**Development of Contextualized Learning Activity Sheet (LAS) for Teaching Molecular Polarity and Miscibility**

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**Abstract**

*The teaching of molecular polarity and miscibility is essential in chemistry education, as these concepts are foundational for understanding chemical interactions in both academic and industrial contexts. This study developed a Contextualized Learning Activity Sheet (LAS) to enhance student engagement and comprehension by connecting these abstract concepts to real-world applications. Using the ADDIE model, the LAS was designed, implemented, and evaluated through a mixed-methods approach, combining quantitative assessments with expert validation. Results from pre- and post-tests demonstrated that the LAS significantly improved students’ understanding, with the experimental group outperforming the control group. This indicates that integrating contextualized activities fosters deeper learning and critical thinking in chemistry. These findings highlight the effectiveness of active and contextualized learning strategies in science education, providing a valuable framework for improving academic outcomes in chemistry.*

*Keywords: Contextualized Learning, Molecular Polarity, Miscibility, Chemistry* Education, Learning Activity Sheet, ADDIE Model, Active Learning

**I. INTRODUCTION**

The teaching of molecular polarity and miscibility is critical in chemistry education, as these concepts underpin many practical applications in both academic and industrial settings. Contextualized learning, which connects educational content to real-world situations, has been shown to enhance student engagement and understanding (Picardal & Sanchez, 2022). This approach is particularly beneficial in science education, where students often struggle to relate abstract concepts to their everyday experiences (Gecolea & Amon, 2022).

The development of a Contextualized Learning Activity Sheet (LAS) aims to facilitate this connection, providing students with a structured means to explore molecular polarity and miscibility through relatable contexts.

Research indicates that contextualized learning not only improves academic performance but also fosters a deeper understanding of scientific principles by making learning relevant to students' lives (Picardal & Sanchez, 2022). By integrating contextual elements into the teaching of molecular polarity and miscibility, educators can enhance students' motivation and interest in chemistry, ultimately leading to improved learning outcomes (Erika et al., 2019).

This study seeks to develop and evaluate a LAS that incorporates contextualized activities tailored to the concepts of molecular polarity and miscibility, thereby promoting a more engaging and effective learning experience.

**STATEMENT OF THE PROBLEM**

The study determined the effectiveness of the LAS as applied in the condition of Mat-i National High School, Surigao City, Surigao del Norte, Division of Surigao City. Specifically, the study answered the following questions:

1. What is the Pre-test Scores of the Grade 11 Students under the control and the experimental group?

2. What is the Post Test Scores of the Grade 11 Students under the control and the experimental group?

3. Is there a significant difference in the Post Test Scores between the control and the experimental groups co-variating the pretest scores?

Hypotheses

At 0.05 level of significance it is hypothesized that:

Ho: There no significant difference in the Post Test Scores between the control and the experimental groups co-variating the pretest scores.

**II. METHODS AND MATERIALS**

The Development of Contextualized Learning Activity Sheet (LAS) for Teaching Molecular Polarity and Miscibility has several stages, utilizing the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) to ensure a systematic approach (Almelhi, A. M., 2021).

**Analysis Phase:**

* Needs analysis
* Contextual analysis
* Task analysis

**Implementation Phase:**

* Pilot testing
* Feedback and Iteration
* Full Implementation

**Development Phase:**

* Content creation
* Material development
* Prototype

**Design Phase:**

* Instructional design
* Contextualization

**Evaluation Phase:**

* Formative evaluation
* Summative evaluation
* Feedback Analysis
* Iterative Improvement

Contextualized LAS

The study will employ a design and development research method, incorporating quantitative approaches.

**Development Phase**

**Content Design:**

Identify key concepts (polarity, miscibility, solubility) and align them with curriculum standards.

Develop structured activities based on the principles of “like dissolves like.”

**Activity Sheet Components:**

**Objectives:** Clearly stated learning outcomes.

**Materials List**: Water, vinegar, vegetable oil, kerosene, food coloring, candle dye, stirring rods, test tubes.

**Procedure:** Step-by-step instructions for mixing substances and observing results.

**Processing Questions:** Prompts to analyze observations and connect them to theoretical concepts.

**Conclusion:** Reflective exercises to summarize learning.

**Expert Validation:**

Consult subject matter experts to ensure scientific accuracy, clarity, and relevance.

**Implementation Phase**

Conduct a pilot test with a sample of high school students.

Administer pre-tests and post-tests to measure knowledge acquisition.

Facilitate teacher-guided activities using the developed learning sheet.

Respondents

A purposive sampling approach will be utilized to carefully select senior high schools situated within the designated geographic area. The subjects of the experimental study will be the Grade 11 Section Narra students in Earth and Life Science Class Subject of Mat-I National High School, District 10 Division of Surigao City, School Year 2024-2025. The study was conducted in a natural setting classroom environment where students were grouped according to their section. The class is considered heterogeneous comprising the fast, average and low learners. As to the teacher respondents, total population of Science teachers in Mat-I National High School and the school head were included. The control of the intervening variables was ensured by involving only one section, with one teacher handling the class, and using the lecture as teaching strategy. Homogenization of respondents was done using the statistical approach namely the Analysis of Covariance where learning achievement of students under the control and experimental group is compared using the post-test covariation their pre-test.

