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Research Article

Development and Validation of Learning Activity Sheets in Rational Expressions and Linear Equations and Inequalities

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ABSTRACT

The purpose of this research study is to develop Learning Activity Sheets (LAS) in Rational Expressions and Linear Equations and Inequalities for the students. Data were collected via survey questionnaire from three sets of evaluators. The LAS was also administered from 100 students of New Society National High School to further scrutinize its validity. The results were interpreted and analysed using the rating scale and statistical tools including on-way ANOVA and mean.

Based from the results of the study, the researcher concluded that: there were fourteen competencies included in the developed LAS which are the not mastered and least mastered competencies of the students. The competency that received the highest mean percentage on the competency test was LAS 17 (graphs and illustrates a linear function and its (a) domain; (b) range; (c) table of values; (d) intercepts; and (e) slope). On the other hand, the competency that received the lowest mean percentage on the competency test was LAS 12 (solves problems involving systems of linear inequalities in two variables). The evaluators found the developed LAS to be effective and useful in terms of objectives, concepts, skills, usability, appropriateness, and adequacy with an interpreted mean rating of very high extent. The researcher also concluded that there is no significant difference in the standard response of the evaluators which is composed of Grade 8 math teachers, master teachers, and LRMDS-trained teachers. Based on the mean percentage results of the administered LAS, there was also a considerable improvement in the students' learning.

Keywords: *Development and validation, Learning activity sheets, Least mastered learning competencies, Linear equations, Linear inequalities, Rational expressions*

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Introduction

Effective mathematics instruction is one of the goals of math teachers. However, the emergence of the COVID-19 pandemic made teaching Mathematics to students more challenging. The COVID-19 pandemic has closed educational institutions and dramatically changed teaching to distance learning. Those in charge of education choose to adopt the new norm in response to these difficulties. The Learning Continuity Plan (LCP) was made available for primary schools by the Department of Education (DepEd). The Higher Education Commission granted academic independence to higher education institutions. They integrated e-learning, distant learning, and other student-accessible other ways of communication. (DepEd, 2020). Different dangers, issues, and challenges were posed for teachers and students alike, particularly in colleges and universities, due to the educational system's departure from the traditional method of instruction and the adoption of online learning. (Tria, 2020).

Although there are many methods of teaching mathematics to students, it is too difficult to tell which of these methods is better than the other while considering different factors such as our student's academic level. However, fortunately, there are ways for us to ensure the interest and motivation of our students by providing varied materials for learning, such as the Learning Activity Sheets (LAS) with proper entry-level instructions for better understanding and easy navigation on the LAS. Teachers can use LAS to comprehend students' prior knowledge, learning objectives, and learning process; simultaneously, they can monitor their learning progress (Lee, 2014). With LAS, teachers become facilitators of the learning process and are equipped with the necessary resources to facilitate the learning process effectively.

Considering the challenges in teaching Mathematics, the researcher felt the need to develop validated Learning Activity Sheets (LAS) in Rational Expressions and Linear Equations and Inequalities for Grade 8 Algebra students to equip them with a proper tool for facilitating in their education. The researcher also considered their experiences with the validated material to further the development of the study. The diverse students of New Society National High School were the respondents of this research.

The developed Learning Activity Sheets (LAS) package is an instructional material that will provide Grade 8 students with various tasks and different instructional activities to enhance their knowledge of, proficiency with, and expertise in Algebra. Given that LAS plays a vital role in pursuing the student's academic excellence, competent professionals validated it to ensure that the contents are appropriate, usable, and valid based on the student's level. This LAS is easy for the students to work on because the instructions, exercises, and learning activities will use suitable language.

Methods

Research Design

This study addressed not mastered and least mastered competencies of Grade 8 students in New Society National High School (NSNHS) by developing Learning Activity Sheets (LAS) that professionals validated. Research and Development (R & D) Design was applied using the ADDIE Model to create the envisioned LAS of this study. It is five-step technique for creating iterative learning and training activities is the instructional design ADDIE Model. Because it is largely an outcome-based framework, it is perfect for creating a measurable learning program. In selecting solutions to instructional difficulties using the systems-based approach of the ADDIE model yields the best results (Allen, 2006). The researcher carefully followed the research procedure to ensure the expected output's quality. The research undergone several stages. The LAS was developed based on the contents, identified not mastered and least mastered competencies in Mathematics in Grade 8 as required by the K to 12 Curriculum, and theories and principles in LAS preparation. Selected professionals validated the LAS to ensure that the standards were met. The researcher looked over the evaluations, comments, and suggestions made by the evaluators to enhance the proposed LAS.

