

# Authentic Learning Activity (ALA) on the Application of Quadratic Equation for Grade 9 Learners

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## ABSTRACT

Authentic learning has gained global recognition and is considered vital in the teaching and learning process in modern education. This approach emphasizes the practical application of knowledge and skills, bridging the gap between theory and real-world practice. It is a student-centered approach in which learners engage in authentic activities that allow them to demonstrate knowledge and skills similar to those used by professionals in their respective fields of expertise. Moreover, authentic learning activities entail tasks that emphasize real-life problems, which go beyond memorization. Despite its benefits, research on authentic learning activities remains limited, particularly in teaching Algebra in the Philippines. To address this gap, this study aims to develop and validate an authentic learning activity for Grade 9 learners using the ADDIE Instructional Design Model. In this study, the authentic learning activity consisted of a series of interrelated activities that helped students connect quadratic equations to the real world. It employed a one-group pretest-posttest design with 25 Grade 9 learners in one of the public high schools in the Division of Misamis Occidental. An achievement test was used to measure learners' achievement levels. The results showed that 56 percent of the learners demonstrated an improvement in their achievement levels, while 44 percent of the learners maintained the same achievement level after the implementation of the activity. In addition, there is a significant difference between the learners' pretest scores and posttest scores at  $p < 0.01$ . Thus, there is a significant improvement in the learners' gained scores after the implementation of the authentic learning activity

**Keywords-** Antithetic Learning, Authentic Learning Activities, ADDIE Model, Development and Validation, Quadratic Equation

## INTRODUCTION

Authentic learning has gained global recognition and is considered vital in the teaching and learning process in modern education. This learning approach highlights the practical application of knowledge and skills connecting the gap between theory and real world practice. It is a student-centered approach where learners co-construct their own knowledge by engaging in and addressing real-life problems [3]. Existing literature highlights key features of authentic learning that are well-suited for 21st-century learners, such as offering real-world contexts that demonstrate how knowledge is applied in real-life situations, providing meaningful activities with real-world relevance, and creating opportunities for learners to share and access learning experiences with each other [15].

Authentic learning activity is one of the basic elements of authentic learning [12]. Authentic learning activity entails tasks that emphasize real-life problems, and task beyond memorization. These tasks are set of complex and ill-define real-life problems with multiple solutions [12].[14] defined authentic learning activity as purposeful and engaging that encourage learners to solve real-life problems, provide a learning environment where they can demonstrate their knowledge and skills, and offers opportunities for a meaningful learning. Furthermore, it provides students the opportunity to apply the knowledge they learned into practice[8]. Hence,

learners are more likely to engage in the classroom activities when they feel the lessons are directly relevant to them and will be useful in their own lives [2][13].

In reviewing the literature, Herrington, Oliver, and Reeves (2003) elaborated ten (10) characteristic sets as guidelines in designing authentic learning activities. Authentic learning activities should have (1) real world relevance, (2) ill-defined that required learners to define the task and sub-tasks need to complete the activity, (3) comprised of complex tasks that enabled learners to investigate over a sustained period of time, (4) provide opportunity for learners to examine the task from different perspective, (5) helped the learners to work collaboratively, (6) provide opportunity to reflect, (7) can be integrated and applied across different subject areas, (8) integrated with assessment, (9) create polished products, and (10) allowed completing solution and diversity of outcomes. Moreover, [16] explained that the entire process of designing an authentic learning activity must cover a large number of characteristics listed, for it is indeed, necessary for any developed activity to be seen as authentic.

Several studies examined the potential benefits of authentic learning activity in the field of education. When incorporating authentic learning activity in mathematics instruction, studies have shown that it enhances critical thinking skills, including comprehension, comparison, proposing new solutions, proving, and reflecting on the problem-solving process[4]. The integration of this type of activity positively affected the academic achievement of the learners[5]. In a recent study conducted by [12] similar result showed that authentic learning activity improved academic achievements among the learners in ratio and proportion. Furthermore, [18] concluded that such activity positively influenced learner's attitude towards the course and appreciated the use of authentic learning activity as it helped learners easily understand and remember the concepts being taught. Despite its benefits, research on authentic learning activities remains limited, particularly in the context of teaching Algebra in the Philippines.

