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Enhancing the Pupils' Discovery Approach in Teaching Water Cycle to the Grade 3 Pupils: A Lesson Study Based Approach

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Abstract

This collaborative study was designed to enhance the discovery skills of Grade 3 pupils. There were 38 participants and data were collected from recorded virtual brainstorming sessions, observation notes, and Online Classroom Actual Implementation of Lesson design conducted in two cycles. It has 2 cycles with the second cycle having an improved version of the lesson plan. Results showed that there were more pupils who generated answers based on the discovery approach in the 2nd cycle of lesson implementation using the refined version of the lesson plan. Furthermore, results of the formative test during the second cycle indicates the benefit of lesson study in enhancing the discovery skills of the pupils leading to mastery of the lesson concept. The teachers' inquiry-based instruction was a factor considered to improve the pupils' discovery skills. Hence, through lesson study, the factors were identified to help improve the pupils' discovery skills.

Keywords: discovery skills, inquiry-based instruction, collaborative study

Introduction

Science teaching has evolved remarkably all throughout the years. The traditional way of delivering instruction is no longer applicable to the demands of 21st century learning wherein process skills is practiced and required among students.

With this, the discovery learning is an inquiry-based approach is one that enhances pupils' learning through active and hands-on learning experiences. With this approach, pupils actively participate in their own learning instead of passively receiving knowledge. To effectively use the discovery learning approach in a classroom, a teacher needs to not only be flexible but also well-prepared and organized (Inventionland Institute, 2018).

Lesson study is an approach where educators review and reflect their teaching methods applying inquiry-based teaching in their lessons which involve a cycle process of collaborative lesson planning, lesson observation, and examination of student learning (Anfara, Caskey and Lenski, 2009 p. 50). Lesson study involves groups of teachers meeting regularly over a period of time (ranging from several months to a year) to work on the design, implementation, testing, and improvement of one or several "research lessons" (Stigler & Hiebert,1999).

Hence, this study aimed to conduct a lesson study on science teaching wherein competence in science teaching will be honed using inquiry-based approach among these teachers for discover learning. This will then help students to learn and understand the concepts in a meaningful manner wherein they could easily remember and understand. Moreover, this will serve as a precursor for teachers to do self-improvement and apply lesson study in their respective schools while incorporating inquiry-based learning.

This study is anchored on the constructivist-learning theory which emphasizes six assumptions of constructivism. (Boethel and Dimock, 2000) First, learning is an adaptive activity. Second, learning is situated in a context where it occurs. Third, knowledge is constructed by the learner. Fourth, experience and prior understanding play a role in learning. Fifth, there is resistance to change. Lastly, social interaction plays a role in learning. Examples of constructivist learning are found in experiential learning, self-directed learning, and reflective practice. These learning strategies explicitly show that the focus is squarely on the learner's construction of knowledge within a social context.

Wales' Guided Discovery is a constructivist instructional design model that combines principles from discovery learning with principles from cognitivist instructional design theory and is characterized by convergent thinking. This Guided discovery approach was developed by Dr. Charles E. Wales at the Center for Guided Design, West Virginia University (Leutner, 1993).

In this approach, the instructor devises a series of statements or questions that guide the learner, step by logical step, making a series of discoveries that leads to a single predetermined goal. In other words, the instructor initiates a stimulus and the learner reacts by engaging in active inquiry thereby discovering the appropriate response. (Mosston, 1972) He specified ten cognitive operations that might take place as the learner engages in active inquiry: recognizing, analyzing, synthesizing, comparing and contrasting, drawing conclusions, hypothesizing memorizing, inquiring, inventing, and discovering.

According to Spencer (1999), there are key features of guided discovery learning. First, there is a context and frame for student learning through the provision of learning outcomes. Second, learners have responsibility for the exploration of content necessary for understanding through self-directed learning. Third, study guides are used to facilitate and guide self-directed learning. Lastly, understanding is reinforced through application in problem-oriented, task-based, and work-related experiences.

Therefore, in order to have a carefully planned Science instruction where discover learning is being implemented, teachers should learn to interact and to communicate their experiences, to create understanding and evaluate it to explain this understanding to others. As teachers go through the lesson study process, there are multiple opportunities for them to reflect, analyze, create action steps, evaluate, and share knowledge with other teachers. These principles of social constructivism help in the development of inquiry skills of Science teachers through lesson study.

