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Symbolic Representation Approach on Students' Academic Performance and Portfolio in Science 10 via Modular Learning Modality

Aprille Kaye O. Jaranilla
Department of Education
SDO of Valencia City–Concepcion National High School,
Concepcion, Valencia City, 8709, Bukidnon, Philippines

Maris Jade Q. Orongan
College of Education
Central Mindanao University, University Town,
Musuan, Maramag, 8714, Bukidnon, Philippines

Abstract:- The study was conducted to assess the student's academic performance in Chemistry through a symbolic representation approach (SRA) among the Grade 10 students of Concepcion National High School. Specifically, it aimed to: determine the level of academic performance of those students exposed to symbolic representation approach (SRA) and those exposed to non-SRA in terms of pretest and posttest; identify the level of student portfolio assessment of those students exposed to SRA and those exposed to non-SRA in terms of Content, Design and Organization, Creativity and Effort, Reflection, and Punctuality; find out if there is a significant difference in the academic performance of the students exposed to SRA and those exposed to non-SRA; and ascertain if there is a significant difference in the students' portfolio assessment for students exposed to SRA and for those exposed to non-SRA. The study used a quasi-experimental research design which was conducted at Concepcion National High School. Grade 10 students were tapped to participate in the study.

Results revealed that they acquired needed academic improvement performance in their pretest for both groups of students. For the student's posttest, the SRA group gained an MPS of 67.38%, implying a fairly satisfactory mean-percentage score for academic performance. On the other hand, the non-SRA had an MPS of 58.42%, indicating a needs improvement in academic performance. In the student's portfolio assessment, the overall SRA group attained a mean score of 81.78 of students, which signifies that the learners are approaching proficiency level; then the non-SRA, which had a mean score of 71.08, bringing the group to the beginning level. It was also found that the academic performance of the students exposed to the symbolic representation approach (SRA) has a significant difference from the non-SRA group. Lastly, there is also a significant difference in the student's portfolio assessment rating between those exposed to SRA and non-SRA.

Keyword:- *Symbolic Representation Approach, Modular Learning, Academic Performance, Portfoli.*

I. INTRODUCTION

Most educators think that teaching students the content of the academic discipline is not tricky. However, teaching students to think effectively about the subject matter is often not easy, and sometimes it is not achieved (Shatri & Buza, 2017). The students are not born with the power to think critically or develop it naturally. It is a learned ability, and educators need to facilitate it accordingly to develop (Makina, 2010). It can then be observed that many of the learners have trouble coping with studying today. With the current health crisis the world is facing, hindrances noticed in learning science are difficulties in communication and lack of vocabulary.

The Programme for International Students Assessment (PISA) assessment in 2018, and the Philippines ranked second-lowest in science among the 79 participating countries. The Philippines gained a science literacy score of 357, lower than the minimum standard score of 489 points (Mateo, 2019). SEI-DOST (2015) stressed that Filipino learners have low retention of concepts and limited reasoning and communication skills. Thus, they could not express ideas in their own words.

Similarly, the academic performance of Grade 10 students of Concepcion National High School of School Year 2019-2020 was poor. Their average Mean Percentage Score (MPS) in science was about 55.2%, lower than the standard MPS of 75% required by the Division of Valencia City. It was possibly due to the current situations in which learners focus more on computer games, Facebook, and other social media. Also, hindrances in learning science are communication difficulties and lack of science vocabulary (Kambouri et al., 2016).

According to Kambouri et al. (2016), symbolic representation supports understanding the science language. It may help bridge the gap between the content of science language and the learners' background. Visual imagery has shown an effective way to communicate abstract and concrete ideas in science. Symbolic representation is the language that scientists use to communicate that can be applied to the model, predict, and explain scientific phenomena (Ralph & Lewis, 2020). Many educators and researchers have stated learners should connect their

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understanding of the symbolic level to the observable, macroscopic, and microscopic levels (Bain et al., 2014).

The chemistry concepts and explanations of chemical phenomena mainly rely on the microscopic world connected to the phenomenological world, by which they are communicated with symbols. Thus, many researchers have pointed out that chemistry's academic performance includes representing and translating chemical problems using macroscopic or observable things, submicroscopic or particulate matter, and symbolic forms of representation (Sujak & Daniel, 2017). Johnstone then added that a good understanding of chemistry needs learners to integrate these levels (Sana et al., 2018).

On the other hand, with the COVID-19 pandemic, there were many educational shifts, especially in the Philippines. The Department of Education (DepEd) expects teachers to grade the learners on written and performance tasks, such as students learning portfolios. The learning portfolio will be considered the learning evidence within the grading period (Mateo, 2020b). Schools must use assessment and grading practices to showcase learners' development and respond to varied learnings (Casal, 2020).

