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Effect of Station Rotation Model in Learning Grade 10 Physics

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***Abstract*—** This study aimed to determine the effect of Station Rotation model (SRM) in learning Grade 10 Physics of Bagatao National High School in Magallanes District of the Division of Sorsogon Province for school year 2022-2023. It used the quasi-experimental method of research. The respondents were the Grade 10 students of Bagatao National High School which were purposively chosen. The statistical tools utilized were the mean and t-test for dependent samples. The study revealed that the students have average mastery in reflection and refraction topics. Likewise, the station rotation model is effective in improving the performance of the students in Physics. By integrating diverse activities and providing flexibility, this model not only enhances understanding of Physics concepts but also cultivates essential skills crucial for academic success and lifelong learning. The station rotation model significantly boosts students' motivation by offering creative and critical thinking, time management skills, student-centered learning environment, and collaborative work over their Physics learning journey.

***Keywords*—** effect, intrinsic motivation, performance, Physics, Station rotation model

I. INTRODUCTION

Education aims to build a society that can grasp and adapt to the inevitable changing world. It aims to equip individuals with competitive skills in various fields of science, preparing them for a scientifically competitive and inclined community. The evolution of 21st century teaching and learning demands educators to change their practice from a traditional way to a more diverse student-centered learning environment. This new approach helps to battle the various needs and demands of every learner, especially the poor performances in understanding the physics subject. The integration of technology has become a part of the teaching and learning process, helping educators in crafting their lessons and creating a flexible and adaptable learning area that promotes students' learning and skills.

Several studies have shown the effectiveness of station rotation model in promoting student learning and achievement. For instance, a study by Tucker-Seeley et al. (2017) found that using station rotation model in a science classroom significantly improved student engagement and performance compared to traditional teacher-led instruction. Another study by Sutarto et al. (2019) reported that station rotation model was effective in improving students' science process skills and scientific attitudes in a physics classroom. Furthermore, a meta-analysis conducted by Khine and Fisher (2013) revealed that station rotation model had a positive effect on student achievement in science subjects.

However, despite the goals and significant contribution of science in different fields, there are still numerous problems and challenges hindering the success of teaching and learning. The Philippines ranked 76th out of 137 participating countries in the quality of math and science education, according to the 2017 World Economic Forum Executive Opinion Survey. The latest results of the Programme for International Student Assessment (PISA) of the Organization for Economic Co-operation and Development (OECD) in 2018 show that the Philippines scored 357 in Science, which is below the average of other participating OECD countries. The Bicol region attained a mean score of 346, which is within the Proficiency Level 1a.

According to the K-12 Basic Education Curriculum, science education aims to develop both scientific and technological literacy, preparing students to comprehend and make judgments and decisions regarding the application of science and technology in real-life situations. Physics, as one of the areas of science and also called the "fundamental science," plays a major role in modernization and sustainable development. Scientific discoveries, innovations, and technological advancements are some representations of the importance of physics that society benefits from. The integration of technology in presenting different science concepts boldly included in the 21st Century skills; ICT, collaboration, communication, and critical thinking skills of both the teachers and students in the learning delivery and engagement of the lesson. During the

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National ICT Summit of the Department of Education in 2021, DepEd Secretary Leonor M. Briones boldly emphasized the importance of integrating Information and Communications Technology (ICT) in both teaching and governance for the delivery of quality, accessible, and relevant basic education for Filipino students. As such, teachers are urged to devise various teaching methods that will make the classroom more engaging.

Physics is difficult for students because they have to contend with different representations such as experiments, formulas and calculations, graphs, and conceptual explanations at the same time. In addition, abstract concepts in Physics courses make it difficult for students to comprehend the subject matter, and the information learned is forgotten quickly because they are unable to associate it with life in general. Learners also face difficulty in problem-solving, which is another challenge to the teachers in improving the teaching and learning of the subject. To address these issues, there is a need to create a learning environment where learners can be active players, increase their engagement in classroom activities, enhance their understanding of science concepts, and develop their 21st Century skills, including their ICT skills. This study was conceptualized, focusing on using the station rotation model to help achieve effective teaching and learning processes. Teachers must pursue opportunities to build their understanding of how students with varied interests, abilities, and experiences can be supported and guided. Subsequently, students may be able to make clear sense of scientific ideas that can be linked to real-life situations. The use and adaptation of the station rotation model to develop lessons enhance students' understanding of physics concepts, improve problem-solving skills, and integrated within the teaching and learning process. In this model, students rotate through various stations that incorporate different types of activities such as experiments, simulations, problem-solving tasks, collaborative work, and teacher-led instruction. This approach enables students to engage in active and collaborative learning, and allows them to work at their own pace and level of understanding. Moreover, station rotation model provides opportunities for the teacher to personalize instruction and differentiate learning to meet the needs of diverse learners.

