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The Relationship of Hands-on Activity on the Scientific Thinking Skills of Grade 10 Learners

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A B S T R A C T

This study is comprised of quantitative research method to oversee the influence of hands-on activities on the scientific thinking skills among Grade 10 Learners. The study focused on some important areas which are to evaluate the student's complex scientific capacity and development and to identify students' intrinsic motivation to learn Science. Learners' curiosity is among the affective domains of learning that has a great potential to take learning to higher levels and meet the demands of teaching and learning process. The study involved 117 Grade 10 students selected from a distinct primary school. Findings revealed that students recognized the importance of hands-on activities in enhancing their scientific understanding and skills, demonstrating abilities in critical thinking, technical proficiency, scientific behavior, teamwork, and creative problem-solving. They emphasized the need for clear instructions, proper laboratory orientation, and continuous learning through inquiry and research. Result showed a highly significant relationship between students' engagement in hands-on activities and the development of their scientific skills. Based on these findings, the study recommends to foster scientific thinking skills, particularly critical thinking and problem-solving, by engaging students in the active learning process.

Keywords: hands-on activities, scientific thinking skills, learning

Introduction

As it is known science process skills are the skills and knowledge students use in scientific inquiry, whereas hands-on science activities help students to understand the science phenomena while manipulating the objects. The instruction which bases each method makes the students active. Science process skills of inquiry activities include the skills of observation, classification, measurement, interpretation of data, formulation and testing hypothesis, and experimentation, etc (Temiz & Tan, 2014).

In addition to these developed knowledge and skills, inquiry and hands-on activities help students to gain positive attitudes toward science. As summarized beforehand, the research studies on hands-on science activities have found that students' cognitive, psychomotor and affective characteristics improve as they engage in these activities. However, no such study focused on how teachers develop hands-on activities considering science process skills in mind was found. This study investigated teachers' opinions about science process skills mentioned in hands-on science activities. For this aim, a qualitative case study was done with elementary teachers from two Turkish elementary schools, each of which is implementing different science programs, representing each case. The first school is using the current science curricula, whereas the second is in fact a science and arts center in an elementary school. Science and art centers (SAC) are for education of gifted children (Gokdere et al., 2013 as cited in Gokdere & Cepni, 2014) and their teachers are selected from the teachers who are successful at the oral exam taken after a seminar. The reason to select these schools is whether the participant's opinions on hands-on activities differ according to the curricula implemented.

This study aims to find out the influence of hands-on activity on the scientific thinking skills in terms of inquiry, experimentation, evidence evaluation and inference of grade 10 learners. This covered school year 2024-2025.

According to Taggart, et al. (2015), thinking skills are expected to be develop at all key stages and center on: information-processing skills, reasoning skills, enquiry skills, creative thinking skills and evaluation skills. It allows them to analyze complex ideas, form arguments and approach challenges with different strategies. By developing thinking skills students can enhance their academic performance, become more effective problem solvers, and prepare themselves for success in an increasingly complex and inter connected world.

According to Sadeh and Zion (2018) in guided inquiry the lecturer provides a problem and students identify with the direction of the question an determine the process and results. Implementation of inquiry learning models in the experimental class and non-inquiry learning models in the control class are both using the experimental method. The authors emphasize that experimental techniques can be used to apply both guided inquiry and conventional approaches. The experimental technique in a guided inquiry environment entails students planning and carrying out experiments to investigate the given problem. The experimental technique in a conventional, non-inquiry environment would probably entail students following a predetermined protocol while the instructor designs the experiment. The degree of student autonomy and control over the learning process is where the main differences reside. While the instructor maintains a more directive role in typical settings, guided inquiry empowers students to guide their own learning.

