

Research-based Instructional Materials in Science

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Abstract: *This study aimed to investigate the least learned competencies in Science 6 and develop instructional material based on the identified least learned competencies. This study used experimental research utilizing a Quasi-Experimental research design, specifically a one-group pretest-posttest design. The study consists of thirty (30) research respondents in the experimental group. The conduct of the procedure inquired about the identification of the least learned competencies in science 6 through the conduct of a pre-assessment. The results of the assessment were the basis for the development of the instructional material. The validated and reliability-tested pretest was given before the exposure of the research-based instructional material in the form of intervention. The posttest was administered after the treatment. The data collected from the pretest and posttest performance were analyzed using the mean and t-test. The findings of the research inquiry are as follows: Primarily, the one-group respondent obtained an average performance on the pretest on the identified least learned competencies in science. The posttest performance on the least learned competencies in science resulted in a high rating. The findings of the study indicate that there is a significant difference in the level of performance in the pretest and posttest of the group when exposed to research-based instructional material favoring the posttest performance.*

Keywords: *Research-based, Instructional Material, Least Learned Competency, Learning Activity Sheet.*

I. Introduction

The burden of the educational gaps have prolonged when the pandemic hit. The Department of Education (2015) reiterated the need to supply sufficient and appropriate instructional interventions to ensure learners are ready before summative assessments. It is stipulated under the issuance of Department Order 08 series of 2015 otherwise known as the Classroom Assessment Policy Guidelines. This study ensured the necessity of the quality of learning through the fulfilment of the instructional materials developed to achieve the remediated competencies.

An article from Aperture Education (2022) states that “evidence-based” and “research-based” are often used to describe intervention activities, like strategies or curricula designed to build skills in specific areas. The researcher utilized the term research-based as a mean of identifying the least learned competencies as the basis for the conduct of the appropriate intervention. Educators, teachers, and policymakers have embraced contextualization as a constructivist approach to bridging the gap between concepts and real-life experiences (Picardal & Sanchez, 2022). The K to 12 science curriculum covers conceptualized content that presents difficulty in understanding when a concept does not deliver appropriately to the learners. It is a must to allow the learners to apply their learning to an application enabling the learners to develop the science-inquiry skills and processes as some learners depend on experiments and observational studies.

Many researchers have stated the benefits of involving students’ everyday life experiences and contextualizing the science content to enhance learning and positive attitudes toward school science (Davidsson & Granklint-Enochson, 2021). These local and indigenous materials are an excellent alternative for learners to be involved in a relevant learning experience. In this way, it reduces the possible gap of needing re-learning as the learning process is simplified and contextualized that is familiar to the learners.

The use of instructional materials supports the student to engage in scientific knowledge construction- to position them as doers of science, rather than the receiver of facts (Miller et al., 2018). The development of material focused on providing interventions to the learning competencies that most learners have not achieved well and that the developed material acting as a factor affecting the learning, supplied the intervention of the unachieved or the least learned competencies. Specifically, the purpose of this study allow the development and implementation of instructional material in science learning competencies. Furthermore, it served as an intervention to the researched and identified competencies that the Grade 6 pupils.

II. Methods

Research Design. This study utilized a Quasi-Experimental research design. It determined the least learned competencies of the Grade 6 pupils as the basis for the development of the instructional materials as a form of intervention; hence, the study considered a one-group pretest-posttest approach.

Respondents of the Study. The study's respondents were the Grade 6- Benevolent class school year 2022-2023 consisting of 30 pupils of Pinapugasan Elementary School. A purposive sampling was applied to identify the respondents. Specifically, it referred to a one-group pretest-posttest design by which the same dependent variable was measured in one group of participants before and after administering treatment. The approach served advantageous as the comparison of scores then followed after treatment. The conduct of acceptance of the research instruments considered Japitan Elementary School from the Schools' Division of Escalante City.

