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Effectiveness of Hydropowered Wheel (Hypowheel) Model on Selected Topics in Physics

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***Abstract*—** This study was conducted to determine the effectiveness of HYPOWHEEL Model on selected topics in Physics. The Solomon Four Groups design was used to assign the participants into four groups through stratified random sampling. A 30-item pre-test and post-test were administered to obtain the needed data. Only the experimental groups were treated with Hypowheel model in the instruction and all the four groups took the post-test. The data revealed that the performance level in the pretest of the control and experimental was the same at low mastery. However, after the treatment of Hypowheel model to experimental group and no treatment to control group the performance level (PL) in the post-test of both groups was improved. Further, the experimental group got higher PL and performed better than control group. Specifically, the performance level in the post-test along the topic energy transformation, work and heat, and power of experimental groups was described as moving towards mastery while the control groups generally described as at average level. In addition, there was a significant difference between the pre-test and post-test result. There was also a significant difference of post-test result between each group. Using Scheffe's test, the difference lies between experimental group 1 and control group 2 with computed F of 22.83(Cohen's d=1.79) and, experimental group 2 and control group 2 with computed F of 25.25(Cohen's d=1.84). It recommended that the teacher and students may develop suitable instructional aids for physics instruction to enhance student's level of competency. Hence, they may use Hypowheel model to help achieve better performance on the said topics. Findings also suggest the need to conduct trainings on innovation, recycling, investigative project, and further studies about Hypowheel model.

***Keywords*—** effectiveness, Hypowheel model, instructional material, performance level, physics concepts.

I. INTRODUCTION

Education is fundamental and essential in nurturing an individual's cognitive, psychomotor, and affective domains. A robust educational system must effectively allocate resources across various segments to ensure quality (United Republic of Tanzania, 1995). However, in Tanzania science education faces significant challenges, including the lack of resources such as equipment and apparatus (Mafumiko, 2005). Furthermore, the insufficient number of science teachers, huge numbers of students, and insufficient time distribution for science education complicated this further (Kaptan & Timurlenk, 2012).

In the Philippine context, the DepEd (2013) emphasized that science education should focus on developing scientific literacy among learners and promoting a strong link between science and technology. Teachers and learners were encouraged to innovate apparatuses and develop instructional materials to meet the expected global competency.

The present state of science education in the country is hampered by surface learning (Tabamo, 2023). Hence, poverty, big class size, ineffective pedagogical methods, very poor materials, and dependency on traditional teaching may trigger this situation. Consequently, this may have a negative impact on the student's interest, motivation, and academic performance.

Referring to the Philippines' performance in science, the country has done poorly and has been dropping for decades. The long-running issues on lack of school facilities, poor-quality teaching and curriculum were great walls that blocked the plan for the present administration's goal for education.

According to Wallace (2016), the new curriculum of the Philippines has given more emphasis on the output-based system. Unfortunately, it has instead become an educational laggard, and the country got the bottom rankings in the three global evaluations (Sison,2022). One of these was the Programme for International Student Assessment in 2022 and 2018, which tested the reading, science, and mathematical skills of 15-year-old students, in which the country ranked fourth and second-lowest, respectively. Another was the Trends in International Mathematics and Science Study in 2019, which was about the evaluation of proficiency in Math and Science of fourth-grade students, which gave the Philippines the lowest rank.

At present, the implementation of the new curriculum, particularly in Sorsogon, found that the Spiral Progression Approach in teaching science presented the concepts and skills in increasing levels of complexity as the grade level increases too (Valin & Janer, 2019). Connecting it with Physics learning, Vollmer (2013) found many problems in understanding the concepts of Physics that may lead to poor performance of students in learning other science concepts. This situation may further contribute to the challenges currently faced in the teaching and learning of science under the existing curriculum. Another observed problem by Bancual and Ricafort (2019) that there were numerous challenges encountered by science teachers in conducting activities, such as limited laboratory space and the lack of adequate facilities and equipment.

These circumstances are perceived to have a direct impact on the National Achievement Test (NAT) Mean Percentage Score (MPS) in Sorsogon province. For instance, data from Danao National High School reveal a declining trend in science-10, dropping from 33.66 in the 2016-2017 school year to 31.33 in 2017-2018 (DepEd LIS,2024). This alarming data from the Learner's Information System (LIS) gave a signal that there should be an immediate remediation to be done. Hence, the science department conducted training to identify those Physics concepts that the learners perceived as abstract and difficult to understand.

Hewitt (2014) identified some abstract Physics concepts, like energy and matter. According to him, the idea of matter is easy to grasp. Energy, on the other hand, is abstract. Energy, unlike matter, cannot be directly observed, making it hard to understand. Thus, several research studies were conducted on how to concretize those abstract concepts by observing how these things are generated through modeling.

To address those problems, DepEd guided its institution by issuing guidelines on how to procure instructional materials, using the funds for fiscal year (FY) 2022 and onwards (DepEd Order no. 20, s. 2022). It ensures the quality of materials, the delivery procedure, evidence of documentation and safekeeping. The procurement of quality learning tools and equipment for science may fill in the scarcity of supply for both urban and rural school areas.