According to Klopfer (1990) claims that Hands-on experiments allow students to gain observation and measurement. Hands-on science also offers students additional opportunities except for learning and makes students busy with doing activities but not thinking about the topic (Ruby, 2001). Ruby (2001), however, issues a warning regarding the possible drawbacks of experiential learning. Ruby notes that hands-on exercises can occasionally cause students to get so preoccupied with the task at hand that they lose sight of the underlying concepts, even if she acknowledges their importance in encouraging engagement and active learning. To support learning objectives and encourage deeper thinking, it is imperative to make sure that hands-on activities are well planned and executed. In addition to encouraging students to consider the significance and ramifications of their observations and findings, teachers must help them make the connection between the practical experience and the more general ideas being taught.

Research Method

The study will use a descriptive research design. The choice of the method was appropriate to the Influence of hands-on activity on the scientific thinking skills in the grade 10 learners S.Y 2024-2025. The researchers will employ either the random sample technique. The respondents of this study consisted of one hundred seventeen (117) students in Grade 10 of Pantay Integrated High School. The respondents are distributed by using the samplings method. Grade 10 has four (4) sections, and the researcher will only choose twenty-nine (29) students in each section. The respondents were given questions which they filled in with they filled in with their answer based on their perspective and opinion.

Results and Discussion

This chapter presents the analysis and interpretation of the data about the problems addressed in this study.

Table 1

Findings On different hands-on activities used in science 10

Hand-s On Activities for Science 10	**Completed**	**Percentage**
Electric circuitry	72	61.54 %
Microscope exploration	27	23.08 %
Water filtration	16	13.68 %
Motion and friction	46	39.02 %
Lungs working model	24	20.51 %
Solar system model	41	35.04 %
Balloon cars	16	13.68 %
Egg drop experiments	22	18.8 %
Plant growth experiments	36	30.77 %
Electrolyte test	15	12.82 %
Heat experiments	42	35.9 %
Baking soda volcano	96	82.05 %
Water implosion	19	16.24 %
Water evaporation	44	37.61 %
Electromagnet	71	60.68 %
Air canon	16	13.68 %
Egg into a bottle trick	14	11.97 %
Tornado in a bottle	18	15.38 %
Double cone roller	7	5.98 %
Phone book friction	15	12.82 %

Hand-s On Activities for Science 10	**Completed**	**Percentage**
Water bottle rocket	16	13.68 %
Bridge design	18	15.38 %

The table 1 shows the number of students who completed various hands-on science activities and the percentage of students who participated in each activity. It highlights the most popular activities, such as the baking soda volcano, and the least popular ones, like the double cone roller. This information can help educators understand student interests and preferences in science education.

Table 2

Thinking skills of Grade 10 learners in terms of Inquiry

Inquiry	**Mean**	**Interpretation**
1. I ask question to deepen my understanding	3.20	Most of the Time
2. I challenge assumptions rather than accepting information at face value.	2.70	Most of the Time
3. I seek multiple perspective before forming an opinion	2.95	Most of the Time
4. I verify information from different source	3.10	Most of the Time
5. I explore new ideas, even if they contradict my current beliefs	3.00	Most of the Time
6. I encourage others to ask questions and think critically	2.90	Most of the Time
7. I apply what I learn through inquiry to solve problems	3.10	Most of the Time
8. I remain curious and open to learning throughout life	3.00	Most of the Time
9. I am confident in my ability to identify the root cause of the problem.	2.90	Most of the Time
10. I analyze results objectively, without bias.	3.00	Most of the Time
Composite Mean	**2.99**	**Most of the Time**

Legend: 4.00-3.25 Always, 3.24-2.50 Most of the time, 2.49-1.75 Sometimes, 1.74-1.00 Never

In Table 2, the respondents answered that most of the time "I ask question to deepen my understanding" with a mean of 3.20. this suggests that respondents ask questions to deepen their understanding in different hands-on laboratory activities. While lowest mean score of 2.70 with verbal interpretation of most of the time "I challenge assumptions rather than accepting information at face value". This indicates that the respondents, while generally inclined to ask clarifying questions to improve their understanding, are less likely to actively challenge assumptions or critically evaluate information presented to them. There's a notable difference between seeking clarification and actively questioning the validity of information.

