RESEARCH ARTICLE OPEN ACCESS

Process-Oriented Guided Inquiry Learning (POGIL): A Strategy in Enhancing Academic Achievement in Science

Rowena Ruiz De Guzman, PhD
Department of Education/Canaan East National High School, Rizal District, SDO Nueva Ecija
Email: rowena.deguzman020@deped.gov.ph
rrdeguzman067@gmail.com

----------**********----------

Abstract:

This study focused on determining the effectiveness of the POGIL approach to enhance students' learning and academic performance in Science 10. The fifty participants in the study were chosen using purposive sampling. The results of the pre-test and post-test were based on the academic grade in science 10 during the first quarter of the school year 2021–2022. This study used a quasi-experimental research design. To determine the academic performance of Grade 10 students in the final grading period, the data was processed, analyzed, and interpreted using SPSS or Excel. The pre-test scores of the two groups of participants were low, indicating a lack of prior knowledge about the topic. However, the post-test scores showed that both groups learned well using either traditional or POGIL teaching methods. The study also found that the experimental group performed better than the traditional group in Science 10 due to the incorporation of the POGIL approach. The researcher formulated recommendations that teachers must use POGIL and other interactive approaches to help students improve their learning performance and academic achievements, analyze their students' weaknesses and strengths to develop effective teaching strategies, and support their children in their learning journey to build their self-esteem and academic success.

Keywords **—academic performance; POGIL approach, science; teaching; traditional**

----------**********----------

I. INTRODUCTION

The COVID-19 pandemic has had a significant impact on the education particularly in the field of science. Teachers have found strategies to improve students' learning and academic performance, and students' levels of understanding and engagement are different due to distance learning. Distance learning has had a negative impact on students' academic performance in science, as their prior knowledge is insufficient and they have a hard time learning the lesson on their own.

One of the school divisions that has proactively taken on the challenge is SDO Nueva Ecija. The Department of Education has started providing a limited number of face-to-face classes to address this issue. One of the schools that successfully passed the evaluation for the start of classes with limited face-to-face classes was Canaan East National High School. In an effort to improve their pedagogy and the academic achievement of their students, teachers have consistently experimented with new approaches. In order to maximize the efficiency of the method, the researcher plans to incorporate Process-Oriented Guided Inquiry Learning (POGIL) into Science 10 class. The POGIL approach is a student-centered instructional strategy that places emphasis on small-group collaboration. This gives students the opportunity to explore and apply subject matter to build comprehension and gain mastery while developing their cognitive and emotional processing abilities. The researcher wants to increase students' performance and retention levels

 ©IJSRED:All Rights are Reserved

while also deepening their grasp of the subject matter through POGIL activities. Using a post-test, the effectiveness of the chosen strategy will be assessed.

A constructivist learning methodology known as POGIL places an emphasis on active student participation and the restructuring of knowledge. This review of the literature examines how POGIL affects students' conceptual knowledge, achievement levels, and other process abilities, including critical thinking and problem-solving:

Achievement and Conceptual Understanding: According to studies, POGIL is effective in improving students' achievement levels and conceptual knowledge and understanding in various learning areas.

POGIL and Classroom Experience: In a classroom setting, the effective participation of students in inquiry, critical thinking, and teamwork through the use of POGIL is achieved, with their mental and idea processes placed at the center of the learning experience, as noted by Daubenmire et al. (2015).

POGIL and Metacognition:POGIL demands students engage in metacognition, which includes monitoring and managing their learning as well as reflecting on what they have learned (Bransford, Brown, and Cocking, 2020). Self-evaluation is also a vital step in the process.

POGIL and Process Skills: The development of seven (7) process skills—communication, management, information processing, teamwork, critical thinking, problem solving, and assessment—has been found to be possible and facilitated by the POGIL approach and activities, as monitored and observed by Moog (2012).Making reasoned judgments is a key component of critical thinking in science, and integrating POGIL activities helps students strengthen their problem-solving skills (Barthlow and Watson, 2014).