Having a clear grasp of the language used in science may help bridge the gap between the language of science content and the learner's background knowledge. Moreover, there is no denying that this generation learns more easily through visualization. With that, the study seeks to identify the effects of the symbolic representation approach on students' academic performance and portfolio assessment via a modular learning modality.

II. METHODOLOGY

The study utilized a quasi-experimental research design. The researcher selected two (2) intact classes of Grade 10 Science (Chemistry) at Concepcion National High School that serve as the study participants. One class was exposed to the Symbolic Representation Approach (SRA), while the other was exposed to the non-Symbolic Representation Approach (non-SRA). A pre-test was given to the two groups of students for their prior knowledge was identified. A post-test was then given after the learners conducted the learning approach.

The study was conducted in Concepcion National High School, Concepcion, Valencia City, Province of Bukidnon, under the Department of Education, Valencia City Division. It has eighteen (18) teachers and one (1) School Head with ten (10) sections for all junior and senior high school grade levels with over 400 student population. Concepcion National High School implemented the printed learning modules for 2020-2021.

A letter of permit requesting approval of the study and modifying the DepEd learning was sent to and approved by the Concepcion National High School (CNHS) School Head and Schools Division Superintendent (SDS) of the Division of Valencia City for the research (Appendix A and B). Two experts then validated the learning modules. As the letter was approved, the researcher prepared the necessary materials, including the printed SRA and non-SRA learning modules and other instructional materials for the needed new normal education. The study's duration was the whole 4th quarter of SY 2020-2021.

Before the study implementation, a brief orientation was conducted with parents and students. However, before the meeting, a consent letter approved by the School Head and SDS of Valencia City was sent to inform both parents and the students. Parents and students then signed a consent form allowing themselves to be part of the study.

The student's academic performance, a 60-item standard exam from Department Education – Valencia for the school year 2019-2020 of Grade 10 - Chemistry used for both SRA and non-SRA groups students. A pre-test was conducted to identify the previous knowledge of the learners for the topic to be given.

The selected Grade 10 class in Science 10 with two (2) sections during the SY 2020-2021 was identified as an experimental and control group. The experimental group implemented a Symbolic Representation Approach (SRA). On the other hand, the control group was exposed to a non-Symbolic Representation Approach (non-SRA). The topic covered one grading period, precisely the fourth grading period that tackles Chemistry, specifically the Gas Law and Chemical Reaction. After conducting the modular learning for both groups, each student made a portfolio and was given the post-test the same test questions. The researcher checked each exam, as the portfolios were rated accordingly.

While conducting the research study, the health and safety protocols for the COVID-19 Pandemic were observed and followed. All participants in the study wore a face mask and kept social distancing. Each group of students had a specific date and time to receive and return their modules to the school, at the same they took their pre-test and post-test.

III. RESULTS AND DISCUSSION

A. Level of Academic Performance of Students

Table 1 shows the academic performance level of students before and after exposure to SRA and those exposed to the non-SRA through pretest and posttest. It presents the frequency distribution and statistical analysis of students' percentage scores in the 60-item test adapted from the Grade 10 – 4th quarter exam of 2019-2020.

ISSN No:-2456-2165

Table 1. Academic performance of students in their pretest and posttest.

RANGE	SRA				Non-SRA				QUALITATIVE DESCRIPTION
	Pre-test		Post-test		Pre-test		Posttest		
%	(f)	%	(f)	%	(f)	%	(f)	%	
90-100	0	0	5	12.5	0	0	1	2.6	Outstanding (O)
80-89	0	0	6	15.0	0	0	5	12.9	Very Satisfactory (VS)
70-79	0	0	5	12.5	0	0	5	12.9	Satisfactory (S)
60-69	1	2.5	11	27.5	0	0	7	18.0	Fairly Satisfactory (F.S.)
59 below	39	97.5	13	32.5	39	100	21	53.6	Needs Improvement (N.I.)
Mean	18.33		41.05		16.63		36.63		
MPS	30.38		67.38		27.82		58.42		
Q.D.	NI		FS		NI		NI		

Legend:

Score Range	Qualitative Description
90-100	Outstanding (O)
80-89	Very Satisfactory (VS)
70-79	Satisfactory (S)
60-69	Fairly Satisfactory (FS)
59 below	Needs Improvement (N.I.)

Table 1 presents the pretest result of forty (40) students in the Symbolic Representation Approach (SRA) who had needs improvement of academic performance, and only one (1) student got a fairly satisfactory guideline. On the other hand, in the non-SRA group, all thirty-nine (39) students needed improvement.

The same table presents the pretest mean percentage result of the 60-item test for both groups. The experimental group had a mean score of 18.23 with a mean-percentage score (MPS) of 30.38 before SRA exposure. The MPS indicates that the students needed improvement. The non-SRA group had a mean of 16.33 with an MPS of 27.82, indicating a need to improve performance.