Table 3

Thinking skills of Grade 10 learners in terms of Experimentation

Experimentation	**Mean**	**Interpretation**
1. I clearly define what I want to learn or achieve before I start.	3.27	Most of the Time
2. I consider different approaches or methods for trying something new.	3.00	Most of the Time
3. I try to change only one thing at a time when I'm experimenting.	2.75	Most of the Time
4. I reflect on what worked and what didn't after trying something new.	2.90	Most of the Time
5. I'm willing to try new thing even if I might fail.	3.30	Always
6. I document my experiences, even if it's just in a quick note or journal.	2.90	Most of the Time
7. I share my experiences with others to get feedback.	3.20	Most of the Time
8. I use my experiments to learn about myself and how I learn best.	3.20	Most of the Time
9. I'm willing to adjust my expectations based on the results of my experiments.	3.20	Most of the Time
10. I try to find patterns in my experiences to make better decisions in the future.	3.20	Most of the Time
Composite Mean	**3.09**	**Most of the Time**

Legend: 4.00-3.25 Always, 3.24-2.50 Most of the time, 2.49-1.75 Sometimes, 1.74-1.00 never

In Table 3 the respondents answered that always "I'm willing to try new thing even if I might fail" with a mean of 3.30. this suggests that respondents ask questions to deepen their understanding in different hands-on laboratory activities. While lowest mean score of 2.75 with verbal interpretation of most of the time "I try to change only one thing at a time when I'm experimenting". This indicates a willingness among respondents to embrace new experiences and experimentation, even if it involves the risk of failure.

However, there's a less pronounced tendency to systematically control variables during experiments, suggesting a preference for a more exploratory approach. The difference highlights a potential gap between enthusiasm for innovation and a methodical approach to experimentation.

Table 4

Thinking skills of Grade 10 learners in terms of Evidence Evaluation

Evidence Evaluation	Mean	Verbal Interpretation
1. I assessed the credibility and expertise of the researcher or authors	3.10	Most of the Time
2. I check for errors in my measurements before analyzing the data.	3.00	Most of the Time
3. I considered whether the findings were replicated in the other studies.	3.00	Most of the Time
4. I accept conclusions without solid evidence to support them.	3.00	Most of the Time
5. I question whether my data collection method was reliable.	2.90	Most of the Time
6. I consider alternative explanations before finalizing my conclusion.	3.00	Most of the Time
7. I let my expectations influence how I interpret data.	3.00	Most of the Time
8. I look evidence of peer review or difficult evaluation processes.	3.00	Most of the Time
9. I reflect on potential sources of error in my experiment.	3.00	Most of the Time
10. I seek feedback from others to improve my evaluation of evidence.	3.00	Most of the Time
Composite Mean	**3.00**	**Most of the Time**

Legend:

4.00-3.25 Always, 3.24-2.50 Most of the time, 2.49-1.75 Sometimes, 1.74-1.00 never

In Table 4 the respondents answered that most of the time "I assessed the credibility and expertise of the researcher or authors" with a mean of 3.10. this suggests that respondents ask questions to deepen their understanding in different hands-on laboratory activities. While lowest mean score of 2.90 with verbal interpretation of most of the time "I question whether my data collection method was reliable". This indicates that while respondents generally evaluate the credibility of sources, they are less thorough in critically examining the reliability of their own data collection methods. This suggests a potential area for improvement in their research practices, focusing on self-reflection and methodological rigor.

