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Developing the Inquiry-Based Teaching Skills among Pre-Service Teachers in Xavier University through Lesson Study

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ABSTRACT

This paper presents a collaborative action research on lesson study which aims to describe the changes in inquiry-based teaching strategies of pre-service teachers and to determine the improvements and challenges that they experienced during the lesson study. The inquiry-based teaching skills in this study focused on the questioning skills, communication skills and the presentation of the lesson. The implementation of the Inquiry-based Teaching was conducted at Macasandig Elementary School, Cagayan de Oro City. The research team was composed of student teachers, DepEd Science teachers and researchers. Data sources were (a) participant interviews, (b) field notes/observations, (c) teacher reflection journals, (d) Inquiry-Based Teacher Rubrics, and (e) audio and video recordings of the implementations of the lesson and brainstorming sessions. The lesson study cycle was implemented collaboratively from the planning of the research lesson during the pre-conferences, to the lesson implementation, followed by the post-conferences where brainstorming was done. Revisions were

integrated and the lesson was then implemented. The results of the lesson study were the improvement of implementers' questioning and communication skills and a clearer delivery of the lesson with appropriateness in using Inquiry-based teaching method. Hence, inquiry-based teaching skills can be developed through productive collaboration using lesson study.

***Keywords*:** Science, inquiry teaching-based skills, questioning and communication skills, lesson study, Philippines

INTRODUCTION

Teaching Science using the traditional lecture method is not effective anymore in developing science process skills of the students. Scientific inquiry helps students develop critical thinking and enables them to construct knowledge like a scientist (Corlu, 2012). Even the K to 12 curriculum competencies includes the essential use of Inquiry Based Teaching. Inquiry Based Teaching is a strategy where teachers facilitate student-centered learning and research, acting more as a colleague and guide rather than the dispenser of knowledge (Llewelyn, 2005).

A strong foundational understanding of scientific inquiry has positive effects on both student achievement and attitudes towards mathematics and science (Anderson, 2002). Therefore, scientific inquiry is widely accepted as an effective instructional practice to teach science in today's classrooms and teachers need to excel in guiding their students to construct knowledge like scientists (National Research Council, 2000).

The challenge confronting science educators now is to draw out the best part of the traditional lecture method, use them where they can be effective, and integrate them with reciprocal methods that focus on student inquiry, presentation, and literature research (Haskett, 2001). Thus, a lesson study is very important to achieve effectiveness in delivering instruction especially in teaching Science through Inquiry. As De la Cruz and Punzalan of UP-NISMED (2012) presented, a Lesson study is a process in which teachers jointly plan, observe, analyze, and refine actual classroom lessons. These lessons are called "research lessons" or "study lessons" It has played an important role in improving the curriculum, textbooks, and teaching and learning materials in Japan. Moreover, the key features of a lesson study include the following:

* It provides teachers a concrete opportunity to see teaching and learning in the classroom; enables them to develop a common understanding of what

effective teaching practice entails.

* It keeps students at the heart of professional development activity.

* It is a teacher-led professional development. Teachers can be actively involved in instructional change and curriculum development.

With the conduct of this lesson study, we can create structured occasions for teachers to examine teaching and learning, improve the lesson planning process, refine instructional strategies and delivery, evaluate the results, evaluate student thinking and increase student mastery (De la Cruz and Punzalan, 2012).

Effectiveness is the standard and the instructors are most likely to meet this standard when they draw from a range of techniques best suited for a particular class. Instructors should maintain flexibility and continuously evaluate the effectiveness of their teaching methods using both their own observations and feedback given by their students. Instructors should be willing to improve or change methods and techniques as the class progresses, depending on their effectiveness (Haskett, 2001).