It can be inferred from the results that most of the students in both experimental and controlled groups had low academic performance with a non-passing score in their pretest based on the standards set by the Department of Education. It shows further that learners had less or no prior knowledge of the topic. The non-exposure of a stimulus was argued by Sanchez (2017). He stated the need for experiments, pictures, and illustrations to produce and have symbolic representations to enhance their learning. Further, the students' underperformance in their pretest may be caused by high grading standards, exposure constraints, and broader context, which require more instructional time.

Macanas and Rogayan's (2019) study also revealed a low level of academic performance of the concepts for the pretest of both control and experimental groups. They had suggested that the learners must be taught to increase their participation, critical thinking skills, and achievement.

On the other side, Table 1 also contains the learner's academic performance after the exposure to SRA. Their posttest shows that the SRA group had a needs improvement academic performance of thirteen (13) students, another eleven (11) students were in a fairly satisfactory level, five (5) of students were on the satisfactory level, another six (6) for very satisfactory level, and five (5) in the outstanding level. For the non-SRA group, twenty-one (21) students got a needs improvement academic performance, seven (7) with a fairly satisfactory level, five (5) students for satisfactory level, another five (5) students for very satisfactory level, and one (1) student achieved an outstanding level of academic performance.

Furthermore, out of 60 items, the SRA group attained a mean score of 41.05 with an MPS of 67.38%, indicating a fairly satisfactory academic performance level after SRA exposure, while the non-SRA group had a mean score of 36.63 with an MPS of 58.42%, implying that there would be a need for improvement on the academic performance.

The result implies that the students exposed to Symbolic Representation Approach (SRA) had a higher mean score after exposure to the SRA than those in the non-SRA. However, both groups' result were not reach the standard score set by the Department of Education, which was 75%. Sanchez (2017) defended that one of the things that may contribute to this underperformance might be a higher grading standard. He added that applying learning methods to the students may increase their mean scores than those without any conditions.

In connection, SRA can be seen to bring a significant mean increase, for the students were given better figures and activities in their modules due to the macroscopic, microscopic, and symbolic representations. Thus, it may lead to a better understanding of the lesson, especially on Gas Laws. Many could answer the activities as seen in the students' answers in their learning modules where SRA was incorporated. Many students had observed to try answering and doing the activities linked to the symbolic representations, especially the problem-solving. Though it can also be observed that some had a hard time answering the chemical reaction, many tried their best.

Nyanhi and Ochonogor's (2020) study also gave a different perspective. Their study results revealed that most students found it easy to identify pure elements and states of matter. Still, they found it hard to negotiate between the three levels of chemical representations of matter. The learners have somewhat the same feeling of difficulty dealing with the three levels, especially on the chemical representation of matter.

Trivic et al. (2018) showed a positive result in their study. There was a significant difference in its posttest compared to its pretest. The study observed that upon reaching the students' test answers to their interview, it was observed that the researchers had found that correct answers in the test were not always based on understanding the concepts. The same with this study on SRA, it was seen that the content criteria had a low mean score (Table 4). Hence, further research should consider dealing with and managing the problems that students who are beginners with these topics and lead them to form a functional system of chemical concepts as what expected the students to be more successful in their education later on.

Jaber and Boujaoude (2012) also agreed with the idea as their finding showed that macro-micro-symbolic teaching may have enhanced the learners' conceptual understanding and relational learning on chemical reactions. However, they also stated that some students might fail to produce meaningful links across the three levels without proper instruction. The learners used only macroscopic and

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symbolic representations and may confound to the microscopic level in terms of constructs and language of the topic. Thus, with the same situation, chemistry instruction with the three levels should become a habit of teaching chemistry, reflected in lesson planning, classroom interaction, and assessment. If the students understood the role of each level of chemical representation, they may often see how to transfer knowledge from one level to another level. Thus, when learners developed relational understanding, they could learn to move quickly and skillfully within the macro-micro-symbolic triangle and meaningfully link the various chemical concepts (Arroio et al., 2016).

Before implementing SRA, the Schools Division Superintendent (SDS) approved a permission letter to modify the DepEd learning module. Two experts then validated the learning modules. It was then reproduced and used for all of the students of the SRA group.

B. Level of Students Performance Using Portfolio Assessment

Table 2-6 presents the students' percentage scores for each rubric criterion of the study. These criteria were used to evaluate the excellent performance of the learner's characteristics in doing the task. The rubrics consist of five (5) criteria: Content, Design and Organization, Creativity and Effort put into the portfolio, Reflection, and Punctuality.

➢ *Content*

Table 2. Level of Portfolio Assessment of Both SRA and non-SRA groups for content.