Given the challenges and gaps in the teaching and learning of Physics in the Philippines, the station rotation model presents a promising approach to enhance students' understanding of Physics concepts, improve problem solving skills, and develop positive attitudes towards the subject. The researcher chose reflection and refraction as topics since these are difficult for the students to understand then it can be exhibited using the station rotation model. Thus, this study aimed to investigate the effect of using station rotation model on the students in learning Grade 10 Physics at Bagatao National High School. The findings of this study may provide insights and recommendations to improve the teaching and learning of Physics in the Philippines and other countries facing similar challenges.

Generally, this study aimed to determine the effect of Station Rotation model (SRM) in learning Grade 10 Physics of Bagatao National High School in Magallanes District of the Division of Sorsogon Province for school year 2022-2023. Specifically, it aimed to (1) describe the effect of the station rotation model on the students in learning Physics and (2) determine the level of agreement of the students in their intrinsic motivation along interest/enjoyment, perceived competence, perceived choice, value/usefulness, effort/importance, pressure/tension, and relatedness.

II. METHODOLOGY

Research Design

The study aimed to determine the effect of Station Rotation Model (SRM) in learning Grade 10 Physics of Bagatao National High School in Magallanes District of the Division of Sorsogon Province for school year 2022-2023. It employed the quasi-experimental method of quantitative research since control and experimental groups were used in the study.

The respondents of this study were the Grade 10 Physics students of Bagatao National High School, Magallanes District. A teacher-made test was utilized in knowing the students' performance in Physics. Similarly, the statistical tools employed were the mean, t-test for independent samples, and weighted mean.

The Sample

The subjects of this study were the 20 Grade 10 students of Bagatao National High School, Behia, Magallanes, Sorsogon for the school year 2022-2023. The students were selected using purposive sampling technique based on their performance in the pre-test. The basis for

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selection was the students who obtained scores within the range of the third quartile and above.

Table 1. The Respondents

Groups	f	%
Control	20	50
Experimental	20	50
Total	40	100

The respondents for the study were selected based on the following criteria: they must be enrolled in Grade 10 Physics at Bagatao National High School in Magallanes District and they must have consented to participate in the study.

The Instruments

The following instruments were utilized in the conduct of the present study.

Pretest and Posttest. A 20 items pre-test/post-test was made and administered by the researcher to evaluate the effect of the developed learning activity sheets on students' conceptual understanding. Two different but parallel or equivalent forms of instruments were used. The first step in the construction of this test was making a table of specifications (TOS) using the taxonomy in evaluating educational objectives. Included in the TOS were the topics, time allotment, number of items, and item placement. The 40-test question were pilot tested to Grade 10 of Caditaan National High School, for the S.Y 2022-2023 before it was administered to the respondents.

In determining the validity in choosing the test items, the result from the pilot test, testing were item analyzed. The item difficulty or difficulty index measured the percentage of the sample taking the test that answered the question correctly. The discrimination index compares the number of people with high test scores who answered the items correctly with the number of people with the number of people with low test scores who answered the same item correctly. Also, the scores gathered during the pilot testing were used for the computation of reliability using Chronbach's Alpha which is a measure of how closely related a set of items are as a group. The result indicated that the reliability of the test is 0.74. This means that the alpha calculated is acceptable since the range for acceptable alpha is greater than 0.8 and greater than or equal to 0.7. Out of 30 items, only 20 items were acceptable based on the difficulty and discrimination indices and were used as the final test items.

Intrinsic Motivation Inventory (IMI). A questionnaire was also used to gather the motivation of the students with the designed activities and the cognitive development processes that took place. This questionnaire was developed by adapting items from the instrument known as the Intrinsic Motivation Inventory. Items had been selected based on their relevance to the study by the researcher.

