Chapter 4

Research Result

The research on science teaching profession development on learning management to promote scientific thinking skill of Mathayom Suksa 3 students using lesson study was aimed at 1) developing the learning provision to promote scientific thinking skills of Mathasom Suksa 3 students, 2) studying the roles of the school administrators, teachers, and students in the process of learning provision using lesson study, and, 3) studying the opinions of the school administrators and teachers on the teaching profession development focusing on learning provision using lesson study.

The science teaching profession development on learning management to promote scientific thinking of Mathayom Suksa 3 students using lesson study was carried out along the procedural steps both before and during the actual operation in the second semester of 2 0 1 1 academic year. The operation was carried out in 3 parts as follows:

Part 1 - Results of the development of the learning management of science teachers to promote scientific thinking skill of Mathayom Suksa 3 students.

Part 2 - Results of the study on use of lesson study of the school administrators, the teachers, and the students in the learning management using lesson study.

Part 3 - Studying the opinion of the school administrators and the teachers concerning the science teaching profession development on learning management using lesson study.

Part 1 - Results of the development of learning management of the science teachers to promote scientific thinking skill of Mathayom Suksa 3 students

The development of the learning management to promote scientific thinking skill of the Mathayom Suksa 3 students was carried out through 4 phases as follows:

Phase 1- Studying the context and condition of science learning management

The process was done through focus group taking part by the principal, the deputy principal on academic affairs, head of the science strand, and 6 teachers who taught science subjects at Jae Hom Wittaya School 2 of whom at Mathayom Suksa 1, 2, and 3. The focus group was done on July 27, 2010, at Wittayasan Meeting Room, to reflect on the results of science teaching in the passing academic year. It was found that everyone had agreed that the learning management carried out so far was based on the model requiring the students to work out along the procedure or methods prescribe in the textbooks closing their opportunity to design the learning method themselves. Most of them would do what the teacher told them to do. If the teacher had not ordered them to do, they would not think nor express their ability in thinking to the peak of their capacity. The forum had consulted concerning the possibility of changing the instruction to emphasize more on having the students plan and search for knowledge by themselves. The researcher had proposed the guideline for developing the learning management to open the opportunity for the students to construct knowledge through inquiry process along the scientific process to promote the student's scientific thinking. The school administrators then had propose to develop science teacher using the learning management basing on knowledge inquiry to promote the student's scientific thinking and had every science teacher take part in the process.

Phase 2 - Organizing the teacher workshop on learning management to promote the student's scientific thinking

After the reflection on science learning management at lower secondary education level using focus group in Phase 1, the school had carried out the science teaching workshop as suggested by the school administrator on the guideline to organize the learning to promote scientific thinking and inquiry learning with Assist. Prof. Dr. Pongsak Paenkaew as the resource person taking 2 days at Romchart Meeting Room, Jae Hom Wittaya School. After the resource person had guided and built up the understanding on inquiry method and learning through 4 steps of scientific process, namely, 1) questioning/problem identifying, 2) hypothesis setting, 3) hypothesis testing, and, 4) concluding and presenting the study, each of all the teachers participating in the workshop had implemented it by writing up a learning managing plans using inquiry along his or her understanding and presented to have it

recommended by the resource person to improve it. From this training workshop, every participant could write the inquiry-based learning plan to have the students learn through scientific process and improve it along the resource person.

Phase 3 – Building up understanding on lesson study

Besides, having changed the process of learning management to open opportunity for the students to enquire knowledge themselves through the learning activities that promote the student's scientific thinking resulting of the science teachers having been developed in phase 1, there was an agreement to develop the science teacher to be able to develop their own profession to satisfy the needs and suit the school context. The researcher had proposed the new method of developing the learning management using lesson study and preliminarily explained about the procedural steps of the lesson study making everybody interested to study tour on the lesson study process having been operated in the real situation. The researcher had suggested study tour to study the condition of learning management using lesson study Thongchai Wittaya School, Muang Lampang District, Lampang Province, which was a school operating the mathematics learning management at primary education level using lesson study to the point of success serving itself as the model of school affiliated with the Office of Lampang Primary Education Service Area 1 and coordinated for the study tour on every step of the lesson study process for 3 times during 2nd and 3rd week of August, 2011, and took part in the lesson opening activities set up on September 7, 2011, opening for every school administrator and teacher to see the real situation of lesson study process and became interested in and believed that they could apply the lesson study in Jae Hom Wittaya School.

