Enhancement the Model Ability Solar System and Moon Appearance of Grade 4 Students through MIS model supplemented with Representatives

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Abstract

This research aimed to study and compare the model ability solar system and moon appearance of grade 4 students through MIS model supplemented with representatives. The sample of this sample group of 1 classroom with 30 students was obtained through cluster sampling from a population consisting of 2 classrooms with a total of 65 students in a medium-sized primary school under Udon thani Primary Education Service Area Office 3 in the second semester of academic year 2022. This research has an experimental design with one-group pretest-posttest design. The research employed the following research tools; 5 lesson plans of MIS model supplemented with representatives and modeling ability test of solar system and moon appearance of grade 4 students. The statistical data were analyzed using mean, standard deviation, and percentage to comparing the mean scores before and after learning by t-test for dependent sample. The research findings indicate that students' modeling abilities after learning ($\bar{x}$ = 11.57 / 72.29%) were higher compared to before learning ($\bar{x}$ = 0.80 / 5.00%). Therefore, this instructional activity has led to students' learning, self-generated knowledge construction, and enjoyment in science learning, which in turn resulted in improved abilities in modeling, better understanding of science, and a positive attitude towards science learning.

Keywords: MIS model, Representatives; Modeling ability

Introduction

Modeling is an often-used means of conveying information to learners, and enhances skill acquisition. The Abilities Model is a more complete way to understand how student minds work. In the past decades, model and modeling have been recognized as an important medium of scientists' inquiry, teachers' teaching, and students' learning about the sciences. In the process of learning and teaching science, models are important representation and tools (Harrison & Treagust, 2000; Justi & Gilbert, 2002; Justi & van Driel, 2006). Scientific model and modeling processes could also make students develop higher order scientific thinking and working, such as

developing meta-cognition to understand the inquiry process in science community, getting familiar with the development and construction of knowledge and individually reflecting on the understanding of scientific knowledge (Coll, France, & Taylor, 2005). Therefore, the researcher is interested to developing students' modeling abilities on the solar system and moon phenomena that this content focuses on students learning or gaining knowledge by explaining from models.

Model-based teaching is instruction designed to support the development and evolution of learners' mental models. We define mental models as internal representations of integrated knowledge that include components of a dynamic system and their interactions, which produce some emergent behavior or property. Learners build, extend, elaborate, and improve the accuracy and completeness of their mental models, much as science extends our understanding of the world about us. Settings may be formal classrooms or informal learning activities. Teaching philosophies may range from didactic to discovery and may employ instructional strategies and tactics that operate over months of instruction to those that operate over seconds (Clement and Rea-Ramirez 2008; Gilbert and Boulter 2000). Gibbons developed a design theory of model-centered instruction (2001) for the purpose of exploring the design implications of dynamic-model content. Model-centered instruction is instruction that is carried out through interaction with dynamic models, and the experience with the model is supplemented by the activities of a learning companion that may supply a variety of coaching, feedback, and other learning support services. Varieties of model-centered instruction are created by considering all of the variations of this basic configuration. The theory of model-centered instruction is based on the assumption that the purpose of instruction is to help learners construct knowledge about objects and events in their environment. In the field of cognitive psychology, theorists assert that knowledge is represented and stored in human memory as dynamic, networked structures generally known as schema or mental models. This concept of mental models was incorporated by Gibbons into the theory of model-centered instruction. This theory is based on the assumption that learners construct mental models as they process information they have acquired through observations of or interactions with objects, events, and environments. Instructional designers can assist learners by (a) helping them focus attention on specific information about an object, event, or environment and (b) initiating events or activities designed to trigger learning processes. Instructional designers may guide learner attention by introducing learners to carefully selected objects and events that occur in certain environments. In some situations, it is not possible to have learners work with real objects, events, or environments. In these cases, instructional designers may create representations of the objects, events, or environments. These representations are called models. A model is a definition or representation of an object, event, or environment that includes some information regarding their properties, actions, or cause-effect relationships. Instructional designers may use a variety of models to help learners construct their own mental models. A model can take various mediated forms, from simple textual descriptions to complex, multimedia simulations. Representation Learning is a process in machine learning

where algorithms extract meaningful patterns from raw data to create representations that are easier to understand and process. These representations can be designed for interpretability, reveal hidden features, or be used for transfer learning. They are valuable across many fundamental machine learning tasks like image classification and retrieval. Therefore, the researcher is interested to study and compare the modeling ability solar system and moon appearances of grade 4 students through MIS model supplemented with representatives. The expected benefits (a) to understand the MIS learning model with thinking representatives that promotes the ability to create models for 4th grade students. Provide the guideline for science teachers and educators to develop the activities of MIS learning model with thinking representatives. Therefore, students are able to create self-cognitive knowledge which impacts to their satisfaction of learning science. Moreover, this will be affected to the ability to create models, understand science, and have a positive attitude towards learning science.

Research Objective

In this research to study and compare the modeling ability solar system and moon appearances of grade 4 students through MIS model supplemented with representatives.