Research Instrument. The research instrument in this study utilized a research-based pre-assessment to identify the least learned competencies, which served as the basis for the development of instructional materials. The pre-assessment test covered a 50-item multiple choice test used for item analysis. Moreover, a pretest and posttest were also utilized which have the same measure developed by the researcher. It covered a 50-item test of varied test types comparing the pupils' mean on both tests.

A developed instructional material was also used and was evaluated using the LRMSD evaluation tool for print resources. The following instruments were validated by the LRMSD Education Program supervisor, the Education Program supervisor in science, and three (3) Master teachers from the schools' division of Escalante City.

Data Gathering Procedure. In the preliminary conduct of the study, consent, and request letters were distributed to the Schools Division Superintendent of Escalante City, School Principals, and teacher advisers who have the authority over the target respondents of the study. Upon permit being granted, a pre-assessment was validated by the Education Program Supervisor in Science, LRMSD Education Program Supervisor, and Master Teachers of the Schools' Division of Escalante City. The conduct of the study undergoes 4 phases, namely; the prior-research phase, pre-experimental phase, experimental phase, and post-experimental phase.

The prior-research phase emphasized the identification of the least learned competencies which were used as the basis in the construction of the instructional material. The aid of item analysis records the frequency of correct responses in every item with its corresponding percentage and interpretation of the mastery of the competencies. The percentage scale of the competencies was interpreted as either mastered, closely approximating mastery, moving towards mastery, average mastery, low mastery, very low mastery, or absolutely no mastery. The results of the analysis reflect the Grade 6 pupils' level of mastery. The researcher considered the items belonging to the low mastery level and below as the least learned competencies in the science curriculum of the Grade 6 pupils in Pinapugasan Elementary School.

After the least learned competencies were identified, the construction of a pretest and instructional material was initiated. The pretest underwent a dry run in one of the sections in Grade 6 of Japitan Elementary School. The instruments have undergone content validation by a panel of experts. After thoroughly revising the instruments, the one-group pretest was immediately administered to Grade 6- Benevolent pupils of Pinapugasan Elementary School.

The treatment used a developed instructional material for the Grade 6- Benevolent after the conduct of the pretest. The conduct of the treatment was exposed to an independent and self-paced learning approach. The teacher-researcher acted as a facilitator providing the general direction of the learning activity sheet at the beginning of the treatment and overseeing the learning process for safety and appropriateness of using materials. The pupils showed initiative in supervising an alternate use of the activity materials enabling other pupils to observe and use the materials. The materials in the activities were placed in one location allowing the learners to move in one direction for alternate use of the materials. The time per activity was based on the learners' pace of finishing one activity. The group received timely feedback after finishing an activity.

After the implementation of the treatment, a posttest of the same set of questions followed immediately after the intervention. The data gathered from the pretest and posttest have undergone a bivariate analysis using statistical methods.

Data Analysis. The conduct of data analysis in this study utilized the following descriptive and inferential statistics to answer the statement of the problem in this study. In order to identify the quality of the developed

research-based instructional material, a descriptive mean was used. To determine the results before and after utilizing the instructional material, the descriptive mean was also used. A paired T-test was used as to determine the significant difference between the level of performance before and after the implementation of developed instructional materials.

III. Results and Discussion

Stressing the pre-research of this study, the development of the instructional material focused on reinforcement as it was developed based on the identified least learned competencies of the Grade 6 pupils in Pinapugasan Elementary School. In identifying the least learned competencies, the researcher adopted an automated item analysis from the schools' division of Escalante City.