Pre-service teachers in Xavier University should be provided with the skills and competence in teaching Science, using Inquiry approach. They should be taught by Science teachers who have the good pedagogical content knowledge and they use effective educational teaching strategies. There will be a problem in the quality of instruction if these teachers are not educated by subject-educated teacher educators. Thus, subject teachers may harm the effectiveness of teacher education programs. Through a collaborative lesson planning, Science Inquiry-Based Teaching Skills of the pre-service teachers will be developed. This will also be a take-off for these pre-service teachers to continue and develop themselves, applying inquiry skills and conducting their own lesson study in the future. Thus, it is also the option of the researchers to have a longitudinal study to follow-up these pre-service teachers who will be teaching in their field in the future and for them to create a culture of lesson study.

Through this collaborative work, new teaching strategies and techniques can be employed to change the usual lecture method. The inquiry-based approach will help the pre-service teachers in their communication skills, questioning skills and their presentation of the lesson. This will prepare the pre-service teachers for the K to 12 transition which focuses on Inquiry and Discovery learning. The overarching aim was a synergy in which pursuing one goal enhances achievement of the others.

FRAMEWORK

Bruner's Constructivist Theory provides the essential rationale that supports the use of the lesson study process as a potential method for improving teacher professional knowledge and development especially in developing inquiry skills. The primary theoretical principle of social constructivism asserts that social nature of knowledge and the belief that knowledge is constructed through social interaction and is a shared experience (Gergen, 1995; Vygotsky, 1978). Thus, social constructivism emphasizes that knowledge is constructed in response to social interactions, through social negotiation, discourse, reflection, and explanation. This principle supports the idea that teachers should be engaged in activities that requires interaction and communication with students and teachers. During the lesson study process, professional collaboration occurs as pre-service teachers experience working together in groups to study their practice through the implementation of a research lesson. Inquiry skills are specifically questioning skills, communication skills and performance level will also be developed through collaborative critiquing and brainstorming.

Another principle of social constructivism states that knowledge acquisition is an adaptive function designed to organize one's experiences (Fleury, 1998; Prawat & Floden, 1994). Therefore, if pre-service or in-service teachers are confronted with problems, this can motivate them to seek, test, and assess answers within socially collaborative environments. Through the lesson study, pre-service teachers will observe and evaluate the implementation of the research lesson, focusing on the use of inquiry skills. For example, a goal statement might read, "What is your goal statement? Is it for students or teachers?" to develop inquiry skills of the pre-service student teachers need in teaching Science. These goal statements are constructed based on a gap that the teachers' perceive between their aspirations for their students and how students are actually developing in their school (Ertle, Chokshi, & Fernandez, 2002). Therefore, teachers focus the lesson study around issues and concerns in their practice that they are motivated to resolve.

The third principle of constructivism relates that knowledge is the result of active mental processing by the individual in a social environment (Cobb & Yackel, 1996; Prawat, 1996). Therefore, 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.

OBJECTIVES

The study aimed (1) to describe the scientific inquiry based teaching strategies and techniques of pre-service teachers and determine its effectiveness. Specifically, this study will focus on how inquiry-based teaching can be incorporated in teaching grades 4-6 Science topics. This was done through lesson study. This further aimed (2) to enhance the critical thinking skills, and research abilities of the pre-service teachers and the lesson study facilitators.

METHODOLOGY

The study is a collaborative action research which is a holistic approach to problem-solving. It stresses the importance of co-learning as a primary aspect of the research process (O'brien, 2001). The research approach was used for this study because of the nature of the research questions and the intent of the researchers to gain an in-depth understanding of the lesson study process. Data sources which will be used are (a) participant structured and unstructured interviews, (b) field notes/observations, and (c) teacher reflection journals (d) Inquiry-Based Teacher Evaluation and Feedback forms– Communication and Questioning Skills and (e) audio and video recordings of the implementations of the lesson study and the brainstorming sessions. Six (6) fourth year Bachelor of Elementary Education student teachers of Xavier University participated as part of the research team. Quantitative and qualitative measures were used to determine the effectiveness of the collaborative lesson planning. Specific measures in the areas of the pre- service teachers' communication skills, questioning skills and mastery of the subject matter were looked into, to determine whether the lesson study practice improved the aforementioned areas.