Moreover, the Department of Education issued the DepEd Order no.18, s. 2020 which was about the implementation of a learning continuity plan. It mandated the education sectors to be innovative, responsive, and resourceful in delivering education to be imposed with quality, accessibility, and liberality that ensure the safety of students and personnel (Briones, 2020). This call of the Department is believed to be a key to resolving the long-term effects of the COVID-19 pandemic on learning, especially on science education by crafting timely resources.

As analyzed by the current study, these issues and concerns must be motivating variables to propose additional solutions. Under the Code of Ethics for Professional Teachers, it was stated in section 1, Article III (PRC Resolution No.435, s.1998) that every teacher must be a facilitator of learning. Therefore, the current study introduced the HYPOWHEEL model that hopes to help the teacher to become 'a guide on the side and not a sage on the stage' inside the classroom (Tab and Mind, 2021). Teachers could utilize the Hypowheel as instructional material to develop a student-centered classroom. Furthermore, the innovative instructional apparatus may help simplify concepts of energy transformation, work and heat, and power in a teaching-learning process. It was also the goal of this endeavor to help the department promote higher performance of students and raise awareness of the importance of recycling, reusing, and reducing waste, since the Hypowheel was mostly made of recycled plastic materials.

II. REVIEW OF RELATED LITERATURE AND STUDIES

Ambrocio (2016) believes that instructional materials are tools for teachers for the effective delivery and promotion of learners' academic achievement. For him, audio or aural instructional materials are those that use the sense of hearing, while audiovisuals are those that use both hearing and seeing. Okpe (2018) states that the effect of instructional material on the achievement of physics students depends on its use and the teacher's attitude to arouse the students' interest. She said that Physics is perceived as a difficult course. Accordingly, Heron and Meltzer (2005) consolidate the findings of many research studies in physics and find that learners have difficulty in understanding the basic concepts of physics, like the concept of energy, work, and power. The factors that the researchers believed to affect this are, gender issues, language, computational problem solving, general culture, and quality. Further, Miña (2002) deduces that a student's learning is affected by the instruction facilitated by the teacher, the use of

instructional materials, and wrong concepts learned from the past.

Pauji, Serevina, and Hanati (2021) developed a miniature teaching aid on the conversion of motion energy into electrical energy as a learning medium. The study found that the aid can be used in the discussion of the conversion of electrical energy into heat. Munir and Atiku (2018) studied the comparative effects of improvised and standard instructional materials in physics on students' academic performance. The study showed that the students who utilized standard instructional material have equal performance on heat concepts compare to students who used an improvised instructional material. Also, Rohman, Werdhiana, and Saehana's (2021) study was about the development of electrical conversion tools as learning media for the concept of energy sources. Study results indicated that the tool, as a learning medium, is suitable for use in the learning process. Further, Michael, Uwaechia, Omowumi, Chinenye, and Temitope (2024) investigated the impact of inadequate instructional materials on the effective teaching and learning of physics. The study recommended that the teachers should get used to the culture of using instructional materials during the lessons. Additionally, Sobremisana's (2017) study was on the development and evaluation of an innovative physics device. Her device was developed based on the students' difficulties in learning relevant concepts, the students' attitude towards the subject, and focused on the basic concepts in mechanics. The innovative device helped students perform better in the physics class and generally improved students' understanding of concepts.

Marces (2019) proposed a study about the development and utilization of supplementary enrichment learning materials. It was found that the learning materials were effective and improved the performance of the students in the chosen least mastered topics in physics. Enteria and Casumpang (2017) assessed the effectiveness of developed comic strips as instructional material on teaching specific science concepts. It found that the comic strips were effective as instructional material in teaching science concepts, particularly on waste generation and management topics in particular.

Bastida and Bastida (2022) study determined the effectiveness of Strategic Intervention Material (SIM). The study concluded that if the students are exposed to SIM, it may help increase their learning outcomes more than using traditional ways of teaching, eventually leading to high academic performance. Escultura and Ricafort (2020) determined the effectiveness of the whole brain teaching strategy in learning some physics concepts about waves by grade 7 in Sorsogon. The study concluded that WBTS improved students' performance way better. Villaroya (2017) studied the inquiry-based approach as a strategy to best learn selected topics in chemistry by grade 8 students in Bulan, Sorsogon. It was found that using either the 5Es or 7Es strategy in teaching Chemistry can enhance the performance of students in the class.

The principle of motivation states that learners must be motivated before learning takes place (Felizelda, 2000). In this study, it is assumed that the HYPOWHEEL model is a great motivational object to enhance the participation and performance of learners. Since all learners have their unique strengths that need to be identified and strengthened, all learners should perform specific kinds of tasks critical to their success in school and at work (DepEd Order No.36, s. 2016). These principles indicate that a positive and motivating school climate, imparts the practice of respect for diversity of students who can possibly develop an impactful well-being, and may achieve far better.

