Using the 4MAT Model to Promote Learning Achievement and Connection Skills on Chemical Reaction of the 10th Grade Students

Ramida Chittiwattanakorn[1]
Faculty of Education, Rangsit University, Thailand

Boonyaras Sookkheo[2]
Faculty of Science, Rangsit University, Thailand
boonyaras.s@rsu.ac.th

Abstract

This research is a part of the thesis on a topic of Using The 4MAT Teaching and Learning for Chemical Reaction to Promote Teaching Achievement and Connection Skills of 10th Grade Students. The purposes of this research were to (1) study the 4MAT lesson planning on Chemical Reaction for secondary education students at a school in Pathumthani province and (2) compare students' learning achievement and connection skills of 10th Grade Students before and after studying the topic. The subjects were 41 students obtained by Cluster Random Sampling. Instruments used in the research were (1) The 4MAT model lesson plan on the topic of Chemical Reaction (2) Learning and Teaching Behavior Observation Form (3) The Students' Achievement Test and the Connection Skill Test on the Chemical Reaction topic. Statistical analyses focused on arithmetic means, standard deviation and T-test. The results were (1) Most of the students who participated in the activity and could achieve 80% of correct content of the work pieces after going through the 4MAT Model and (2) The students' achievement and the connection ability of the subject were higher after the treatment with a statistical significance (p = .05).

Keywords: *4MAT model lesson plan, connection skills, chemical reaction*

1. Introduction

Learning management is an important tool to encourage learners to love learning. Teachers play an important role in learners' academic achievement. If teachers can create various types of activities to accommodate different abilities in learners, the learners can definitely benefit from those activities. Possible benefits are (1) learners will gain knowledge and will have positive attitude towards what they learn, and (2) learners can apply the knowledge in their daily life and acquire further knowledge in the future (Valaya Alongkorn Rajabhat University under the Royal Patronage, 2010: 3).

As different learning activities are believed to bring benefits, proper lesson planning is vital in increasing the learners' achievement and the learners' connection skills. There are different teaching and learning approaches that can be used to enhance learners' achievement such as Problem-based learning, Brain-based learning, 5E learning and CIPPA learning. Equally important as those approaches mentioned, the 4MAT model is another effective learning model because its lesson planning caters for 4 types of learners: Active Experimenter, Reflective Observator, Abstract Conceptualizer, and Concrete Experiencer. Besides, the learning activities described in the model can respond to both the left-side and the right-side of the brain (Sasithon, 2013). In other words, the 4MATS activities facilitate different types of learners, making them happy with learning

and activities that they feel comfortable to do. At the same time, the 4MAT provides a challenge and a satisfying response to the needs of the learner (Sukchai, 1999).

One of the advantages of 4 the MAT model is that it can be applied to all subjects and its activities are easy to perform in the classroom (Monthana, 2005). The 4MAT also encourages students to join activities, thus students have an opportunity to cooperate in the creation of work. Unlike the traditional method, the 4MAT model emphasizes evident development of the learners' connection skills for the learners to learn from understanding instead of memorization. Therefore, the tendency is high that the 4MAT model may increase learning achievement better than the traditional counterpart. This is consistent with Jang's (2013), which studied about "Bible" teaching. The content was "the geographical background of the Bible and its importance in studying the book of Genesis", "the Creation and the Fall", "true worship", and "true faith". The results of class achievement and aptitude test scores within individual groups indicate that the traditional lecture method is less effective than the 4MAT methods among adult learners in a Korean church context. The 4MAT lesson planning comprises 8 steps: (1) Creating experience (2) Analyzing experience (3) Concept visualization (4) Concept development (5) Practicing by concepts (6) Extension (7) Analyzing and application and (8) Exchanging experience (Kittichai, 2001: 32-41).

Therefore, in hope of enhancing learners' achievement, the researcher used the 4MAT model to promote learning achievement and connection skills on the subject of "chemical reaction" of the 10th Grade students through activities rather than memorization.