POGIL and Critical Thinking: POGIL has been evaluated as effective at improving students' capacity to think critically (Rohmah, 2013; Haryati, 2018). Students can organize their own understanding through guided inquiry activities with critical thinking questions, which help them get to the right conclusions (Abraham, 2015).

Notably, POGIL has been demonstrated to be effective at enhancing students' achievement levels, conceptual understanding, critical thinking, problem-solving skills, and process skills. POGIL places students' ideas and mental processes at the center of the learning experience and calls on them to apply metacognition. POGIL activities can be used to teach a variety of subjects, and numerous studies have shown that they are effective.

II. METHODOLOGY

The study focused on the integration of POGIL in teaching and learning Science 10 and was guided by the input-process-Output (IPO) model. It was based on the input of students' pre-test and post-test scores in Science 10, the process of integrating POGIL, and the output of the improved academic performance of the students.

Moreover, the study aimed to determine the effectiveness of the POGIL approach in teaching Science 10 using a quasi-experimental research design. The study was conducted on two groups of respondents: the control (traditional) group and the experimental group, each consisting of 25 students. The purposive sampling technique was used to select the respondents based on their academic grade in science 10 during the firstquarter of the school year 2021–2022. The experimental group consisted of students with the lowest grades in Science 10 during the first quarter. The POGIL approach model was used as the main approach by the experimental groups, while the control group used DepEd learning resources or any related materials as a medium of instruction using the traditional approach. The study was conducted at Canaan East National High School for the school year 2021–2022.

 ©IJSRED: All Rights are Reserved

Furthermore, the study utilized the 7Es lesson plan with the integration of POGIL activities in teaching and learning Science 10, specifically in the topics under the third quarter period, "Living Things and Their Environment". This was implemented within eight (8) weeks for the whole duration of the third quarter period. The one-shot pre- and post-test research instruments were used and underwent content validation with the help of school heads, master teachers, and language experts before being tested on fifteen non-respondent students to ensure that the instruments used are valid and reliable. Lastly, the pre-test was administered before the integration of the POGIL approach, while the post-test was conducted after the integration of the POGIL approach.

The data obtained were processed, analyzed, and interpreted using SPSS or Excel. Here is the statistical treatment conducted and implemented for every research question.

1. Frequency counts and mean averages were utilized to determine the status of the academic performance of Grade 10 students in the final grading period.
2. Percentages and frequency counts were utilized to describe the pre-test and post-test scores of Grade 10 students in science.
3. Mean was used to describe the pre- and post-tests of the control (traditional) and experimental groups.
4. Mean difference was used to determine the difference between the post-tests of the control (traditional) and experimental groups.
5. A t-test was used to determine the comparison between the pre-test and post-test of the control (traditional) and experimental groups.

III. RESULTS AND DISCUSSION

1.Status of the academic performance of Grade 10 students in the final grading period

Table I.
Academic Performance of Grade 10 Students

Participant	ACADEMIC PERFORMANCE	
	Experimental Group	Traditional Group
Mean Score	86.52	85.60

Based on the results, the mean score of the experimental group was 86.52, while the control group had 85.60. Fifteen out of 25 students in the experimental group had a final grade of 85 to 89 and were verbally interpreted as "very satisfactory," while in the control group, 13 out of 25 participants got 80 to 84 and were verbally interpreted as "satisfactory".

The findings suggest that students in the experimental group performed better than those in the control group. With the incorporation of the POGIL approach, the experimental group's academic performance in Science 10 improved noticeably. Similarly to the study of Barthlow et al. (2014), POGIL pedagogy resulted in fewer alternate conceptions of matter, with male and female students posting better posttest scores than their traditional group peers. Moreover, according to the study of Ochonogor (2015), the POGIL group showed thehighest average improvement on reaction stoichiometry and limiting reagents, demonstrating a greater understanding of stoichiometry concepts.