A researcher-made evaluation and feedback form was used focusing on communication skill, questioning skill and the implementation of the collaboratively made lesson plan. On questioning skill, during the implementation, all questions raised by the implementers (pre-service teachers) were transcribed and classified whether it is a lower-order or higher-order, convergent or divergent questions. These were deliberated and discussed especially on how these questions were answered by the students.

The implementation of the Inquiry-Based Teaching of the three grade levels (Grade 4-6) was conducted in Macasandig Elementary School, Cagayan de Oro City. All Elementary-level student teachers (n=6) were invited to attend a seminar on lesson study where they were oriented about collaborative lesson study.

The following data characterize it as mostly qualitative and this includes the usual classroom setting as a direct source of data, the descriptive form of the data to be collected (such as pre- and post- lesson study interview, classroom observation guides, and questionnaires), the concern with the teaching process, and the group lesson planning verbalized during instruction.

Each participating student teacher prepared a lesson plan on a topic they themselves chose from the S & T curriculum guide based on the DepEd Basic Education Curriculum. Selection of topics was limited to those scheduled during the first quarter of the school year 2013-2014.

The Lesson Study Model as adopted in this study constituted one learning cycle for the pre-service teachers. One learning cycle focused on one study lesson. There are three study lessons in the study. Thus, the lesson study group went through three learning cycles. One learning cycle consisted of a series of activities.

First was the preparation of the draft lesson plan – Teacher 1 wrote the first draft of the study lesson. Second is scheduling – lesson study sessions (pre and post) and classroom teaching of the topic was scheduled according to the normal flow of the syllabus. The aim was to take care of prerequisite concepts and skills and not to disrupt the class schedule. Third, was the pre-implementation study session/Brainstorming – Teacher 1 presented his/her draft lesson plan to the lesson study group. All four pre-service Teachers jointly discussed and critiqued the study lesson. This meeting would be very crucial and would usually take an hour or more. Fourth, was the revision of the lesson plan – Teacher 1 revised the lesson plan for its first classroom implementation. All suggestions for improvement made during the lesson study session will incorporate. Fifth, was the teaching the revised lesson plan – Without disrupting the normal school schedule, T1 taught one class the revised lesson plan, while being observed by other pre-service teachers and the research team. Observations focused on variables that reflected teacher's effectiveness incorporating inquiry-based teaching skills, specifically questioning and communication skills. The sixth step was the post-implementation study session – Observers gave feedback about the conduct of the lesson in class. The discussion covered specifically the two aspects of classroom teaching which are Inquiry-based teaching skills – questioning and communication skills. The group also reflected on what they learned from their observations and discussed how

the lesson could be improved. (Researchers were also consulted). The teaching of the revised lesson plan was then be scheduled. The seventh step was the second revision of the lesson plan – T2 took over to further improve the lesson plan based on the post-implementation discussion of the study lesson. The eighth step was the teaching of the revised lesson plan to another class – T2 taught the revised lesson plan to another class. Other pre-service teachers and the researchers served as observers. The ninth step was the second post-implementation study session. – The lesson study group jointly discussed their observations and insights. The discussion will focus on both the good elements of classroom implementation of the lesson plan and the elements that needed improvement. Lastly, Finalization of the lesson plan followed – The lesson plan was finalized based on the suggestions during the second study session.

All members of the lesson study group participated in the brainstorming sessions before (pre-implementation study sessions) and after teaching the lesson (post–implementation conference). All members of the lesson study went through the experience of writing, brainstorming/discussing, revising and teaching a study lesson as shown in Table 1.

Table 1. Learning Cycle of the Three Research Lessons Implemented

Learning cycle	Lesson Topic (selected by the pre-service teachers)	T1	T2	Section Taught & Observers (to be set with the teachers in the cooperating school)	
1 (Grade 6)	Mutualism and Competition Relationship	A	H	**1	**2
2 (Grade 5)	Animal Adaptation	B	G	**1	**2
3 (Grade 4)	Three Phases of matter	C	F	**1	**2

Teacher 1 – wrote the draft of the lesson plan, did the first revision and taught the lesson for the first time to a certain class

Teacher 2 – did the second revision and the final revision, taught the lesson for the second time to another class

**1 – section taught on first implementation

**2 – section taught on second implementation

Note: members of the research team also serve das observers for both T1 and T2.