2. Research Objectives
1. To study the 4MAT lesson planning on the topic of "Chemical Reaction"
2. To compare students' achievement of the 10th Grade students before and after the 4MAT lessons on the topic of "Chemical Reaction"
3. To compare connection skills of the 10th Grade students before and after the 4MAT lessons on the "Chemical Reaction" topic

3. Research Methodology
The research methodology was described below:

3.1 Research Design
This is a classroom action research adopting the concept from Kemmis and Taggart (1988). The concept consists of 4 components: planning, action, observation, and reflection. In planning, the researcher planned the activity of 4MAT in "chemical reaction". Then, in the action step, the researcher used the plans developed earlier in the classroom. In observation, the researcher and the teacher mentor observed the learners' and the teacher's behavior. Next, the researcher categorized the observations into the learning and teaching behavior form. In the last step, reflection, the researcher considered the results to develop revision to the next plan.

3.2 The Subjects
The study participants were 41 Mattayom 4/1 students from Mathematics-Science Program. The group was obtained by Cluster Random Sampling. All of them studied chemical reaction in Semester 1, Academic year 2017.

3.3 Research Instruments

Three instruments were used in this research.

3.3.1 Experimental tools were 8 4MAT lesson plans on "chemical reaction", covering 12 fifty-minute periods. Lesson plans consisted of learning standards, content, learning objectives, content, measurement and evaluation, 4MAT instructional activities, instructional media, and records after using the lesson plans.

The 4MAT instructional activities included 8 steps on "chemical reaction"

Step 1: Creating experience (Right-side brain): the teacher prompts the learners to think about their experiences by giving questions relevant to daily life. This step is optimal for Reflective Observer type of learners.

Step 2: Analyzing experience (Left-side brain): the learners are made more curious by questions relevant to those in step 1, in order for them to consolidate their experience or knowledge. This step is optimal for Reflective Observer type of learners.

Step 3: Concept visualization (Right-side brain): lessons are taught and ideas are summarized by the teacher and learners. This step is optimal for Abstract Conceptualizer type of learners.

Step 4: Concept development (Left-side brain): the learners integrate the concept with their daily life. This step is optimal for Abstract Conceptualizer type of learners.

Step 5: Practicing by concepts (Left-side brain): the teacher leads the learners to the experiments or activities. This step is optimal for Active Experimenter type of learners.

Step 6: Extension (Right-side brain): learners are offered the opportunity to create their own work freely. This stage will expose learners' different personalities. Their work can come in the form of a video presentation, a booklet, a pop-up and a slide presentation. This step is optimal for Active Experiment type of learners.

Step 7: Analyzing and application (Left-side brain): the teacher offers the opportunity for learners to analyze their work before they modify the work again. This step is optimal for Concrete Experiencer type of learners.

Step 8: Exchanging experience (Right-side brain): the learners analyze their peers' work and rate each. This step is optimal for Concrete Experiencer type of learners.

3.3.2 Reflective tools were:
- The Learning Behavior Form
- The Teaching Behavior Form

3.3.3 Evaluation was from:-
- A test on chemical reaction, designed by the researcher.
- The Students' Achievement Test containing 30 questions of 4 multiple choices
  - Accuracy of the content and relevancy to the purpose is between 0.5-1.00 IOC.
  - Difficulty is between 0.20-0.80 and discrimination is between 0.50-1.00.
- The Connection Skill Test containing 9 questions of 6 short answer tests and 3 Fill-in-the-blanks

o Accuracy of the content and relevancy to the purpose is between 0.5-1.00 IOC.

4. Data Collection

The researcher collected data by using the 4MAT lesson plans on "chemical reaction" topic with the students in the study. The steps of data collection were as follows:

1. The researchers asked for collaboration from the targeted school for one classroom to conduct the research. It was Matthayom 4/1.
2. The researchers studied the background of the students and informed the students of the 4MAT lessons.
3. The researchers gave the pre-test to the sample subjects.
4. The lessons were taught according to the 4MAT lesson plans.

The 8 lesson plans covered 12 fifty-minute periods. Details of the lesson plans are below:

- Chemical reactions   2 periods
- Equilibrium balance   1 period
- Factors affecting rates of chemical reactions   2 periods
- Factors affecting rates of chemical reactions (Continued)   1 period
- Chemical energy   2 periods
- Rate of reaction   1 period
- Chemical reactions in daily life   2 periods
- Summary of chemical reactions   1 period

5. The data was collected with records after using the lesson plans, which in turn were analyzed to reflect the efficiency.