III. RESEARCH METHODOLOGY

Research Design

This study determined the effectiveness of the Hydropowered Wheel (Hypowheel) Model on selected topics in Physics. The research design used in the study was the technique of Solomon-Four groups. In this method of research, a treatment or stimulus, such as that of the Hypowheel model, was administered to two experimental groups but not to two control groups. The said method was conducted to evaluate the effectiveness of the treatment. The design measured the dependent variable before and after the treatment is implemented. This design is comparable to a within-subjects experiment, where each participant is initially tested under a control condition and subsequently under the treatment condition (Research Method of Psychology, 2016).

Part of the methodology of the study was the test administration using the 30-item pre-test and post-test. The lessons taught to students were guided by the use of the two types of lesson plan, one type was for control groups, and the other type was for experimental groups. The data collected from the test were analyzed by the use of statistical tools like percentage, mean, t-test with p-value, ANOVA, Scheffe's test, and Cohen's d.

The Sample

There were 60 students from two regular Grade 9 sections of Danao National High School who were utilized as respondents. These respondents were divided into two major groups such as experimental and control groups, through draw lots. There were 15 participants per group. Using stratified random sampling, the previous general average and the result from the diagnostic test were used to determine the upper 32 and the lower 28 based on the range of their total weighted average performance. To obtain their total weighted average performance, 50% of the performance was derived from their general average and 50% came from the equivalent rating of their score from the diagnostic test, which was arranged from lowest to highest to determine the upper and lower groups.

Firstly, to get 15 respondents per subgroup, the researcher got 8 students from the upper group combined with 7 students from the lower group to come up with 15 members per group. These students were distributed evenly to each group to finally establish a 15-member group; two groups for experimental and two groups for control.

The Instrument

The main research tool used in the study were two sets of lesson plans and the 30-item test, which were checked and validated by three science-teacher experts coming from senior high school department. Further, the student's journal was used as a source of reflection and analysis on how the Hypowheel model assisted their learning on physics concepts. The ideas collected from the journal were incorporated into the interpretation of the values derived from the computation of verified variables. These research instruments allowed the researcher to carry out the inferential approach effectively with the use of appropriate statistics for data interpretation.

To check the validity of the test, the science teacher experts examined it. The test for dry run was initially conducted on April 24, 2023. After the dry run, the researcher analyzed the items using the DepEd-approved item analysis template for the revisions of the test for the final draft. The final revised 30-item test was administered again on April 27, 2023 to determine its reliability coefficient using the Kuder-Richardson Formula 20 (KR-20). The computed reliability for the measure of internal consistency was 0.74, which means that the test was acceptable based on the scale used by Ricafort (2018).

To validate the usage of the apparatus, the researcher experimented to test if it can be used to explain certain concepts last February 2000. The data gathered was treated with statistics, analyzed, and used to draw conclusions.

Data Collection Procedures

Firstly, the researcher prepared a letter of request to conduct a study to be sent to the principal of Danao National High School and two teacher-advisers handling the two Grade 9 classes. The researcher asked permission from the principal to conduct a study within the school requesting Grade 9 students as the respondents of the study and, requested to have a structured schedule of classes which was prepared by the researcher to avoid disruption and to ensure continuity of the regular class schedule.

With the approved request, the researcher administered the pre-test on May 2, 2023, using the validated 30-item test. These students were instructed on how to answer the test before its administration. The test papers were retrieved, checked, and analyzed using the appropriate statistical treatment. On the afternoon of May 2, 2023, the first session was attended by control groups, followed by its second session in the morning of May 3, 2023, for its first lesson (L-1). The experimental groups attended their first lesson on the afternoon of May 3 and continued the next day in the morning. This alternating schedule was followed until all lessons were taught.

After each lesson, the students were asked to write self-reflections in their journals, highlighting what they had learned from the specific concepts discussed. They also articulated the relevance of the Hypowheel model to the lesson and how it helped their understanding. The reflection part of the journal was consolidated to support the interpretation of the values obtained from the computation of the performance level and significant difference in the performances of the groups.

After all lessons had been taught to all groups, the post-test was conducted on May 18, 2023. The researcher retrieved the results, checked, and analyzed the scores of the students. It was tallied and interpreted with the use of statistical tools.

Data Analysis Procedures

The statistical measures used in this study were the frequency count, percentage, and mean. These were used to determine the performance level of the students in the pre-test and post-test of the control and experimental groups.

The results of the pre-test and post-test were conveyed by the use of Mean Percentage Score (MPS) or with the Performance Level, with its descriptive equivalent in terms of mastery level. The maximum scale of 96-100% MPS means that the concepts of the test are "mastered," while a minimum rating of 0-4% MPS can be described as "absolutely no mastery" (DepEd Memo no. 160 s. 2012).

The t-test was used at the level of significance of 0.05. The t-test for independent samples was used to determine the significant difference between the pre-test by the control and experimental groups. Whereas, to test the difference between the result of pre-test and post-test gathered from two types of respondents, the t-test for correlated samples was used. To measure the probability of significance, the p-value was quantified and interpreted. The difference among the performance of the four groups in the post-test was determined using the F-test, one-way ANOVA. Furthermore, to describe and compare the post-test results of the four groups of respondents, the Scheffe's test was used as a test for comparison. Moreover, Cohen's d was used to indicate the difference between the two means and the effect of the treatment (Bradburn, 2020).