Conceptual Framework

The research conceptual framework based on the concept of MIS model together with representatives' approach which means learning management that focuses on allowing students to learn from designing and creating science models through hands-on activities. supplement with thought representative that represents the knowledge and understanding that students express in the form of pictures, symbols, gestures, and writing. The details are as follows.

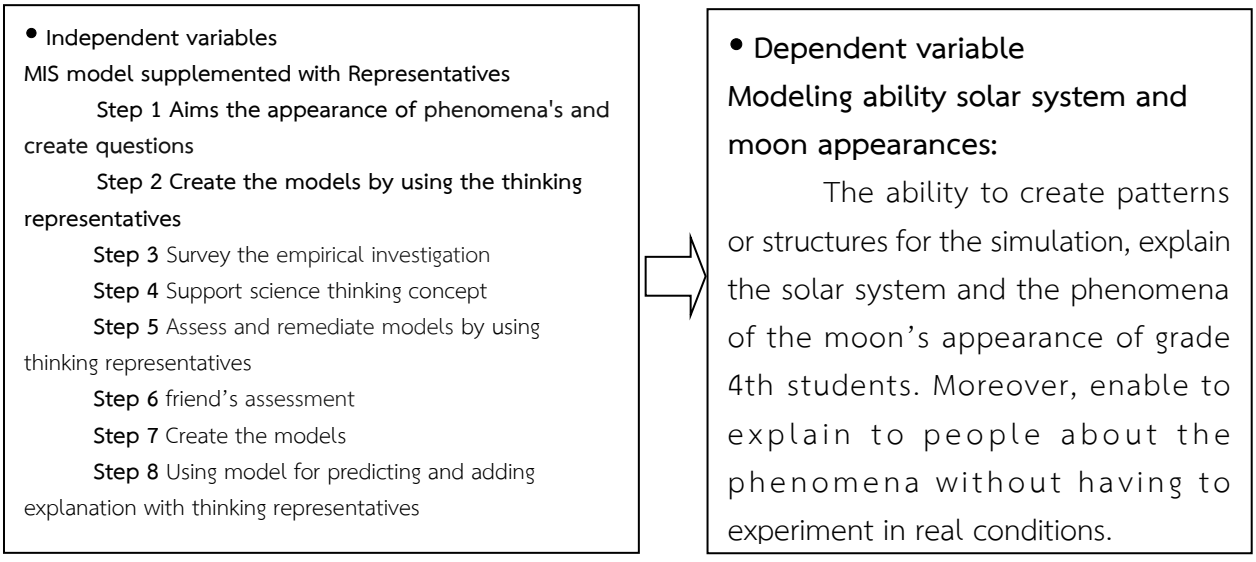

Fig.1 Conceptual Framework

Research Methodology

1. Population and Samples

The sample group used in this research consisted of grade 4 students, totaling 30 students from a classroom selected through cluster sampling. The sample was drawn from a population of grade 4 students from a medium-sized primary school in Nong Han District, Udon thani Primary Education Service Area Office 3, in the second semester of academic year 2022. The population comprised two classrooms with a total of 65 students.

2. Variables used in the research

Independent variable: MIS model supplemented with representatives

Dependent variable: modeling ability of solar system and moon appearances

3. Duration of time used in the research

The duration of time used in this research involved a teaching experiment 5 weeks, with each 3 hours of teaching. The total teaching hours amounted to 15 hours. This experiment excluded the hours dedicated to pre-test and post-test assessments.

4. Research Design

This research was a pre-experimental design. Research design used is one group pretest and posttest design. (John & James, 2005)

Pretest	Treatment	Posttest
O_1	X	O_2

O_1 : Pretest

X : MIS model supplemented with representatives

O_2 : Posttest

5. Research Instruments

5.1 The lesson plans based on MIS model supplemented with representatives that included topics the solar system and moon's appearance phenomenon for 4th grade students and consisted 5 lesson plans, 3 hours per lesson plan, totaling 15 hours. The 5 lesson plans are as follows 1) Our moon, 2) Moon rise and fall, 3) The change of moon's shape, 4) The Composition of solar system, and 5) Solar System's trajectory. The contents of this researcher used indicators and core learning content with science learning group (revised edition B.E. 2560, A.D.2018) according to the Basic Education Core Curriculum B.E. 2551 (A.D. 2008), content 3, science of the world and space, standard 3.1, indicators 1, 2, and 3, grade 4, topic, solar system and moon's appearance phenomenon. The lesson plans were qualified checking from 3 science educators' expert. The appropriateness of the learning activities, time, measurement, evaluation, and media used in the lesson plans were evaluated. The quality of the lesson plans was very good level (average value equal to 4.94). The lesson plans were tested with grade 4th students who were not in the sample group to find the appropriateness of the activities, time, measurement and evaluation, and media. It was found that the lesson plans were suitable for the learning activities.

The students were fun, happy, able to create models, present in front of the class confidently, and wanted to learn more in this type of activity.