To address this gap, the study focused on the development and validation of an authentic learning activity for teaching selected topics in Grade 9 Algebra. Specifically, it aimed to create an activity aligned with the DepEd K-12 Mathematics Curriculum and the Most Essential Learning Competencies (MELCs), particularly for teaching quadratic equations in one variable.

This study aimed to develop and validate authentic learning activities in Quadratic Equation for grade 9 learners. Specifically, the study aimed to attain the following objectives:

1. Describe the development procedure of authentic learning activity in quadratic equations for Grade 9 learners using the ADDIE Model.
2. Investigate learners' achievement level in Quadratic Equation through the implementation of authentic learning activity.
3. Determine the learner's perception of utilizing authentic learning activity through its implementation.

## **METHODS**

### **Research Design**

This study employed a one-group pretest-post-test design with qualitative support. This study was conducted to develop authentic learning activity in teaching quadratic equations. The scores of the students in the achievement test were used as the quantitative part while the perception was done by a short interview served as the qualitative part. The scores of the learners in pretest and post-test were analyzed using a paired t-test because the data were found to be at the normal range. The qualitative data were obtained to support the quantitative data described using sentences to reach a conclusion. Lastly, a thematic analysis was used to analyze and interpret the student's perception towards authentic learning activities.

### **Research Setting**

This study was conducted in one of the public high schools of the Division of Misamis Occidental, Misamis

Occidental. The said school offered Junior High School (Grades 7- 10) and Senior High School (Grades 11 to 12). The researcher utilized the said school with the approval from the DepEd Division of Misamis Occidental and the office of the School Principal.

### **Research Participants and Sampling**

This study used a stratified sampling method in the selection of the participants. It is a method that belongs to the category of probability sampling technique. Stratified sampling divides the population into several sub-group of population (strata) that are individually more homogeneous than the total population. The researcher randomly identified one (1) section out of three (3) sections in the Grade 9 level.

### **Research Instruments**

The Achievement Test was utilized in this study to determine the achievement level of the learners, particularly in the first two (2) most essential learning competencies of the K-12 Mathematics First Quarter Curriculum. To ensure the content validity of the achievement questionnaire, a table of specification (TOS) was utilized. Moreover, this 25-item multiple choice achievement questionnaire was tried out at other public schools in the division of Misamis Occidental. It underwent an item analysis process to assess reliability of the test. Based on the result, there are nine (9) items that were considered as a poor item and need to be rejected. These items were revised by the researcher with the help of the class adviser.

A standardized rubrics from DepEd LRMSD for printed materials was adapted. This evaluation tool consists of both numerical and qualitative responses from the panel of evaluators which were used to evaluate the developed ALA prior to implementation. A checklist consisting of ten characteristics of authentic learning developed by Herrington, Oliver, and Reeves (2003) was adapted to assess the authenticity of the developed Authentic Learning Activity (ALA). This checklist provided a framework for evaluating how well the ALA aligned with key principles of authentic learning. Guide Interview Questionnaire was utilized. It consists of five (5) open-ended questions to determine how the authentic learning activity affected their learning and how it helped them in learning quadratic equations.

### **Data gathering procedure**

The following steps were based on the ADDIE instructional Design Model developed by the Florida State University in 1975 in developing the Authentic Learning Activity (ALA) in Algebra. It follows a systematic process: Analysis, Design, Development, Implementation, Evaluation.

In the analysis stage, the researcher identified the learning objectives that fall under first (1) and second (2) competency of the MELCs in mathematics 9 first quarter. The researcher asked one mathematics teacher who was handling grade 9 Mathematics for over ten (10) years and some learners.

In the design stage, the researcher planned how to relate the learning objective in the first and second competency into the actual setting considering the context and the situation of the learners where the study was conducted. The results of the design stage are as follows: the draft guidelines used in the development of the ALA, and the template used for the ALA

In the development stage, the researcher developed the ALA based on the results from the design stage. The panel of evaluators evaluated it using the Evaluation Rating Sheet for Print Materials and Modified Authentic Learning Activity Checklist. Then, the researcher revised the ALA based on the comments and suggestions of the evaluators.