After the study tour at the school actually operated by using the lesson study, in order to assure the clear understanding on lesson study, a workshop was organized for the target group school administrators and the teachers at Room 3302, Faculty of Education, Chiang Mai University, with Lect. Dr. Anchalee Tananone and the team serving as the resource persons who provided knowledge and details as well as responded to the questions raised on the issues still doubtful enabling them to have mutual understanding and confidence and insisted to use the lesson study process.

Consequently, during the phase of building up understanding on the lesson study, this research would use the process in 2 forms, namely, the study on the authentic condition in the school organizing learning using lesson study process and the training facilitated by experts to build up correct understanding on lesson study, particularly the assumptions and points of caution concerning each of the steps the lesson study process as well as the important issues which had to be clearly set up in developing the plans together.

Phase 4 - Carrying out the development of the learning management to promote scientific thinking using lesson study

This phase was for the operation of the learning managing development to promote scientific thinking using lesson study in every week of the 2nd semester, 2011 academic year, along the 3 steps of lesson study cycle, namely, setting up the learning managing plans, implementing the learning managing plans, and classroom observation, reflection, and conclusion. After everyone had knowledge and understanding on the learning management to promote scientific thinking and lesson study process, the operation to develop the learning management to promote scientific thinking of Mathayom Suksa 3 / 9 students, Jae Hom Wittaya School, was carried out. The researcher in collaboration with the teachers had analzyed and set up the learning plans for teaching Mathayom Suksa 3 science subject by dividing its content into 5 learning units for the learning activities taking 20 weeks for 60 hours the details of which are as tin Table 4.1 as follows:

Table 4.1 Results of analyzing and organizing learning managing plans for Mathayom Suksa 3 science subject

Unit No./Unit Topic	Standards/Indicators	Duration (hours)	Task
1. Force and Motion of Objects	Sc.4.1 M.S. 3/1 -3 Sc..4.2 M.S. 3/1 -2	15	Experiment Report
2. Work and Energy	Sc..5.1 M.S. 3/1 -3 Sc..5.2 M.S. 3/1 -2	10	Experiment Report
3. Universe	Sc..6.1 M.S. 3/1 -3 Sc..6.2 M.S. 3/1 -2	10	Knowledge Concluding Document
4. Heredity	Sc..1.1 M.S. 3/1 -3 Sc..1.2 M.S. 3/1 -2	10	Knowledge Concluding Document
5. Biodiversity	Sc..2.1 M.S. 3/1 -3 Sc..2.2 M.S. 3/1 -6	15	Science Project
Total		**60**	

In organizing the learning activities to promote scientific thinking of Mathayom Suksa 3/9 students using lesson study, in all of the 5 learning units, the teacher had organized the learning activities that required the students to enquire knowledge themselves at every step. Starting from step 1 - confirmation inquiry, step 2 - structural inquiry, step 3 - guided inquiry, and, step 4 - open inquiry.

In setting up the learning activities in this semester, every concerned side from the school administrators, teachers, and students, had lent their cooperation in developing the learning management. Each of the participants would take role in various ways. Through this, the researcher, as a superintendent, would facilitate and provide advices in case the teachers had doubt or were unclear about carrying out

various activities by observing and note taking the behaviors that occurred along the semester of which the results are as in Part 2 that follows:

Part 2 – Results of the studying the roles of the school administrators, the teachers, and the students in carrying out the learning management using lesson study

In the teaching profession development on learning management using lesson study carried out in second semester, 2011 academic year, for all the contents learned, there were 5 learning units taking 60 hours to carry out lesson study in 3 steps, namely, step 1 – setting up the learning management plans, step 2 – implementing the plans in the classroom and classroom observing, and, step 3 – reflecting and concluding the learning results every week, the details of which are as follows:

2.1 Roles of the school administrators in learning management using lesson study

From the notes taken during observing the behavior and roles of the school administrators and the motion recorded which was transcribed to summarize the crucial behaviors occurring in each of the learning units enabling the researcher to conclude the significant roles of the school administrators in carrying out the lesson study along the period of changes as follows:

Step 1 - Setting up the learning management plans

Unit 1 – During the first 3 weeks, it was found that during the teachers working together to set up the learning management plans, both of the 2 school administrators would sit in distance to observe and walked in to raise some questions and stimulate the teachers to help one another in setting up the plans and then sat closer. Having found that the teachers had not yet a clear planning, the school administrators had suggested them to use the plans previous set that were on similar content to start with and served as the guideline for setting up the learning management plans. The adjustment was done on the learning activities making them focus more on having the students to think and put into practice. In most of the operations, the school administrators would sit in distance and would and keep asking if the teacher would need the instructional media and equipment used for organizing activities. Sample of the administrator's advices in the 2nd week is as follows:

" *During the time we work together on planning, let 's see what media, materials, or equipment we need. Are these available in our science lab? If there are needs for buying them or any other things, please make a request via the Learning Strand Head and Deputy. I wholeheartedly support...*"

The principal, November 11, 2011

Units 2 - 5 – When the school administrators had observed that the teacher had clearer roles and guideline for setting up the learning management plans and could systematically work together, both of them would open the opportunity for the teachers to work freely, express ideas, and set up the operational plans to the full extent. They would walk out of the room and continued their task somewhere else and came back later during the presentation on the learning management plans before implementing them in the classroom.

Every week, after the teachers had presented the learning management plans, the administrators would ask about the readiness of the existing learning resources, media, and equipment and other additional materials and supplies needed by the teachers for organizing the learning activities for the students. They also asked the personnel and the concerned others to set up the places, learning resources, and facilities for the teachers to use in setting up the learning managing plans before implementing them in the classroom. The school administrators would conclude and recommend on important issues on organizing the learning activities in every session.

Step 2 - Implementing the plans in the classroom and classroom observing

After the teacher had completed the planning on learning management of step 1, the teacher would put the learning management plan to set up the learning activities in the classroom observed by the 2 school administrators using the learning management planned collectively set by the teachers as the guideline for the classroom observation. The main goal of the observation was to observe learning behaviors of the students reflecting their scientific thinking. In each of the week, the school administrators would have a notebook as a main tool. While observing the students engaging in the activities and finding the event or behavior expressed by the students along the issues of interest, the teacher would note down onto her notebook. Besides

noting down the student's learning behavior, the deputy principal on academic affairs would also use camera to take photo of the work or variety of behaviors of the students to use them in the presentation in the Step 3.

Stet 3 – Reflecting on and Concluding the Learning

Reflecting on and concluding the learning would be carried out after the teachers had implemented the learning plans during which the classroom observation was carried on along the continuous process as follows:

Unit 1 (Weeks 1 - 3) - The school principal took the role on reflecting the learning results having the teacher who had taught did it first. She would reflect on her own learning management and had other teachers, the deputy principal on academic affairs, and the researcher respectively reflect on them. As it was during the initial period of the research operation, it was found that the direction and issues of the teacher's reflection were not much clear. Most of them had reflected on general behavior of the students, such as they were not attentive, did not respond to the teacher's questions, or haggled over the work to be done, for example. Consequently, the principal had everybody to help one another to come up with the main issues to be observed to use the results in terms notes or photos as important evident to reflect on the learning management. The principal also stressed on the agreement on classroom observation focusing on the studying behavior of the students and warned the classroom observers not to ask or talk to them during the classroom observation.

In week 2 , the principal had observed that there were many observers coming in to the classroom and some of them walking around the room. He then suggested them to divide the area for the observation to assure their information collection being done in a comprehensive way. He reminded every observer to take photo and note down the behaviors that should be reflected on in the reflecting session. In the beginning, most teachers had reflected along their view than shown the recorded evidences. Then, the administrators helped conclude and asked about the things found by the teachers and the expression of the student's learning behavior occurring at each step to show if their scientific thinking skill had shown up and how.