5.2 The ability measuring of creating models is a four-question of subject tests and used evaluation rubric scoring from Schwarz et al. (2009). The researcher studied documents related to the measurement and ability measuring of creating models analyzed the learning content of the solar system and moon's appearance phenomenon, the learning objectives, analyzing the model building ability that resulted from the MIS model supplemented with representatives, and evaluated the quality of the test by considering the content validity by the same experts in science learning management as the author. The index of congruence (IOC) of 0.67 and higher was used to determine content validity. According to the test assessment data, the IOC of the test was between 0.67 and 1.

6. Data Collection

6.1 Pretest: Before staring the experimental research, the sample group has been applied a scale of modeling ability solar system and moon appearances pretest by the ability measuring of creating model's subject test.

6.2 Experimental: The experimental were taught by 5 lesson plans on solar system and moon's appearance phenomenon using the MIS model supplemented with representatives. The teacher was informed about the purpose of the study and then used the MIS model supplemented with representatives during the process teacher was observed, the interaction between teacher-students and students-students; participation and contribution of students into learning environment and teacher as well as the physical conditions and material availability of the classroom. Students in the sample group were instructed with the MIS model supplemented with representatives. In instruction, teaching and learning activities and lessons plans were designed to maximize student's active involvement in the learning process. Teacher only provides questions, suggested approaches, gave feedbacks, and assesses understanding.

6.3 Posttest: After finishing the experimental the sample group has been applied a scale of posttest that the test same pretest. So, the study tools 5 weeks for the instruction, 2 weeks for the application of the pretest and the posttest.

7. Data Analysis

The mean, percentage, and standard deviation of measured quantities were determined, and the t-test for one sample and t-test for dependent samples were done for hypothesis testing.

Research Results

The Analysis results of the ability to create a model of the solar system and the moon's appearance phenomenon of Grade 4th students by using MIS learnings model with thinking representatives was determined before learning that showed students had an average score of 0.80, which was 5.00 percent. After learning, students earned an average score of 11.57, which

was 72.29 percent. From the comparison of the results of the capacity to develop a model, it was observed that after learning was greater than before learning considerably at the 0.01 level.

Discussions

According to the data analysis, it was found that before learning most students did not have the ability to create models of the solar system and the moon's appearance phenomenon, could not explain the models, and did not have the ability to create models. After the learning process, it was found that students had improved scientific modeling skills, that is most students had scientific modeling skills at level 4, 50.00 percent, thus, meaning that students had the ability to draw model pictures that were consistent with the concepts or the phenomena that the teacher assigned correctly, with all the components included. Next were levels 2, 1, 3, accounting for 25.83, 17.50, 6.67 percent, respectively. The reason why students had higher skills might be due to the following reasons:

The learning process by using MIS learning model with thinking representatives resulted in the ability to create models. Students actually practiced creating models, which in steps 2, 3, 5, 7, and 8 were steps that enhanced students' ability to create better scientific models. From improving the model, adding thinking representatives to make the model that students created more complete, exchanging ideas within the group in the classroom, and summarizing as a model that is the resolution of the class, it made students have more ability to create models. But some students still had poor modeling skills. This might be due to the fact that creating models had various components, such as drawing, model size compared to reality, students had to draw abstract things into concrete shapes, resulting in incomplete and incomplete components.

Conclusion

This research has an experimental design with a one-group pretest-posttest design. The research employed the following research tools; 5 lesson plans of MIS model supplemented with representatives and modeling ability test of solar system and moon appearance of grade 4 students. The statistical data were analyzed using mean, standard deviation, and percentage to compare the mean scores before and after learning by t-test for dependent samples. The research findings indicate that students' modeling abilities after learning ($\bar{x}$ = 11.57 / 72.29%) were higher compared to before learning ($\bar{x}$ = 0.80 / 5.00%). Therefore, this instructional activity has led to students' learning, self-generated knowledge construction, and enjoyment in science learning, which in turn resulted in improved abilities in modeling, a better understanding of science, and a positive attitude toward science learning.

Suggestions

1. Suggestions for applying the research results

1.1 In applying the MIS learning model with thinking representatives, the teacher should read the details, steps, study clearly to understand the lesson plan. Moreover, prepare media,

equipment for learning management are crucial. Concern the appropriate for group work and should always recording after lesson plan to notice the problems and observe the development of student behavior to make the activity more effective.

1.2 Learning process by using MIS learning model with thinking representatives is an activity that requires cooperation between students within the group. The teacher should encourage each student to have a role and responsibility to help each other within the group. Interact with students within the group.

1.3 Learning process by using MIS learning model with thinking representatives, students have to spend a lot of time creating models. The teacher should adjust the time or encourage them to be on time. Set appropriate time for each step. Therefore, the teacher must plan the time for each step appropriately to make the activity as effective as possible.

1.4 In applying the MIS learning model with thinking representatives in measuring the results of scientific modeling skills, the teacher should use various methods of measurement such as using models to explain phenomena. During learning management to know the development of modeling skills during the activity.

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