In the implementation stage, the following were the steps followed by the researcher in the implementation of the study. After the validation of the ALA by the panel of evaluators, achievement test validation, ethics committee approval, the researcher requested permission through a letter from the school principal to conduct the research study to their respective school.

Upon the approval by the school principal, the researcher was referred to JHS Academic Head Teacher and

later was introduced to the cooperating adviser. The researcher communicated the purpose of the study to the cooperating adviser and asked her permission to use the section in the study. After the approval, the researcher went back to the school to formalize the distribution of the parent's consent and learner's assent form to finalize the list of participants in the study and the forms were collected the following week.

After collecting the parents consent and learner's assent form, the researcher conducted a short orientation regarding the research study. The researcher informed the learners the goals, objectives of the study, how long it will be conducted, and explained the agreement that all the data collected in this study will be confidential. After the orientation, a pretest was conducted using paper and pencil. The achievement was done a week before the implementation of the study. The scores were checked and recorded to be used in the analysis.

The researcher began the implementation of the ALA after a week of discussion on the quadratic equation. The class was divided into four groups (4) consisting of 5 learners in every group and they were grouped using the traditional counting method. The activity consists of four (4) sub-activities. These sub-activities are a series of interrelated activities that help students connect quadratic equations to the real-world. The learners were expected to complete one (1) sub-task every session and by the end of the session they were expected to submit their outputs.

After two weeks of implementation, the researcher conducted the same achievement test as post-test to the learners. To guarantee that all learners completed the post-test, the researcher announced ahead of time that there would be a post-test administered using the same methods which is the paper and pencil test.

A short interview was done the moment the learners turned in their post-test. This was done by pair so that the learners won't get too nervous that they just considered it as a regular conversation about the activity and the short interview guide questionnaire was used during the conduct of the interview. After the two-week implementation in the targeted school, the researcher gathered and secured all the data and organized them for analysis. Data analysis was done to investigate the learner's achievement level, and their perception through the implementation of the ALA.

## RESULTS AND DISCUSSIONS

### Results on the first Objective

This part of the study discussed the procedure of the development of authentic learning activity utilizing ADDIE Instructional Design Model. The first stage of ADDIE is the analysis stage. In this stage, the researcher started asking a mathematics teacher who was handling grade 9 mathematics for over ten (10) years. According to her, students had difficulty in learning some topics in Algebra, especially in quadratic equations. Learners failed to understand the concept and how to solve quadratic equations and especially when it comes to solving application problems. She further added that quadratic equation topic was one of the least learned learning competencies in Grade 9 level in her school.

When learners were asked, they mentioned that they failed to see the importance of the topic to their daily experiences. They preferred to learn the topic given with an aid to personally experience this particular lesson. Thus, for this reason, the researcher was eager to develop ALA to provide opportunities to the learners to demonstrate and apply their knowledge in real-life settings for them to realize the relevance of quadratic equations and its real-life application. Thus, the result of the preliminary analysis led the researcher to create the initial design of ALA.

The major tasks in the design stage were to established learning objectives based from the Most Essential Learning Competencies (MELCs) of the Mathematics Curriculum Guide. The topics covered were the first and second competencies for the first quarter in the K-12 Curriculum. These competencies were as follows:(1) Illustrate quadratic equation, and (2) solves quadratic equation by extracting the square roots, factoring, and solving quadratic equation using quadratic formula, and how to relate these learning competencies into actual practice considering the context and the situation of the learners and the locale of the study. From the analysis stage and based on the literature review, the researcher put forward the development of authentic learning

activities. The researcher developed the authentic learning activity following a guideline, developed by Reeves (2006), consisting of 10 characteristics of authentic learning activities. The researcher used these 10 characteristics of ALA as a checklist, which served as a guide throughout the development process and the template on

The major task in the development stage was the creation of the authentic learning activity based on the design stage. As shown, In Part I includes an overview of the activity which explained the general idea that the learners looked forward to when doing the activity. Fig. 1 provides the sample of the overview of the improved version of the developed ALA.

**AUTHENTIC LEARNING ACTIVITY**

**Name of the Learner:**  
**Grade Level:**  
**Section:**  
**Date:**

**I. Overview:**

**“Authentic Learning Activity :“Designing a Rectangular Garden Bed”**

This activity entails real-life application of quadratic equations in one variable. This activity connects the abstract mathematical concepts of quadratic equations to real world problems in landscape designing. The purpose of this activity is to provide students the opportunity to apply knowledge and skills in quadratic equations by designing a rectangular garden bed.