Units 2 - 5–At this period, all research participants began to increasingly understand their roles at each step of the lesson study. Each of the teachers had used the information from their notes at each step of plans being implemented and results of the

classroom observation to reflect by describing the behavior and picture of their works that reflected their scientific thinking such as in Unit 2, in week 10, there were some observers reflecting on the activities engaged by the students that:

"The students of Group 5, after obtaining the equipment, would immediately consult one another. One of them drafted the things to be done such as

1. Experiment's question.....

2. Experiment's hypothesis.....

3. Experiment's method

3.1 Equipment

3.2 Experimental steps

4. Results of the experiment……

...etc.

A teacher, December 9, 2011

Meanwhile, another teacher reflected that…

"The student's experimental activities varied. The students in the group of the smart ones had helped one another engage in their activities to the end while those in the lower achievement group sat still doing nothing."

A teacher, December 6, 2011

The principal then reflected that "So far, we let students get into group themselves making ability of each group widely differed. Some groups carried out the experiment with a plan and actualized it until finished. Some other group had not known how to start and showed no group process as they should. Consequently, there should we a new way of grouping students. Each group should have students with variety of ability – smart, moderate, and weak. During the experiment, the teachers should have students sit turn facing the others and helped one another design and implement it along the steps."

When the teachers had reflected on learning management that had not yet achieved the goal in each week, both school administrators had suggested everyone to help adjust the activities by adding more motion media, clips, or learning resources outside classroom enabling the students to learn by themselves. In each week, the school administrators would summarize the results of the operation on lesson study project and appreciated all of the teachers who had helped develop the learning activities and preparing various media to be used in the classroom. They also encouraged everyone to bring in the phenomena or events to be applied in organizing the learning activities in their own classrooms.

Every week, the school administrators would ask about the results of observing the student's learning behavior from the notes taken by each teacher. When every teacher had finished the reflection, the deputy principal on academic affairs and the researcher would add up with the parts not yet reflected. Before the session ended, the principal would summarize the main issues occurred in such week and had everyone propose the guideline to improve and develop the learning managing plans in the week to come.

Hence, it could be concluded that along the 3 steps of lesson study in this research, the school administrators had taken 3 main roles as follows:

1) Providing the needed facilities and supports for the teachers

From the information analysis, the trends of behavior were found as follows. Every week the school administrators would ask about readiness of the materials and equipment and various learning resources to be used in the learning managing activities. They had regularly provided supports and facilities for the teachers. These are reflected in what the school administrators always said, such as:

"*…I have told the official to take copy of the plan materials or the sample of works produced by all of us. It you have any document to have them copy, please give them up to have it more conveniently done....*"

"*...Today, are there any documents or other materials to be made copy? From now on, you should compile the materials to be used for 3 periods and then give them to the official so that they could make the copy for you to get things prepared...*"

The Principal, November 11, 2011

When the teachers had reflected that some students had come up to consult on the instruction which they would like to have it changed from the present one which was of slow process to the new one in which the teacher summarize the content so that they could obtain the knowledge in time for entering the test competition, the principal would come in to the class and build up the understanding for the students in their time free from the classes and described about the activities for supplementary teaching specially for the purpose of test competition.

In every time for setting up the learning management plans to have the students carry out the experiment, the school administrators would ask about the equipment and materials to be used in the experiment to assure the readiness before implementing the plan in the in the classroom. These are reflected in the expressions typically made by the school administrators after the teachers had presented the learning management plan at step 1 of the lesson study, such as:

"... What equipment is needed for this experiment?..."

"... Now, do we have enough equipment?... "

"...What else do you need?..."

"...We have to be prepared and had to check well on the equipment, particularly the new ones which we have added to from the previous plan. If there is something wrong, we could then correct them in time... "

2) Recommending and providing the development guideline

The analysis on the trends of behavior has revealed that:

In each week, if there were some issues to be improved, corrected, or added up to the operation to make it clearer and more goal achievable, the school administrators would asked about them and make some comments after listening to the presentation, such as:

When the school principal found the points made in step 2 of the lesson study, he would note down and reflect on them in step 3 of the lesson study to provide guideline for improving or modifying behavior in the week to come as shown in the following advices:

"...Don't we forget the agreement....the classroom observers have to come in the classroom to observe the student's learning behavior reflecting scientific thinking along the four procedural steps. If we found something, we should note them down to later reflect. We should help conclude our roles in the classroom observation. Next week, we then could improve our observation. Don't forget our agreement, please?

