Full Length Research Paper

Development of environmental knowledge, team working skills and desirable behaviors on environmental conservation of Matthayomsuksa 6 students using good science thinking moves method with metacognition techniques

Charinrat Ladawan*, Adisak Singseewo and Paitool Suksringarm

Faculty of Environment and Resource Studies, Mahasarakham University, Kantarawichai District, Maha Sarakham 44150 Thailand.

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The research aimed to investigate environmental knowledge, team working skills, and desirable behaviors of students learning through the good science thinking moves method with metacognition techniques. The sample group included Matthayomsuksa 6 students from Nadoon Prachasan School, Nadoon District, Maha Sarakham Province. The research tools were (1) 6 teaching plans designed under the good science thinking moves method with metacognition techniques, entitled “Human and Sustainability of the Environment,” (2) a 40-item test on environmental knowledge with the reliability index of 0.7918 and the difficulty and discrimination indexes ranging from 0.26 to 0.78 and 0.24 to 0.82, respectively, (3) a team-working observation form, and (4) a behavior observation form. The results revealed that the teaching plans designed had the effectiveness index of 0.7290. The students gained more environmental knowledge after learning with the p-value of 0.001. In addition the students gained better team working skills and presented desirable behaviors after learning with the score higher than 50% of the total score.

Key words: Good science thinking moves, metacognition techniques, environmental knowledge, team working skills, desirable behaviors.

INTRODUCTION

Social and technological advancements lead to unlimited use of natural resources causing several environmental problems at the community, country, and global levels. World environment has dramatically deteriorated and this greatly affects all living entities (Gore, 1993). To sustainably solve the environmental problems, we should focus on changing the people's attitude toward environment by educating and directing them to see the value of

*Corresponding author. E-mail: Meawch90@gmail.com.

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the environment, have environmental awareness, understand the relationship between people and environment, and willfully protect and conserve the environment. As a result, it is necessary to implement environmental education at every educational level (Huckle, 1991).

Environmental education involves the educational processes that study the relationship between people and environment, environmental problems, environmental conservation and development to create environmental awareness, knowledge and understanding, positive attitude, evaluation skills and involvement in environmental problem-solving of the learners (Stapp et al., 1969; UNESCO, 1976). Moreover, environmental education can be used as a tool for preventing and solving environmental problems (Wisconsin Department of Public Administration, 1991). People with environmental knowledge are likely to see the importance of the environment and are eager to help improve and conserve the environment (Federal Interagency Committee on Education, 1978).

An appropriate method is required for the effective transfer of environmental knowledge and contents to learners. The integration of the good scientific thinking moves with metacognitive techniques is among the most effective teaching methods for environmental education as this teaching method, developed by Mittlefehldt and Grotzer (2003), integrates metacognition with scientific learning and inquiry-based learning processes. The integration of the good scientific thinking moves with metacognitive techniques could not only help create the environmental knowledge understanding, awareness, and positive attitude but also develop the desirable behaviors of the learners. The learner would develop skills in environmental preservation, community involvement and awareness of sustainable environmental and natural resource conservation.

**Purposes of the study**

1. To investigate the effectiveness index of the teaching plans entitled “Human and the Sustainability of the Environment”, developed under the good science thinking moves method with metacognition techniques for Matthayomsusak 6 students.
2. To compare the environmental knowledge of the students before and after learning through the designed teaching plans.
3. To investigate the team working skills and desirable behaviors of the students while learning through the designed teaching plans.

**Population and sample**

The population for this research includes 189 Matthayomsusak 6 students studying in the 2013 academic year in Nadoon Prachasan School, Nadoon District, Maha Sarakham Province under the supervision of the Maha Sarakham Office of the Secondary Education Service Area 26. The sample group was 40 Matthayomsusak 6 students from 5 classes in the second semester of the 2013 academic year, selected by using the cluster random sampling technique.

