Module Equipped Manipulative and Interactive Strategic Intervention Material (MI-SIM) in Chemistry 9

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Abstract - Variation in students' learning makes the teacher creative in delivering lessons. To cope with the 21st century learners with different learning styles that learn best through experience, the researcher made an innovation, "Manipulative and Interactive Strategic Intervention Material (MI-SIM)". MI-SIM is combination of manipulative and interactive instructional tool that aims to improve the Least Mastered Skills in Science. Purposive sampling was used for the selection of respondents at Manila Science High School.

Pretest was conducted before the facilitation of intervention to the group. Posttest was then initialized after the intervention. Mean Test and Standard Deviation were used to evaluate MI-SIM's effectiveness. Results showed that it had met standards in all aspects such as sub-tasking with a mean of 4.14 (±0.57), congruence 4.36 (±0.54) and functionality 4.23 (±0.46). Data showed that it had exceeded standards in technicality with a mean of 4.42 (±0.51). The overall evaluation of MI-SIM revealed that it had met standards 4.29 (±0.44) and was acceptable.

Paired T-Test was used to test the difference in the mean of pre-test and post test scores of students who experienced intervention using MI-SIM instructional tool. Results indicated that there was a statistically significant difference between pre-test and post-test of the students with t (30) value of -18.108 and p value of < .05. The group's mean pre-test score 13.90 (±3.68) and post test score 29.94 (±4.33). There was an improvement of 16.03 (±4.93). The effect size of the mean difference is 3.25 which means very statistically significant according to Cohen d scale. The null hypothesis was rejected.

Index Terms: Education, Chemistry 9, learning style, manipulative, interactive, intervention and instructional tool

1 INTRODUCTION

In the world where change is inevitable, the only constant is modification. In every aspect of life, people modify things to cope in some changes. These quick changes and increased complication of today's world show new challenges and put new strains in the education system (Yam, Rhoades, Sweeney & Kaput, 2002). To cope with these changes, teachers tend to modify things to hook students' interest, which is so limited nowadays. Students' focus is more on gadgets that could distract them on their studies.

In the field of pedagogy, the kind of learners change as time goes by. These deviations and improvements in technology have led many educationalists to re-evaluate outdated, uniform teaching methods and stress the significance of seeing student's learning styles in the design and provision of course content (Romanelli, Bird & Ryan, 2009). There has been in general an increasing consciousness of the need to alter and improve the preparation of students for creative functioning in the frequently changing and extremely challenging setting (Yam, Rhoades, Sweeney& Kaput. 2002).

Students of new generation have different learning styles. Learning styles vary in every person. Some students learn best when things are projected, heard, uttered, moved, rational, groups and alone. Other students gain knowledge through hands-on activities which they can only acquire by experiencing the manipulation of instructional tools. The learners of today exhibit the different learning styles. How do teachers cope with this change? The answer is "innovation". Innovation develops the creativity of classroom facilitators. This made the researcher to create a simple box used in traditional teaching and modify it into something new to meet the desires of the learners with different learning styles. The "Box of Learning and Fun", that is created by the researcher, is equipped with varied manipulative and interactive activities in Chemistry based on the least mastered skills in Chemistry 9.

Manipulative and Interactive Strategic Intervention Material (MI-SIM) is "A Box within a Box", an instructional tool that would aid students in learning chemistry topics the easiest way. It aims to improve the academic performance of Grade 9 in Chemistry.

Strategic Intervention Material is designed for the improvement of least mastered skills in a certain topic in any field of subject. It is used as an intercession towards mastery of the subject matter. The researcher makes an innovation for an OLD SIM to a modified one. The

researcher combined the concept of manipulative and interactive SIM as one instructional tool.

Manipulative and Interactive Strategic Intervention Material is designed for the students with varied learning styles. It is equipped with games both interactive and manipulative to inspire students in learning difficult topics.

Experienced-based learning in the use of Manipulative and Interactive Strategic Intervention Material would hook theinterests of learners to learn the least mastered skills in Chemistry 9.

Learners learn in different ways. Their learning depends on their learning styles. Some students learn best when things are touched, seen, heard and felt. This variation of students' learning makes the teacher more creative in delivering the lessons. These lessons are well-delivered using instructional tool. This made the researcher create an innovation from an old SIM. Specifically, it sought to answer the following questions:

1. How effective is MI-SIM in relation to the following:
   a. Sub-tasking
   b. Congruence
   c. Functionality
   d. Technicality
2. What is the overall interpretation of students in the use of MI-SIM?
3. Is there a significant difference in the mean pre-test and post test scores of students who experienced MI-SIM intervention materials?
4. Is there an increase in the academic performance of the students in Chemistry 9?

