EVALUATING THE INFLUENCE OF S.T.E.M-BASED RESEARCH TOWARDS S.T.E.M STUDENTS' SCIENCE ATTITUDE AND ACADEMIC ACHIEVEMENT

[1]Vergil L. Alon, [2]Girlie C. Petiluna, [3]Pricelo L. Pausanos, Jr.

[1]*Senior High School Teacher, Misamis Occidental National High School, Oroquieta City 7207, Philippines*
[2,3]*Junior High School Teacher, Misamis Occidental National High School, Oroquieta City 7207, Philippines*

Corresponding Authors
[1]*email: alonvergil12345@gmail.com; [2]email: girliemarch.petiluna@gmail.com; [3]email: pricelojrpausanos@gmail.com;*

ABSTRACT. *The purpose of this study was to evaluate how Science, Technology, Engineering and Mathematics (STEM)-Based Research in STEM-Senior High School students affects their attitude toward science and science achievement. A total of 86 respondents (n=86) were evaluated of Grade 12-STEM of the Misamis Occidental National High School, Oroquieta City. Questionnaires and grades of the respondents were used as bases of assessing the relationship of the said variables. Science Attitude Questionnaire (SAQ), a 45-item survey test and final rating of the respondents were used and tabulated. Almost all of the respondents had positive attitudes toward science as evident in their responses. Interestingly, the respondents had showed that they love the subjects and that their courses are dependent in science. In addition, they showed exemplary performance in the three (3) learning areas of science namely; Physics, Biology and Chemistry. In getting the relationship of the variables, the researcher used Pearson Correlation Coefficient, r and the result showed strong positive relationship which shows that the respondents had experienced active engagement in their research journey and able to appreciate science not just a subject but a career that has contribution in the society. Research findings suggest that STEM teachers must be creative and innovative in guiding their students towards their future career.*

Keywords: *science achievement, science attitudes, STEM-based research, future career, performance, S.T.E.M, relationship*

1. INTRODUCTION

Science, Technology, Engineering and Mathematics (S.T.E.M) Education in the country requires teachers to really engage in the core discipline of the strand itself in order for the students to love the course. In Senior High School, STEM is one of the strands which cater students who would like to pursue in STEM-inclined courses. The Department of Science and Technology-Science Education Institute (DOST-SEI) offers privileges to students who are enrolled in the said strand as automatic candidate for the Undergraduate Scholarships. Meanwhile, science teachers are expected to cultivate learning through various modalities to the students for them to appreciate their strands and to self-actualize that they are in the right track and strand. However, problems encountered with students who were still undecided of their course and still taking Bridging Program who are in STEM and shifted to other strands related courses and the vice versa. Research shows that students' motivation and experience have direct effect on their attitude and perceptions toward STEM (Brown et al. 2006; Turner and Patrick 2004; Weinberg et al. 2011). In addition, STEM students who have passionately loved in science, mathematics and engineering in the early years of their education are closely would like to pursue the STEM-related career (After-School Alliance

2015). Thus, the importance of motivating students to learn STEM content will help them to express their interest in STEM. In classroom setting, various instructions are used. STEM-Based Research as a Problem-Based Learning is timely for students to exquisitely love their strand. In this approach, contextually, the students are indulge in a semester of research where they are orient the nature and purpose of research, taught how to identify research problems and find solution to the problems by innovating research projects.

This research specifically aims to seek the following questions:

1. What are the respondents' attitudes towards science?
2. What are the respondents' academic achievements toward science in the two quarters?
3. Is there a significant difference between the pre-test and posttest responses of the respondents in their attitude towards science?
4. Is there a correlation between respondents' attitudes toward science and their academic achievement in science?

2. MATERIALS AND METHODS

The study was realized with the Senior High School students attending Grade 12-STEM. These students were subjected to research activities throughout a semester. The researcher designs a matrix of activities for the students to be guided with what to do and achieve.

2.1. Respondents

The data was obtained from eighty-six Grade 12-STEM students of the public school (n=86). The school was selected for it offers STEM as strand in its second year of operation as Senior High School. Mean age of the students was 16. Detailed information about grades and number of students is presented in the Table 3.