Percentage	No. of items	Interpretation
96-100%	0	Mastered
86-95%	3	Closely Approximating Mastery
66-85%	9	Moving towards Mastery
35-65%	18	Average Mastery
15-34%	14	Low Mastery
5-14%	6	Very Low Mastery
0-4%	0	Absolute No Mastery

Table 1. *Percentage and Frequency of the Competencies scaled from mastered to no mastery*

Table 1 presented the scale of the pre-assessment results, which allowed the identification of the least learned competencies, which referred to the items with a percentage of 34% and below under an interpretation of low mastery of the competencies. The table showed that there were a total of 20 items out of 50 in the pre-assessment that was identified as the least learned competencies. The following are the identified least learned competencies of the Grade 6 pupils in science Quarter 1 of Pinapugasan Elementary School:

- a. Identify the kinds of mixtures
- b. Describe uniform and non-uniform mixtures
- c. Describe the appearance and uses of solutions such as;
 - i. Liquid to liquid
 - ii. Liquid to gas
 - iii. Gas to liquid
 - iv. Solid to solid
 - v. Gas to gas
- d. Infer that not all solutes dissolve in all solvents
- e. Describe how to separate mixtures through sieving or sifting
- f. Describe how to separate solid-solid mixtures through filtering
- g. Describe how to separate solid-liquid mixtures through filtering
- h. Describe the process of separating mixtures through a funnel
- i. Describe the process of separating mixtures through evaporation
- j. Explain the importance of separating mixtures in our everyday life
- k. Enumerate and describe the benefits of separating the mixture through picking and sieving/sifting
- l. Enumerate and describe the benefits of separating the mixture through filtering
- m. Enumerate and describe the benefits of separating the mixture through evaporation

The least learned competencies were the result of the pre-research serving as the basis for the construction of the instructional material. The identification of the least learned competency is essential to aid the pressing need of the learners to master the competencies by constructing an intervention and focusing on the topics that they struggled with. It is supported by Delos Santos, Lim, and Rogayan Jr. (2021), who stated that the students' reasons for low mastery include a lack of interest in the topics, poor retention, poor conceptual understanding, and poor prior knowledge about the topic and not thoroughly discussed by the teacher.

Quality of the Research-based Instructional Material

During the conduct of the treatment, research-based instructional material was developed to aid the academic reinforcement of the pupils on the identified least learned competencies. To assure the quality of the instrument, the developed instructional material underwent a thorough expert evaluation from five validators using the LRMDS evaluation tool for printed resources.

Table 2 indicates a consolidated summary of the evaluation from the panel of experts. The tool indicates the mean of every aspect of the individual factors in the evaluation tool and the overall mean of the instructional material. The tool contains four factors, namely, the content, formats, presentation and organization, and accuracy and up-to-datedness of information.

Parameters	Me an	Std. Dev.	Descript ion
Factor 1. Content	4.14	0.31	Excellent
Factor 2. Format- Prints	3	9	Excellent
Illustrations	4.7	0.11	Excellent
Design and	4.57	6	Excellent
Layout	5.0	.000	Excellent
Paper and		0	Excellent
Binding	4.4	0.22	Excellent
Size and	5.0	.000	Excellent
Weight		0	Excellent
Factor 3 Presentation and Organization	4.48	0.19 88	Excellent
Factor 4. Accuracy and Up-to- datedness of Information	4.6	0.14 9	Excellent
Over All Mean	4.56	0.16 6	Excellent

Table 2. *Quality of Research-based Instructional Materials*

*Quality – 1.0-1.75(poor); 1.76-2.50(good); 2.51-3.25 (very good); 3.26-.00(excellent)

As shown in the table, all of the factors obtained a mean of 3.26 and higher, interpreted as an excellent quality of the instructional material. Having an overall mean of 4.56, assuring an excellent quality of the developed research-based instructional material in science 6.

Level of Learning Performance in Science 6

The conduct of pretest was administered after the identification of the least learned competencies allowing the researcher to construct the remaining instruments of the study. The pretest was given to only one group of respondents consisting of thirty (30) pupils as a regulation of the one-group pretest-posttest design. After the conduct of the pretest, a treatment using the research-based instructional material as a form of intervention was utilized by the pupils to reinforce their low-mastered competencies. The pupils were facilitated by the teacher-researcher allowing an independent learning approach. After the treatment, a posttest was immediately conducted.

