Development of 7E model lesson on earth systems: a lesson study

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Abstract. The study aimed to develop a 7E model lesson on Earth Systems and implement it through the lesson study approach. The developed lesson was based on the standards provided by the Department of Education in the K to 12 Basic Education Curriculum Senior High School where it underwent a series of validation, revision and evaluation for further improvement prior to its implementation. The study tested the effects of the developed 7E model lesson on the conceptual understanding of the respondents. The developed 7E model lesson was implemented through lesson study approach to the three class sections of Grade 11 STEM of Iligan City National High School, School Year 2017-2018. Achievement test was conducted to the respondents. The result of the study shows that respondents exposed to the developed 7E model lesson had significant higher test scores in the post-test as compared to the pre-test. Result implies that there is a positive significant impact of the 7E model lesson on the conceptual understanding of the respondents on Earth Systems.

1. Introduction

In today’s generation, the importance of a sound education is to enhance and develop teaching instructional materials that would motivate and augment the learning of the students. These materials should lead them to explore and learn on their own.

For some, science is just an extension of everyday world and that can be learned naturally by experience. But, most young learners think of science as one of the most difficult subjects, aside from Mathematics. One reason that could be attributed to the difficulty is because of the traditional way of teaching. This manner of teaching is impossible for 21st century learners. The 21st century learning means having skills on collaboration, communication, creativity, innovation, critical thinking, problem-solving and digital literacy. It is what the new generation or the so called millennials have to demonstrate in order to thrive in today’s world.

Teaching strategies in science and mathematics such as collaborative learning, problem based learning, inquiry based approach, and 7E learning cycle approach had been tried and proven to be effective in current classroom strategies. One innovative and constructivist model that teaches students with 21st century skills is the 7E learning cycle and instructional model by Arthur Eisenkraft [1] which
emphasizes transfer of learning and the importance of eliciting prior understanding. This model is transition from the 5E model to the 7E model to ensure that instructors do not omit crucial elements for learning from their lessons. The 7E stands for elicit, engage, explore, explain, elaborate, evaluate and extend.

Many studies concluded that 7E model is more effective than the traditional method of teaching and this is affirmed by the study of Shaheen & Kayani [2], Gok [3], Taguiam-Clavero [4], Kunduz & Secken [5] and Yilmaz et al. [6]. Further, studies also found out that using 7E model helps improve the conceptual understanding of the students.

Meanwhile, lesson study is a professional development that originated in Japan wherein teachers work collaboratively to plan, teach, observe and critique a lesson to examine teaching and learning processes. The foci of lesson study are to improve lesson planning process, refine instructional strategies and delivery, evaluate results, evaluate student thinking, and increase student mastery [7].

The researcher intends to test the effectiveness of the 7E model lesson to the STEM senior high school students as a new strategy of teaching and learning. In order to improve and enhance the developed 7E model lesson, it was implemented through the lesson study approach.

1.1. Statement of the problem
The problem that this study sought to address is about the increasingly diverse classrooms that need to cater to the variety of learning styles, interests, and abilities exhibited by the students. It also looked into the lack of modules or learning materials for the Earth Science subject of Grade 11 STEM Senior High School in the Philippines public schools. Because of these, the senior high school teachers who are handling Earth Science subject have to prepare and develop their own lesson, activities or materials for their students.

The main objective of the study is to develop a 7E model lesson on Earth Systems and implement it through the lesson study approach and to test its effectiveness on the conceptual understanding of the respondents. Specifically, the study aims to design a 7E model lesson on Earth Systems; to determine the evaluators' comments and suggestions on the developed 7E model lesson on Earth Systems; to compare the performance of the respondents from the three groups and to describe the implementation of the developed 7E model lesson through the lesson study approach.

1.2. Conceptual framework
This study is anchored on the theory of Constructivism, which states that "learning is an active process in which learners conduct new ideas or concepts upon their current or past knowledge."