**RESEARCH DESIGN**

This research is quasi-experimental research with one group pretest-posttest design. The research tools consist of (1) 6 teaching plans titled “Human and the Sustainability of the Environment”, including the 3-h per week plans on Environment and Natural Resources, Water Resources, Soil Resources, Air Resources, Forest and Wildlife Resources, and Human and Environment and Natural Resources, (2) a 40-item test on environmental knowledge, (3) an observation form on team working skills including participation, attention, and discussion skills, and (4) an observation form on desirable behaviors in 4 dimensions: discipline, faithfulness, willingness to learn, and responsibility.

**Research procedure and data collection and analysis**

After using the cluster random sampling technique, 40 students from the 6/2 class were selected for the experiment. The experiment started with the pre-testing of the sample group by using the 40-item test on environmental knowledge. Then, the sample group was taught by using each of the 6 teaching plans for 3 h a week for 6 weeks and at the beginning of each plan, there was a 10-item pretest and at the end, there was a 10-item posttest. During class, the observation forms were used to collect the data on team working skills and desirable behaviors. The total time for the implementation of the 6 plans was 18 h.

At the end of the class, there was a posttest using the same 40-item test on environmental knowledge. The statistic used for data analysis was the Pair t – test.

**RESULTS**

**Results on effectiveness index**

It was found that the total effectiveness index of the 6 teaching plans was 0.7290 with the index in each plan ranging from 0.6321 to 0.8109.

**Results on environmental knowledge**

The research compared the environmental knowledge and understanding of the students before and after the implementation of the 6 teaching plans. It was found that the mean score () of the students on the environmental knowledge and understanding before learning was 13.82 or 44.52% of the total score, which was lower than the 50% criterion set for measurement. However, after learning though the 6 designed teaching plans, the mean
score ( ) of the students had increased to 34.25 or 85.63%, which is much higher than the 50% criterion. When examining each plan separately, it was found that the mean scores of the 6 plans ranged from 4.05 to 4.48 or 40.50% to 44.80% of the total score, which were lower than the 50% criterion for all plans. After the implementation of the plans, the mean scores of the plans ranged from 8.35 to 8.60 or 83.50% to 86.00%, which were higher than the set criterion of 50% for all plans (Figure 1).

In addition, the students significantly had higher score after learning through the 6 designed teaching plans with the significance level of .05 (p<.001).

**Results on team working skills and desirable behaviors**

The team working skills and desirable behaviors of the students were investigated through the observation forms during the implementation of the plans. The results revealed that the mean scores on team working skills in the 6 teaching plans were from 8.73 to 10.93 or 72.75% to 91.09% of the total score, which was higher than the 50% criterion set for measurement. In terms of the desirable behaviors, the mean scores ranged from 9.95 to 11.33 or 82.92% to 94.42% of the total score, which was also higher than the 50% criterion (Figure 2).

**DISCUSSION**

The effectiveness index of the 6 teaching plans was 0.7290 and this means that the students were progressive in learning at 72.90%, which is higher than the 50% criterion set. This finding is in line with that of Siwina et al. (2009) who implemented teaching plans using good science thinking moves method with metacognition techniques for Mattayomsuksa 3 students and found that the effectiveness indexes of their teaching plans were from 50.00 to 70.97%, which were equal to or higher than the 50% criterion. The 6 designed teaching plans were highly effective probably because they were designed by integrating the good science thinking moves method with the metacognition techniques. The good science thinking moves method consists of five learning processes: connection, enquiry, reflection, truth revelation, and opinion comparison, and the metacognitive techniques include three aspects: intelligibility, plausibility, and wide-applicability. These scientific learning processes and metacognition aspects enabled the students to learn critically and provide them with an opportunity to develop their critical thinking skills (Siwina et al., 2009). While studying, the students were allowed to make an enquiry on what they were learning, search for evidence or answers for the enquiries they have, reflect their own ideas or opinions, discuss and compare their ideas or opinions to those of the others, and finally come up with the final answers or solutions (Mittlehldt and Grotzer, 2003). In short, the high effectiveness index of the plans resulting from the scientific learning process and metacognition techniques could promisingly help guarantee that the students learning through these teaching plans would have gained more environmental knowledge and understanding, better team working skills, and more desirable behaviors.