Data Gathering Procedures

Before the implementation of the SRM, the preparation phase involved seeking permission from the school head to conduct the study and obtaining informed consent from the students and their parents or guardians. Also, the researcher made a of schedule the administration for validation of the pre-test and post-test.

The pre-test was administered to the students to establish a baseline for their performance. The SRM activities was then implemented, which focused on the integration of station rotation model. The activities were developed by the researcher in consultation and reviewed by the panel members to ensure content validity.

To gather the experiences and perceptions of the students, a reflection journal was used. Likewise, the questionnaire was administered to the students after the completion of the activities. The post-test was then administered to evaluate the effectiveness of the SRM on students' learning.

Throughout the data collection process, confidentiality and privacy of the participants were ensured by keeping the collected data secure and anonymous. To ensure accuracy and reliability of the data, established protocols and procedures were followed.

Data Analysis Procedures

The gathered data from the students were subjected to appropriate statistical analysis depending on the nature of the data. The mean was used in describing the mean performance level of the control and experimental groups in pre-test and posttest along reflection and refraction of light. To analyze the scores of students in the pre-test and post-test, the researcher computed for the mean score by dividing the total score by the total population. To interpret the mean score, the researcher

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computed the performance level in percentage, dividing mean score by the number of certain items then multiplied by one hundred. Performance levels were described using the DepEd Order 8 series of 2015. These are as follows:96-100 (Outstanding), 85-89 (Very Satisfactory), 80-84 (Satisfactory), 75-79 (Fairly Satisfactory), Below 75 (Did Not Meet Expectations.

Similarly, the t-test for independent samples was employed in determining whether the difference between pre-test and posttest results was significant or not. Also, the Cohen's d was utilized to find out the effect size if the difference was found significant.

In addition, the weighted mean was used in determining the level of agreement on the effect of station rotation model on students' motivation. This scale was employed in interpreting the results: 1.00-1.49 (Strongly Disagree); 1.50-2.49 (Disagree); 2.50-3.49 (Neutral); 3,50-4.49 (Agree); 4.50-5.00 (Strongly Agree).

III. RESULTS AND DISCUSSION

1. Effect of the Station Rotation Model on the students in learning Physics

This section covers the effect of the Station Rotation Model on the students in learning Physics. It includes the performance of the control and experimental groups in pre-test and posttest. Also, the test of difference between the pre-test and posttest performance of the control and experimental groups.

Pre-test and posttest performances of the control and experimental groups. Table 2A includes the mean performance level (MPL) of the control and experimental groups in the pre-test and posttest along the identified topics.

Table 2A. *Pre-test and posttest performances of control and experimental groups*

Groups	**Mean Performance Level (MPL)**			
	Pre-test		Posttest	
	Reflection	Refraction	Reflection	Refraction
Control	50.0 (DNME)	22.5 (DNME)	65.0 (DNME)	37.0 (DNME)
Experimental	53.0 (DNME)	19.0 (DNME)	86.5 (VS)	50.5 (DNME)
Average	51.5 (DNME)	20.75 (DNME)	75.75 (FS)	43.75 (DNME)

It can be asserted that the experimental group had a higher mean performance level (MPL) on both pre-test and post-test compared to the control group.

For the reflection topic, the experimental group had a MPL of 53.0 on the pre-test, which increased to 86.5 on the post-test, while the control group had a MPL of 50.0 on the pre-test, which increases to 65.0 on the post-test.

While for refraction topic, the experimental group had an MPL of 19.0 on the pre-test, which increased to 50.5 on the post-test, while the control group had an MPL of 22.5 on the pre-test, which increased to 37.0 on the post-test.

Overall, the average performance level for experimental group on both pre-test and post-test was higher compared to control group. Specifically, the experimental group had an average MPL of 36.0 on the pre-test, which increased to 68.5 on the post-test, while the control group had an average of 36.25 on the pre-test, which increased to 51.0 on the post-test.

It suggests that the incorporating station rotation model in implementing the lesson had a positive effect on performance level on both topics, as evidenced revealed by higher mean performance level scores in the experimental group compared to the control group.