This collaborative study is designed to enhance the discovery skills among the Grade 3 Pupils through Lesson study and to nvestigate through Lesson study, what factors need attention to help improve the pupils' discovery skills in learning about a simple Science topic.

Method

This study is a collaborative action research through lesson study approach to enhance the pupils' discovery learning through inquiry-based teaching. The respondents of this study were 38 Grade 3 pupils of a private school. A purposive sampling method was used to select the participants. Brainstorming through Google meet and Microsoft Teams were used as a platform during the collaborative lesson planning, Lesson Implementation, Post Conferencing Discussion, Sharing of Reflections, and Re-teaching of the lesson.

The first lesson implementation was conducted through online class via Microsoft Teams and the Improved Lesson Implementation was done the next day using the same platform. Online Learning was used in the delivery of instruction as a part of the Learning Continuity Plan of the private school. Data sources used in this study were observation notes, teacher reflection journals, and video recordings of the brainstorming sessions and actual lesson implementation to describe the inquiry based instruction and how this improves the discover learning skills of the pupils. The research lesson was about the Water Cycle.

The following process was carried during the course of this study.

STEP 1 Collaborative Lesson Planning. Through Instant Messaging, the research team convenes virtually in a collaborative platform by deciding on the topics and learning goals to be employed in this study. The Team members shared their ideas on how to design the lesson based on their past observations, present pupils and teacher's lesson guide and competencies.

STEP 2 Pre Implementation. A recorded brainstorming activity was conducted by the research team that took 3 to 4 hours via Google Meet. Lesson Plan was created based on the 5E Instructional Model. Each member was assigned to a 5E lesson part where they are tasked to develop based on the agreed topic and specific goal skills. Each member then presented its lesson concept and was carefully discussed, analyzed, and assessed for improvement. This session ended with a Lesson Plan that described the lesson design in a contextualized manner.

STEP 3 Implementation Proper. The actual lesson was implemented by the teacher presenter through a virtual classroom and the rest of the research team members served as lesson observers. The lesson was designed according to the 5E learning model where the discovery approach was used to introduce the topic and engage the pupils. Significant observations were noted in the teacher's journal. The Observation notes were focused on variables reflecting the use of lesson study in enhancing the discovery learning skills of the Grade 3 pupils.

STEP 4 Post Implementation. A virtual post-conference was conducted discussing the feedback of the lesson study. The research team members were given the opportunity to share their insights and relevant observations regarding the lesson implementation. Different suggestions were cited to improve lesson design. The Discussion covered the two aspects of inquiry-based teaching skills – thinking and questioning skills.

STEP 5 Revision of the Lesson. A recorded brainstorming session was again conducted to revise the lesson for re-implementation. An updated version of the Lesson plan was carried in this step enhancing the lesson design and focusing on the acquisition of lesson objective as a result of sharing.

STEP 6 Reteaching the New Lesson Version. The 2nd lesson implementation was carried in this step. Research team members served as lesson observers. This implementation served as the culmination point of the lesson study.

STEP 7 Sharing Reflections about the New Version of the Lesson. A google meet session was conducted to this effect where the research team shared reflections and reactions on the newly implemented version of the lesson. The discussion focused on the new lesson design and how much of the goal skill has been attained by the pupils through the different activities conducted that culminates in an online assessment test. The research team participated well in the brainstorming sessions. Good points observed were taken into detailed minutes to have a record of the good ideas that were generated during the lesson study for future references.

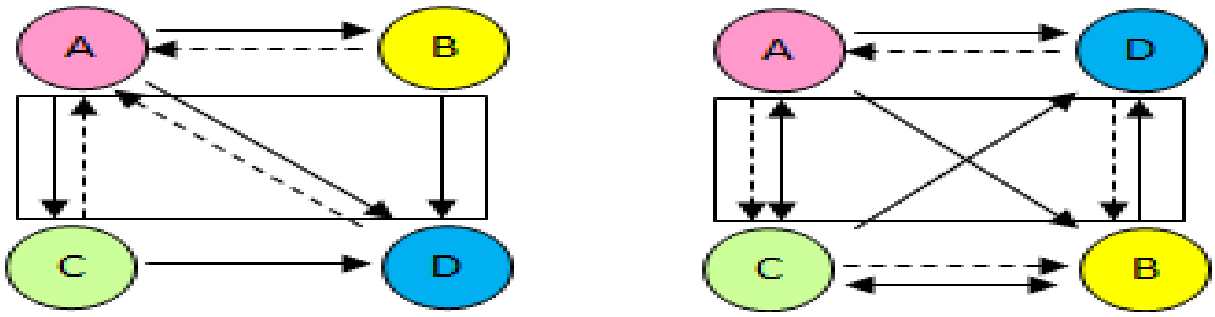
Results and Discussion

Through lesson study, the discovery skills of the Grade 3 Pupils were . The lesson study technique was used as an intervention to guide the pupils in developing their discovery skills about the topic on the water cycle. Observation notes were collected and proceedings of the recorded implementation including the results of assessments were presented, analyzed and interpreted in this part of the paper.