RESULTS AND DISCUSSION

The results show a big difference in their inquiry skills and implementation of the lesson as compared to their teaching demonstrations prior to the conduct of the lesson study.

Before the conduct of the lesson study, the pre-service teachers' teaching skill was described as less inquiry-based. The results of the Inquiry based teacher evaluation and feedback forms are presented in Tables 2 and 3.

Table 2 shows the distribution of Pre-service teachers' Inquiry-based teaching skills before the lesson study.

Table 2. Distribution of Pre-service Teachers' Inquiry-based Teaching skills Before the Lesson

Inquiry-based Teaching Skill	Frequency	Percentage
Very Good [3.70 – 4.00]	0	0.00
Good [2.80 – 3.69]	0	0.00
Fair [1.90 – 2.79]	6	100.00
Poor [0.00 – 1.89]	0	0.00
Total	6	100.00

Over-all Mean = 2.28 Fair sd = 0.45

Indicators	Mean	Description
Questioning Skill	1.79	Poor
Communication Skill	2.80	Good
Presentation skill	2.25	Fair

As indicated in Table 2, the pre-service teachers who were implementers had poor (x=1.79) questioning skill. This is evident because based on the field notes/ observations, they raised few questions and which were more about clarifying and checking the students' understanding. Mostly, questions raised demand only low-order thinking and were usually close-ended or convergent questions, answerable by yes and no. The pre-service teachers shared in their reflection journals that they had an idea of the art of questioning, but they were not able to practice it appropriately. They emphasized the fact that when they asked questions and give waiting time, they were tempted more to answer their questions immediately. Moreover, there was difficulty in the use of the right questions and in encouraging

the students to answer the questions. Examples of questions were: "What is solid, liquid and gas?"; Do we benefit from plants and do plants benefit from us?"; "What can you see in the picture?". For most of the implementers, they have reflected that the big challenge was on crafting questions that will motivate the students to think, to answer and to ask questions.

Their communication skills were rated as good, with a mean of 2.80. This was evident during their implementation and confirmed when they shared during the interview that this is because they were already exposed to different teaching demonstrations where they practiced communicating through their gesture, poise, eye contact, and voice. However, they were not that conscious of the vocabulary limitations of the class. There is still room for improvement to make their communication skills more proficient.

Lastly, their presentation skills were rated fair (x=2.25) in terms of presenting in the inquiry-based approach. They were the sage in class because after an activity was given, analysis and abstraction follows and usually starts with the introduction of the concepts by definition or by providing the information right away. This was followed by further elaboration and giving of examples. Concepts were mostly fed to the students. As one implementer said during the interview, "We are not used to conducting a Science class through Inquiry techniques."

Moreover, the pre-service teachers also perceived teaching Science before as very difficult and challenging. As major in General Education, all of them confirmed that they were afraid because of the difficulty in transferring the Science concepts and ideas to the students and making it exciting at the same time. One pre-service teacher did not appreciate Science much because she perceived it as mere memorization of the concepts.

After the conduct of the lesson study, there was a degree of improvement evident in the results. Table 3 presents the distribution of Inquiry-based teaching skills after the conduct of the lesson study.

Table 3. Distribution of Pre-service Teachers' Inquiry-based Teaching skills After the Lesson Study Cycle

Inquiry-based Teaching Skill	Frequency	Percentage
Very Good [3.70 – 4.00]	2	33.33
Good [2.80 – 3.69]	3	50.00
Fair [1.90 – 2.79]	1	16.67
Poor [0.00 – 1.89]	0	0.00
Total	6	100.00

Over-all Mean = 2.95 Good sd = 0.39

Indicators	Mean	Description
Questioning Skill	2.67	Fair
Communication Skill	3.82	Very Good
Presentation skill	2.95	Good