The Principal, November 7, 2011

"... Having students working in group in the class where the students sit in rows would block some students in helping their group-mates carrying out the activities. Hence, during the engagement of the group activities, the teacher should have them sit facing one another and keep encouraging them to carry out the activities together…"

The principal, November 18, 2011

In the presentation on learning management plan on force and motion on which the students had to experiment on different surfaces, the principal had provided recommendations as follows:

"… I think for this plan, we should come up with the materials with variety of surface for the students to choose to try on. We may then see new method of experiment designed by the students...."

The Principal, December 9, 2011

Meanwhile, the deputy principal would always stress on the control of the variables such as:

" … What variables does this experiment have...Concerning the scientific experiment, don't forget to control the variables too such

as the sphere which when used in the experiment, we have to control its size. They must be the same ..."

Deputy Principal, December 23, 2011

" ...In conducting scientific experiment, don't forget to control variables like when we use sphere, we need to control the size and texture of it. They must be the same...."

" ...Next week, there will be the mid-term test, we have to work two weeks ahead of time, don't you think? ..."

Deputy Principal, December16, 2011

3) Motivating and providing moral supports to the teachers

The analysis on the trends of behavior has revealed that:

Every time when noticing that the teachers were encountering with the problems or obstacle during their setting up the learning managing plans, both administrators would walk in and ask and provide advices for the correction as, for example:

While the teachers were working together in planning organizing the learning activities for unit 1 during weeks 1 – 3 , they all were worried about the student's learning behavior. The students were quiet, not talk, and did not like to respond. The teacher had reflected that such behavior shown on the students was not the nature of students in this class. Some students came up to consult her and suggested that she should teach the way she previously did for fear that they would not be able to do well in the test competition. The school administrator had commented that:

"I think it is probably not a big issue. It's only new and the students might not get used to it. After we had passed this point, the students would come back to thank us in having provided opportunity for them...."

The principal, November 11, 2011

In setting up the learning management plans for unit 2, the principal had noticed that the teachers began to be clear in their roles and had helped one another in solving

the problems and providing various recommendations. After the teachers had finished the presentation of learning management plan, the principal said that:

> *"...I am glad to see you all set up the instructional plan together and having heard you guys present with all the information, I feel good as so far, I have only sat down doing only the documentary check. What you have presented has shown a clearer view of the classroom. Should have any question or something to suggest, please right away do it..."*
>
> The Principal, November 11, 2011

Meanwhile, the deputy principal would keep on suggesting on the appropriateness and constraints and provide the way out for the operation. For the learning management on unit 2 on energy whose part of the content had thing to do with calculation, the deputy principal on academic affairs had proposed that:

> *"...In this plan, there should be a provision of some background knowledge before the students actually do the experiment for 1 hour in advance. What we have had might not be appropriate. Let's switch and consulted with other teachers. Anything you want me, as the deputy principal, to do it, please speak up...."*
>
> Deputy Principal, January 13, 2012

Every week, the school administrators would thank the teachers who had come to help one another set up the plans and solve the occurring problems such as:

> *"Seeing everyone happily works like this, I am glad and thank you for your devotion and sacrifice. The results gained from the work we all have helped today would have an impact on us and our children...."*
>
> The principal, December 16, 2011

"...Thanks everyone to devote on the work. I have seen you all have helped one another in working and solving the problems, dividing duties and responsibilities, and coming punctually every time. Some week, I could not come the join the activities but had followed up with the superintendents and found that everyone has been well engaging in the job. We might not see its results right away but I truly believe the process we are promoting would surely have positive impact on our students for sure..."

The Principal, December 23, 2011

In setting up the learning plan for the lesson opening activity which was the last plan the teachers had helped carried out in this semester, the principal had concluded as follows:

"...In working in team, we have consulted and worked together to set up the plans for the work. You can take whatever process or method well usable with your work and have them up as academic work, please go ahead. Regarding the instruction, whatever you need to develop, please tell me. I would fully support for sure...."

