the students according to their prior performance and learning styles.

Day 2
Teacher will present the to the class the essential question ***"How will I make decisions?"*** and the unit question ***How is knowledge of systems of linear equations and inequalities in two variables used to solve real life problems?***

Teacher will present the timeline of the project and give the students a copy of the project descriptions. The teacher will show the assessment tools and explains the criteria and level of performance. Students are encouraged to give feedback on how they will be assessed throughout the project. Working in groups students will now brainstorm on the questions and plan on their project.

A sample student output will be shown to the class and ask them to give critical feedback. To do this, students will refer to the **business presentation** checklist and give comments on the output shown. Teacher will facilitate the discussion by asking questions such as "In what way does the output meets the required elements of the project? " Do you think the problem created is correct?" " Do you think all the solutions are correct"

Figure 3. Stage 3. Design Learning Plan

In stage 3, the learning plan was then developed ensuring that the instructional activities are organized to achieve desired results and targeting the evidences of learning.

Pretest was given to determine the prior content knowledge of the students and being addressed during instruction. Posttest was done to determine the students demonstrated understanding on targeted desired results. Pretest and posttest scores were summarized in Table 1.

Table 1. Comparison of Pretest and Posttest scores

Test	Mean	Standard Deviation	Compute t-value	t-critical
Pretest	8.20	0.39	8.39	1.97
Posttest	13.89	0.56		

H_o: There is no significant difference between pretest and posttest scores

As shown in Table 1, the students have higher mean posttest scores compared to pretest scores. Since the computed t-value of 8.39 is greater than t-critical, then the null hypothesis *"There is no significant difference between pretest and posttest scores*" is rejected. The performance of the students in posttest is significantly better compared to their pretest scores.

Further analysis was done to compare male and female posttest scores. Summary of the posttest scores is shown in Table 2.

Table 2. Comparison of Male and Female Posttest scores

Sex	Mean	Standard Deviation	Compute t-value	t-critical
Female	13.22	4.77	1.24	1.98
Male	14.60	6.18		

H_o: There is no significant difference male and female posttest scores

As shown in Table 2, the male students have higher mean posttest scores compared to female studets. Since the computed t-value of 1.24 is less than t-critical of 1.24, then we failed to reject the null hypothesis *"There is no significant difference between pretest and posttest scores*". This implies that male and female perform equally in the posttest scores.

Motivation intrinsic inventory was given at the end of the activity, a linear relationship exist between Mathematics performance and motivation scores as shown in Figure 4.

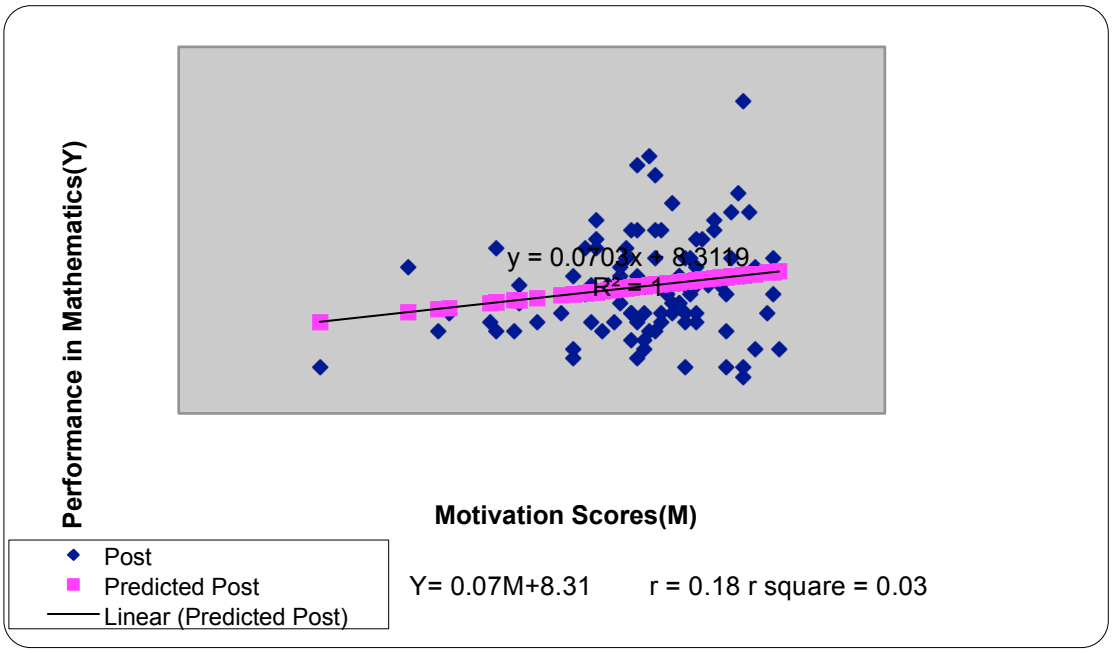


Figure 4. Scatter plot and regression line on the relationship of performance in Mathematics and Motivation Scores.