In the analysis of the pretest and posttest, a descriptive mean requires to determine the level of test performance of the pupils before and after the exposure to the research-based instructional material as a form of intervention. The result of the tests was compared to determine if there was a significant difference in the outcome of the pretest and posttest. Table 3 shows the statistical summary of the pretest and posttest results of the pupils before and after the implementation of the treatment.

Table 3. *Level of Performance of Grade 6 pupils in Pretest and Posttest*

Variables	SD	Mean	Interpretation
Pretest	5.27192	22.0000	Average
Posttest	5.63089	33.5000	High

As shown in the table, the pretest result of the respondents obtained an average performance indicated by the corresponding mean score of 22.0000. The average performance indicated a balance learning capacity of the group. Following the posttest, the result of the respondents’ test obtained a high performance indicating an increase of 11.5 points of the mean score from the pretest result. Following the difference in the mean score of the pretest and posttest improved the learners’ performance on achieving the least learned competencies. The findings were supported by Cordova, Medina, Ramos, and Alejo (2019), which stated that the results of the competency-based strategic intervention materials demonstrate that content advancement has helped in the improvement of convenient learning and long-partition learning. Furthermore, it is also supported by Dacumos (2016), who highlighted in an article in the AsTEN Journal of Teacher Education that using these materials is essential for achieving the needed competencies of the students, which they failed to achieve in regular classroom instruction. It only showed that the utilization of the research-based instructional material was an effective tool to provide remediation and reinforcement to the learners concerning the identified least learned competencies.

Comparison of the Pretest and Posttest Performance in Science 6 upon the implementation of the treatment

To determine the significant difference between the pretest and post-test performance in the science curriculum of the respondents, a T-test for the dependent variable was used. Table 4 compares the performance of the Grade 6 pupils in the pretest and posttest.

Table 4. Difference of Pretest and Posttest Performance

Variable	SD	Mean	T-test	P	Interpretation
Pretest	5.27192	22.0000	20.436	.000	Highly significant
Posttest	5.63089	33.5000			

As shown in Table 4, the pretest result of the group obtained a mean score of 22.0000, which is interpreted as an average performance of the pupils. The posttest, on the other hand, obtained an increase of points in the mean score of the pupils. The posttest attained a mean score of 33.5000, which is interpreted as a high performance of the group. The probability value of the test is .000, which is less than 0.05; a scale of .000 interprets it as highly significant.

The result of the statistical evaluation showed that there is a significant difference in the pretest and posttest scores of pupils under the implementation of the research-based instructional material. The differing results of the pretest and posttest are supported by Limbago-Bastida & Bastida (2022) and Dacumos (2016), who stated that the intervention materials help master competency-based science skills. It shows that the developed instructional material based on the pre-research result upon identifying the least learned competencies allowed the pupils to improve their performance in the posttest gradually. The identification of the least learned competencies allowed the pupils to focus on the competencies that they were struggling with, as well as the researcher to construct an appropriate intervention in the form of a learning activity sheet based on the competencies identified during the conduct of the pre-research assessment. Given the above findings, it can be implied that research-based instructional material is an effective tool and strategy that helps increase pupils’ academic performance in science.

IV. Conclusions

The results of this study indicate that the implementation of the developed instructional material contributed to the improvement of the mastery level towards the learning competencies of the Grade 6 pupils in science. Having the Grade 6 pupils exposed to a reinforcement of their least learned competencies through instructional material with the integration of indigenous materials in the learning activities can significantly improve the mastery level of the pupils with regards to the identified least learned competencies based on the pretest and posttest results. Thus, the researcher concluded that the implementation of the developed

instructional material as an intervention favors the improvement of the pupils concerning the identified least learned competencies in Science 6.

Conflicts of interest. The authors declare that for this article they have no actual, potential or perceived conflict of interests.

Ethics committee approval. The identity and well-being of the learners was protected at all time. Data privacy was ensured by the researcher and data collected was deemed confidential throughout the conduct of the study. The researcher adhered to safety protocols during the conduct of the study.

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