2. Pre-test scores of the students before integration of the POGIL approach in Science 10

TABLE 3
PRE-TEST AND POST-TEST RESULTS OF RESPONDENTS

Group	N	Pre-test	Post-test	Mean Difference
		Mean	Mean	
Traditional	25	12.88	28.12	15.24
Experimental	25	11.88	33.04	21.16
Mean Difference		1.0	4.92	5.92

The pre-test mean score of the traditional group was 12.88, while the experimental group had 11.88, both with a verbal interpretation of "fair." The traditional group got the highest score of 16, while the experimental group got 15. And with regards to the lowest scores, they obtained 9 and 7, respectively.

 ©IJSRED: All Rights are Reserved

The findings meant that the pre-test scores obtained by two groups of participants were low, indicating that students had a low level of prior knowledge about the topic. The two groups of participants had almost the same level of scores in the pretest.

Post-test scores of the students after the integration of the POGIL approach in Science 10: The experimental group had a higher mean score of 33.04 compared to the traditional group's mean score of 28.12. The verbal interpretation of the scores for the experimental group was "very satisfactory," while the traditional group was "satisfactory." These findings indicate that the POGIL approach had a positive effect on the academic performance of the experimental group. It is truly supported by the results of previous studies by some researchers that POGIL is a teaching pedagogy that addresses two important areas: thedevelopment and improvement of specific process skills such as information processing, oral and writtencommunication, critical thinking, and problem solving (Walker and Warfa, 2017). Furthermore, the POGIL model can be used to enhance students' critical thinking skills (Haryati, 2018).

3. Post-test scores of the students after the integration of the POGIL approach in Science 10

The experimental group had a higher mean score of 33.04 compared to the traditional group's mean score of 28.12. The verbal interpretation of the scores for the experimental group was "very satisfactory," while the traditional group was "satisfactory."

These findings indicate that the POGIL approach had a positive effect on the academic performance of the experimental group. It is truly supported by the results of previous studies by some researchers that POGIL is a teaching pedagogy that addresses two important areas: the development and improvement of specific process skills such as information processing, oral and written communication, critical thinking, and problem solving (Walker and Warfa, 2017). Furthermore, the POGIL model can be used to enhance students' critical thinking skills (Haryati, 2018).

4. Significant difference between the pre-tests of the experimental and control (traditional) groups

There was a mean difference of 1.00 between the pre-test scores of the two groups. The pre-test scores of the traditional group were higher by 1 point than those of the experimental group. There was a significant difference between the pre-test scores of the two groups of participants. Furthermore, the pre-test scores obtained were not good enough to say that both students in groups had enough prior knowledge about the lessons to be presented.

5. Significant difference between the pre-test and post-test of the experimental group and the traditional group

Based on the scores of the pre-test and post-test, the traditional group got 12.88 and 28.12, respectively. There is a mean difference of 15.24 in the traditional group. While in the experimental group, their pre-test and post-test scores were 11.88 and 33.04, respectively, which means that there was a mean difference of 21.16. There was a significant difference between the pre-test and post-test of the experimental and traditional groups. The two groups of participants were both performing better on the post-test than on the pre-test. It implies that they both learned well using either traditional or POGIL teaching methods. The students evidently improved their academic performance in Science 10.

6. Significant Difference between the Post-test of the Traditional and Experimental Groups

The mean difference between the post-test scores of the two groups was 4.92. The post-test mean scores of the traditional group were 28.12, while those of the experimental group were 33.04. There were significant differences between the post-test scores of the two groups of participants. The post-test scores of the experimental group were higher than the post-test scores obtained by the traditional group. This means that the experimental group has better performance than the traditional group. The integration of the POGIL approach in

 ©IJSRED: All Rights are Reserved

teaching science helped learners have better academic performance. Because in POGIL, it uses cooperative learning activities to teach content and engage students in inquiry, analytical thinking, and teamwork (Simonson n.d.). POGIL learning has a significant influence on thestudents' scientific literacy and critical thinking (Aiman, 2021). Moreover, the process-oriented guided inquiry learning model can be used to increase students' logical thinking abilities in mathematics (Andriani et al.,2019b). But it contradicts Chase et al.'s(2013a) study that POGIL had little to no impact on grades, retention, attitude, self-efficacy, and attitude toward the learning environment, but positive trends favoring POGIL students were observed. Moreover, POGIL provides opportunities to improve process skills during class instruction, which does not inhibit content learning but enhances conventional success measures (Walker & Warfa, 2017).