SCORE RANGE	CONTENT SRA f	SRA %	NON-SRA f	NON-SRA %	DESCRIPTIVE RATING
16-20	10	25	2	5.1	Excellent
11-15	30	75	19	48.7	Effective
6-10	0	0	18	46.2	Acceptable
2-5	0	0	0	0	Good Enough
0-1	0	0	0	0	Need Improvement
Mean	16.10		12.95		
SD	2.02		2.97		
Descriptive Rating	Excellent		Effective		

Legend:

Portfolio Score Range	Qualitative Description
16-20	Excellent
11-15	Effective
6-10	Acceptable
2-5	Good Enough
0-1	Need Improvement

Table 2 presents information on the learners' characteristics of modular learning with SRA and in non-SRA, specifically the content.

Thirty (30) students from the SRA group got a score range of 11-15, which falls in the effective level, and there were only ten (10) students who earned a score range of 16-20, on the excellent level. There were nineteen (19) students from the non-SRA group who were on the effective level, eighteen (18) students on the acceptable level, and only two (2) students got into the excellent level.

Most students from both groups had portfolio performances that belonged to the effective level. The SRA group had a higher percentage (75%) of students in the effective level than the 48.7% of students in the non-SRA. A small number of students got the highest score range, or 25% of students from SRA and 5.1% from non-SRA. For the Content criteria, the SRA had a mean score of 16.10 with an excellent level. Higher than the non-SRA, with a mean score of 12.95, indicating that it was on the effective level.

In the scoring rubrics description (Appendix F), it can be described that the learners in the excellent level were they had precise and correct answers in all activities with a 0-2 missing activities in their answer sheets. For the SRA group of students, there were a lot of learners on the effective level. It may mean that a few activities were not answered in their answer sheet as seen in the learner's portfolio with approximately 3-5 activities. Nevertheless, the learners could answer the activities as accurately as possible and follow the directions given on that particular activity.

According to Meador (2019), having a portfolio assessment can be time-consuming. It may be one of the factors of the slight fall making same of the students in the study, as they have felt cramming in answering their learning modules. However, they were given four weeks to answer the modules they provided. Moreover, some students may not be focused on their modules as they may think that the time allotted was much longer than in the previous quarters of modular learning. Also, they were not focused because of the many modules given to them.

Sutton (2019) described that one of the significant disadvantages is time. The students needed time to help them understand the purpose and structure of the portfolio and had a self-reflection after doing the activities for the portfolio. Birgin et al. (2007) added that there were no strict rules for the portfolio content since the portfolio had a different purpose in terms of its evidence. They suggested that deciding the contents of a portfolio should consider the students' desire and intention of collecting the activities. The activities done in the study for SRA were described and explained before the quarter started. With the hope that the parents and students understood the process, the study was pushed through. There were also communications done with the learners and the researcher. Bryant and Timmins (2002) added that changing and adjusting the paradigm shift can be difficult and even painful because of the strength of habit done with the new normal.

➢ *Design And Organization*

Table 3 presents the frequency and percentage of students per score range for the design and organization rubric criteria.

Table 3. Level of Performance Using Both SRA and non-SRA groups for Design and Organization.

SCORE RANGE	DESIGN AND ORGANIZATION SRA f	SRA %	NON-SRA f	NON-SRA %	DESCRIPTIVE RATING
16-20	14	35.0	13	33.3	Excellent
11-15	21	52.5	18	46.2	Effective
6-10	5	12.5	8	20.5	Acceptable
2-5	0	0	0	0	Good Enough
0-1	0	0	0	0	Need Improvement
Mean	16.03		13.59		
SD	3.24		3.62		
Descriptive Rating	Excellent		Effective		

For the SRA group, the data presents that twenty-one (21) students got an effective level in portfolio assessment rating, specifically on the Design and Organization. Which was followed by fourteen (14) students on the excellent level,

ISSN No:-2456-2165

and lastly, five (5) students on the acceptable level. The non-SRA, on the other hand, eighteen (18) students were on the effective level with their rating for Design and Organization, then thirteen (13) were on the excellent level, and eight (8) students were on the acceptable level.

The result indicates that the SRA groups had twenty-one (21) learners on the effective level in the Design and Organization criterion and fourteen (14) students on the excellent level. Both had a higher rating than non-SRA. The non-SRA group got eighteen (18) students on the effective level and thirteen (13) students on the excellent level. Further, in this criterion, SRA students got a mean score of 16.03, which belong to excellent level, while the non-SRA, a mean score of 13.59 was obtained, which belonged in the effective level. The excellent level was rated through characteristics like aesthetically pleasing. It demonstrated a high understanding of the lesson, readable answers, and activities presented logically and were easy to track. Hence, the student's portfolio was satisfactory, demonstrated an average understanding of the lesson; the text was readable, and activities were presented logically (Appendix F).