2.2. Instruments

2.2.1. Science Attitude Questionnaire (SAQ)

A 45-item Science Attitude Questionnaire (SAQ) was used to measure students' attitude toward science. The questionnaire was adapted from the study of Shruba (2008) which she used to evaluate student attitude toward science and prepared based on students level of understanding which is in senior high school level. Thus, the items of the questionnaire reflect the particular level of the students. Accordingly, items in the instruments were divided into four dimensions as;

1. Students' interest toward science lessons (Interest)
2. Students' attitude on the importance of science for their future career (Career)
3. Students' attitude on the importance of Science lessons (Importance)
4. Students' attitude toward Science teachers (Teacher)

2.2.2. Science Achievement

The students were evaluated on their achievement in Science based on the quarterly grades. Their grades were categorized in five (5) levels namely Outstanding (90-100), Very Satisfactory (85-89), Satisfactory (80-84), Fairly Satisfactory (75-79) and Did Not Meet Expectations (Below 75). The said categorizations were based on the Department of Education (DepED) Form 138 of the Senior High School.

2.2.3. Journal Making/Reflection Book

The students wrote their reflections and experiences in conducting the research study from the start of problem identification until the paper had done. Every week the research teacher will check their journal and their reflections.

2.3. Research Work Matrix

Table 1. Timetable of the Research Project Activities

Period	Activities	Learning Outcomes
Week 1-2	Administering the Pre-test	Pre-test results of the respondents
	Overview of the STEM-Based Research	The students will have their background about the nature of the subject.
Week 3-4	Research Problem Identification	The students will formulate their research problem.
	Formulating Research Plan	The students will formulate their research plan.
Week 5-6	Research Title Defense	The students will defend their research title.
Week 7-8	Literature Review	The students will gather related sources by reviewing literatures.
Week 9-10	Methodology ✓ Assessing the availability of the materials to be used ✓ Benchmarking/University/ Laboratory visit	The students will benchmark with other schools and assess the availability of the procedures/tests to be performed.
Week 11-13	Consultation/Mentoring with the experts regarding the methodology	The students will be guided with the correct procedures in performing the laboratory tests.
Week 14-16	Performing the Laboratory procedures/Methodology	✓ The students will be guided with the correct procedures in performing the laboratory tests. ✓ The students will be able to perform the tests and will be able to arrive the desired results.
Week 17-19	Formulating the following parts of the research paper: ✓ Results and Discussions ✓ Conclusions and Recommendations ✓ Consultations	✓ The students will be able to formulate the following parts: a. Results and Discussion b. Conclusion and Recommendations ✓ The students will be able to consult and refer the results with the experts.
Week 20-21	Classroom Defense	✓ The students will be able to present their research problems and their solutions to it.
Week 22-25	✓ Finalization of the paper ✓ STEM Research Expo ✓ Participation of Research Congress/Competition	✓ The students will be able to communicate their results by defending their research studies in front of the research panel.

Week 26	✓ Administering Posttest	✓ Posttest results of the respodents

3. RESULTS AND DISCUSSION

3.1. Grade 12 STEM Students Attitude toward Science

Table 2. Mean and Qualitative Rating of Grade 12 STEM Students on their Attitude toward Science

Dimension	INDICATORS	Pre-Test Mean	SD	Qualitative Rating	Post Test Mean	SD	Qualitative Rating
Importance	1. Science is useful for solving the problems of everyday life.	3.12	1.23	Undecided	4.79	0.41	Strongly Agree
Interest	2. Science is something that I enjoy very much.	2.80	1.44	Disagree	4.54	0.63	Strongly Agree
Interest	3. I like the easy science assignment best.	3.23	1.15	Undecided	4.57	0.82	Strongly Agree
Interest	4. I do not very well in science.	2.80	1.22	Undecided	2.15	0.84	Disagree
Teachers	5. Science teachers show little interest in their students.	2.93	0.98	Undecided	1.86	1.09	Disagree
Interest	6. Doing science labs or hands-on activities is fun.	3.65	1.06	Agree	4.88	0.32	Strongly Agree
Interest	7. I feel at ease in a science class.	3.40	0.48	Undecided	4.18	0.63	Agree
Interest	8. I would like to do some extra or un-assigned reading in science.	3.22	0.40	Undecided	4.2	0.58	Agree
Importance	9. There is a little need for science in most of today's jobs.	2.60	1.12	Disagree	2.56	1.64	Disagree
Interest	10. Science is easy for me.	2.98	0.58	Undecided	3.52	0.71	Agree
Interest	11. When I hear the word "science", I have the feeling of dislike.	1.71	1.03	Strongly Disagree	1.85	1.07	Disagree
Interest	12. Most people should study science.	3.50	1.29	Agree	4.68	0.71	Strongly Agree
Interest	13. I would like to spend less time in school studying in science.	2.64	0.53	Undecided	2.25	0.65	Disagree