Figure 1 shows that that the performance and motivation scores of the students have a weal positive relationship with r = 0.18. The positive linear relationship implies that the higher the motivation score, the higher the performance in Mathematics.; or the lower the motivation scores, the lower the performance. The strength of relationship of the variability explained in performance as explained by motivation scores is only about 3%.

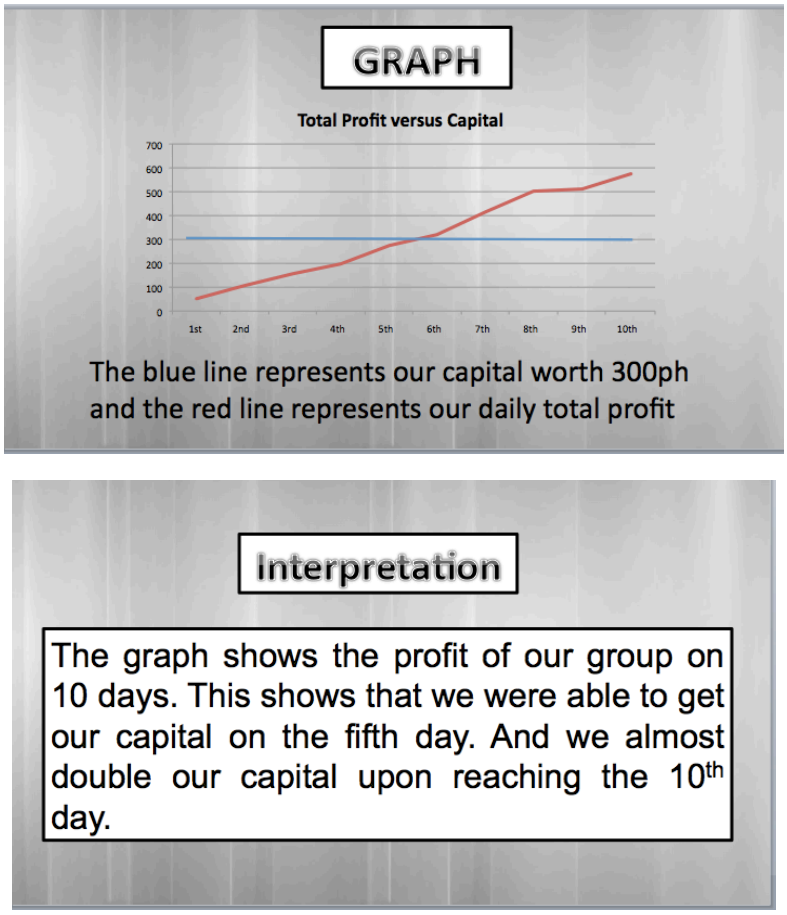


Figure 5. Sample presentation slide of the students on the performance task activity

As the students work on their outputs, constant monitoring was utilized using the checklist and peer evaluation. The outputs of the student were evaluated using the rubrics. Multimedia presentation outputs showed that the student students demonstrate understanding on the application of systems of linear equations in business.

SUMMARY AND CONCLUSIONS

The researchers followed the three stages on Understanding by Design Framework starting with the desired results, assessment evidence and learning plan. Investigating the influence of the performance task in pretest and posttest scores, researchers found out that there is a significant increase on their posttest scores when compared to their pretest scores. The researchers also found out that there is no significant difference between male and female student in terms of their posttest scores. Results also show that there is a positive linear relationship between motivation scores and performance in Mathematics.

The multimedia presentations of the students demonstrate understanding of the content by applying the

RECOMMENDATIONS

Based from the findings of this study, development of the performance - based task engaged students and helped them understand the content as shown in the increase of the students' posttest scores. The researchers recommend training for teachers in designing Mathematics activities that that enable students to monitor their own progress create products and develop problem-solving skills.

Since there is weak relationship between motivation scores and performance in Mathematics, the researchers recommends to continue exploring the relationships of the variables by continuously implementing the performance task activities in Mathematics classroom and determine its relationship to motivation.

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