The study was conducted at Manila Science High School - the Philippines' pilot Science High School. Students in this institution are screened well. In order for them to qualify in the entrance examination, they should have NO grade lower than 85. They must pass the entrance exam and interview. Though they are selected well, there are still students who find difficulty in meeting the standards of the school. This may be due to the fundamental aspects that further affect their educational performance in school. This made the researcher developed an instructional tool that can support the learners on their academic endeavor, specifically their science subject-chemistry.

Furthermore, most of the respondents belong to the middle-class family. Based on their Form 137, seventy-five percent came from private schools during their grade school. They live in different places such as Laguna, Cavite, Bulacan, Quezon City. Most of them are from Manila. Table 1 shows the demographic profile of the respondents. In the intervention class of thirty-one 61.29% are boys while 38.71% are girls. They came from different sections handled by the researcher. All of the respondents have grade lower than 85 in Chemistry 9. Student who got grade lower than 85 is said to be low in academic performance. They are the respondents of this study. Below is the demographic profile of the respondents.

2 METHODOLOGY

Manipulative and Interactive Strategic Intervention Material (MI-SIM) is an innovative instructional tool that primarily aims to develop the least mastered skills in Chemistry 9. Pretest Scores revealed that students had difficulty in the following topics: Mole Concept, Molar Mass and Percentage Composition.

This made the researcher developed an intructional tool that would serve as an intervention for the development of Least Mastered Skills in Consumer Chemistry. The MI-SIM is composed of Guide Card, Activity Card and Assessment Card. It is also equipped with Module which the Mole Concept, Molar Mass and Percentage Composition, are discussed in detailed. Below are the images of the MI-SIM:

Figure 2 Manipulative and Interactive Strategic Intervention Material (MI-SIM)

Figure 2.a Guide Card 1

Figure 3 Activity Card 1

Score Sheets were handed to the students prior to the use of MI-SIM. This is where they will paste the collected science badges gained for every correct answer in the activity cards and assessment cards. In Figure 2.a, the instructions for using the activity card 1 are carefully explained in Guide Card 1. This will lead the students in answering the Activity Card 1 as shown in figure 3.

The title of the activity is SPIN-NAME-SOLVE. In this activity, students will spin the wheel. First, they need to name the element for the corresponding atomic number and symbol, only then that they can answer the question once the element is identified correctly. Students have only five

chances of spinning the wheel. Students will then answer Assessment Card 1 which is shown in Figure 4 and Figure 4.a below. Topics enclosed in this segment of "Box of Learning & Fun" is "The Mole Concept".

Figure 4 Assessment Card 1

Figure 4.a Assessment Card

In Figure 5 below, directions for answering the Activity Card 2 are carefully explained in details. Activity Card 2 is shown in Figure 6 and 6 below.

Figure 5 Guide Card 2

Figure 6 Activity Card 2

The title of activity card 2 is ELEMENTS OF LADDER. In this activity, learners will roll the dice. The number in the dice corresponds to the moves of the player to the tile from the starting point. Before they can move to the next tile, they need to answer the allotted problem question for each tile. If they get the correct answer, only then that they can roll the dice and will move to the next tile. If the move points to a ladder, they will move up. If the move points to a snake, they will move down. The GOAL is to reach the number 30 elements, only then that the player will win the game. Five players are allowed to play this game. Science badge is acquired for every correct answer. Students will then proceed to answer the Assessment Card 2 as presented in Figure 7 below.

Figure 7 Assessment Card 2

Figure 8 Guide Card 3

Figure 8 above shows the Guide Card 3. In Guide Card 3, procedures for Activity Card 3 are explained in details. The title of Activity Card 3 in Figure 9 and 9.a (below) is Flowery Mole. In this activity, students will pick a petal of their choice. Each petal has a corresponding Mole Conversion problem which the students need to answer as prerequisite to the picking of next petal. Students cannot proceed to the next petal if their answer in the previous petal is incorrect. Students are allowed to pick five petals only. Badges are earned for every correct answer in the Mole Conversion problem solving. Students will then answer the Assessment Card 3 as displayed in Figure 10 and 10.a below

Figure 10 Assessment Card 3

Figure 10.a Assessment Card 3

Figure 11 below illustrates the Guide Card 4. Guidelines in answering Activity Card 4 in Figure 12 are explained in details. The title of Activity Card 4 is Ball in the Hole. In this activity, learners are invited to drop the ball. Each hole contains percentage composition problem which the students need to answer correctly in order to drop another ball for the next problem. Students are only allowed to drop the ball five times.