Interest	14. Sometimes I read ahead in our science book.	2.79	0.76	Undecided	3.79	0.89	Agree
Importance	15. Science is helpful in understanding today's world.	3.62	1.35	Agree	4.83	0.37	Strongly Agree
Interest	16. I usually understand what we are talking about in science.	3.44	0.46	Agree	4.27	0.86	Strongly Agree
Teachers	17. Science teachers make science interesting for me.	3.36	1.13	Undecided	4.56	0.73	Strongly Agree
Interest	18. I do not like anything about science.	2.33	1.05	Disagree	1.08	0.28	Strongly Disagree
Interest	19. No matter how hard I try, I cannot understand science.	2.71	0.78	Undecided	1.35	0.48	Strongly Disagree
Interest	20. I feel tense and upset when someone talks to me about science.	2.71	0.98	Undecided	1.40	0.81	Strongly Disagree
Teachers	21. Science teachers present materials in a way that I understand.	3.44	1.25	Agree	4.46	0.65	Strongly Agree
Difficulty	22. I often think "I cannot do this" when a science assignment seems hard.	3.05	0.83	Undecided	2.75	1.00	Undecided
Importance	23. Science is often great importance to a country's development.	3.78	1.28	Agree	4.93	0.26	Strongly Agree
Importance	24. It is important to know science in order to get a job.	3.37	0.77	Undecided	4.05	0.90	Agree
Interest	25. It does not disturb or upset me to do science assignments.	3.36	0.95	Undecided	4.15	0.73	Agree
Future	26. I would like a job that does not use any science.	2.19	0.98	Disagree	1.36	0.50	Strongly Disagree
Teachers	27. Science teachers know when I am having trouble with my assignments.	3.51	1.02	Agree	3.92	0.80	Agree
Interest	28. I enjoy talking to other people about science.	3.63	1.11	Agree	4.35	0.94	Strongly Agree
Interest	29. I enjoy watching a science program on television.	3.74	1.26	Agree	4.56	0.78	Strongly Agree

Interest	30. I am good at working science labs and hands-on activities.	3.83	0.53	Agree	4.13	0.82	Agree
Teachers	31. Science teachers do not seem to enjoy teaching science.	1.81	0.50	Disagree	1.26	0.49	Strongly Disagree
Interest	32. I like the challenge of science assignments.	2.78	1.18	Undecided	3.81	1.03	Agree
Importance	33. You can get along perfectly well in everyday life without science.	2.50	0.73	Disagree	1.62	1.15	Strongly Disagree
Interest	34. Working with science upsets me.	3.12	0.92	Undecided	3.81	0.75	Agree
Interest	35. I remember most of the things I learn in science class.	2.97	0.84	Undecided	2.61	0.86	Undecided
Interest	36. It makes me nervous to even think about doing science.	3.22	0.65	Undecided	2.11	1.25	Disagree
Interest	37. I would rather be told scientific facts than find them out from experiments.	4.09	0.51	Agree	1.43	0.59	Strongly Disagree
Importance	38. Most of the ideas in science are not very useful.	3.01	1.26	Undecided	2.01	0.98	Disagree
Interest	39. It scares me to have a science class.	3.26	0.95	Undecided	4.08	1.18	Agree
Teachers	40. Science teachers are willing to give me individual help.	4.17	0.71	Agree	4.39	0.94	Strongly Agree
Interest	41. The only reason I am talking science is because I have to.	2.99	0.82	Undecided	4.79	0.89	Strongly Agree
Importance	42. It is important to me to understand the work I do in the science class.	3.69	1.13	Agree	4.48	0.41	Strongly Agree
Interest	43. I have a good feeling toward science.	4.00	0.55	Agree	4.99	0.57	Strongly Agree
Future	44. Science knowledge is necessary for my future career.	4.31	0.75	Strongly Agree	4.99	0.11	Strongly Agree
Future	45. My future career is dependent from science.	3.50	1.19	Agree	4.99	0.11	Strongly Agree