Respondents

There three (3) sets of evaluators who reviewed the first draft of the Learning Activity

Sheets (LAS): five (5) Mathematics Teachers, five (5) Master Teachers in Mathematics, and five (5) LRMDS-trained teachers. In selecting the respondents, a purposive sampling was used. It is a sampling strategy in which the researcher randomly selects volunteers from the general public (Black, 2010). These three groups of evaluators come from the General Santos City Division.

The LAS was also administered to 100 participants, which are the Grade 8 students from New Society National High School, that was randomly selected from the total population of 754 students.

Data Gathering Procedure

This study adapted the Research and Development Design (R&D), utilizing the ADDIE Model. To begin with the development of the Learning Activity Sheets (LAS), the researcher requested certain instructions for creating instructional materials that adhere to the standards of the Learning Resource Management Development System (LRMDS) in a letter that was written and coordinated with the Education Program Supervisor-LRMDS in the Department of Education (DepEd). The researcher also utilized library visits and the internet to learn more about developing instructional material, such as learning activity sheets. The researcher also utilized other Algebra books as references. During the Analysis stage, the Grade 8 Mathematics learning targets from the K to 12 curriculum—which is used in all public schools as required by DepEd—were examined. The Grade 8 Mathematics teachers in NSNHS have met and consolidated the not mastered and least mastered competencies of the students. The researcher adapted module assessments and developed a 50-item competency test containing learning competency questions from the determined topics in rational expression and linear equations and inequalities. The researcher made sure that a fair representation of sample of questions appear on the test by making a table of specifications. The LAS content was based on the findings during the analysis stage, and the initial draft was written using the information gathered as a reference.

The researcher-developer carefully reviewed and polished the LAS's initial draft before it was ready for validation, focusing on following standards. A five-point scale was employed by the researcher-developer in the procedure.

In DepEd General Santos City, the researcher coordinated with the Education Program Supervisor-LRMDS for a list of educators, specifically secondary mathematics teachers, who have received LRMDS training. The researcher then profiled and identified potential schools in relation to the amount of mathematics master teachers. The researcher requested the school heads of the selected schools' help in validating the preliminary draft by sending letters of communication or requests to them.

The questionnaires and the preliminary LAS were given to the assessors by the researcher in person who are: five (5) Mathematics Teachers, five (5) master teachers, and five (5) LRMDS-trained teachers from General Santos City Division. The researcher gave ample time to the evaluators to evaluate the developed LAS using the validation tool. The researcher-developer then set up a schedule retrieval of the questionnaire-instrument and the ideas and proposals for improving the LAS. To get ready for the next step, the evaluation questionnaires and the created LAS were collected and gathered.

The evaluation questionnaires were put together by the researcher in groups. Statistics were applied to the data gathered and each group's findings were examined independently. To evaluate if each group answered equally or differently, the researcher used a significant difference test. The updated LAS was given to the students for testing after the evaluation findings were statistically processed.

The researcher revised the LAS to ensure its high-quality and readiness for use in mathematics instruction for Grade 8 students while taking into account the constructive criticism and recommendations of the panel members, research adviser, and evaluators.

Research Instrument

To validate the developed Learning Activity Sheets (LAS), the researcher adapted a

Cutamora (2016) questionnaire that was validated by a panel of experts.

The evaluators evaluated the LAS centered on the following six standards: objectives, contents/topics, skills usability, appropriateness, and adequacy. The learning activity sheets' initial draft was examined and validated by the three groups of evaluators using a five-point scale, and the researcher-developer used that score to determine how well the learning activity sheets meet the requirements.

Data Analysis

To analyze the data gathered from the respondents, the researcher used the following statistical treatments:

To answer the subproblems one (1), two (2), three (3), and four (4), the responses that were given by the respondents were tallied and statistically treated and computed using mean percentage to get the not mastered and least mastered learning competencies and weighted mean to obtain the combined outcomes for each of the three sets of validators. Weighted Mean transcribed the five-point scale along with its qualitative description to describe the indicated results of the study.

To answer subproblem five (5), One-way Analysis of Variance (ANOVA) was utilized to investigate how the findings from the three sets of validators varied significantly.