Difference in the pre-test and posttest. Table 2B lists the statistical bases and statistical analyses of the difference between the pre-test and posttest of the control and experiment groups. The t-test for independent samples was used in analyzing the data.

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Table 2B. Difference in the pre-test and posttest

Statistical Bases	Statistical Analyses			
	Reflection		Refraction	
	Pre-test	Posttest	Pre-test	Posttest
Critical value	1.69	1.69	1.69	1.69
Computed value	0.34	3.55	0.76	1.76
Cohen's d	0.11	1.12	0.24	0.56
Decision on HO	Do not reject	Reject	Do not reject	Reject
Conclusion	Not sig	Sig	Not sig	Sig

Note: Df=38; a=0.05; Cohen's d=0.0-0.19(trivial effect); 0.2-0.5 (medium); >.80(large)

It can be gleaned from the table that the performance of the control and experimental groups in the pre-test in terms of Reflection is not significantly difference since the computed value of 0.34 is less than the critical value of 1.69. Thus, the non-rejection of the null hypothesis. However, the posttest performance of the two groups showed significant difference because the computed value of 3.55 exceeds the critical value of 1.69. Therefore, the null hypothesis is rejected. This means that the station rotation model has large effect in the students' performance in the said topic as reflected in Cohen's d value of 1.12.

In relation to Refraction topic, the computed value for the pre-test of 0.76 is lower than the critical value of 1.69 at 0.05 level of significance with degrees of freedom of 38. Hence, the null hypothesis is not rejected which states that there is no significant difference between the performance of control and experimental groups in the pre-test. On the other hand, the posttest performance of the two groups significantly differs because the computed value of 1.76 that is higher than the critical value of 1.69. Therefore, the rejection of the null hypothesis. It means that the station rotation model is effective in improving the performance of the students since the Cohen's d is 0.56.

2. Effect of the Station Rotation Model on the students' motivation

This portion encompasses the effect of the Station Rotation Model on the students' motivation in learning Physics.

Table 3. Likert scale average, and percentage level of motivation

Subscale	Average	%
Interest/Enjoyment	3.92	56.00%
Perceived competence	4.15	83.00%
Perceive choice	3.87	55.29%
Value/Usefulness	4.61	65.86%
Effort/Importance	3.96	79.20%
Pressure/Tension	3.90	78.00%
Relatedness	3.76	47.00%

The data presented appears to be from a study that investigated the impact of the Station Rotation Model on student's motivation to learn Physics concepts. The study used the Intrinsic Motivation Inventory (IMI) to measure the subjective experiences of the experimental motivation.

The IMI consists of seven subscales that measures different aspects of intrinsic motivation, which include interest/enjoyment, perceived competence, perceived choice, value/usefulness, effort/importance, pressure/ tension, and relatedness.

The findings suggest that the Station Rotation Model had a positive effect on student's motivation to learn physics concepts. The experimental group reported high levels of perceived competence (average score=4.15, percentage, percentage=83%), value/usefulness (average score=4.611, percentage=66%). And effort/importance (average score=3.96, percentage=79%). These results indicate that students felt very confident in their ability to learn the concepts, perceived the activity as valuable and useful, and considered it important for their learning.

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However, students reported moderate levels of interest/enjoyment (average score=3.92, percentage = 56%), perceived choice (average score = 3.87. percentage = 55%), and relatedness (average score = 3.76, percentage = 47%). These scores suggest that while students found the activity somewhat interesting and enjoyable, they still had a moderate sense of control over the activity and a moderate sense of connection to others during activity.

Additionally, the pressure/tension subscale yielded a moderate average score (average score = 3.90, percentage = 78%), indicating that some students experienced moderate levels of stress during the activity.

In summary, the results of the study suggest that the Station Rotation Model positively influenced student's motivation to learn physics concepts. However, these is room for improvement in terms of increasing student's interest/enjoyment, perceived choice, relatedness, and reducing stress levels.

Here are some interview response gathered from the experimental group that strongly supported the effect of Station Rotation model towards students' motivation. It was taken after the implementation of the model in Grade 10 Physics class.