Legend:
4.21-5.00 = Strongly Agree
3.41-4.20 = Agree

2.61-3.40 = Undecided
1.81-2.60 = Disagree
1.00-1.80 = Strongly Disagree

The findings in Table 2 show the attitude of Grade 12-STEM students toward science. As observed all students showed positive attitude toward science. They have strongly agreed and agreed on the positive statements about their attitude toward science. Interestingly, indicators 43-45 showed strong attitude which students have their good feelings towards science, that their science is necessary for their future career and that's conclude that science is dependent of their future careers. According to Roberts et al. (2018) the students' engagement in their experiences in STEM Education will eventually help them love their choice and able to increase their appetite in loving science.

Table 3.T-test result of respondents' attitude in pre-test and posttest

Variables	t-value	p-value	Remarks
Pre-test vs Posttest	-7.17	0.00	Significant

*α=0.05

As shown also in the t-test to determine if there is a significant difference between the grades of the respondents in the third and fourth quarter, interestingly, the result shows that there is a significant difference (*p=0.00)* of the said two quarters.

Table 4. Range, Frequency, Percentage and Qualitative Rating of Grade 12-STEM in terms of their Science Achievement

Range	*f*	Percentage (%)	Qualitative Rating
90-100	80	93.02	Outstanding
85-89	6	6.98	Very Satisfactory
80-84	0	0.00	Satisfactory
75-79	0	0.00	Fairly Satisfactory
Below 75	0	0.00	Did not meet Expectations
Total	**86**	**100.00**	

In addition, Table 4 presents the science achievement of STEM students in three learning areas namely; Physics, Chemistry and Biology. In the average, almost (93.02%) Grade 12-STEM students perform exemplary in their science courses and only few (6.98%) have obtained "Very Satisfactory" in their grades in 3 science learning areas. This implies that students really love the subjects as they perform better in the said learning areas.

Table 5. Relationship of Grade 12-STEM Students Attitudes towards Science and Science Achievement

Variables	r	Interpretation
Attitudes vs. Achievement	0.923	Strong positive relationship

Shown in table 5 is the relationship of the respondents' attitudes and academic achievement toward science. It reveals that the value of Pearson Correlation Momentum, r has promising result which is on the level of being strongly related. As further revealed, r, 0.923 has an impact of being strong and thus the approach is worth emulating. In the study of Papanastasiou and Zembylas (2002), science achievement is directly related to students' attitudes toward science. The more they love the subjects, the eager they want to learn and they better grades they obtain.The results of the correlation showed strong positive relationship (r=.923) which obtained using Pearson Correlation Coefficient r.

3. CONCLUSION AND RECOMMENDATION

Using authentic strategy to students' necessity and requirements will eventually help the students self-actualize and realize their full potentials on the said tracks that they are in. STEM teachers need to be aware of their roles in

bringing the value of science to their STEM learners not just making Science a theory but with direct engagement through STEM-Based research approach that could passionately push them to love science and perform exemplary in science. Therefore, STEM-Based Research is an approach in bringing more scientists in the nation to continually innovate amazing inventions for the economic growth and status of the country. Based on the results, the researcher would recommend the following:

1. determine the significant difference of the academic achievement of the respondents in the two quarters;

2. examine other variables that could contribute the performance of the students like socio-economic status and sex; and

3. recommend the science teachers to incorporate genuinely the first hand-on experience or outdoor learning towards the learners and innovate possible resources that could facilitate learning and boost their confidence to love science.

4. ACKNOWLEDGEMENT

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