The research paradigm used in this study is divided into three (3) phases, the development, the evaluation and the implementation. The development of 7E model lesson follows a process of testing, evaluation of the face-validation evaluators and the “panel of experts” and revisions. Implementation was done through the lesson study approach to enhance the lesson by improving the identified weaknesses of the lesson during implementation.

2. Method
This study used both quantitative and qualitative methods of research. In the quantitative research method, the data were obtained from the ratings of the evaluators on the developed 7E model lesson, and from the performance of the respondents in the pre-test and post-test. In the qualitative research method, the data were obtained from the comments and suggestions of the evaluators and the observers during the implementation of the developed 7E model lesson.

The subjects of the study were the three class sections of Grade 11 STEM (Science, Technology, Engineering and Mathematics) of Iligan City National High School (ICNHS), academic year 2017-2018. The Grade 11 STEM students were composed of thirty nine (39) male students and fifty five (55) female students, a total of ninety four (94) students. Prior to the implementation, a try-out was done to the twenty one (21) Grade 10 students of Datu Tanggor Memorial National High School, Marorgong, Lanao del Sur. The instruments used were: K to 12 Senior High School Curriculum, Rating Scale for the
developed 7E model lesson, Achievement Test and Observation Form for the observers during the implementation.

3. Result and Discussion

The developed 7E model lesson was designed based on the standards and learning competencies provided by the K to 12 Basic Education Curriculum. It is all about the Earth Systems, the biosphere, the hydrosphere, the geosphere and the atmosphere, that make up the Earth. The developed 7E model lesson is designed according to 7E learning cycle that consists of 7E phases: elicit, engage, explore, explain, elaborate, evaluate and extend. It had undergone two phases of evaluation: face-validation by the research adviser and panel members and the experts' validation by in-service Science teachers.

Revisions of the developed 7E model lesson were done based on the comments and suggestions of the face-validation evaluators. After the face-validation and revisions, the developed 7E model lesson underwent a second phase evaluation: the experts' validation. Experts evaluated the developed 7E model lesson through rating and giving comments and suggestions for the improvement of the developed 7E model lesson.

Table 1. Mean rating of the developed 7E model lesson on Earth Systems by the experts.

| 7E Model Lesson Content         | Overall Rating | Remarks     |
|---------------------------------|----------------|-------------|
| a. Objectives                   | 3.80           | Excellent   |
| b. 21st Century Skills Integration | 3.35           | Excellent   |
| c. Elicit                       | 3.20           | Very Good   |
| d. Engage                       | 3.47           | Excellent   |
| e. Explore                      | 3.50           | Excellent   |
| f. Explain                      | 3.10           | Very Good   |
| g. Elaborate                    | 3.40           | Excellent   |
| h. Evaluate                     | 3.40           | Excellent   |
| i. Extend                       | 3.50           | Excellent   |
| Overall Rating                  | 3.41           | Excellent   |

Table 1 presents the ratings given by the expert evaluators on the developed 7E model lesson based on the identified criteria. All of the criteria were rated Excellent except for the Elicit Phase and the Explain Phase which were rated as Very Good. It can be said that the experts agreed that the developed 7E model lesson was well developed.

Prior to the implementation of the developed 7E model lesson, other revisions were done based on the results of the try-out on Grade 10 students as activities in each phase were found not achievable within the allotted time. Further, some difficulties encountered by the try-out students were noted by the researcher.

3.1. Performance of the respondents in the pre-test and post-test

Figure 1 illustrates the mean scores of the respondents in the pre-test and post-test. It is clearly illustrated in the graph that the performance of the respondents in Group 1, Group 2 and Group 3 in the achievement test increases.
Figure 1. Comparison of the pre-test and post-test scores of the respondents.

Table 2 shows the comparison between the pre-test and post-test scores of the respondents belonging to Group 1, Group 2 and Group 3. As shown, the mean difference of the pre-test and post-test scores of the respondents in the three groups are 3.61765, 3.46429 and 3.18750 respectively.