**Research Instrument**

Readily available test from RM NO. 0275, S. 2022 – SUKDANAN’S STANDARDIZED TEST MATERIALS IN SCIENCE will be used in measuring the learning achievement of students for pre-test and post-test. The test covered the topic for polarity of molecules which has contained 10 items. These were used during the pretest and another 10 items test were employed for the post-test both the control and the experimental group. The tests were validated by the Department of Education, Caraga Region.

**Data Analysis**

Mean and Standard Deviation was employed to determine the learning achievement of students based on the pre-test and post test results;

T-test for dependent samples was used in determining whether significant difference in the assessment exists between the pretest and post test scores;

Analysis of co-variance (ANCOVA) was employed in determining the significant difference between the post test scores of the control and the experimental group co-variating the pretest scores.

**III. RESULTS**

Table 1:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Descriptive Data for Control Group | | | | | |
|  | **N** | **Mean** | **Median** | **SD** | **SE** |
| PRETEST CONTROL | 30 | 15.9 | 15.5 | 3.47 | 0.633 |
| POSTTEST CONTROL | 30 | 19.0 | 18.0 | 5.37 | 0.980 |

Table 2:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Paired Samples T-Test for Control Group | | | | | | | |
|  |  |  | **statistic** | **Df** | **p** | **Mean difference** | **SE difference** |
| PRETEST CONTROL | POSTTEST CONTROL | Student's t | -2.65 | 29.0 | 0.013 | -3.13 | 1.18 |
| Note. Hₐ μ Measure 1 - Measure 2 ≠ 0 | | | | | | | |

Table3:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Descriptive Data for Experimental Group | | | | | |
|  | **N** | **Mean** | **Median** | **SD** | **SE** |
| PRETEST EXPERIMENTAL | 30 | 25.8 | 24.0 | 6.21 | 1.134 |
| POST TEST EXPERIMENTAL | 30 | 32.6 | 31.5 | 5.46 | 0.996 |

Table 4:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Paired Samples T-Test for Experimental Group | | | | | | | |
|  |  |  | **statistic** | **df** | **p** | **Mean difference** | **SE difference** |
| PRETEST EXPERIMENTAL | POST TEST EXPERIMENTAL | Student's t | -7.32 | 29.0 | < .001 | -6.80 | 0.929 |
| Note. Hₐ μ Measure 1 - Measure 2 ≠ 0 | | | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ANCOVA - POSTTEST | | | | | |
|  | **Sum of Squares** | **df** | **Mean Square** | **F** | **p** |
| GROUP | 680 | 1 | 679.7 | 26.65 | < .001 |
| PRETEST | 244 | 1 | 244.5 | 9.58 | 0.003 |
| Residuals | 1454 | 57 | 25.5 |  |  |

**III. DISCUSSIONS**

The results of the study indicate that the Contextualized Learning Activity Sheet (LAS) significantly enhanced students' understanding of molecular polarity and miscibility, as evidenced by the comparison of pre-test and post-test scores in both control and experimental groups.

For the control group, the mean post-test score (M = 19.0, SD = 5.37) was significantly higher than the pre-test score (M = 15.9, SD = 3.47), with a mean difference of -3.13, t (29) = -2.65, p = 0.013. This demonstrates that learning occurred even with traditional teaching methods.

However, the experimental group, which utilized the LAS, showed a more substantial improvement, with a mean post-test score (M = 32.6, SD = 5.46) significantly higher than the pre-test score (M = 25.8, SD = 6.21), yielding a mean difference of -6.80, t(29) = -7.32, p < 0.001.

These results highlight the superior effectiveness of the LAS in facilitating student learning. The ANCOVA analysis further supported this, showing a significant group effect (F = 26.65, p < 0.001), indicating that the experimental group significantly outperformed the control group after adjusting for pre-test scores.

The pre-test scores also significantly influenced post-test outcomes (F = 9.58, p = 0.003), emphasizing the role of prior knowledge in learning. These findings demonstrate that the LAS is a highly effective tool for teaching molecular polarity and miscibility, providing a contextualized and hands-on approach that enhances student engagement and comprehension compared to traditional methods.

The effectiveness of the LAS can be attributed to its alignment with principles of active learning, which have been shown to increase student performance in science, engineering, and mathematics (Laurel, 2022). By engaging students in contextualized activities, the LAS fosters a deeper understanding of molecular concepts, as supported by previous research indicating that students benefit from learning experiences that connect scientific principles to real-world applications (Freeman et al., 2014; , Sonmez, 2024).

For instance, Host et al. demonstrated that students' understanding of molecular polarity improved when they utilized various visual representations, suggesting that diverse teaching methods can enhance comprehension (Host et al., 2012).

Moreover, the findings align with the notion that inquiry-based and model-based learning approaches promote mastery of chemical concepts (Pyatt, 2014; Gupta et al., 2014).

The LAS's hands-on activities likely encouraged students to explore molecular polarity and miscibility through experimentation and collaboration, which are critical components of effective science education (Gupta et al., 2014). This approach not only enhances understanding but also cultivates critical thinking skills, as students negotiate their understanding of complex concepts through peer interactions (Gupta et al., 2014).

**IV. CONCLUSIONS**

In conclusion, the study's results affirm the efficacy of the Contextualized Learning Activity Sheet in teaching molecular polarity and miscibility. By integrating contextualized learning strategies, the LAS provides a robust framework for enhancing student engagement and comprehension in chemistry education, ultimately leading to improved academic outcomes.

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