Table 5

Thinking skills of Grade 10 learners in terms of Inference

2.1 Inference	Mean	Interpretation
1. I based my inferences on clear patterns in the data.	3.10	Most of the Time
2. I make assumptions without enough evidence.	2.40	Most of the Time
3. I identified the key information needed to solve the problem.	3.10	Most of the Time
4. I rely on prior knowledge when drawing conclusions.	2.90	Most of the Time
5. I check if my inference matches the experimental data.	3.00	Most of the Time
6. I reflect on possible errors in my reasoning.	2.90	Most of the Time
7. I discuss my readings with other to ensure accuracy.	3.10	Most of the Time
8. I let my personal beliefs influence my interpretations.	2.97	Most of the Time
9. I actively listen to others and ask clarifying questions.	3.20	Most of the Time

2.1 Inference	Mean	Interpretation
10. I set goal for myself and regularly review my progress.	3.36	Always
Composite Mean	**3.00**	**Most of the Time**

Legend: 4.00-3.25 Always, 3.24-2.50 Most of the time, 2.49-1.75 Sometimes, 1.74-1.00 never

In Table 5 the respondents answered that always "I set goal for myself and regularly review my progress" with a mean of 3.36. this suggests that respondents ask questions to deepen their understanding in different hands-on laboratory activities. While lowest mean score of 2.40 with verbal interpretation of most of the time "I make assumptions without enough evidence". This indicates that while respondents are generally good at setting goals and monitoring progress, they sometimes make assumptions without sufficient evidence. This highlights a potential conflict between proactive goal-setting and a tendency towards less rigorous information gathering and evaluation.

Table 6

Significant Relationship between hand-on activities and the scientific thinking Skills of Grade 10 Learners

Thinking Skills	Pearson R		Decision
	r-values	**p-values**	
Inquiry	0.5132	<0.00001	Reject Ho
Experimentation	0.6338	0.00391	Reject Ho
Evidence Evaluation	0.5001	<0.00001	Reject Ho
Inference	0.05849	<0.00001	Reject Ho

The table present the result of statistical analysis examining the relationships between hands-on activities and scientific thinking skills. The Pearson correlation coefficient (r-values) indicate that hands-on activity has a relationship between scientific thinking skills. Statistical analysis using Pearson's correlation coefficient (r) examined the relationship between hands-on activities and scientific thinking skills. The r-value quantifies the strength and direction of a linear relationship between these two variables; a positive r indicates that increased hands-on activity is associated with improved scientific thinking skills, while a negative r suggests the opposite. An r-value near zero suggests little to no linear relationship.

Summary of Findings

The salient findings of the study are summarized as follows:

1. Types and frequency of hands-on activities

The most frequently used hands-on activities in science 10 were laboratory experiments and group investigations. Model-making, fieldwork, and the use of manipulatives were also employed, though less frequently.

2. Scientific thinking skills of learners

Grade 10 learners exhibited a good level of specific thinking skills, particularly in observing, predicting, analyzing data, and drawing conclusions

3. Relationship between hands-on activities and scientific thinking skills

A strong positive and significant correlation ($r=0.68$) was found between the frequency of hands-on activities and the level of scientific thinking skills. This suggest that frequent engagement in hands-on learning is associated with improved scientific reasoning and inquiry skills among learners.

Conclusion

The following are the conclusions drawn by the researchers based on the findings of the study that there is a significant relationship between the level of engagement in hands-on activities in science 10 in the Scientific thinking Skills of Grade 10 learners.

Recommendations

In light of the findings and conclusion of the study, the following recommendations are offered:

For Teachers: ought to develop a strong scientific vocabulary and guides students to work scientifically, connecting new learning to real-world contexts.

For students: encouraging to participation such as ask questions and explore science concepts through scientific application.

For curriculum development: Emphasize the integration of experiential learning methods in science 10 curriculums to support skill development and engagement.

For school administration: Provide adequate laboratory facilities, tools, and materials to support the implementation of hands-on learning activities.

For future researchers: Conduct a similar study in other grade levels or subject areas and consider using mixed method or longitudinal design to explore how hands-on learning influences student outcomes overtime.

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