Table 2. Comparison of the pre-test and post-test scores of the three groups.

| GROUP | Pre-test | Post-test | Mean Difference | Standard Deviation | T        | p-value |
|-------|----------|-----------|-----------------|-------------------|----------|---------|
| 1     | 14.6176  | 18.2353   | 3.61765         | 2.58216           | 8.169    | 0.000   |
| 2     | 18.7143  | 22.1786   | 3.46429         | 2.51635           | 7.285    | 0.000   |
| 3     | 15.4688  | 18.6562   | 3.18750         | 3.86412           | 4.666    | 0.000   |

Paired samples t-test above show that the difference between the pre-test and post-test means of Group 1, (t[33]= 8.169, p=0.000), Group 2, (t[27]= 7.285, p=0.000), and Group 3, (t[31]= 4.666, p=0.000) are statistically significant. The data guaranteed that the mean difference between the pre-test and post-test scores of the three groups are significant at 95% confidence level; thus, the pre-test and post-test scores of Group 1, Group 2 and Group 3 respondents differ significantly. This means that the respondents belonging to Group 1, Group 2 and Group 3 scored significantly higher in their post-test than in the pre-test. This implies that there is a significant improvement in the respondents' conceptual understanding about Earth Systems, thus, the developed 7E model lesson on Earth Systems is effective.

Similar to the findings of other studies, 7E learning cycle and instructional model has positive effects on the student's conceptual understanding. Gök [3] concluded in his study that instruction based on 7E learning cycle model can lead to better acquisition of scientific concepts in addition to higher perception of motivation and learning strategy use. Taguiam-Clavero [4] claimed that there is an improvement of conception among the students when the 7E Learning Cycle Approach was applied in the lesson proper. Mecit [8] concluded that 7E learning cycle model caused significantly better improvement on the students’ critical thinking skills than what the traditional method did. Balta & Sarac [9] found that 7E strategy can enhance educational effects and its effect is so high.

Yet, it can be seen in Table 2 that the mean difference from Group 1 to Group 3 is decreasing instead of increasing. The result is contrary to the anticipated result of this study. It could be inferred that the decreasing mean difference is due to class schedule of the three groups. Class time of the three groups was not equal. Group 1 had two hours in their Earth Science while Group 2 and Group 3 had one and half hour only. Thus, during the second implementation and the third implementation of the lesson (Group 2 and Group 3), there are parts of the lesson that were not discussed thoroughly and respondents were in a hurry to complete the given activities. For this, respondents in Group 2 and Group 3 might have missed some important concepts of the lesson due to limited time. According to Karjalainen et al.
[10], learning and studying also take place within the framework of time. A too tight schedule does not enable effective learning but results in student overload and superficial learning.

Another reason is that, the class schedule of the three groups were not similar. Group 1 was scheduled early in the morning at 8:00 am while Group 2 and Group 3 were in the afternoon, 1:00 pm and 2:30 pm respectively. This factor may have also affected the performance of Group 2 and Group 3 respondents. Pope [11] concluded in his study that student's productivity is higher in the morning than in the afternoon and students learn more in the morning than later in the school day.

Further, part of the lesson study is the revision of the lesson every after implementation. After the first implementation of the lesson to the Group 1 respondents, it was observed that the lesson was quite long and was not enough for a one-hour class and some parts of the lesson such as the activities were not achievable within the allotted time. Thus, some parts of the activities were changed and shortened in the second implementation and in the third implementation. This might be one of the possible reasons that some contents or concepts of the lesson were missed during the second and third implementation. This implies that the decreasing mean difference from Group 1 to Group 3 is due to time constraints. It also implies that in lesson study, uniformity of the contents of the lesson throughout the implementation must be ensured.