Fig. 1. Sample of the Overview of ALA

Part II includes the learning competencies and code. The learning competency was subdivided into two learning objectives; (1) illustrate quadratic equation; (2) solving quadratic equation by extracting the square roots, factoring, completing the square, solving by quadratic formula. Part III provides the scenario of the activity. This part highlights the scene where the learners acts as a professional and solves real-life problems. Fig. 2 shows the second and third parts of the improved version of the developed ALA.

**II. Learning Competency with Code:**

At the end of the this activity, the learners will be able to formulate real-life problems involving quadratic equation (M9AL-Ia-1)

**Learning Objectives**

1. Leamers will be able to illustrate quadratic equation
2. Leamers will be able to solve quadratic equation by (extracting the square roots, factoring, completing the square, and solving using quadratic equation)

**III. Scenario:**

You received a call from a client seeking help in designing a rectangular garden bed in his backyard. The client wants to create a rectangular garden bed at the center of the backyard which will be filled with flowers. He mentions that his wife loves walking and has requested to have a concrete pathway,  $x$  meters wide, around the entire garden bed and to be enclosed with a fence. Additionally, the client wants the area of the concrete pathway to be equal to the area of the garden bed to determine the amount of concrete cement required for the project. Your task is to calculate the width of the concrete pathway.

Fig. 2. Sample of the II and III Part of ALA

Part IV, includes the process of the ALA. Part IV include the step-by-step procedure of the activity. It consists of six interrelated sub-activities which the learners must take to complete the activity. Fig. 3 presents the fourth part of the ALA.

**IV. Process:**

A. Provide a list of all necessary data that you have planned, such as:

- i. Dimension of the Garden Bed (Length and Width)
- ii. Dimension of the Fence with respect to the Length and Width of the Garden Bed and the x meter width of the pathway.
- iii. The area of the Garden Bed

B. Create an illustration of the rectangular garden bed which is already enclosed by a fence.

- i. Label the dimension of the rectangular garden bed
- ii. Label the dimension of the fence
- iii. Shade the area of the Garden Bed and the Pathway with distinct colors.

C. Formulate a mathematical equation using the standard form of a quadratic equation in one variable:  $ax^2 + bx + c = 0$

D. Use the concept of Quadratic equation to calculate the width of the pathway using the formulated quadratic equation from C.

E. Inquire at the local stores for the price of concrete cement per sacks

F. Construct the rectangular garden bed according to your design and ensure all dimensions from the illustrations are accurately implemented. Detailed documentations particularly regarding the measurement of its dimensions are required. (Provide a photo taken during the actual measurement process)

Note: Since the participants are high school students, there is no need to purchase the materials mentioned. Students may use any available materials in their area. (ex. Using bamboos for the fence and the garden bed and a pile of rocks for the pathway)

Fig. 3. Sample of the IV Part of ALA

Part V includes the final product. It is considered as the final outputs of the learners where they showcase all the things they have done during the 2-week implementation. Fig. 4 presents the fifth part of the ALA.

**V. Final Product**

- \* A finished drawing of the rectangular garden bed enclosed by a fence with labeled dimensions.
- \* Finish Product of the Rectangular Garden Bed. Documentation is needed. (Photos)
- \* Detailed report explaining the mathematical process used to determine the quadratic equation including the formulation of the mathematical equations, and calculations.
- \* A detailed explanation of the total cost of concrete cement based on your design.
- \* Reflection about everything that learners have learned during and after the activity.

Fig. 4. Sample of the V Part of ALA

The developed ALA were evaluated by the panel of evaluators. The panel was composed of three (3) master teacher in mathematics who are currently practicing his/her profession in the field. The first evaluation tool was the DepEd LRMSD evaluation tool for printed materials and the second tool was the modified authentic evaluation checklist.