Rosaroso (2016) explained that for the students to enhance their involvement in the learning process, an authentic assessment is required to improve comprehension, vocabulary and refine other complex skills. They emphasized that tasks are intended for students' ownership and output revisions representing meaningful learning into good use in an authentic assessment class. McDonald (2012) also believed that portfolio assessment is a conventional assessment that allows assessing those complex and difficult to understand lessons.

Birgin et al. (2007) also believed that a portfolio is not a collection of learner's activity works cluttered everywhere in the portfolio. Thus, they suggested that its purpose be defined in developing a portfolio, and evidence and assessments should be included. These three essential factors are closely related, dramatically affecting each other. These portfolios should help students learn, and the activities should be multi-dimensional and address different learning areas. Thus, the students should design and organize it to show their understanding and interest in the lesson and activities. As students who managed their learning progress and performance, they can transfer learnings onto authentic outcomes as to their portfolio (Tolentino, 2009).

- *Creativity And Effort*

Table 4 presents the frequency and percentage of students per score range for the rubric criterion of Creativity and Effort.

Table 4. Level of Performance Using Both SRA and non-SRA groups for Creativity and Effort.

SCORE RANGE	CREATIVITY AND EFFORT SRA		NON-SRA		DESCRIPTIVE RATING
	f	%	f	%	
16-20	12	30.0	3	7.7	Excellent
11-15	23	57.5	21	53.8	Effective
6-10	5	12.5	15	38.5	Acceptable
2-5	0	0	0	0	Good Enough
0-1	0	0	0	0	Need Improvement
Mean	15.83		13.46		
SD	3.21		3.07		
Descriptive Rating	Effective		Effective		

The data shows that twenty-three (23) students from the SRA group belonged to the effective level, twelve (12) students were on the excellent level, and five (5) students were on the acceptable level. On the other hand, in the non-SRA group, there were twenty-one (21) of the students that were on the effective level, fifteen (15) students on the acceptable level, and only three (3) students on the excellent level.

Based on the data, it can be inferred that in this third category, there were still more learners on the effective level in both SRA and non-SRA. It shows further that there was not much difference between the two groups. Twenty-three (23) students for the SRA and twenty-one (21) students of non-SRA are both on the effective level. For this third criteria, both groups exposed to the SRA and non-SRA belong in the effective level, with a mean score of 15.83 for SRA and a mean of 13.46 for the non-SRA. In fact, this effective level learners were characterized being capable to use their ideas most of the time and had worked hard most of the time.

Rosaroso (2016) stated that the activities' outputs observed students' creativity, imagination, and ingenuity. In connection, Handley et al. (2015) figured that portfolio assessment is one tool that can evaluate students learning in various ways, such as incorporating experiences that were written, visual, and kinesthetic into the final product, which was manageable to evaluation and comparison.

- *Reflection*

Table 5 presents the frequency and percentage of students per score range for the Reflection rubric criteria.

Table 5. Level of Performance Using Both SRA and non-SRA groups for reflection.

SCORE RANGE	REFLECTION SRA		NON-SRA		DESCRIPTIVE RATING
	f	%	f	%	
16-20	8	20.0	0	0	Excellent
11-15	25	62.5	17	43.6	Effective
6-10	7	17.5	22	56.4	Acceptable
2-5	0	0	0	0	Good Enough
0-1	0	0	0	0	Need Improvement
Mean	14.45		11.85		
SD	2.75		2.36		
Descriptive Rating	Effective		Effective		

For the Reflection criteria, data shows that twenty-five (25) students belong to the effective level, eight (8) students were on the excellent level, and seven (7) students were on the acceptable level. On the other hand, the non-SRA, had twenty-two (22) students who were in the acceptable level, and seventeen (17) students were on the effective level.

The data may be inferred that in the Reflection criteria, the students from the SRA group got a higher result than the non-SRA, wherein twenty-five (25) of the learners from the SRA group belonged to the effective level, and eight (8) are in the excellent level. For the reflection criteria, the SRA group obtained a mean score of 14.45 with a rating of effective level. On the other hand, the non-SRA group got a mean score of 11.85, which fell on the effective level. This excellent level had a characteristic of reflection that illustrated the ability to critique works effectively and

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suggest some constructive practical alternatives with more than eight sentences written in an essay form. Most of the students from the non-SRA group got the most significant number of students who belonged to the acceptable level, with twenty-two (22) students to be exact. This level had a descriptive characteristic of illustrating the critique work and suggesting alternatives.