As shown in Table 3, the inquiry-based teaching skills of the pre-service teachers have improved, with a mean of 2.95, which was described as good. The questioning skill of the first implementers and second implementers were rated "Good." Specifically, they have improved in the following indicators: questions were answered directly by the pupils/students, questions were adapted to the needs of the students, and there was improved phrasing of questions. It was also observed that the students' responses are correct. However, there were some which were not elaborated further, and there is a need to give more waiting time for students to answer the teachers' questions. One implementer shared in her journal that during the revision of her lesson plan, she applied all the suggestions during the brainstorming/ post conference sessions and she had in mind how to guide students to think through asking the right questions. An example of the class observation was how "Animal Adaptation" was discussed. The implementer showed pictures and asked the pupils to describe the behavior and characteristics of animals. She then wrote these on the board. Afterwards, she asked the pupils why such animal changed color or have different sleeping habits or changed behavior. The students gave their responses – "a) because the animals need to hide from big animals, from predators; b) because they need food; c) because they need to reproduce, etc. A follow-up question was then raised by the teacher saying, WHY? Why do they need food, they need to hide, they need to reproduce and so on. Unanimously, the students said – "TO SURVIVE." The pupils were

then asked to give their own examples of animal adaptations. As simple as this flow, the pupils were guided and were able to think deep in the process of the lesson.

After many changes, in the second implementation, more responses became relevant to the topic because the responses were elaborated and explored more through the contributions of each student in the class.

Both implementers improved in giving purposeful and clear questions, and in giving sufficient waiting time for students to answer.

In terms of the type of questions raised, generally, both implementers improved in giving follow-up questions and encouraging students to say something about their classmates' answers. It was observed in the first implementation, that questions were thrown to all pupils, and some pupils supported the answers of their classmates by giving more answers. This was attributed to the questioning skill of the implementer. One implementer shared her reflection after the brainstorming sessions and the classroom observations that there is a need to craft questions by imagining how the lesson would go and what are the expected questions or responses that the students would raise. Moreover, after changes were made, implementer 2 raised a lot of questions promising leads, building on contributions, leading students to arrive at the essential ideas, and this was less practiced prior to the conduct of the lesson study. Furthermore, in the second implementation, open-ended questions were modified for better understanding and interesting interaction among pupils. More techniques in questioning were made that led the pupils to arrive at the correct responses. In addition, the pre-service teachers also shared during the interview, that in handling elementary students, it was challenging to think along with the students while raising questions because the students would sometimes give unexpected answers. Follow-up questions should then be proper to lead or probe students to discover the concepts by thinking and consolidating all ideas shared by both the teacher and the students.

Both implementers have improved in their communication skills, which were evidently shown through an effective eye contact with students, effective pitch and tone of voice, and effective gesture, pauses, and silence. Moreover, both communicated clear directions and explanations and demonstrated proper listening skills. One observation highlighted how one of the second implementers, exhibited a very high listening skill after every question raised by the students and supplements their answers through the answers of other students in the implementers' follow-up questions. He shared his realization on how important

it is to make connections of all answers of the students by guiding them through asking the right questions.

Both 1st and 2nd implementers showed appropriateness in using Inquiry-based teaching method through the proper activities and use of instructional materials which they have initiated from the beginning to the conclusion of the lesson. Even with the limitation in the usage of technology, pictures were prepared and served as a tool to entice the students to give their responses guided by the teachers' questions. The inquiry was used through raising questions on what students observed in the picture presented.

Moreover, a clearer delivery of basic concepts and processes was evident in both the first and the second implementation; both implementers checked the prior knowledge of the students and bridged this knowledge to the new concepts, which was done through Inquiry.

Student-centered activities were also experienced by the implementers in their past demonstrations, but the inquiry was less practiced. The students were just allowed to participate in a collaborative activity, and then lecture follows after the activity. What amazed the implementers, as mentioned in their reflection journals, is how questioning gives students the venue to undergo the thinking process in coming up with an idea based on what they see, on what they listen to from the questions raised by the teacher and the answers of their classmates, and on their prior knowledge connecting to the concept related to it.