Using the first evaluation tool, the developed authentic learning activities passed all four (4) factors including the content quality, format, presentation and organization, and the accuracy and up-to-datedness of information. As shown in table 1, the mean of the four (4) factors falls in the passing intervals based on the evaluation tool's numerical standard.

| Factors                       | Panel of Evaluators |    |    | Mean  | Remarks |
|-------------------------------|---------------------|----|----|-------|---------|
|                               | 1                   | 2  | 3  |       |         |
| Content                       | 28                  | 28 | 28 | 28    | PASSED  |
| Format                        | 71                  | 72 | 72 | 71.97 | PASSED  |
| Presentation and Organization | 20                  | 20 | 20 | 20    | PASSED  |
| Accuracy of Information       | 24                  | 24 | 24 | 24    | PASSED  |

Table 1. Summary of Evaluation Result for ALA using Evaluation

Using the second evaluation tool, the developed authentic learning activities covered most of the characteristics listed. As the literature suggested, a large number of characteristics is necessary to be seen as authentic [21]. Table 2 below shows the general summary result using the modified ALA evaluation checklist.

| Characteristic   | Panel 1 |    | Panel 2 |    | Panel 3 |    |
|--|---------|----|---------|----|---------|----|
|  | Yes     | No | Yes     | No | Yes     | No |
| 1. ALA have real-world relevance   | /       |    | /       |    | /       |    |
| 2. ALA are open-ended, and requiring learners to define task and sub-tasks | /       |    | /       |    | /       |    |
| 3. ALA must be investigate over a sustained a period of time               | /       |    | /       |    | /       |    |
| 4. ALA examine task from different perspective                             | /       |    | /       |    | /       |    |
| 5. ALA promotes collaboration  | /       |    | /       |    | /       |    |
| 6. ALA provide opportunity to collaborate                                  | /       |    | /       |    | /       |    |
| 7. ALA can be integrated and applied across different subject area         | /       |    | /       |    | /       |    |
| 8. ALA are integrated with assessment                                      | /       |    | /       |    | /       |    |
| 9. ALA create polished products  | /       |    | /       |    | /       |    |
| 10. ALA allow learners to completing solutions diversity of outcomes.      | /       |    | /       |    | /       |    |

Table 2. Summary result for ALA using ALA Checklist

### Results on the Second Objective

Normality test was used to determine if the data set is well modeled by a normal distribution and to compute how likely it is for a random variable underlying the data set to be normally distributed. The researcher used the Shapiro Wilk Test to tell if a random sample comes from a normal distribution. Accordingly, the data set is normally distributed if the p-value is greater than 0.05 alpha value. Otherwise the data set is not normally distributed. The test hypothesis with 0.05 level of significance provides:

Ho: The pre-test and post-test are normally distributed.

Ha: The pre-test and post-test are not normally distributed

| Normality Test Result | P-value | Sample Size |
|-----------------------|---------|-------------|
| Pre-test              | 0.5147  | 25          |
| Post-test             | 0.1208  |             |

Note: Significant if p-value < 0.05\* and p-value < 0.01\*\*

Table 3 Shapiro-Wilk Test Result

Table 3 shows the summary of normality test result of the data distribution of the pretest and post-test. We test the hypothesis at alpha 0.05, we do not reject our hypothesis if and only if the value or the area under the curve is greater than or equal to the set level of significance 0.05. The result that all p-values are greater than 0.05, thus we fail to reject the null hypothesis for pretest and post test. Therefore, the pretest and post-test are normally distributed and can used the parametric test of Paired T-test as statistical tool.

Before the implementation of Authentic Learning Activity, the researcher conducted a pretest to determine the learner's prior knowledge on quadratic equation. After two weeks of implementation, a post-test was conducted to measure the achievement levels of the learners. Fig. 5 summarizes the learner's distribution of achievement test scores and with their respective interpretation and percentages.