The results were presented based on the following specific objectives (1) To Enhance the discovery skills of the Grade 3 Pupils of Xavier University in terms of their thinking and questioning skills. (2) To Describe the impacts of Lesson study to the discovery skills of the Grade 3 pupils of XUGS in learning about the Water Cycle Lesson.

Enhancing the Learner's Discovery Skills

X **Y**



Legend : Ask Question - - - - Answer and Gives Explanation thru discovery

Figure 1. Class Interaction Flow During Lesson Implementation

Figure 1 indicates the class interaction flow during the first (X) and second(Y) cycle of Lesson implementation. These implementations were conducted using different respondents marked as X (Section A) and marked as Y (Section B).

First Cycle Lesson Implementation

During the 1st cycle of implementation (X), Teacher A started the lesson with a review by presenting a Key question. Pupils have contradicting answers but Pupil A was able to draw a concept on the water cycle. During picture analysis, by showing relevant pictures about the melting of ice (image file) and drying of lakes(GIF). Student B, D, and C were able to answer the teacher's probing questions. However, it was noted that it took time for the pupils to discover the concept because the learning material used specifically in the GIF was not clear enough to encourage the easy discovery of the concept. In the 2nd part of the lesson, A music video about Water Cycle was shown to the pupils. The guide questions were asked and learners' solicited answer was based on the video. It was then observed that the music video failed to encourage learning discovery skills since the main concept of the lesson was already featured in the video. One important observation is that the video spoon-feeds the concept and it does not fit to be given at the start of the lesson as it will spoil the concept of discovery approach. Further, the activity advances to the exploration stage where The Cotton Ball Activity was the highlight. It aimed to allow the pupils to discover concepts about the processes in the water cycle through simple manipulation using the following materials: cotton balls, a medicine dropper, a glass of water, and a saucer or small basin. This activity is guided by a demonstration video. Prediction questions were raised before the start of the activity. The pupils were eager to perform the activity but it was noted significantly that while they were having fun, there are a few who played with the materials after performing the activity and were distracted, ending up disengaged in the class. In the *Explain* part, teacher A conducted a short discussion about the activity by asking relevant questions. It was observed that Teacher A missed collating the findings of the activity as to how many drops it takes to make the cotton ball cloud rain, but instead proceeded immediately to relate the activity to the concept processes by asking which part of the activity illustrates the different water cycle processes. The pupils were given the opportunity to share their findings. It was observed in this part that students B, C, and D took time in answering the guiding question, however, they were able to explain and answer the questions partly well. During the *Elaborate stage,* Teacher A proceeded to reinforce the concept by showing a water cycle diagram. She then connects the processes to situations in real-life situations like drying up of clothes as a process of evaporation. A new concept on transpiration was introduced in this part. Subsequently, pupils were asked to draw or illustrate any processes in the Water Cycle that they observed in the surroundings. Afterward, some of the pupils presented their outputs. Reflection questions were given and a fruitful discussion took place. The class was concluded with an online 10- item objective type formative test.

Second Cycle Lesson Implementation (Reteaching the New Version)