The study of McDonald (2012) supports the results of this study. He mentioned that many students do not have a habit of making reflections, which might be why some students have a hard time making this part of the portfolio. He added that creating a portfolio allows students to give feedback on the activities within the learning process. In this part, students can also provide information that offers meaningful insights into their behavior and related changes. Thus, the result somehow defies the purpose of the portfolio assessment, where it can help the learners to have an active and meaningful engagement in their assessments. However, some students took them and felt about the new learning modality.

Hudori et al. (2020) added that students were asked to reflect on their work to engage in a self and goal-setting portfolio assessment. The researchers believed that reflection quality would affect the students' achievement tests, work, and attitude. Thus, it is needed to reinforce the students' reflection writing capabilities based on the assessment rubrics of reflection.

➢ *Punctuality*

Table 6 presents the frequency and percentage of students per score range for the punctuality rubric criterion.

Table 6. Level of Performance exposed to both SRA and non-SRA groups for punctuality.

SCORE RANGE	PUNCTUALITY				DESCRIPTIVE RATING
	SRA		NON-SRA		
	f	%	f	%	
16-20	35	87.5	33	84.6	Excellent
11-15	5	12.5	6	15.6	Effective
6-10	0	0	0	0	Acceptable
2-5	0	0	0	0	Good Enough
0-1	0	0	0	0	Need Improvement
Mean	19.38		19.23		
SD	1.67		1.83		
Descriptive Rating	Excellent		Excellent		

The data shows that thirty-five (35) students from the SRA group belonged in the excellent level where five (5) of them were on the effective level. For the non-SRA group, thirty-three (33) students belonged to the excellent level, and six (6) were on the effective level.

The result shows that most of the students belonged to the excellent level, where the SRA group had a higher frequency of thirty-five (35) than the non-SRA, with thirty-three (33). Additionally, the SRA group for this criterion had a mean score of 19.38 and a 19.23 for the non-SRA group with a rating of excellent level. It would mean that both groups had returned their modules and passed their required portfolios on time. Though the learners were prompt in giving their portfolio, it may have caused some issues to the other criteria of the rubrics in the portfolio assessment.

The learners were exposed to SRA and their parents were briefed about the timeline and activities that should be done. In its nature, portfolio assessment needs a lot of time to be done accordingly (Syafei, 2021). Hudoti et al. (2020) pointed out that one of the weaknesses of portfolio assessment it's time consuming for most students, and some are not interested in doing the activity. Moreover, portfolio activities take time, and it centers on self-evaluating, reviewing, and correcting students.

Hudori et al. (2020) stated that portfolios might provide a great way to consider and develop students' related skills. Portfolio assessment may focus on a meaningful collection of students' performance and meaningful reflection and evaluation of activities. In connection, portfolio assessment can be used as a future reference and record the student's achievement over a specified time. The researcher mentioned that portfolio assessment was time-consuming.

Furtherly, Table 7 presents the overall student portfolio assessment rating for both SRA and non-SRA groups.

Table 7. Student's Over-all Mean Rating in the Portfolio Assessment.

Academic performance using Portfolio Assessment	SRA	NON-SRA
a. Content	16.10	12.95
b. Design and Organization	16.03	13.59
c. Creativity and Effort	15.83	13.46
d. Reflection	14.45	11.85
e. Punctuality	19.38	19.23
Mean	81.78	71.08
QD	Approaching Proficiency	Beginning

Legend:

Score Range	Qualitative Description
90-100	Advanced
85-89	Proficient
80-84	Approaching Proficiency
75-79	Developing
0-74	Beginning

It could be seen that in SRA group, punctuality got the highest score among all the five (5) criteria with 19.38%, followed by content with 16.10%, design, and organization of 16.03%, creativity, and effort of 15.83%. Moreover, the reflection got the lowest mean of 14.45%. For the non-SRA group, punctuality was also the highest mean among all the criteria with 19.23%, followed by design and organization with 13.59%, creativity and effort of 13.46%, then content with 12.95%, and finally, reflection with the mean score of 11.85%.

The result shows that the SRA group of students had a higher rating on the portfolio assessment with an overall mean score of 81.78%, a moderate/average score that signifies that the learners were approaching proficiency. In contrast, the non- SRA group had a mean score of 71.08%, which indicates that the learners were on the beginning level.

There is a positive outcome with the SRA group of students' mean score in their portfolio assessment rating. The study of Syafei et al. (2021) agrees with the result of this study as they had somewhat exact outcomes of 88% of their students indicating positive perceptions where 12% showed disagreement with the application of portfolio assessment. In their study, the application of portfolio assessment demonstrated positive outcomes by the students. Most learners commented on good reviews about portfolio assessment. This setup helped observe health protocols,

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engaged them to a comprehensive evaluation. This was a fair process-oriented assessment since it also engaged them to be active learners, more organized, time flexible, self-initiated, and responsible learners. They had become more involved in their education where they were in control on it.