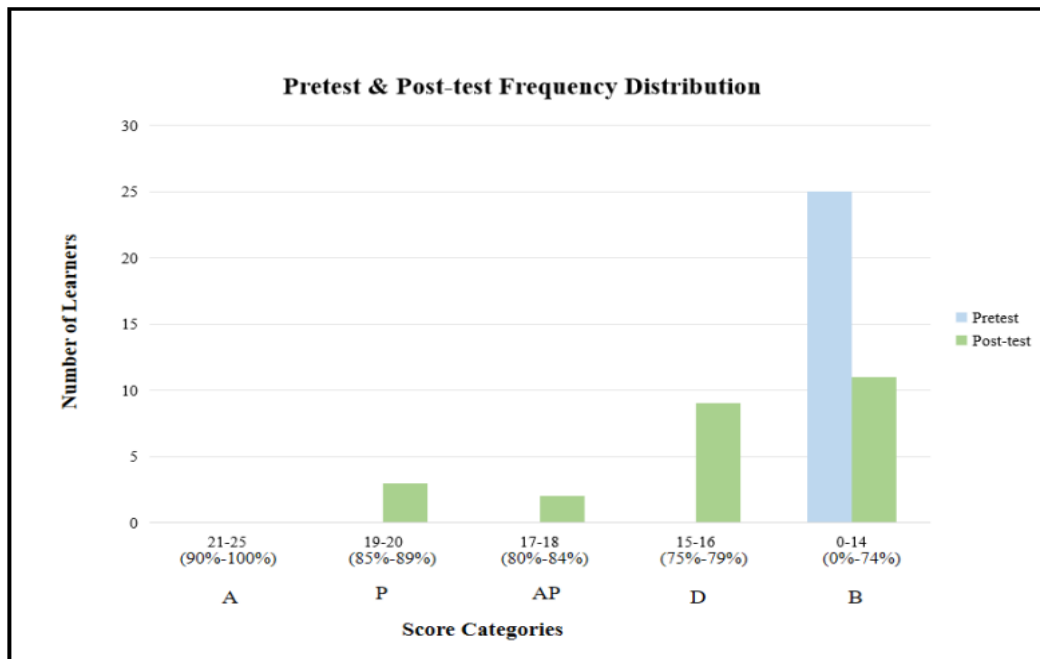


Fig. 5. Learners Achievement Scores in Pretest and Post-test

**Legend:** *A- Advanced Proficient, P- Proficient, AP- Approaching Proficient, D- Developing Proficient, B- Beginning Proficient*

As shown in fig. 5, the results indicate that 100% of the learners' scores in the pretest fell within the 0-14 range. The scores for the pretest spanned from a minimum of 3 to a maximum of 14, highlighting the initial achievement level of the learners.. This implies that at the start of the study the learners were at the beginning proficiency level. Furthermore, the pretest results did not meet the standard passing score as prescribed by the Department of Education since it was the first time the learners encountered the topic in the said grade level. Furthermore, pretest results showed low performance in most cases since many of the learners were only starting and lacked the necessary knowledge to answer the questions [9]

Within the two weeks duration, the developed authentic learning activity was implemented. The researcher conducted a post-test to determine the improvement of achievement level among the grade 9 learners and to identify the learner's proportion who improved in quadratic equation. The result reveals that 3 (12%) learners



got a score between 19-20 intervals which fell on the level of Proficient, 2 (8%) learners got a score between 17-18 intervals which is Approaching Proficient, 9 (36%) learners got a score between 15-16 intervals which is on Developing Proficient, and 11 (44%) learners got a score between 0-14 intervals which is on Beginning Proficient. This implies that only 56% of the learners improved their achievement levels, while 44% of the learners maintained the same achievement level.

Table 5 presents the summary statistics of the achievement test using the Paired t-test to determine the significant difference between the pretest and post-test with the level of significance of 0.05.

| Paired Difference |          |           |          |           |          |           |
|-------------------|----------|-----------|----------|-----------|----------|-----------|
|                   |          |           | <i>M</i> | <i>SD</i> |          |           |
|                   | <i>M</i> | <i>SD</i> |          |           | <i>t</i> | <i>p</i>  |
| Pretest           | 9.08     | 2.914     | 5.68     | 2.19      | -12.94   | 0.00001** |
| Post-test         | 14.76    | 2.5865    |          |           |          |           |

Table 5 Summary of the Achievement Test Scores in the Pretest and Post-Test

A Paired t-test shows that the mean difference is statistically significant at  $p < 0.01$  which means that the test score after the implementation of the authentic learning activity ( $M = 14.76, SD = 2.58$ ) is significantly higher than the test score before the implementation ( $M = 9.08, SD = 2.91$ ). As can be seen from the result presented in table 5, there was a significant improvement in the learner’s achievement scores after the implementation of ALA. Therefore, the pretest and post-test had significant impact especially when we check the descriptive summary indicates that the proportion of post-test in beginning proficiency decreased compared to the pretest. This is consistent with the study of [8] found out there was a significant difference between the mean pretest and post-test achievement scores of the experimental group taught using authentic learning activities.