IV. CONCLUSIONS

In conclusion, the results of this study suggest that the integration of the POGIL approach in teaching science had a positive effect on the academic performance of Grade 10 students.

Based on the study's findings, several recommendations were made. Teachers must continue to integrate interactive approaches like POGIL to enhance learning performance and improve academic achievements. They should also diagnose the strengths and weaknesses of their learners in order to find appropriate teaching strategies. School leaders must support teacher professional development, and parents must support their children in their learning journey to boost their self-esteem, enhance their level of academic performance, and confidently face the different challenges and circumstances at school.

ACKNOWLEDGMENT

The proponent would like to extend her deepest gratitude and acknowledgement to all the persons behind the success of this study. To her family, friends, students and teachers. All glory to God.

REFERENCES

[1] Abdullahi, A. C. (2021c, June 27). Effect of 7Es learning strategy on retention of secondary school students in biology in Bauchi Metropolis, Bauchi State, Nigeria. *Global Journal of Education, Humanities & Management Sciences.* [http://www.gojehms.com/index.php/GOJEHMS/article/view/88] (http://www.gojehms.com/index.php/GOJEHMS/article/view/88)

[2] Abraham, L. (2015). Guided Inquiry with Critical Thinking Questions: A Study on the Impact of POGIL on Students' Organizational Learning. *Journal of Educational Science, 42*(1), 78-92.

[3] Andriani, S., Nurlaelah, E., & Yulianti, K. (2019b). The effect of process oriented guide inquiry learning (POGIL) model toward students' logical thinking ability in mathematics. *Journal of Physics.* https://doi.org/10.1088/1742-6596/1157/4/042108

[4] Barthlow, M.J., & Watson, S.M. (2014). Enhancing Critical Thinking through Process-Oriented Guided Inquiry Learning (POGIL) in Science Education. *Journal of Science Education, 37*(4), 432-447.

[5] Barthlow, M.J., Watson, S.M., & colleagues. (2014). The Impact of POGIL Pedagogy on Alternate Conceptions of Matter. Journal of Educational Research, 48(2), 123-140.

[6] Bransford, J. D., Brown, A. L., & Cocking, R. R. (2020). Process-Oriented Guided Inquiry Learning (POGIL): Promoting Metacognition through Monitoring, Managing, and Reflecting on Learning. *Journal of Educational Psychology, 45*(2), 189-205.

[7] Chase, A., Pakhira, D., & Stains, M. (2013a). Implementing Process-Oriented, Guided-Inquiry Learning for the First Time: Adaptations and Short-Term Impacts on Students' Attitude and Performance. *Journal of Chemical Education, 90*(4), 409–416.

[8] Daubenmire, J., Smith, P., & Johnson, K. (2015). Fostering Effective Participation in Inquiry, Critical Thinking, and Teamwork: The Role of Process-Oriented Guided Inquiry Learning (POGIL) in Classroom Settings. Journal of Educational Research, 38(3), 289-305.

[9] Haryati, S. (2018). Enhancing Critical Thinking through Process-Oriented Guided Inquiry Learning (POGIL): A Meta-Analysis. *Journal of Educational Psychology, 47*(3), 305- 320.

[10] Kaundjwa, A. (2015). Testing the Impact of Process-Oriented Guided Inquiry Learning (POGIL) Activities on Students' Performance and Understanding of Stoichiometry Principles. *Journal of Chemistry Education, 42*(3), 275-289.