IV. PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

4.1. Performance level of the Control and Experimental Groups in the Pre-test along a. Energy Transformation; b. Work and Heat; and c. Power

Table 1 shows the computed level of performance of the experimental group and control group in the pre-test conducted. The pre-test was done before the treatment of the Hypowheel model in the lessons.

The result of the pre-test on the topic about energy transformation of the experimental group got a 24.44% performance level, which was at low mastery, and the control group got 30.37%, which was also at low mastery. On the topic of work and heat, the experimental group had a performance level of 25.00% while the control group was at 29.44%, both had low mastery. And, on the topic of power, the experimental group got a 23.70% performance level while the control group got a 24.44% performance level, which were both at low mastery. In summary, the average performance level in the pre-test of the experimental group was 24.38, and the control group was 28.08. Both fell at a low mastery level.

Table 1. *Level of Performance of Control Group 1 and Experimental Group 1 in the Pre-test*

Topics	Experimental Group 1		Control Group 1	
	Rating	Description	Rating	Description
Energy Transformation	24.44	Low Mastery	30.37	Low Mastery
Work and Heat	25.00	Low Mastery	29.44	Low Mastery
Power	23.70	Low Mastery	24.44	Low Mastery
Average	24.38	Low Mastery	28.08	Low Mastery

The respondents from both experimental and control groups had the same prior knowledge about the topics in science 9 since they were described under the same descriptive equivalent of mastery level.

The result also showed that the respondents had already developed some minimal skills in different aspects of the lesson.

The low result of the pre-test conducted suggested that the respondents may need ample learning materials, learning resource space, appropriate lessons, effective learning and teaching strategies, remediation of the past lessons from the last grade level, and reading resource materials to enhance their academic learning.

Thus, it is needed that the education sector should focus on diagnosing the educational learning of the students.

4.2. Difference between the Pre-test Results of Control and Experimental Groups along the Identified Topics

Table 2 revealed that the computed t-value for the topic about energy transformation was 0.91 with a p-value of 0.36, for the topic about work and heat was 0.48 with a p-value of 0.63, and for the topic about power was 0.31 with a p-value of 0.76. These t-values implied that the null hypothesis could not be rejected because they were within the critical t-value of 2.05 with the degrees of freedom of 28 at a 5 percent level of significance. The p-values further revealed that it failed to reject the null hypothesis per topic. Hence, there was no significant difference between the pre-test results of the experimental and control group along the topics on energy transformation, work and heat, and power. This finding revealed that the two groups of respondents had equal performance in the pre-test.

Table 2. Difference between the Pre-test Results of Control and Experimental Groups

Statistical Bases	Statistical Analyses		
	Energy Transformation	Work and Heat	Power
Computed t-value	0.91	0.48	0.31
Tabulated t-value	2.048	2.048	2.048
P-value	0.36	0.63	0.76
Decision on H0	Do not reject	Do not reject	Do not reject
Remarks	Not Significant	Not Significant	Not Significant

Note: $\alpha = 0.05$, $df = 28$

In addition, the result in all topics with "not significant" remark showed that the respondents may have similar conception of the new ideas being presented to them through a 30-item test.

Few of the students have advanced knowledge on the new lessons and approximately 90% of the respondents have little ideas on the topic.

The test result showed that both experimental and control groups have the same grasp of ideas on new lessons with low levels of mastery.

According to Escultura and Ricafort (2020), this low performance in the pre-test of both groups may be attributed to the following reasons such as the progression of topics under the K to 12 curriculum and the readiness of the students to learn new concepts.

Hence, in the case of the spiral progression approach, there may be a scenario where the concepts of energy transformation, work and heat, and power were not yet totally grasped by the learners due to time constraints and no mastery at all in their previous grade level.

4.3. Performance Level of the Four Groups in the Post-test along the Identified Topics in Physics

The concepts tested in the post-test were about energy transformation, work and heat, and power. Those topics and items were similar to what was being tested in the pre-test. Hence, the result of the post-test was necessary for inference purposes. Table 3 revealed the performance level of the four groups in the post-test along the identified topics in physics.

Reflected from the table was the obtained performance level along the topic energy transformation of the experimental group 1 which was 71.85%, experimental group to was 73.33%, control group 1 was 58.52%, and control group 2 was 51.11%.

It can be inferred that the performance level of experimental groups 1 and 2 was described as moving towards mastery, while control groups 1 and 2 were at an average level of mastery of the said topic.

This only suggests that the respondents acquired knowledge from the lessons with or without the treatment of the Hypowheel model in the process, because of the apparent increase in the performance level in the post-test.