### Results on the Third Objective

Based on the data presented in table 5, there was a significant improvement in gain scores in achievement tests to the learners after the implementation of ALA. The use of ALA motivated the learners to engage with the topic and encouraged collaborative work. The learners perceived ALA as a useful material as it helped them appreciate importance of the topic in real-life situation, and it helped them learn the topic. To prove these claims for those learners who made improvements in their achievement level, the following statements were a few recurrent themes based on their responses during the conduct of the short interview.

#### The learners were motivated to learn the topic through ALA

Learners who participated in the activity said that authentic learning activity encouraged them to learn more about mathematics and they recommended the use of ALA to their teachers since it motivates them. This is aligned to [6] suggest that learners' motivation is a crucial factor in the learning process, as the success of learning depends on the level of students' motivation . The statements below were taken from the learners’ responses in their perception questionnaire on how ALA motivates them to learn.

*“The students can be more motivated in learning math if activity such that is involve rather than just simply explaining the lessons all the time”. E4*

*“The activity can stimulate students to learn math actively”. E14*

*“Yes I will recommend the activity to my teacher because it’s stimulating, we can truly learn something because we are motivated”. E17*

This shows that learners who are exposed to authentic learning activities become more motivated to learn quadratic equations. Learners who are motivated to complete tasks are more likely to succeed in their learning compared to those who lack motivation [17]. The improvement of motivation using authentic learning activities is consistent with the result of [10]. They found out that learners who are exposed to authentic

learning increased in intrinsic motivation and they are eager to apply their new learning beyond their lessons.

### **The ALA allowed learners the opportunity to collaborate.**

Learners who participated in the activity perceived ALA as an important tool to create a collaborative learning. Here, students learned the lesson through generating, sharing, and organizing varied ideas to come up with a more concise and accurate concepts. The statements below were taken from the learners' responses that helps that supports this claim.

*"It's nice to have an activity like that because we were working as a group, we can learn from each other at the same time. We were able to organize our different ideas as a team".E12*

*"Yes I will recommend it because aside from the great time we experienced while working as a team, we can also do a lot of brainstorming at the same time and from that, there's a lot of ideas we can learn from the subject". E20*

*"Working as a group while doing the activity made the activity enjoyable more. We've learned a lot from each other as we share our different ideas towards the topic".E24*

This is clear that collaboration is one of the important factors that allowed the learners to successfully complete the ALA. They were able to compare and contrast ideas and chose the best solution to the given problem/s. This result is consistent with the finding of [11] that the utilization of authentic learning activities resulted to a high level of motivation among the pre-service teachers.

### **The ALA helped learners appreciate the importance of real-life application of the topic.**

Teaching applications of Mathematics has many benefits as it helps learners to improve their mathematical understanding of his environment, motivates them to learn mathematics with pleasure, and see its importance in his daily life and in various fields which helps him decide his future career [1]. The statements below are a few of the learners' responses that supports this claim.

*"I would recommend it (authentic activity) to my teacher because I can be able to see the importance of math lessons through this activity".E21*

*"the use of this activity because we were able to see that usage and application of math outside the classroom".E22*

*"It's enjoyable because we step outside to do the activity and we were able to find the value and application of math even outside of the classroom".E1*

This shows that the use of ALA has helped the develop greater appreciation for the real-life application of the topic. Learners are now able to connect theoretical knowledge to the real world. The learners enjoyed the activities as it gives them chance to interact with the environment and many learners even recommended incorporating similar activities into their mathematics classes. As a result, they see the practical application of the topic. This result is consistent to the the findings of [18] that appreciate the use of ALA as it helped the learners to better understand concepts and help them easily remember what was being taught since it reflects the importance of real-life application of the topic.

### **It allowed learners to learn the course through the implementation of ALA**

Learners who participated in the activity said that they learn quadratic equation through the use of authentic learning activities. The statements below are a few of the learners' responses that supports this claim.