Figure 11 Guide Card 4

Figure 12 Activity Card 4

This activity will lead the students in answering the Assessment Card 4 as shown in Figure 13 below.

Figure 13 Assessment Card

Figure 13 Activity Card 5

MI-SIM is also equipped with Guide Card 5, Activity Card 5, Assessment Card 5 and Enrichment Card (placed in a flash drive for interactive activity). It also contains Answer Card which is found in the module and box itself. Answer Card is provided so the teacher and students can directly check whether answers are correct. It is also used to check if they are on the right track in solving problems in the MI-SIM. Enrichment Card is also provided and used as supplemental activity to enrich the knowledge of the students in Chemistry. All the topics are aligned in the K to 12 Standards. Learning Competencies in the said curriculum are implemented in the MI-SIM.

Framework

The researcher used Survey Research Design and Quasi-Experimental Research Design particularly one-group posttest only design as its research designs. Survey Research Design was used because it is low in costing, the information is readily available and it is a valuable tool for evaluating ideas and trends (Shuttleworth, 2008). A pretest-posttest design was also administered to determine the effectiveness of the intervention (Shuttleworth, 2009). Below is the flow chart of the methods used by the researcher.

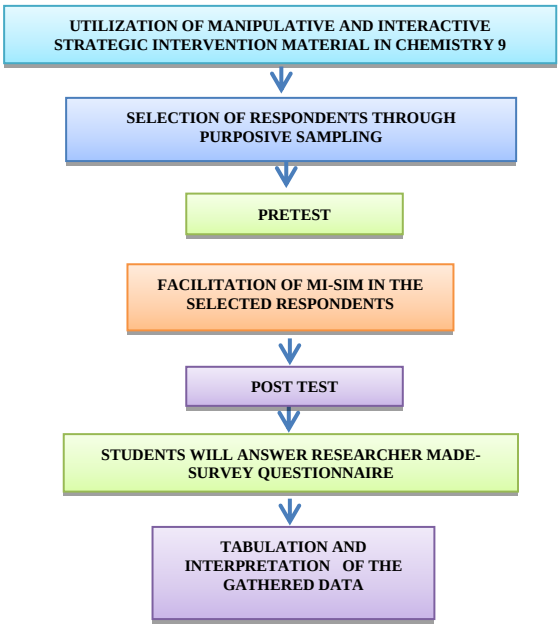


Figure 14
Flow Chart of the Research Design

Purposive sampling is the sampling procedure used by the researcher. It is a non-probability sampling method that occurs when "elements selected for the sample are chosen by the judgment of the researcher. Researchers often believe that they can obtain a representative sample by using a sound judgment, which will result in saving time and money" (Black, 2010)

The researcher believed that it was the most appropriate sampling technique because it eliminated sampling bias. Students with grade lower than 85 in the Chemistry Class of the researcher were the respondents of this study. There were thirty-one students from three sections handled by the researcher.

The researcher administered a Pretest in the purposively selected students from Grade 9 class of the researcher at Manila Science High School. This was directed in order to determine the least mastered skills in Grade 9 Chemistry. After determining the least mastered skills in Chemistry 9, Manipulative and Interactive Strategic Intervention Material (MI-SIM) was used as an intervention for the improvement student's academic performance. It was utilized as an instructional tool. Post Test was then conducted after the intervention. Respondents answered the researcher-made survey questionnaire to evaluate the use of MI-SIM. The science department head and master teachers of the school validated the researcher made survey questionnaire. Data were gathered and tabulated for Pretest and Post Test Exam and Survey Form in MS Excel.

The data gathered from the pretest and posttest score were treated using the Paired T-Test. It evaluated whether the mean difference between two sets of observations is zero. In a paired sample t-test, each subject is measured twice, resulting in pairs of observations. Difference in the means of pretest and pot test scores may result to the effectiveness of the intervention used in the research study.