Table 3. Level of Performance of Four Groups in the Post-Test

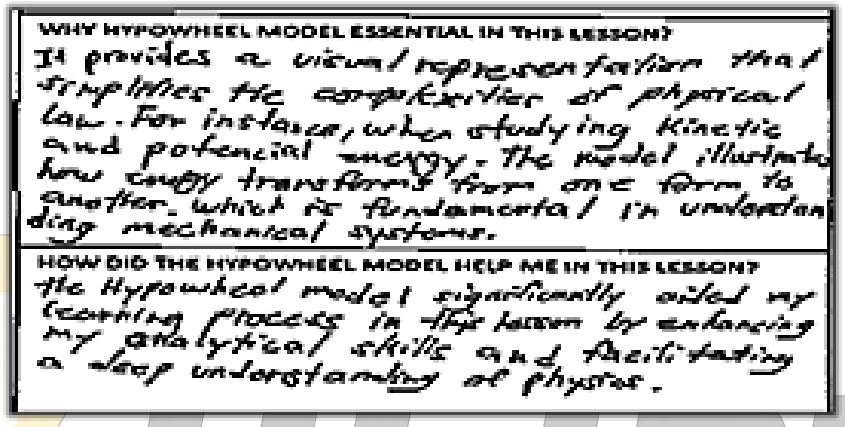
Topics	EG 1		CG 1		EG 2		CG 2	
	R	D	R	D	R	D	R	D
Energy Transformation	71.85	MTM	58.52	A	73.33	MTM	51.11	A
Work and Heat	77.78	MTM	70.00	MTM	79.44	MTM	58.33	A
Power	78.52	MTM	71.85	MTM	78.52	MTM	54.07	A
Average	76.05	MTM	66.79	MTM	77.10	MTM	54.50	A

Legend: R-Rating, D-Description, MTM-Moving Towards Mastery, A-Average, EG 1-Experimental Group 1, CG 1-Control Group 1, EG 2-Experimental Group 2, CG 2-Control Group 2

The table also reflected the performance level of the four groups in the post-test along the topics of work and heat. It can be gleaned from the table that the computed performance level of experimental group 1 was 77.78%, experimental group 2 was 79.44%, control group 1 was 70.00%, and control group 2 was 58.33%. It implied that the performance level of experimental groups 1, 2, and control group 1 was described as moving towards mastery, while control group 2 was at an average level of the said topic.

Further, it can be gleaned from the table that regarding the topic of power, the experimental groups 1 and 2 obtained a performance level of 78.52%, control group 1 got 71.85%, and control group 2 got 54.07%. It indicated that the performance level of experimental groups 1, 2, and control group 1 was described as moving towards mastery, while control group 2 was at an average mastery level of the said topic.

The data revealed that the experimental group led the other set of groups in terms of achievement in the three selected physics topics. And, based on the average performance level, the experimental group 1 got 76.05 and experimental group 2 got 77.10 ratings, while control group 1 got 66.79 and control group 2 got 54.50 ratings. It can be observed that it seems that the experimental groups were highly motivated in learning the lessons. Thus, it was believed that the Hypowheel model may be one of the factors that helped the students learn a lot and retain some facts of the lesson since this learning material is manipulative.


WHY HYPOWHEEL MODEL ESSENTIAL IN THIS LESSON?
It provides a visual representation that simplifies the complexities of physical law. For instance, when studying kinetic and potential energy. The model illustrates how energy transforms from one form to another which is fundamental in understanding mechanical systems.

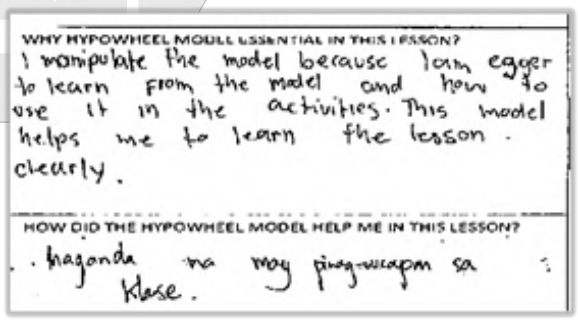
HOW DID THE HYPOWHEEL MODEL HELP ME IN THIS LESSON?
the Hypowheel model significantly aided my learning process in this lesson by enhancing my analytical skills and facilitating a deep understanding of physics.

Plate 1. *Reflection of Learner 6*

As shown in Plate 1, a Learner 6 wrote in his journal that the Hypowheel model was an aid in learning physics. It enhanced his analytic skills and understanding of the topic.

Further, it provided him with a visual representation of abstract concepts and simplified a complex physical law of the transformation of energy.

As shown in Plate 2, another student who manipulated the model showed excitement to use it because it was new for him. The student used the model and applied it in the suggested activities from the lesson. It was stated from his journal that it made the lessons clear and it could spark conversation about the topic upon manipulating the model.


WHY HYPOWHEEL MODEL ESSENTIAL IN THIS LESSON?
I manipulate the model because I am eager to learn from the model and how to use it in the activities. This model helps me to learn the lesson clearly.

HOW DID THE HYPOWHEEL MODEL HELP ME IN THIS LESSON?
. Maganda na may pag-uusapan sa klase.