*"We can learn math more if there is an activity like this".E3*

*"I enjoyed the activity since it's fun and I've learned more lessons in math".E7*

“It’s really effective because I finally learned something important about Algebra”. **E12**

“We can learn more about math because of this type of activity”. **E19**

This shows that learners successfully acquired knowledge on the topic through authentic learning activities. Several students expressed that participating in this activity greatly helped enhance and deepen their knowledge on quadratic equation. This result is consistent to the findings of [19] that improved learner’s learning in mathematics course when authentic learning activities was utilized.

However, despite the advantages presented by most learners who improved their achievement test scores through the implementation of the authentic learning activity (ALA) to one (1) step or higher, there are eleven (11) learners as seen in table 4 whose achievement level have not improved and are still on developing level. Upon considering their responses in the short interview conducted, most of them regard the ALA as helpful material in improving their learning, but there are some challenges encountered during the conduct of the ALA. The following themes were the challenges and difficulties experienced by the learners and their responses to the short interview.

1. Lack of prior experience and familiarity with different measuring tools.

*“ It was a little bit difficult for me because I am not used to read a measuring tool”*. **E1**

*“ It was about that time when we need to use the measuring tool and it was really difficult for us since it was our first time and we don’t know how to use it accurately because we are not used to using a measuring tool”*. **E2**

*“ I’m having a difficulty in measuring the length and width of the object because I’m not used to using a measuring tool. It’s a new experience to me because all we do in our math classes is solving”*. **E4**

2. Lack of mastery of the content.

*“I still lack the mastery to understand the whole concept of the activity given to us”*. **E20**

*“I find it difficult to solve the problem in the actual activity”*. **E8**

3. Miscommunication among the learners.

*“I find it difficult applying what I’ve learned because my teammates and I were having a hard time communicating to each other”*. **E21**

4. Time constraint.

*“We were having a hard time finishing the activity because of the limited allotted time”*. **E6**

With all these challenges encountered by the learners, they manage to cope up by asking out to the teacher and to their classmates who have improved through the ALA. The teachers have a vital role in the learning process even after the lesson. It is very important teachers check and follow up their learners especially with those learners who scored that is below the standard score and who are absent. We can say that this education innovation requires learners to be equipped with practical skills and dedicated to their school activities. Thus, the implementation of ALA greatly helped in making a meaningful and life-long learning in Mathematics.

## CONCLUSION

Using the ADDIE Instructional Design Model in the development of the authentic learning activities (ALA), learners were able to achieve the learning objectives through the learning material given to them. The ALA passed all criteria in the evaluation rating including content quality, format, presentation and organization, and accuracy and up-to-dateness of information. Using the modified authentic learning activity checklist, it was found acceptable as it passed most characteristics of authentic learning activity. These indicate that the ALA is

acceptable and appropriate material in teaching quadratic equations. Fifty-six (56) percent of the learners demonstrated an improvement in their achievement levels, while Forty-four (44) percent of the learners maintained the same achievement level after the implementation of the authentic learning activity (ALA). Moreover, the learners perceived ALA as a helpful tool as they claimed that they were motivated to learn Algebra through its implementation as they were able to apply their acquired knowledge in real-life situations, and give them the opportunity to work collaboratively. It was also clear from the findings that the problems presented in the ALA allowed them to appreciate the relevance of real life application of Mathematics. The ALA made the learners experience a fun-filled learning yet challenging. However, there are eleven (11) learners who made no improvement to their achievement level and admitted that they encountered difficulty such as lack of prior experience and familiarity of using different measuring tools, lack of mastery of the content, miscommunication among the learners, time constraint. Therefore, it is evident in their perception that they appreciated the great help of the developed ALA through its implementation.

## LIMITATIONS AND RECOMMENDATIONS

The learning material is limited to the concept of quadratic equations in one variable. Therefore, future researchers could explore the development of ALA in other areas of mathematics. This study, conducted with only 25 participants from a single public school, limits the generalizability of the findings. Future researchers could expand the sample size to include participants from multiple schools or a larger cohort of students. Employing control and experimental groups could further enhance the reliability of the results and provide a more thorough investigation of the effects of its implementation. Additionally, conducting group-specific analyses to identify whether certain groups (e.g., high-performing vs. low-performing students) engage differently with the ALA could provide valuable insights.

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