Even in pre-pandemic, Handley et al. (2015) study showed a positive outcome on the portfolio assessment's learners' performance. Their study revealed that the portfolio allowed the students to highlight their strengths, address their weaknesses, include class activities from other subjects to expand their chemistry training, draw connections, and evaluate their overall performance.

Meanwhile, Hudori et al. (2020) had the same perspective as they stated in their study that portfolio assessment could benefit students and teachers. The teachers could recognize the changes in classroom practices, school-wide responsibilities and identify organizational structures and professional development opportunities for themselves and their learners. Moreover, their study also considered portfolio as a comprehensive assessment tool that could widen their assessment strategies, encourage collaborative learning, promote thinking skill in learners and develop their interest in the subject matter.

C. Analysis of Covariance (ANCOVA) on Student's Academic Performance

Table 8 illustrates the analysis of covariance on students' academic performance exposed to both SRA and Non-SRA. The pretest was used as a covariate to equate different predictive variables, affecting the analysis statistically.

Table 8. Analysis of covariance (ANCOVA) on student's academic performance exposed to SRA and Non-SRA

GROUP	N	MEAN	SD
SRA	40	67.38	15.94
Non-SRA	39	58.41	16.45
Total	79	62.95	16.71

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Group	6270.411	2	3135.206	16.956	.000
Pre-test	6141.068	1	6141.076	33.213	.000
Error	14052.458	76	184.901		
Total	334866.667	79			

*p<0.05 ns= not significant

Table 8 shows that students exposed to SRA obtained a mean score of 67.38, while students exposed to non-SRA obtained a mean score of 58.41. The computed f-value between the two groups was 16.956 with a p-value of 0.000, which indicates a highly significant difference. Thus, the null hypothesis is rejected that there is no significant difference in the students' academic performance exposed to the symbolic representation approach (SRA) and those exposed to non-SRA.

This could imply that the students exposed to SRA had a higher academic performance than the non-SRA group. Thus, the results conclude a significant difference in the students' academic performance. In connection, the SRA's significant mean and MPS improvement may be because most of them had understood the learning method's concept, especially in their activities. Moreover, the result shows that the learner's individual learning experience made them do independent learning to measure their ability to understand their subject.

This considerable improvement also relates to Shatri et al. (2017) study. It was illustrated in their study a positive effect in visualization in the teaching and learning process. Thus, the method used may motivate the students to learn, making them more cooperative and developing their critical thinking skills. The study of Jaber et al. (2012) has also found a significant improvement in the students' conceptual understanding due to their exposure to macroscopic, microscopic, and symbolic modes used to represent chemistry concepts.

Furtherly, the study of Aleksander (2014) gave light as he concluded that having an intervention like symbolization level of a learning process can be effective for children with insufficient apparatus and within a situation of uncertainty. He also described that the effective use of symbolization in the educational process might depend on teacher-student interaction. The learners' current health situation was limited access to some apparatus to needed activities.

Evagorou et al. (2015) added some suggestions in their study that visualization should shift from conceptual understanding to engaging in visualization in teaching science. Activities may invite learners to engage in visualization as evidence, reasoning, experimental procedure, or means of communication and reflect on the practices done. This could imply that there should be an emphasis on visualization through adding them up in the activities in the classroom or the modules being used. Moreover, it also supported the idea on the portfolio activity as it gives way to the learners to communicate and reflect on the activities they had.

D. The difference in Students' Portfolio Assessment

Table 9 shows the students' portfolio assessment difference when exposed to the SRA and those exposed to non-SRA. It further illustrates the values comparing the students' portfolio assessment for students exposed to SRA and those exposed to non-SRA in terms of content, design and organization, creativity and effort, reflection, and punctuality.

Table 9. The difference in the Students' Portfolio Assessment in Chemistry using SRA and Non-SRA

Portfolio Assessment	Mean		SD		t-value	Sig.
	SRA	Non-SRA	SRA	Non-SRA		
a. Content	16.13	12.95	2.04	2.97	5.565	.000*
b. Design and Organization	16.05	13.59	3.28	3.61	3.635	.001*
c. Creativity and Effort	13.46	14.44	3.07	2.78	3.788	.001*
d. Reflection	14.44	11.85	2.78	2.36	5.230	.000*
e. Punctuality	19.49	19.23	1.54	1.83	1.000	.324ns

GROUP	Mean	SD	df	t-value	Sig.
SRA	81.78	9.45	77	4.66	.000*
NON-SRA	71.08	10.92	74.87		

*p<0.05 ns= not significant

The data show that the students exposed to SRA acquired an overall mean score of 81.78, higher than the mean score obtained by the non-SRA group of 71.08. The

data further shows that for the overall portfolio assessment rating, the t-value was 4.66 with a probability value of 0.000, indicating a significance at the level of 0.05. Thus, the null hypothesis that there is no significant difference between students' portfolio ratings is rejected.