The Learning Activity Sheets were regarded as valid if the average was at least 3.0 using the computed mean and five-point scale as the basis. This is assuming that all of the aforementioned requirements are met to a moderate amount.

Result and Discussion

In determining the level of mastery of the students in different competencies, the researcher adapted a scale suggested by the Department of Education to track and assess the progress and accomplishment of students. The standard scale set for determining the learner's mastery level are as follows: Mastered (80-100%), Nearly Mastered (60-79%), Least Mastered (40-59%), and Not Mastered (0-39%). Table 1 presents the not mastered and least learning competencies of Grade 8 learners included in the Learning Activity Sheets.

As shown on the table, there are 14 competencies that were the Not Mastered and Least Mastered Competencies of the students with a mean percentage that is below 59.00% of the criteria set. The following Not Mastered and Least Mastered competencies were the basis in creating the learning activity sheets (LAS) to help the students in augmenting their learning in Mathematics.

It is also noticeable that most of the competencies are either not mastered or least mastered, however, there are also four competencies were the students excelled and are rated with a mean of 60% and above and interpreted as Nearly Mastered (60%-79%) and Mastered (80%-100%).

Table 1. Not Mastered and Least Mastered Learning Competencies of Grade 8 Learners

No.	Competency	%	Description
1.	Illustrates rational algebraic expressions.	88.30	**Mastered**
2.	Simplifies rational algebraic expressions.	61.65	Nearly Mastered
3.	Performs operations on rational algebraic expressions.	65.85	Nearly Mastered
4.	Solves problems involving rational algebraic expressions.	70.43	Nearly Mastered
5.	Illustrates a system of linear equations in two variables.	43.30	Least Mastered
6.	Graphs a system of linear equations in two variables.	35.80	Not Mastered
7.	Categorizes when a given system of linear equations in two variables has graphs that are parallel, intersecting, and coinciding.	34.15	Not Mastered
8.	Solves problems involving systems of linear equations in two variables by (a) graphing; (b) substitution; (c) elimination.	53.75	Least Mastered
9.	Differentiates linear inequalities in two variables from linear equations in two variables.	37.50	Not Mastered

No.	Competency	%	Description
10.	Illustrates and graphs linear inequalities in two variables.	40.80	Least Mastered
11.	Solves problems involving linear inequalities in two variables.	45.34	Least Mastered
12.	Solves problems involving systems of linear inequalities in two variables.	28.17	Not Mastered
13.	Illustrates a relation and a function.	43.30	Least Mastered
14.	Verifies if a given relation is a function.	33.30	Not Mastered
15.	Determines dependent and independent variables.	41.10	Least Mastered
16.	Finds the domain and range of a function.	35.80	Not Mastered
17.	Graphs and illustrates a linear function and its (a) domain; (b) range; (c) table of values; (d) intercepts; and (e) slope.	56.25	Least Mastered
18.	Solves problems involving linear functions.	31.25	Not Mastered
	Mean Percentage Score	**52.34**	**Least Mastered**

Legend: 0 – 39% – Not Mastered; 40 – 59% – Least Mastered; 60 – 79% – Nearly Mastered; 80 – 100% – Mastered

Table 2. Summary of Proposed Learning Activity Sheets in terms of Objectives, Concepts, Skills, Usability, Appropriateness, and Adequacy

Criteria	Overall Mean	Description
Objectives	4.94	Very High Extent
Concepts	4.82	Very High Extent
Skills	4.84	Very High Extent
Usability	4.83	Very High Extent
Appropriateness	4.81	Very High Extent
Adequacy	4.74	Very High Extent
Mean	4.83	Very High Extent

Legend:
1.00 – 1.49 – Very Low Extent
1.50 – 2.49 – Low Extent
2.50 – 3.4 – Moderate Extent
3.50 – 4.49 – High Extent
4.50 – 5.00 – Very High Extent