Plate 2. *Reflection of Learner 3*

The study of Gravito and her colleagues (2023) affirmed these findings. Their research on homemade manipulative materials for teaching developed the students' cognitive skills. Through real-life manipulative materials, students can touch and concretize the concepts they want to learn because the assimilation of learning is faster. According to them, if the teacher makes innovation as part of their teaching strategy, it would be easy for them to facilitate learnings to their students, while instilling values towards conservation and recycling.

4.4. Difference between the Pre-test and Post-test Results of Experimental and Control Groups

It can be gleaned from Table 4, that the experimental group 1 had computed t-value of 9.57 for energy transformation, for work and heat was 10.20 and for the topic power was 12.80. These values were outside the boundary of the critical value of 2.215 with level of significance of 0.05 (df=14). Hence, there was a significant difference between the pre-test and post-test result from the said group.

For control group 1, the computed t-values for topic energy transformation were 4.95, 7.18 for work and heat and 4.46 for power. This further revealed that, similar to experimental group 1, significant difference was observed between the pre-test and post-test result per topic.

Table 4. *Difference between the Pre-test and Post-test Results*

Topics	**Experimental Group 1**		**Control Group 1**	
	t-computed value	Remarks	t-computed value	Remarks
Energy Transformation	9.57	Significant	4.95	Significant
Work and Heat	10.20	Significant	7.18	Significant
Power	12.80	Significant	4.46	Significant

Note: α=0.05, df=14, t-tab.= 2.215

Based on the result, the null hypothesis was rejected, and therefore, there was a significant difference between the pre-test and post-test results of the control and experimental groups. It implied that the performance of both the control and experimental groups in the post-test was improved. However, maybe using the Hypowheel model in the instruction, the experimental group improved more than the control group. It may be that the Hypowheel model helped the students from the experimental group to be motivated in performing the activities designed in the four lessons. Maybe it also helped them to retain facts and understand the abstract concepts of energy, work, and power.

Based on Plate 3, the Learner 1 said that the Hypowheel model helped him to become active and participative in the class. The learner was guided by the model on the understanding of physics concepts. Since he perceived it as a simple toy, they manipulated the parts with enthusiasm.

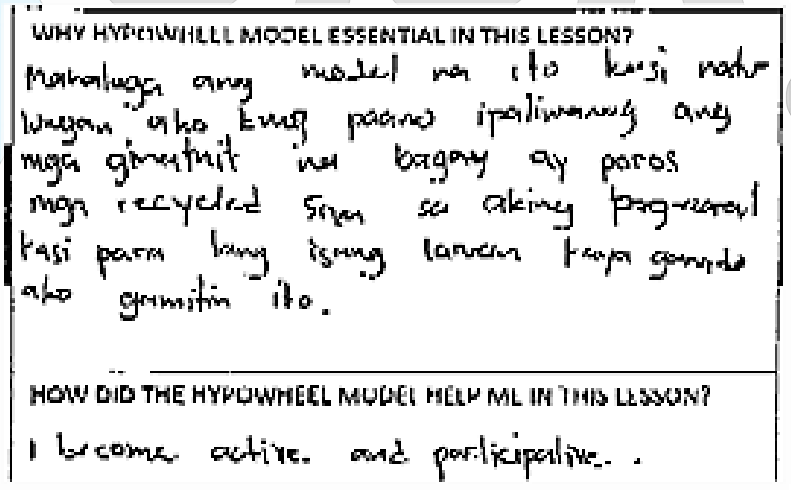


Plate 3. *Reflection of Learner 1*

Table 5. *Difference among the Performance of the Four Groups in the Post-test*

Sources of Variance	**df**	**Sum of Squares**	**Mean Squares**	**F-Values**		**Decision on H0**	**Remarks**
				Computed F	Tabular F (0.05)		
Between Groups	3	355.01	118.37	8.787	2.77	Reject H0	Significant
Within Groups	56	753.59	13.46				

Reflected from Plate 4 was the feedback of Learner 5, for him, their sessions in the lessons became fun because the model, as a toy, was a good aid for learning and games. Further, the model helped them to become cooperative, and they learned a lot by doing the activities.

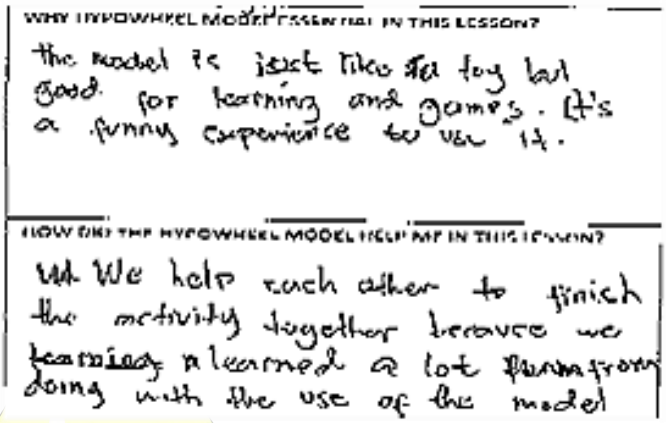


Plate 4. *Reflection of Learner 5*

Since the researcher followed the 7Es of lesson planning and used the Hypowheel model in the actual teaching-learning process for experimental groups, it is believed that these teaching strategies helped in enhancing the performance of the students in class (Villaroya, 2017). According to Destura and Ricafort (2022), improvements in the post-test performance of the students were due to a strategy that facilitated the improvement of the level of performance.