5. Data Analysis

The researcher and the teacher mentor conducted the analysis using the Learning Behavior Evaluation Form and the Teacher Behavior Evaluation Form as major reflective tools. Also, they analyzed the students' achievement and connection skills of the subject on "chemical reaction" from the results of the tests mentioned earlier. Arithmetic means, standard deviation and t-test of comparison pre- and post- lesson were obtained.

6. Results

The results of this research are in 3 sections.

6.1 Results from the 4MAT model lesson plans

The results of the 4MAT instructional activities from the Learning Behavior Form and Teaching Behavior Form, and 8 steps of instructional activities on "chemical reaction" were as follows. At Step 1 (Creating Experience), it is found that the learners based their answers on what they experienced and the answers tended to go in the same direction. At Step 2 (Analyzing Experience), the learners started to provide a variety of answers, reflecting their own individual opinions. At Steps 3 and 4 (Concept Visualization and Concept Development), these steps showed that the learners perceived abstract ideas and conceptualized them into knowledge very well. It is noticeable that, at these stages, the learners started to question, showing their curiosity and enthusiasm in the lessons. Moreover, a change in answering questions was also observed. They started to give answers formulated from collaborative learning and summary with teachers and peers, instead of depending solely on their own experiences. At Step 5 (Practicing by Concepts), Active Experimenters type of learners were very enthusiastic in the

experiment or activities, as evident from enthusiasm in preparing the equipment and role assignment. At Step 6 (Extension), learners' different personalities were exposed. Their work could come in the form of a video presentation, a booklet, a pop-up, and a slide presentation. With only the topics assigned by the teacher, the learners could connect topics and summarize ideas to create the work. These activities developed connecting skills in the learners as they could relate knowledge and took initiative to create the work. Moreover, their work was more than 80% accurate for every part of "chemical reaction" topic and they could create the work that reflected their achievement of all the sub-topics under "Chemical Reaction". At Steps 7 and 8 (Analyzing and Application, and Exchanging Experience), the learners analyzed their own work and rated their peers'. Most learners preferred this activity because they received feedbacks from their peers and put forward their feedbacks too. Since they were not willing to underrate their peers' work, judgment on the work was rather biased. This was when the teacher stepped in to take part in giving justified rating to the work.

As demonstrated, the 4MAT lesson plans can respond to the 4 learning types of the learner: Active Experimenter, Reflective Observer, Abstract Conceptualizer, and Concrete Experiencer. It is found that each learner can show the characteristics of more than one type and can respond better if the characteristic he/she has is supported by teachers and peers. Moreover, most of the students were attentive to the activities in the classroom. After the 4MAT lesson planning was implemented, they could create pieces of work that demonstrate the accuracy of more than 80% of the content.

6.2 Comparison of Students' Achievement Pre- and Post-4MAT Learning Activities on "Chemical Reaction"
Students' achievement post-4MAT learning activities increased significantly (p =.05). the Pre-4MAT score was 11.27 (SD = 3.905), while the Post-4MAT score was 19.10 (SD = 3.904).

6.3 Comparison of Students' Connection Skill Pre- and Post-4MAT Learning Activities on "Chemical Reaction"
Students' connection skills improved significantly (p = .05). The Pre-4MAT score was 3.54 (SD = 2.237), while the post-4MAT score was 10.54 (SD = 2.367).

7. Discussion
The 4MAT lesson plans on "Chemical Reaction" covered 12 fifty-minute periods. Lesson plans consisted of learning standards, content, learning objectives, content, measurement and evaluation, 4MAT instructional activities, instructional media, and records after using the lesson plans. From the activities in the lesson plans, it is found that a learner possesses more than one learning characteristics, depending on how much that particular learner understands the content and activities. If the learner already has some understanding of the content, he/she can better show potential and is more ready for activities than those who have no knowledge of the content. The lesson plans of the 4MAT model could encourage learners to learn from activities with their peers in the classroom. It was found that most of the learners enjoyed the activity and cooperated with the activities as well. Moreover, learners were able to create work that reflected their connection skills about the topic with more than 80% accuracy. However, the 4MAT model has some limitations. If the teacher does not have sufficient understanding of the aptitude of the learners, some learners may not succeed in learning. In addition, the

4MAT model takes a long time because there are 8 steps in the learning procedure. As a result, the teacher should make clear lesson plans to achieve precise time management before teaching (Kittichai, 2001: 165 -166).