The 2nd cycle of lesson implementation and its Class Interaction flow was shown in Figure 1 labeled (Y). The revised lesson version was conducted a day after to Grade 3 Lucas of XUGS via Microsoft Teams Virtual Classroom. It is indicated in figure 1 labeled Y that there are more answers and explanations thru discovery approach was generated by the pupils. The lesson started with a review of prior knowledge about the percentage of water composition on Earth. It was observed that pupils have contradicting answers to the key question whether the amount of water on earth increases or decreases. To reinforce their discovery skills, the engage part used an image file of Melting Glacier and Drying Lake instead of GIF used in the first implementation to emphasize clearly the concept of a drying lake. The pupils were very eager to answer and the concept about the water composition staying the same was drawn easily because of the appropriate learning resource and a very good questioning technique used by the Teacher. The lesson then proceeded to the Explore part where the Cotton Ball activity was the highlight. The Music video about the water cycle which was originally presented in the engage part during the first cycle implementation was moved to a later part of the lesson. The demonstration video on the Cotton Ball activity was still presented in this part to guide the pupils in performing the activity. Prediction questions were still asked at the start and the lesson. A significant observation during this part is that the pupils performed the activity well and responded promptly to the teacher's questions. After the activity, the pupils were instructed to keep the materials aside. This helped the class focused on the guided questions and the drawn answer from the pupils were evident of enhanced discovery skills. The results of their predictions and actual answers were also collated. The pupils' attention was observed to be intense as they look exceedingly satisfied with new concepts that they have discovered during the activity. Moreover, the explain part gave the pupils an opportunity to share their findings. Using their own words, they were able to explain well the concept of the water Cycle processes. The music video about the water cycle was then shown for reinforcement and correction of misconceptions. It was observed that this learning resource was very effective for reinforcement of the lesson rather than as a motivation. The *Elaborate* segment proceeded without changes from the original version. The material for assessment had also undergone few revisions as there are confusing questions and unspecified choices.

In summary, Figure 1 indicates that there are more answers and explanations generated from the pupils through the discovery approach in the revised version of the lesson labeled Y as compared to the first cycle of lesson implementation labeled as X.

Table 1. Lesson Design Detailed Implementation Revision

Lesson Design	1st Cycle Implementation	2nd Cycle Implementation
• ***Engage***	1. Show a globe to the class. 2. Ask the pupils the following questions: a. How much of the earth is covered with water? b. Does the amount of water on earth increase or decrease? or does it stay the same? c. Why do you say so? d. How does nature provide a constant supply of freshwater on earth? (Lead them to answer Water Cycle) 3. Post this guide question: What are the three processes that are involved in the water cycle? 4. Show a music video about the water cycle. 5. Solicit answers from the guide question presented.	1. Show a globe to the class. Ask the pupils the following question: a. How much of the earth is covered with water? Show relevant pictures about the melting of ice and drying of lakes. a. What do you see in the pictures? Would you like to describe the pictures? b. Does the amount of water on earth increase or decrease? or does it stay the same? c. Why do you say so? d. How does nature provide a constant supply of freshwater on earth? (Lead them to answer Water Cycle)
• ***Explore***	Cotton Ball Activity:	Cotton Ball Activity:

	1. Ask the pupils to prepare the ff materials: a. Cotton ball b. Medicine dropper c. Glass of water 2. Ask the students: How many drops of water can a cotton ball hold before it spills a drop? 3. Let them watch a video demonstration about the activity and ask them to follow the procedure as instructed in the video. They have to use a medicine dropper to put a drop on the cotton ball counting each drop to see how many drops it can hold before the rain.	• Ask the pupils to prepare the ff materials: a. Cotton ball b. Medicine dropper c. Glass of water d. saucer/ a small basin • Let them watch a video demonstration about the activity and ask them to follow the procedure as instructed in the video. They have to use a medicine dropper to put a drop on the cotton ball counting each drop to see how many drops it can hold before the rain. • The pupils will make a prediction on what will happen to the cotton ball after the activity. *After the activity, instruct the pupils to set aside all the materials used.
• ***Explain***	1. The teacher will conduct a short discussion about the activity by asking relevant questions. 2. The pupils will have the opportunity to share their findings. 3. The proper definition will be given and pupils' misconceptions will be corrected. Guide Question: What processes of the water cycle are involved or illustrated in the activity? (expected answers: condensation and precipitation)	• After the activity, ask the pupils to share their findings on how many drops of water a cotton ball can hold. • Let the pupils raise their cotton balls and continue dropping water and ask the pupils: a. What situation in your surroundings is similar to this activity? (expected answer: RAIN) b. Where does the rain come from? (expected answer: from the clouds) c. What are clouds? How are they formed? (expected: through condensation) • Show a video on Water Cycle • Guide Question: What are the processes involved in the water cycle? • Let the pupils define the processes in the water cycle in their own words. • Show a diagram of the water cycle and let them identify the processes.