The LAS was thoroughly examined by the evaluators and it is noteworthy that all of the criteria of the developed learning activity sheets received a Very High Extent rating and an overall mean score of 4.83. The developed LAS on this study came out to be realistic, measurable, attainable, clear and specific in terms of objectives. These learning goals describe a level of knowledge that can be assessed through assessment activities. As the LAS was developed through the objectives of each competencies, it should be given high regard and must be aligned to the students' need to augment their learning and mastery on the content. The vocabulary used in explaining the concepts presented in the LAS was developmentally appropriate for the students. Real-life contexts were used to explain most of the concepts in the developed LAS which is aligned to the competencies and intended learning outcomes of the curriculum. In this research study, the critical thinking skills of the students were developed through activities congruent to the objectives of the curriculum. Teaching and learning through doing tasks that foster critical thinking in students is suited for application to real-world situations and aids in the development of the knowledge and abilities that students will need to succeed in the information age. The language used in instructions are also clear and easy to follow. The content was sequenced from the simple to complex ideas which would make it more logically effective. The assessment of the student activities could

also serve as the teacher's basis on important pedagogical decisions if they wish to integrate or adopt the develop LAS in their class. The developed LAS were also found to be appropriate as the contents were aligned to the objectives indicated in the learning competencies. The exercises were varied and enhances the mathematical skills of the students. It was also notable that exercises in the LAS are varied enough to target the different capabilities of the students, thus developmentally appropriate.

Table 3. Difference in the Evaluation of the Proposed Learning Activity Sheets among Grade 8 Mathematics Teachers, Master Teachers and LRMDS-trained Teachers

Criteria	Source of Variation	*SS*	*df*	*MS*	*F*	p-value	Remarks
Objectives	Between Groups	0.02	2	0.01	1.90	0.20	no significant difference
	Within Groups	0.05	9	0.01			
	TOTAL	0.07	11				
Concepts	Between Groups	0.085	2	0.043	2.30	0.144	no significant difference
	Within Groups	0.224	12	0.019			
	TOTAL	0.309	14				
Skills	Between Groups	0.064	2	0.032	0.41	0.281	no significant difference
	Within Groups	0.272	12	0.023			
	TOTAL	0.336	14				
Usability	Between Groups	0.037	2	0.019	0.52	0.608	no significant difference
	Within Groups	0.432	12	0.036			
	TOTAL	0.469	14				
Appropriateness	Between Groups	0.101	2	0.051	1.81	0.206	no significant difference
	Within Groups	0.336	12	0.028			
	TOTAL	0.437	14				
Adequacy	Between Groups	0.101	2	0.507	1.47	0.270	no significant difference
	Within Groups	0.416	12	0.347			
	TOTAL	0.517	14				

It demonstrated that the three groups of evaluators do not significantly differ in how they assessed the objectives of the Learning Activity Sheets (LAS), with an F-value of 1.90 and a p-value of 0.20. Additionally, the concepts included in the LAS do not show significant differences, with an F-value of 2.30 and a p-value of 0.144. This indicates that the objectives and ideas presented in the LAS were thought to be relevant, appropriate, and prescribed by the evaluators. The remaining four criteria skills — (F-value of 0.41 and p-value of 0.281), usability (F-value of 0.52 and p-value of 0.608), appropriateness (F-value of 1.81 and p-value of 0.206), and adequacy (F-value of 1.47 and p-value of 0.270) — also received no

significant difference remark in relation to the mean of the assessment of the three sets of evaluators. This shows that the created LAS is valid, which means that it considers and develop skills that enable students in achieving the subject's particular objectives, permits the development of higher cognitive skills, and is appropriate for their vocabulary and level of ability. The three groups of evaluators also discovered that it is very usable, acceptable, and adequate for the purpose for which it was built. The developed learning activity sheets (LAS) was administered on one hundred (100) student-participants to strengthen its validity. The mean percentage results of the students on the administered LAS are displayed in Table 4.

Table 4. Mean Percentage Results of the Implemented Learning Activity Sheets on Students