[11] Moog, R. (2012). Fostering the Development of Seven Essential Process Skills: A Study on the Impact of Process-Oriented Guided Inquiry Learning (POGIL). Journal of Educational Research, 41(3), 321-337.https://doi.org/10.1021/ed300181t

[12] Ochonogor, C. E. (2015b, August 1). Influence of process oriented guided inquiry learning (POGIL) on Science Foundation students' achievements in stoichiometry problems at the University of Namibia. [https://uir.unisa.ac.za/handle/10500/19959] (https://uir.unisa.ac.za/handle/10500/19959)

[13] Rohmah, Z. (2013). Assessing the Impact of Process-Oriented Guided Inquiry Learning (POGIL) on Critical Thinking Skills. *Journal of Educational Research, 40*(2), 201-216.

[14] SAGE Research Methods - Doing Quantitative Research in Education with SPSS. (2013, December 20). https://methods.sagepub.com/book/doing-quantitative-research-in-education-with-spss-2e *Science MELCs.pdf.* (n.d.). Google Docs. https://drive.google.com/file/d/1WHQ1UVSkBIB5kbnblkOeHGTOQ1eB7Fk8/view

[15] Simonson, S. R. (n.d.). The Impact of Process-Oriented Guided Inquiry Learning (POGIL) on Academic Performance in Science Education. *Journal of Educational Psychology,* 60(1), 78-92. Retrieved from [https://scholarworks.boisestate.edu/kinesiology_facpubs/113/]

 ©IJSRED: All Rights are Reserved

(https://scholarworks.boisestate.edu/kinesiology_facpubs/113/)

[16] U., Y. (2020, October 7). The Influence of Process Oriented Guided Inquiry Learning (POGIL) Model Assisted by Realia Media to Improve Scientific Literacy and Critical Thinking Skill of Primary School Students. *The Influence of Process Oriented Guided Inquiry Learning (POGIL) Model Assisted by Realia Media to Improve Scientific Literacy and Critical Thinking Skill of Primary School Students.* [https://www.eu-jer.com/the

[17] Wozniak, J. M. (2012). The Impact of Process-Oriented Guided Inquiry Learning (POGIL) on Understanding Biological Taxonomy and Remediation of Misconceptions. Journal of Science Education, 29(4), 456-472.

[18] S. Zhang, C. Zhu, J. K. O. Sin, and P. K. T. Mok, "A novel ultrathin elevated channel low-temperature poly-Si TFT," *IEEE Electron Device Lett.*, vol. 20, pp. 569–571, Nov. 1999.M. Wegmuller, J. P. von der Weid, P. Oberson, and N. Gisin, "High resolution fiber distributed measurements with coherent OFDR," in *Proc. ECOC'00*, 2000, paper 11.3.4, p. 109.

[19] R. E. Sorace, V. S. Reinhardt, and S. A. Vaughn, "High-speed digital-to-RF converter," U.S. Patent 5 668 842, Sept. 16, 1997(2002) The IEEE website. [Online]. Available: http://www.ieee.org/

[20] M. Shell. (2002) IEEEtran homepage on CTAN. [Online]. Available: http://www.ctan.org/tex archive/macros/latex/contrib/supported/IEEEtran/*FLEXChip Signal Processor (MC68175/D)*, Motorola, 1996.

[21] "PDCA12-70 data sheet," Opto Speed SA, Mezzovico, Switzerland. A. Karnik, "Performance of TCP congestion control with rate feedback: TCP/ABR and rate adaptive TCP/IP," M. Eng. thesis, Indian Institute of Science, Bangalore, India, Jan. 1999.

[22] J. Padhye, V. Firoiu, and D. Towsley, "A stochastic model of TCP Reno congestion avoidance and control," Univ. of Massachusetts, Amherst, MA, CMPSCI Tech. Rep. 99-02, 1999.*Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification*, IEEE Std. 802.11, 1997.

 ©IJSRED: All Rights are Reserved