Also, the inquiry-based teaching requires deep thinking, and an intricate choice of the activities, the right and effective questions, the application and assessment part of the lesson which was exemplified by the implementers and simplified through the collaboration done and ideas learned during the brainstorming sessions.

The first and the second implementer improved in the valuing process of the lesson especially in relating the lesson to real-life processes and situations which was not practiced before the conduct of the lesson study. Specifically, based from classroom observations on a Science topic- "Mutualism and Competition Relationship," Implementer 1 emphasized why animals compete in order to get that food; and Implementer 2 highlighted the analogy of the concept to the competition that happens in class or any setting.

All these findings support the first principle of social constructivism which refers to the social nature of knowledge and the belief that knowledge is constructed through social interaction and is a shared experience. The knowledge of inquiry skills and how to improve these skills require a shared experience or a

productive collaboration between the teachers and the students, which are also highly encouraged among in-service teachers and pre-service teachers during the internship.

Other incidental findings include the following: 1) the collaborative process of lesson study has improved their confidence in teaching science instruction even if they perceived that science is a very hard and challenging subject. This was evident in their implementation of the lesson. This was attributed to the preparations made and the collaborative lesson planning done, as well as in the feedback and ideas brainstormed during the conferences; 2) common misconceptions about the three topics: Mutualism and Competition Relationship, Animal Adaptation and Three Phases of Matter, were noted and were addressed immediately; after many changes were made, the creativity of students through thinking of relevant examples was evident in the second implementation which is the result of the questioning techniques of the implementer; 3) Classroom management and student engagement are also factors noted that makes inquiry based teaching successfully; 4) The main difficulty encountered by the implementers was asking the right questions, trying to balance in giving both factual and thought-provoking questions, to help the pupils discover the science ideas of the lesson.

All these observations are products of the experiences and insights of the pre-service teachers in their planning and implementation which were done collaboratively and supported by the brainstorming with the in-service teachers and knowledgeable others. It is also through the reflective inputs of the pre-service teachers and through insightful brainstorming sessions, which led to the improvements of the inquiry-based teaching skills. These support the two other principles of social constructivism that knowledge acquisition is an adaptive function designed to organize one's experiences and that knowledge is the result of active mental processing by the individual in a social environment. Improvements do not stop, it is continuous, and new insights can be acquired through another learning cycle.

CONCLUSION

The pre-service teachers, who were the implementers, have improved and have acquired learning and insights in the process of planning, brainstorming and implementing the lesson plan. Specifically, there was a new paradigm shift that was experienced in inquiry-based teaching. They have developed their questioning skills, communication skills and their presentation of the lesson but there were still much room for improvement. Moreover, the pre-service teachers have highlighted improvements in their use of rigorous and effective questions, activities, applications, and assessments in Inquiry-Based Teaching. The collaborative work of pre-service teachers has equipped and prepared them the necessary inquiry skills and the flexibility in delivering effective instruction. In this research study, it has proven that lesson study promotes improvement in critical thinking skills, research skills and teacher self-reflection in regards to inquiry-based teaching.

RECOMMENDATIONS

Based on the findings, the following recommendations were made:

1. A healthy collaboration through lesson study between the pre-service teachers and the In-service teachers should be practiced even during their internship or through partnership activities which will help both parties in the improvement of the lesson planning and implementation.

2. Through lesson study, a Science Inquiry culture and a culture of lesson study will be created as early as with Pre-service teachers. Hence, this can benefit the cooperating schools, especially that this will create a culture of lesson study in the school. The development of an understanding of Lesson Study as a collaborative process and how this will help strengthen teaching and learning in schools will be propagated and will be used for professional development. This study will surely support the teachers (pre-service and in-service) in initiating and building Professional Learning Communities with the use of Lesson Study.

3. The improved and revised research lessons can be banked and can be subject to improvement. Hence, lesson study should not only be implemented in Science teaching but also in other subjects.

4. Seminars and orientation about lesson study should be conducted in different schools so that the teachers will acquire enough knowledge on how to conduct lesson study.

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