Theme 1: Improved Creative and Critical thinking

One of the goals of Science Curriculum is to equipped learners with competitive skills. Using this station rotation model in teaching science class would help to achieve this goal. There are evidences that showed the effect of utilizing this model. It was mentioned by the set of students on how it impacted their critical thinking skills. "With each task given per station I noticed that by sharing thoughts with my groupmates through asking opinions from each member I urged myself to think deeply for an answer to a certain problem". Another responded "It's a mind blowing activity because the time is ticking per station that challenged us to think fast and correctly".Facione (2000) said, the disposition to think critically reflects the "consistent internal motivation to engage problems and make decisions" (p.65). Letting student engage in various task per station with problem solving helped them to trained their minds in achieving metacognitive skills. Through an exchange of thought with a certain member of their group lead to another mind to start formulating answer. Likewise, in station 4 activity with (Reflection topic),it required student to derive formula in identifying the image form in two plane mirrors. In this case, learners have focused on finding solutions to the problem. In the National Research Council (2012) report, the authors consider critical thinking along with creative thinking and content knowledge, to fall in cognitive competency category.

Theme 2: Enhanced Time management skills

Time management is the process of maximizing the use of available time, which includes organization, goal setting, prioritizing goals and activities, communication, and delegation. By controlling oneself at the same time, individuals are able to perform many tasks, recognize their task and adjust their limitations. The development of other resources is contingent upon the presence and availability of time (Mohamadkhani et. Al, 2017). Aligned with the response acquired learners said "SRM taught me on managing my time in doing the task per station. And it helped on to focus performing the task. It reminds me how important in giving emphasis on things that needs my attention ". Moreover, "It allows me to engage in various activities and it helped me to find focus in doing the task. It enables me to manage my time well because it has specific limited time allotment in finishing the given task". The model are designed with different activities per station with at least 10-15 minutes. Therefore, students must be able to manage their time, as time management is important part of academic success (Aduke, 2015). Effective time management were noticed when students know how to set things that needs their attention the most. Especially by allowing themselves in following the procedures first before drawing conclusions in answering quide questions in each given activity sheets per station. According to Al-Zoubi (2016), the best use of time is to prioritize task based on their importance.

Theme 3: Increased Student-centered learning environment

Unlike traditional teaching method, applying Station Rotation model allows student to learn the context of the lesson in performing various activities. It engage student to learn while doing the task per station. It have strong impact on students' motivation in class. One of the student who experienced this model provided this feedback " Dahil sa Station Rotation Model napagtanto ko na masaya pala pag-aralan ang Physics subject. Dahil hinahayaan kami na mag-explore sa iba't ibang activities na kami mismo ang hahanap ng sasagot sa pamamagitan ng aming imbestigasyon". Additionally, "It helped me to appreciate Physics subject that I

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considered as one of the hardest field of science. I enjoyed the rotational activity in a sense that our teacher let us experienced various task with a twist. I am thrilled that we moved from one station to another. We are also allowed to access the internet or youtube. That gave support in finishing our task.

Theme 4: Improved Collaborative work among students

Having a sense of belongingness portraits a favorable learning environment that would motivate student to continue learning with enjoyment. Thus, this model has a positive effect in promoting such kind of learning place were all student are included in spite of their differences. In line with this, a student said "I love doing the activity because each us in a group must have part in doing the task per station. Being in a group taught me to be cooperative". Moreover, "It taught me to be friendly. Because it enables me work with my groupmates. That's why I find it enjoying while learning Physics lesson such as Reflection and Refraction".

IV. CONCLUSION AND RECOMMENDATIONS

This study concluded that the students have average mastery in reflection and refraction topics. Likewise, the station rotation model is effective in improving the performance of the students in Physics. The station rotation model offers a transformative approach to Physics teaching, fostering behavioral, cognitive, and emotional engagement among students. By integrating diverse activities and providing flexibility, this model not only enhances understanding of Physics concepts but also cultivates essential skills crucial for academic success and lifelong learning.

It was recommended that t The teachers may utilize the station rotation model to other topics in Physics and encourage other teachers to use it in their subjects since it is proven as effective in improving the performance of the students. The teacher may use the station rotation model, integrating diverse activities and fostering active engagement to deepen understanding, encourage collaboration, and enhance critical thinking skills among students to optimize Physics learning. To enhance students' motivation, the teacher may implement the station rotation model with diverse activities, personalized learning opportunities, and collaborative experiences to foster a sense of engagement in their Physics learning journey.

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