As presented, the five criteria, namely the data, the content, design and organization, creativity and effort, and reflection, obtained a probability value of less than 0.005. These values imply a significant difference between the students' portfolio rating for those exposed to SRA and those exposed to non-SRA. However, only the criteria of punctuality got a probability higher than 0.05.

Syafei (2021) stated that portfolio assessment needed a lot of time to be done accordingly. On the other hand, the learners were prompt in passing their required learning portfolios. Though learners were quick in giving their portfolio, it may have caused some issues to the other criteria of the rubrics in the portfolio assessment. As added by Hudori et al. (2020), they stated that doing the activities for the portfolio took so much time, and it centered on self-evaluation. With that, they indicated in their study that time management was one of the weaknesses of portfolio assessment.

Nevertheless, this kind of assessment aims to give critical feedback to learners and teachers. Portfolio assessment should be distinguished and transparent so that it is constant in every teaching or learning process, curricular aims, and contents (Bryant et al., 2002). Just like what study wanted, the portfolio allowed the integration and application, that incorporated materials of any form, encouraged reflection on learning, and developed a sense of responsibility, which can also activate their sense of ownership in crafting their education (Handley et al., 2015).

Ponnamperuma (2014) argued that the purpose of a portfolio is to demonstrate learning, and it is not just to chronicle a series of experiences. He believed that learning from experience will only happen if reflection and application in practice modifications have taken place. Thus, the portfolio assessment showed how the learning has been applied and would form as the basis of a review or evaluation. Birgin et al. (2007) agreed that a portfolio was an alternative assessment method that observed students' developments and assessed their performance during the learning process. The portfolio could help the learners reflect on their performance to see their weak and robust domain and observed their progress during the learning process. The learners hopefully could take more responsibility for their learning.

The necessity of portfolio assessment has been emphasized by many researchers (Birgin et al., 2017; Gussie, 1998; Micklo, 1997; Norman, 1998). A portfolio gives more reliable and dynamic data about students for the teachers, parents, and students themselves. This assessment method provided transparent information about the students, fulfilled their weaknesses, and helped teachers plan other teaching processes. As other Ministries of Education suggest, the assessment activities should discover the students' weaknesses (Birgin et al., 2017).

McDonald (2012) added that a portfolio allows the individuals and activities in the learning process that are being evaluated to be involved in their change process and their actual decision to change. In addition, portfolios provide meaningful insights into behavior and related changes. Thus, portfolio assessment can help learners have an opportunity to actively and meaningfully engage in student assessments.

In addition, Syafei et al. (2021) suggested that having a portfolio assessment during the pandemic may help the learners think critically and implement the teacher's material. Furtherly, they recommended proper guidance, attention, and direction to students, especially those that still need good learning facilitation. Rosaroso's (2016) study shows that individual students' growth and progress were documented through a portfolio. He added that portfolio assessment should be implemented in all subject areas, with parents as active partners in educating their children to support academic and non-academic endeavors.

In general, the study may be helpful for educators as they gain insights from the results of this study to try designing a learning approach where students can actively and authentically participate in their learning process. In addition to that, trying the symbolic representation can be helpful for learners in a situation like the new normal education where they are not exposed to things like apparatus. The information in the study may help in innovating more the activities to motivate learners to be more engaged.

In connection, the portfolio assessment also played a significant role in considering the learner's academic performance and for the possibility of manipulating materials if learners are more likely to make progress. Furthermore, the findings of this study may be applied to other educational settings and be improved where it mainly aimed to raise the student's self-awareness and consciousness of their strategies that may develop some kind of critical and reflectivity towards how and what they learned.

IV. CONCLUSIONS

Based on the findings of the study led to the following conclusions:

The students' chemistry's academic performance exposed to both Symbolic Representation Approaches (SRA) and non-SRA groups has a pre-test result that needs improvement. After implementing the study, the SRA group has a fairly satisfactory level in their academic performance, while for the non-SRA, their level of academic performance is needs improvement level.

After exposure to SRA, Punctuality gets the highest mean score in students' portfolio assessment rating. It was then followed by the Content, Design and Organization, Creativity and Effort, and last is Reflection. For the overall

mean of the two groups, the SRA group has a higher mean score rating than the non-SRA group of students.

The students exposed to SRA have a higher academic performance than the non-SRA group. Thus, there is a significant difference in the students' academic performance exposed to SRA and those that are exposed to non-SRA.

Lastly, for the students' portfolio assessment rating, those that are exposed to SRA, are acquired to reach a higher mean score than those exposed to non-SRA. Thus, there is a significant difference in the students' portfolio assessment non-SRA. Thus, there is a significant difference in the students' portfolio assessment.

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