3.2. Implementation of the developed 7E model lesson through the lesson study approach
The developed 7E model lesson was implemented to Group 1, Group 2, and Group 3 respondents through the lesson study approach for three times. This was to improve the lesson based on careful observation during implementation by collecting and analysing instructional strategies and student behavior. The lesson study team was composed of five teachers including the researcher as the one who taught the developed 7E model lesson to the three groups; the two Science teachers who handle the Earth Science of the Grade 11 STEM of ICNHS as observers during implementation and the research adviser and one panel member of this study as the knowledgeable other and at the same time as observers during implementation.

Every after implementation of the developed 7E model lesson, the lesson study team convened for the post colloquium to discuss what worked and what did not work on the developed 7E model lesson based on observations. Both negative and positive observations were noted by the observers as part of the lesson study.

Based on the observation during the first implementation of the developed 7E model lesson, allotted time in each phase exceeded, thus, the lesson took 1 hour and 40 minutes instead of 1 hour. There were parts of the lesson that were not discussed such as the answer on 4Pics 1 Word and the played video. Although respondents were doing their activities, but some of them were not. It was also observed that respondents had difficulties in their group activity as they hardly understood the written instruction especially in making a concept map.

In the second implementation, the same observers observed that Group 2 respondents were more active and participative compared to the Group 1 respondents. This is due to easier instruction compared to the first implementation and this was clearly stated by the teacher before the respondents started the activity. Further, the 4Pics 1 Word in the Elicit phase was enjoyed by the respondents as it was projected on the board instead of answering it on their sheet. In the Engage phase, respondents were active in sharing their drawings/sketches to the class and during interactive discussion. However, there were also parts of the developed 7E model lesson that have to be modified such as the instruction, the activities and the time allotment.

During the third implementation, the other two members of the lesson study team were the observers. Based on their observations, it was noted that time allotment in each phase exceeded except on the Elicit phase. However, compared to the first and second implementation, the developed 7E model lesson on its third implementation took 1 hour and 20 minutes to finish the lesson. It was noted by the observers that Group 3 respondents enjoyed and were able to perform the activities in the lesson; they could relate to the activity because it was localized and contextualized. Further, respondents were actively participating during discussion. This implies that as the developed 7E model lesson was implemented
through the lesson study approach, the progress and improvement of the lesson from the first implementation to the third implementation were observed particularly the instructional strategies and the behavior of the respondents. Lesson study addresses one lesson at a time, but impacts learning and instruction in several aspects [12]. Cerbin & Kopp [13] argue that one of the main reasons that lesson study is worth the time and effort in higher education is teaching improvement, as teachers focus on how their students learn and what kinds of instructional activities support student learning and thinking. Lesson study is a professional learning process. It works because it focuses on the learning and progress made by children as their teachers develop specific pedagogic techniques designed to improve a particular aspect of teaching and learning that they have identified within their subject area [14].

4. Conclusion
The performance of the three groups in the pre-test and post-test differ significantly. Thus, the use of the developed 7E model lesson on Earth Systems as an instructional material improved the respondents' conceptual understanding on Earth Systems. As the developed 7E model lesson was implemented through the lesson study approach, it was observed that the delivery of the lesson and the respondents' behavioral responses towards the lesson had improved from first implementation up to the third implementation. However, it was found that the mean difference between pre-test and post-test among the respondents from Group 1 to Group 3 was decreasing. The possible reasons of this is time constraints and some concepts of the lesson were missed by the Group 2 and Group 3 respondents due to shortened time and the revisions made on the developed 7E model lesson.

Thus, future lesson study should ensure that contents and standards of the lesson are similar throughout the implementation. No contents or concepts should be missed in revising and re-teaching the lesson, only instructional pedagogies or strategies are to be modified to ensure that all groups are exposed to the same concepts of the lesson. Further, allotted time throughout the implementation of the lesson needs to be constant to determine the effects of the lesson study approach to the performance of the respondents.

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