3 RESULTS AND DISCUSSION

Purposively selected respondents were asked to use the MI-SIM. After using the MI-SIM, respondents were asked to answer the researcher made survey by completing the 19-item Likert scale, evaluating the use of MI-SIM in terms of 1) Sub-tasking; 2) Congruence; 3) Functionality, and 4) Technicality. The scoring and interpretation of the data gathered on 1) Sub-tasking; 2) Congruence; 3) Functionality, and 4) Technicality, and Overall Evaluation, as shown in Table 2, were adapted from the book "Action Research" (Domingo, 2017).

Table 3. Scoring and Verbal Interpretation

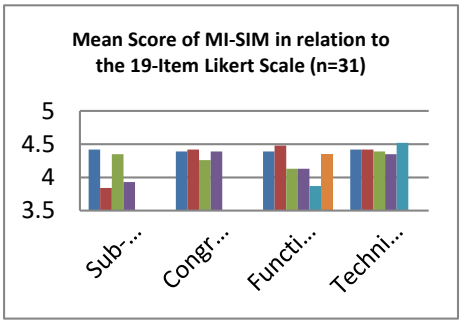
Score Range	Verbal Interpretation	Remarks
4.00 – 5.00	Exceeds Standards	Highly Acceptable
2.01 – 3.99	Meets Standards	Acceptable
1.00 – 2.00	Below Standards	Not Acceptable

Table 3 shows the mean, standard deviations, and verbal interpretations of the participants' evaluation of the use of MI-SIM in relation to the 19 items in the researcher-made questionnaire. Results showed that the use of MI-SIM had "Exceeded the Standards" and therefore highly acceptable in relation to Items 1, 3, 5 to 12, 14 to 19. In relation to items 2, 4 and 13, MI-SIM had "Met the Standards" and was acceptable.

Table 4. Mean, Standard Deviations, and Verbal Interpretation of Evaluation of the Use of MI-SIM in relation to the 19-Item Likert Scale (n=31)

Aspect	Mean	SD	Interpretation
Item 1	4.42	0.56	Exceeds Standards
Item 2	3.84	0.97	Meets Standards
Item 3	4.35	0.75	Exceeds Standards
Item 4	3.93	0.99	Meets Standards
Item 5	4.39	0.72	Exceeds Standards
Item 6	4.42	0.72	Exceeds Standards
Item 7	4.26	0.68	Exceeds Standards
Item 8	4.39	0.72	Exceeds Standards
Item 9	4.39	0.80	Exceeds Standards
Item 10	4.48	0.51	Exceeds Standards
Item 11	4.13	0.76	Exceeds Standards
Item 12	4.13	0.76	Exceeds Standards
Item 13	3.87	0.85	Meets Standards
Item 14	4.35	0.66	Exceeds Standards
Item 15	4.42	0.72	Exceeds Standards
Item 16	4.42	0.85	Exceeds Standards
Item 17	4.39	0.72	Exceeds Standards
Item 18	4.35	0.61	Exceeds Standards
Item 19	4.52	0.57	Exceeds Standards

Items 1 to 4 describe the Sub-tasking category. This domain assesses MI-SIM as learning material according to competency, blooms taxonomy and variation of activities. Items 5 to 8 refer to the congruence category. This domain evaluates the activities and assessments used in the MI-SIM. Items 9 to 14 represent the functionality category. This domain gauges the elements of MI-SIM. Items 15 to 19 define the Technicality category. This domain measures the usability of MI-SIM. Below is the summary of MI-SIM's mean score presented in graph per domain.



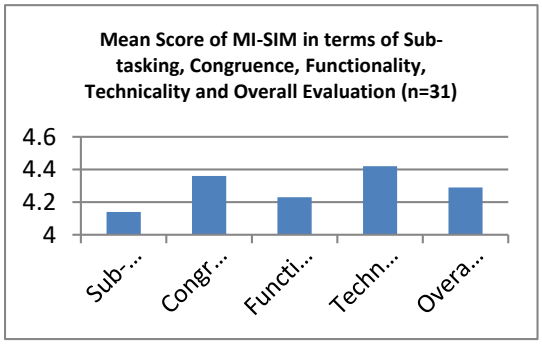
Graph 1. Mean Score of MI-SIM in relation to the 19-Item Likert Scale (n=31)

Similarly, results of the evaluation on the use of Manipulative and Interactive Strategic Intervention Material (MI-SIM) showed in Table 4 that it had Exceeded Standards in terms of Sub-tasking with a mean of 4.14 (±0.57), Congruence with a mean of 4.36 (±0.54), Functionality with a mean of 4.23 (±0.46) and Technicality with a mean of 4.42 (±0.51). Subsequently, the overall evaluation of the MI-SIM showed that it had Exceeded the Standards and was Highly Acceptable with a mean of 4.29 (±0.44).