The students had significantly gained more environmental knowledge after learning through the designed
teaching plans with the significance level of .05. This finding is similar to that of Siwina et al. (2009), Sihapong (2010) and Budtha (2012). The 5 scientific learning processes and the 3 metacognition aspects of the plans enabled the students to learn effectively in class. This teaching method focuses on the development of critical thinking skills and makes use of the inquiry-based instruction processes. In class, the students will be asked to think about the topics they have learned and are learning and then they will have to compare their opinions with others enabling them to critically express themselves and share their ideas with others. The good science thinking processes can help improve the students’ critical thinking skills. The students are able to examine their understanding to see the plausibility and compare their opinions with those of the others to see similarities and differences. The designed teaching plans also enable the students to learn through argumentation and discussion (Hogan, 1999). In addition, the metacognition techniques also help improve the students' environmental knowledge and understanding. The three metacognitive aspects: intelligibility, plausibility, and wide-capability can lead to the changes of student’s opinions after discussing and comparing their thought with peers and can provide the retention of the new knowledge learned (Blank, 2000; Georghiader, 2000); they can also help improve students' critical and logical thinking skills (Mittlefehldt and Grotzer, 2003).

While learning through the designed teaching plans, the students performed better team working skills (72.75% - 91.09%) and showed more desirable behaviors (82.92% - 94.42%). This means that the teaching plans designed under the good science thinking moves method with metacognition techniques can help improve students' team working skills and influence students to have desirable behaviors. This is probably because the scientific learning processes allow the students to work in group as they have to help one another to think, create a question, express ideas, compare ideas, and find a solutions. These processes cannot be done alone, so students have to work together to complete the tasks. As the designed teaching model also makes use of cooperative learning and the learning processes are conducted through the good science thinking moves method with metacognition techniques, the students are able to work in group and conduct cooperative learning activities (Scanlon, 2000), using the five scientific learning processes and the three aspects of meta-cognitive techniques as a guideline for learning. The students, then, are able to effectively practice team working skills. They learn how to share, listen, and respect the opinions of the others. The designed teaching plans direct the students to think critically with intelligibility, plausibility, and wide-applicability (Beeth, 1998) and enable them to develop their thinking processes in relation to what they have learned and are learning (Hennessey, 1999). Finally they will develop high order thinking (Livingston, 1999) as they think and compare their ideas with others leading to desirable behaviors in class (Mittlefehldt and Grotzer, 2003). The students are willing to participate in group activities and help one another to complete the assigned task. According to the law of exercise (Thurndike, 1939), the students were able to develop their knowledge and team working skills all the time during class. The cooperative learning generates the peer pressure and the desire to complete a good task causing the students to behave themselves and reveal more desirable behaviors in class.
This is the reason why the students had more desirable behaviors in class during the experiment at a rate of higher than 50%.

Conclusion

It can be concluded that the teaching plans designed under the good scientific thinking moves and metacognitive techniques can significantly help improve students' environmental knowledge and understanding, team working skills, and desirable behaviors and characteristics. It can be used as a tool for environmental education to improve environmental knowledge of young people so that they will use the knowledge gained to develop and conserve the environment of their communities for sustainable improvement of the country's environment and natural resources.

RECOMMENDATION

The good scientific thinking moves method is an inquiry-based approach and the metacognitive techniques is a higher order thinking-based approach, both of which can be integrated to design teaching plans for environmental education classroom. The teaching plans can help enhance the students' learning outcomes to meet the requirement of environmental education and literacy. The teaching model should be supported by related organization and should be used as a model for learning and teaching environmental knowledge in any level of educational institutions.

Conflict of Interests

The authors have not declared any conflict of interests.

REFERENCES