		• Let them synthesize the processes by telling a story about the water cycle.
Elaborate	1. The teacher will show sample pictures of the processes of the water cycle observed in the surroundings and elaborate on each to the class: a. Drying of clothes b. Sweating of plants . The pupils will draw or illustrate any processes of the water cycle that they observe in the surroundings. . Let the pupils present or show their drawings or illustration and let them explain. 1. Reflection: 2. Will the water cycle continue if there is no Sun? How does the Sun affect the water cycle? 3. Action: 4. Show a picture of the massive cutting of trees. 5. Ask the pupils: How does it affect the water cycle? How can you stop it?	6. The teacher will show sample pictures of the processes of the water cycle observed in the surroundings and elaborate on each to the class: a. Drying of wet clothes b. evaporation in plants . The pupils will draw or illustrate any processes in the water cycle that they observe in the surroundings within 2 minutes. . Let some of the pupils present or show their drawings or illustration and let them explain. • Reflection: • Will the water cycle continue if there is no Sun? How does the Sun affect the water cycle? • Action: • Show a picture of the massive cutting of trees. • Ask the pupils: How does it affect the water cycle? How can you stop it?
• ***Evaluate***	Formative Assessment: 10-item Quiz	Revised Formative Assessment: 10-item Quiz

The lesson Implementation revisions were shown in table 1. After the first cycle implementation, revisions were made from the observation notes and critical feedback. Goal skill setting was also changed from focusing on their inquiry skills into allowing pupils to discover the topic and its relevant concepts. The lesson design was based on a 5E learning model.

The following are the highlights of revision:

- More conscious observance and noting of the pupils' responses in the question: Does the amount of water increase or decrease? Or stay the same?
- Water Cycle music video presentation from *Engage* to *Explain*
- Emphasis on the setting aside of materials after the Cotton Ball Activity in *Explore*
- In *Explain,* pupils are given the opportunity to expound their interpretation with regards to the activity using their own words
- To further validate their understanding, pupils will be asked to identify the processes in the Water Cycle diagram

- To check appreciation of the lesson, pupils are asked to tell a story or journey of water in the Water Cycle based on the relevance of the topic

The Importance of Lesson Study to Enhance the Pupil's Discovery Skills

The formative assessment results shown below indicates the impact of using lesson study to enhance the discovery skills of the Grade 3 pupils of XUGS.

Table 2. Formative Assessments: 10-Item Quiz Results

Quiz Item	1st Cycle		2nd Cycle	
	No. of correct responses	%	No. of correct responses	%
1	15	83	18	95
2	13	72	17	89
3	12	67	19	100
4	15	83	16	84
5	7	39	17	89
6	12	67	16	84
7	16	89	19	100
8	9	50	17	89
9	15	83	18	95
10	14	78	18	95

Total # of Pupils	18	19
Mean of scores	7.3	9.2

Table 2 summarizes the number of pupils who got the correct responses in each item and the average scores for each lesson implementation. The 1st cycle implementation has a mean score of 7.3 during the formative assessment. This implies that the level of lesson mastery was satisfactory, yet an indicative measure that there are parts of the lesson that they find confusing and misleading. On the other hand, the 2nd cycle of implementation obtained a mean score of 9.2. This score indicates a very satisfactory mastery level of the lesson which implies that learning by discovery was well carried in the lesson design and that the revision and refinement of the lesson plan through Lesson Study has improved greatly the instructional design. Hence, Lesson study has a positive impact in enhancing the discovery skills of the pupils in the grade 3 level as indicated by the mean score which is higher by 2.1.

The findings of this study suggest that the lesson study process embodies the core features of lesson inquiry, discovery skills and professional development experiences identified by Garet, et al. (2001). Further, it has a significant positive impact in enhancing the discovery skills of pupils, increased teacher knowledge and skills and changes to instructional practice. The sustained, on-going nature of the lesson study experience, involving the processes of researching, collaborating, active learning, observation, and focused reflection and discussion, led to professional growth that these participants believe will have lasting impact on their instructional practices.

Conclusion

Based on the research data and summary of results, the pupils' discovery skills in learning Science can be enhanced through the teachers' thinking skills and effective questioning skills which are considered part of inquiry-based skills. Instructional practice and lesson designing has improved and yielded a positive results in the pupils' engagement in the lesson and as shown in the results of formative assessment during the 2nd Cycle of lesson implementation. Furthermore, it is through Lesson Study that the participating teacher-researchers recognized the opportunity to plan and design a contextualized lesson collaboratively, teach, observe, critique the instructional practice and refine the lesson design for a better attainment of the pupil's learning goals. Through lesson study, the teacher has gained a better understanding of the delivery of instruction that resulted into an improved pupil's performance especially in enhancing their discovery skills as a means to master a lesson concept.

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