After the 4MAT learning activities, the learners' achievement was found to have increased significantly (α =0.05). The Pre-4MAT score was 11.27, while the Post-4MAT score was 19.10. This is in line with the study from Kantikan's (2008), which studied the learning outcomes and problem solving abilities on substances in daily life of the sixth grade students taught by 4MAT approach. The results showed that 4MAT lessons increased the learners' achievement significantly, as evidenced by the post-test results. The findings were also consistent with Nissara's (2010), which was a comparison of the eighth grade students' learning achievement in Khlong Si-suphab poem by using the 4 MAT learning cycle strategy and the traditional method. The result was that 4MAT yielded a better score and the score was significantly different.

The tenth Grade learners' connection skills improved significantly. The Pre-4MAT score was 3.54, while the post-4MAT score was 10.54. This is consistent with Sunantha's (2013), which studied the effect of the 4MAT teaching and learning on mathematical achievement and mathematical connection skills in measurement of the eighth grade learners. Her subjects gained a higher score after the 4MAT lessons and it was statistically significant at the probability level of 0.01.

8. Conclusion

The 4MAT lesson plans on "chemical reaction" can respond to the ability to learn in 4 types of learners: Active Experimenter, Reflective Observer, Abstract Conceptualizer, and Concrete Experiencer. It is found that each learner can possess the characteristics of more than one type and can respond better if the characteristics he/she has are supported by teachers and peers. The 4MAT learning activities also effectively engage learners to the activities and take part in learning and creating work pieces that contain the content of more than 80% accuracy. According to the results of the study, learners' achievement of the 10th Grade students improved significantly (p =.05) after the 4MAT lessons. Moreover, their connection skills improved significantly after the 4MAT lessons (p=.05). Regarding its limitations, the researchers suggest that the 4MAT lesson planning takes plenty of time due to various steps. Therefore, each activity should be compact and with a clear description. Since the 4MAT allows learners to do a presentation, time should be allocated appropriately so that the lesson can be covered in a designated period.

9. The Authors

Ramida Chittiwattanakorn is a graduate student in the M.A. Program in Teaching Science at the Faculty of Education, Rangsit University, Thailand. Her current research is in the area of science education with a focus on chemistry at the secondary school level.

Boonyaras Sookkheo, Ph.D., is an assistant professor in chemistry. She is currently Head of Chemistry Department at the Faculty of Science, Rangsit University, Thailand. Her research focused on protein chemistry and chemistry education.

10. Acknowledgements

11. References

Jang, J. D. (2013). A comparative analysis of three instructional approaches to teaching the Bible in selected Korean churches (Order No. 3570153). Available from ProQuest Dissertations & Theses Global. (1398883837).

Kantikan, S. (2008). A study of learning outcomes and problem solving abilities on substances in daily life of the sixth Grade students taught by the 4 MAT Approach. Thesis of Master of Education. Department of Curriculum and Instruction Graduate School. Silpakorn University. Thailand.

Kemmis, S and McTaggart. R.(1988). The action research planner. Geelong.Victoria: Deakin University Press.
Kittichai, S. (2001). The Science's activities that depend on equality of student's brain (4MAT Model). *Academic Journal*. 4(1), 32-41.

Monthana, W. (2005). The 4MAT system. SU. *Education Research Journal*. 4(3), 42-53.

Nissara, W. (2010). A comparison of Mathayomsuksa two student learning achievement in Khlong Si-suphab poem by using 4 MAT learning cycle stratgy and the conventional method. Thesis of Master of Education in Teaching Thai Language. Silpakorn University.

Sasithon, W. (2013). The Usage of Social Networking Sites for Education in the Higher Education Context, Proceedings of the AHFE 2016 International Conference on Human Factors, Business Management and Society, July 27-31, 2016, Walt Disney World®, Florida, USA , 225-238.

Sukchai, N. (1999). Learning and teaching follow by 4 MAT system. Journal of Education : Faculty of Education. *Srinakharinwirot University*. 2(12), 12-26.

Sunantha, B. (2013). The effect of the 4MAT teaching and learning on mathematical achievement and mathematical connection skills in measurement of Mathayomsuksa II students. *Veridian E-Journal*. 6(3). 193-207.

Valaya Alongkorn Rajabhat University under the Royal Patronage. (2010: 3). *System Guide for Student centered*. Pranakron Sri-ayutt