4.5. Differences among the Performance of the Four Groups in the Post-test

It can be gleaned from Table 5 that the value of computed F of 8.797 is greater than the tabular value of F of 2.77 at a 5.0% level of significance with 3 and 56 degrees of freedom. Hence, the null hypothesis was disconfirmed. It implied that the four groups had varied performances in the post-test.

Further, to check where this difference lies among the four groups, the Scheffe's test results confirmed these findings. Table 6 showed the F'-values of the groups' post-test performance where significant differences existed.

As reflected from the Table 6, there was a significant difference in post-test results between experimental group 1 and control group 2 with a computed F-value of 22.83, and between experimental group 2 and control group 2 with a computed F-value of 25.25. Furthermore, the values computed from Cohen's d of 1.79 and 1.84 revealed that the effect of the treatment on the experimental groups was very large, respectively. It implied that the result may be due to the use of the Hypowheel model.

Table 6. *Comparison of the F-values of the Four Groups Post-test Performance*

Comparison Between Groups	F'-Value	Statistical Analyses	Cohen's d	Interpretation
EG 1 vs EG 2	0.0607	Not Significant	-	-
EG 1 vs CG 1	3.7679	Not Significant	-	-
EG 1 vs CG 2	22.83	Significant	1.79	Very Large
EG 2 vs CG 1	4.79	Not Significant	-	-
EG 2 vs CG 2	25.25	Significant	1.84	Very Large
CG 1 vs CG 2	8.0486	Not Significant	-	-

As shown in Plate 5, the student found happiness in doing the activity using the Hypowheel model. The student further stated that a lot of things can be learned thoroughly if someone uses the apparatus in doing experiments. Therefore, Hypowheel model was essential for learning and an eco-friendly material according to Learner 2.

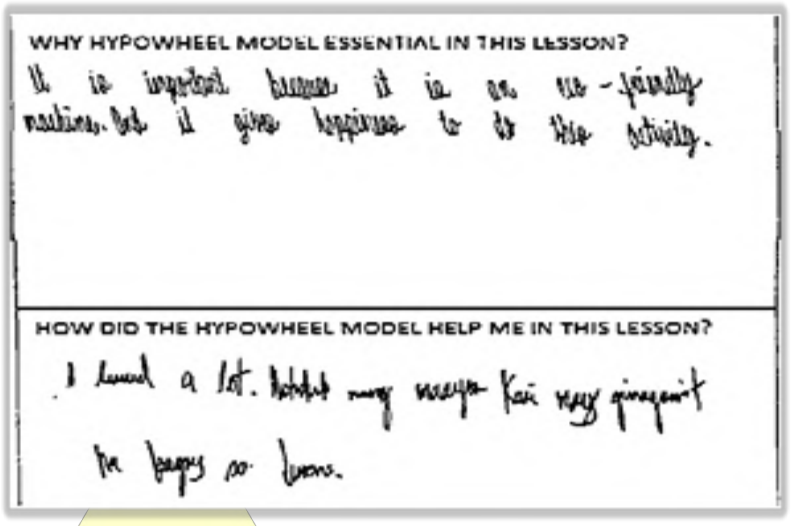


Plate 5. *Reflection of Learner 2*

Right (2018) declared that the use of instructional materials can significantly increase students' achievement by supporting student learning. In addition, Lukman (2021) agreed that it makes learning more interesting, practical, and realistic that can improve students' performance.

Further, the post-test results of control group 1 versus experimental group 1; control group 1 versus experimental group 2; and experimental group 1 versus experimental group 2 revealed no significant difference. It disclosed that the teaching strategies used in these groups equally enhanced the performance of the students, especially those with treatment of the Hypowheel model. It was also observed that there was no significant difference between control groups 1 and 2, which suggests that their performance in the post-test was relatively similar. Agarwal and Bain (2019) concluded that strategies based on science learning can increase students' confidence and engagement.

As shown in Plate 6, the student said that he joined the group in using the Hypowheel model in the experiment enthusiastically. He needs to learn more and explore everything with the use of that model. Since it was a recycled material, innovation may be possible for improvement by the student.