Least Mastered Learning Competency	Mastery Percentage		Interpretation
	Competency Test Result	Implemented LAS Result	
LAS 5 - Illustrates a system of linear equations in two variables.	43.3%	73.10%	Nearly Mastered
LAS 6 - Graphs a system of linear equations in two variables.	35.8%	73.90%	Nearly Mastered
LAS 7 - Categorizes when a given system of linear equations in two variables has graphs that are parallel, intersecting, and coinciding.	34.15%	70.90%	Nearly Mastered
LAS 8 - Solves problems involving systems of linear equations in two variables by (a) graphing; (b) substitution; (c) elimination.	53.75%	72.10%	Nearly Mastered
LAS 9 - Differentiates linear inequalities in two variables from linear equations in two variables.	37.5%	74.40%	Nearly Mastered
LAS 10 - Illustrates and graphs linear inequalities in two variables.	40.8%	70.80%	Nearly Mastered
LAS 11 - Solves problems involving linear inequalities in two variables.	45.34%	72.80%	Nearly Mastered
LAS 12 - Solves problems involving systems of linear inequalities in two variables.	28.17%	48.30%	Least Mastered
LAS 13 - Illustrates a relation and a function.	43.3%	72.70%	Nearly Mastered
LAS 14 - Verifies if a given relation is a function.	33.3%	71.90%	Nearly Mastered
LAS 15 - Determines dependent and independent variables.	41.1%	73.20%	Nearly Mastered
LAS 16 - Finds the domain and range of a function.	35.8%	69.60%	Nearly Mastered
LAS 17 - Graphs and illustrates a linear function and its (a) domain; (b) range; (c) table of values; (d) intercepts; and (e) slope.	56.25%	82.80%	Mastered
LAS 18 - Solves problems involving linear functions.	31.25%	55.50%	Least Mastered

The learning competencies listed on the Competency Test Result were the not mastered and least mastered competencies of the students before the implementation of the LAS.

Among the competencies, it is worth notable that LAS17 had a significant increase on mean results from 56.25% (not mastered) to 82.80% which is interpreted as Mastered. In this study, content-based materials were utilized to make sure that the LAS is content-valid. To master the learning competencies, it is vital to create instructional materials that are content-based. Since this is the starting point for all materials production, teachers typically view this as a crucial component of any learning resource material (Cajayon & Benavides, 2022). Proper questioning techniques were also used in the development of LAS to make sure that the students would have a deeper grasp of the concepts that are being asked in the LAS. In this manner, higher order thinking skills of the students is improved and mastery of the content is enhanced.

Among the developed, it is observable two LAS did not meet the criteria set to be interpreted as nearly mastered, much less mastered. The following competencies were both not mastered competencies based from the competency test: LAS 12 (from 28.17% to 48.3%) and LAS 18 -(from 31.25% to 55%). However, there is a notable increase in the mean percentage of 20.13% on LAS 12 and 24.25% on LAS 18. These two LAS may not have reached the threshold for nearly mastered criteria however these increase in the mean result percentage means that learning has occurred after the LAS was administered. The study of Escoreal (2012) on the Learning Intervention Tools to reduce the least mastered skills of the students came to the conclusion that these tools provide baseline information and should be used to prevent the marginalization of students. This is in light of the results of the students still having the least mastered skills after the implementation of the LAS.

Conclusion

The researcher developed conclusions based on the findings of the research study. There were fourteen competencies included in the developed learning activity sheets (LAS) which are the not mastered and least mastered competencies of the students. The competency that received that highest mean percentage on the competency test was LAS 17 (Graphs and illustrates a linear function and its (a) domain; (b) range; (c) table of values; (d) intercepts; and (e) slope). On the other hand, the competency that received the lowest mean percentage on the competency test was LAS 12 (Solves problems involving systems of linear inequalities in two variables).

The evaluators found the developed LAS effective and useful in terms of objectives, concepts, skills, usability, appropriateness, and adequacy with an interpreted mean rating of Very High Extent. The standard response from Grade 8 math teachers, master teachers, and LRMDS-trained teachers did not significantly differ, according to the findings of the research. Based on the mean percentage results of the LAS that was used, there was also a considerable improvement in the students' learning.

Recommendations

The researcher offered the following recommendations in light of the findings and conclusions: (1) The New Society National High School may use the developed Learning Activity Sheets for Grade 8 Mathematics classes during the first and second quarters of the academic year. (2) The developed Learning Activity Sheets for Grade 8 students may also be used in General Santos City Division schools. (3) Table of Specifications should be made if the learning activity sheets were not mastered or least mastered, to make sure the that key areas and importance are given appropriate focus. (4) Appropriate instructional materials should be used in the teaching-learning process parallel to the goals of the LAS to augment the learning of the students. (5) An in-depth study on the effectiveness of the learning activity sheets should be done for it be used as a supplementary learning material for teachers. (6) The effectiveness of the developed learning activity sheet may be further assessed and improved using robust experimental design. (7) Schools should place a high priority on providing trainings and seminar-workshops on the development of educational materials like Learning Activity Sheets.

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