Table 5. Mean, Standard Deviations, and Verbal Interpretation of Evaluation of the Use of MI-SIM in terms of Sub-tasking, Congruence, Functionality, Technicality, and Overall Evaluation (n=31)

Aspect	Mean	SD	Interpretation
Sub-tasking	4.14	0.57	Exceeds Standards
Congruence	4.36	0.54	Exceeds Standards
Functionality	4.23	0.46	Exceeds Standards
Technicality	4.42	0.51	Exceeds Standards
Overall Evaluation	4.29	0.44	Exceeds Standards

Graph 2. Mean Score of MI-SIM in terms of Sub-tasking, Congruence, Functionality, Technicality, and Overall Evaluation (n=31)



Consequently, Table 6 showed that the mean pretest score of the group was 13.90 (±3.68) and the mean post test score was 29.94 (±4.33).

Table 6. Pretest and Posttest Scores of Students in MI-SIM Methods

	Mean	SD	T-Test	P Value
Pretest	13.90	3.68	-18.11	< .05
Posttest	29.94	4.33		

Based on the means of the pre test and post test and the direction of the t value, there was a statistically significant difference between the scores of the respondents from 13.90 (±3.68) to 29.94 (±4.33). There was an improvement of 16.03 (±4.93). Results of paired t test done revealed that there was a significant difference between the pre test and post test of the learners with t(30)=-18.108 and p value < .05.

Cohen d was also used to determine the effect size of the mean difference. Results showed that the effect size is 3.25. This indicates that the mean difference between the two scores is very large and very statistically significant.

Table 7. Academic Performance of Respondents during the 2nd Grading Period

Academic Performance	Frequency	Percentage
Below 85	5	16.13%
Above 85	26	83.87%

Table 7 revealed that 83.87 % of the respondent's grade in the 2nd quarter had increased in relation to their academic performance.

4 CONCLUSIONS AND RECOMMENDATIONS

Survey results revealed that theManipulative and Interactive Strategic Intervention Material (MI-SIM) is effective in relation to the aspects of Sub-tasking, Congruence, Functionality, and Technicality. It had "Exceeded the Standards" and was Highly Acceptable.

The overall interpretation of students in the utilization of MI-SIM exceeded the standards and was highly acceptable.

Paired T-Test was used to test the mean difference of pre-test and post test scores of students who experienced the MI-SIM intervention. Taking into consideration the pretest and post test scores of the respondents, the following conclusions were made: There is a significant difference in the mean pre-test and post test scores of students who experienced MI-SIM intervention. The null hypothesis is rejected. The MI-SIM intervention was found to be effective.

There was also an increase of 83.87 % in the academic performance of the respondents Teachers should understand how the learners learn for them to be able to create the right instructional tool to be used for each of them.

This will also encourage good teacher-student relationship. Based on the findings above the following commendations were made:

School Administrators.The findings of this study may aid them in developing appropriate action plan suited to the needs of diverse learners. Developed instructional tools will also elevate the quality education that public schools portray.

Curriculum Makers.Results of this study may help them in creating curriculum thus improving the academic performance of learners to attain excellence in education.

Science Supervisors.Outcomes of this study may serve as enzyme in refining instructional methods. This will also guide them in looking at the GAP in making of instructional tools. It will further provide assistance in the implementation of strategies and other assessments necessaryto obtain quality education.

Science Teachers. Commendations of the students in using MI-SIM will encourage them in creating and innovating instructional tools that will upgrade their strategies in the teaching-learning process.

Parents. Discoveries of this study may boost parent's active contribution in assisting the needs of their child. It will further mend their rapport as devotees and associates of the school in attaining substantial academic performance of their children.

Pupils.Effects of this study may be of great help to pupils. It could give them inspiration on how to manage their difficulties and persuade them to study hard to overcome their weakness in Science.

*Future Researchers.*This study may be of great significance for they can outsource data while conducting their own studies.

Overall, the researcher recommends further study, modification and evaluation of the use of MI-SIM.

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