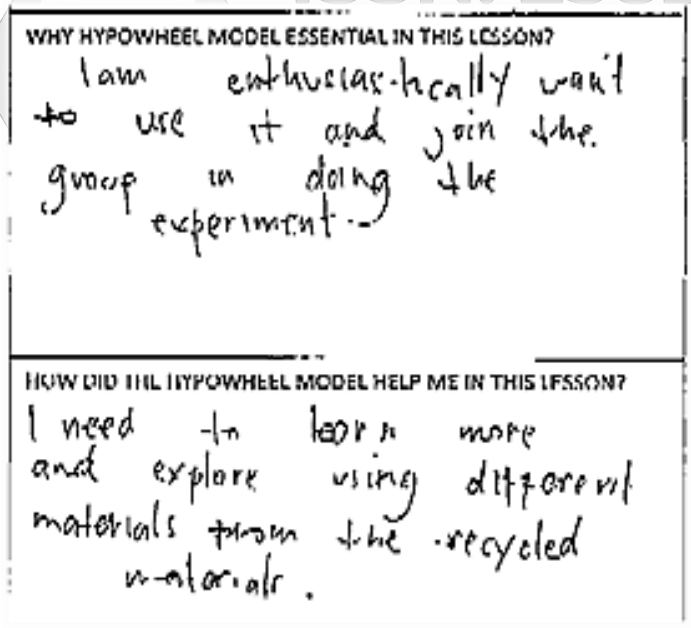


Plate 6. *Reflection of Learner 4*

V. SUMMARY OF FINDINGS, CONCLUSION, AND RECOMMENDATIONS

Findings

- The performance level in the pre-test of the control and experimental groups was the same. On the topic about energy transformation the experimental group got 24.44% while the control group got 30.37%; on the topic about work and heat, the experimental group got 25.00% while the control group got 29.44%; and, on the topic about power, the experimental group got 23.70% while the control group got 24.44% performance level. All of the ratings obtained from the identified topics were described as at a low mastery level.
- There was no significant difference between the pre-test results of the control group and experimental group. It revealed that the computed t-value for the independent sample was 0.91 with a p-value of 0.36 for the topic energy transformation, 0.48 with a p-value of 0.63 for the topic work and heat and 0.31 with a p-value of 0.76 for the topic power.
- The performance level in the post-test along the topic energy transformation of experimental group 1 was 71.85%, experimental group 2 was 73.33%, control group 1 was 58.52%, and control group 2 was 51.11%. It can be inferred that the performance level of experimental groups 1 and 2 was both described as moving towards mastery, while control groups 1 and 2 were at an average level of mastery of the said topic. Along the topic work and heat were as follows, experimental group 1 was 77.78%, experimental group 2 was 79.44%, control group 1 was 70.00%, and control group 2 was 58.33%. It implied that the performance level of experimental groups 1, 2 and control group 1 were described as moving towards mastery while control group 2 was labeled as average. And, along the topic power by experimental groups 1 and 2 got both 78.52%, control group 1 got 71.85%, and control group 2 got 54.07%. It indicated that the performance level of experimental groups 1, 2 and control group 1 were described as moving towards mastery while control group 2 was at average level.
- There was a significant difference between the pre-test and post-test results of the control and experimental groups. For control group 1, the computed t-value for the topic energy transformation was 4.95, for topic work and heat was 7.18, and for the topic power was 4.46. For experimental group 1, the computed t-value for the topic energy transformation was 9.57, for the topic work and heat was 10.20, and for the topic power was 12.80. These values for both groups were beyond the critical t-value. It implied that the performances of both control and experimental groups in the post-test per topic were improved.
- The value of computed F of 8.797 is greater than the value of tabular F of 2.77 at a 0.05 level of significance with 3 and 56 degrees of freedom. Thus, the null hypothesis was disconfirmed in favor of the research hypothesis. It implied that the four groups had varied performances in the post-test. Specifically, there was a significant difference in post-test results between experimental group 1 and control group 2, with a computed F of 22.83, and between experimental group 2 and control group 2, with a computed F of 25.25. Further, Cohen's d values of 1.79 between experimental group 1 and control group 2 and 1.84 between experimental group 2 and control group 2 revealed that the effect of treatment was very large in favor of the experimental groups.

Conclusion

- The level of performance in the pre-test of the control group and experimental group is the same. Both groups had equal prior knowledge and skills in the subject matter before the researcher conducted the treatment.
- There is no significant difference between the pre-test results of the control group and experimental group.
- The experimental groups performed better than the control groups in the post-test and showed higher performance along the topic energy transformation, work and heat, and power.
- There is a significant difference between the pre-test and post-test results of the control and experimental groups.
- The two experimental groups who were treated with the use of the Hypowheel model equally performed in the post-test, but performed differently from the control groups.

Recommendations

- Teachers may develop instructional materials that suit the needs of the students attending science lessons in energy transformation, work and heat, and power, and those instructional materials should fit in enhancing students' level of competency about the said lesson.

- Teachers may keep abreast of the continuous innovations of instructional materials and updates on teaching-learning strategies that can arouse students' interest to learn science concepts. They may foster a motivating environment inside the classroom.
- The Hydropowered Wheel Model (Hypowheel) may be used in the instructions, specifically in lessons like energy transformation, work and heat, and power to achieve better performance. Furthermore, the teacher may be creative in crafting activities with the use of Hypowheel on either a demonstration or experimental approach.
- School administrators may encourage teachers to attend seminars and training focusing on time-tested strategies, instructional innovations, and waste recycling programs to enhance their creativity and resourcefulness in creating instructional materials.
- Students may involve themselves in innovating, recycling, and exploring by conducting investigatory projects. They may upgrade the usability of the Hypowheel model and sustain its usefulness.
- Further studies may be conducted to supplement the findings of the study.

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