The Principal, February 17, 2012

2.2 Roles of the teachers in the managing learning using lesson study

From the note on the observation on behavior of the teachers taken by the researcher and analysis on the motion pictures, it could be concluded that the key roles of the teachers along the procedural steps of the lesson study as follows:

Step 1 - Setting up the learning management plans

Units 1 - 2 – In the beginning, weeks 1 – 3, each teacher had not yet well understood her roles as much as possible. Everyone would expect that the Mathayom Suksa 3 teacher who would teach to set up the learning management plans and prepare the instructional media first before they would come in and provide

additional suggestions. They had kept asking the superintendent (the researcher) on setting up the plans and the instructional media that should be used. Sometimes, they had the Mathayom Suksa 3 teacher to prepare the media for the convenience of setting up the plans making the learning management plans for units 1 – 2 have no various instructional media and equipment for the students carry out the activities on the scenario having created by the teacher but only the question along the issues of such experiment.

From week 5 onward, every the teacher would prepare the content and sample the media to be used during the step of gaining attention from the students but still lack of clear ideas on the scenario or questions to guide the students in designing their learning such the failure to set up the condition for controlling the variable for the experiment, the students designed the experiment without the variable control causing the experimental results of some group erroneous.

Units 3 - 5 - The teachers started to understand their roles. Every one of them now came to help one another in analyzing the old learning managing plans already taught by them to analyze and plan again. Everyone had opportunity to express opinion and had begun to take their role leading to the collaboration in planning to organize the clearer learning activities. The teachers had apparently understood their own roles when the **appointment time arrived, everyone would come up with the document containing indicators and textbooks and samples of instructional media. Sometimes, they arrived before the time and had sat there waiting for the appointed time to come.** In working on the planning, they would examine so far what learning activities the students had carried out. All these pieces of information were acquired from asking Mathayom Suksa 1 and Mathayom Suksa 2 teachers.

There were 2 – 3 weeks when some of the teachers could not take part in the activities but had asked friend to bring the materials, media, or contents they had prepared to the session. All the teachers then helped one another in pointing out issues and revise the learning activities focusing more on having the students think and practice by themselves. All teachers were determined and paid attention to set up the learning management plans. They took out the school activity calendar to check and set up the plans to design the activities, tasks, and assignments for the students to do and learn from various learning resources out of the class. The session reflected the clear

collaborative and supportive atmosphere. When realizing the problems raised in the reflective session, everyone would consult and help one another to solve them. Each of the teachers had come to fully understand her own roles. Every week everyone would help set up the scenarios and the learning management plan, questions at the end of the activities, media and equipment to be used each time. They had worked together to have all these done week by week. In setting up the learning management plans for these units 3 – 5 taking 5- 6 weeks, the teachers had collaborated and most of the time was devoted to the selection of the media and scenarios that fitted the content sometimes beyond the time scheduled but everyone was determined to have the works done for every week. The general atmosphere reflected the collaboration though once in a while there were some quarrels which could be settled down later on leading the success of the learning management planning every time with some laughs occasionally.

The learning management plans collaboratively set up again by the teachers participating in the research had differed from the old ones. This was mostly clear at the step of surveying and discovering as in the old plans the teachers had set up the procedural steps of the experiment and result recording table, as well as the format of reporting the experiment's results for the students to put into practice and record the results along the steps set all on which regarded as the knowledge enquiring in level 1 – enquiring knowledge to confirm the information, and level 2 - enquiring structural knowledge. The new plans would assign the scenarios for the students to analyze the issues, set up the hypothesis, design the experiment, and concluding the results and presenting the experiment findings. All these would be freely carried out by the students along the agreement of the group. In some activities, the teachers had provided the equipment for the students to choose to carry out the experiment in various ways which was the level 3 of knowledge inquiry- the guided inquiry, and, level 4 – the open knowledge inquiry. The difference between the learning management using 5 Es process in the old and new learning management plans is shown in Table 4.2 below.

Table 4.2 – Difference between old learning management plan and the one emerged as the result of teaching profession development using lesson study

Instructional Steps	**Old learning Management Plan**	**New learning Management Plan**
1. Engagement	**The teacher** reviewed the content and prescribed the issues for the students to examine	**The teacher** set up scenario **The students** discussed and identify the problem themselves
2. Exploration	**The teacher** prepared the equipment, set up the experimental procedures and result recording tables **The students** followed the prescribed procedure.	**The teachers** set the scenario and equipment. **The students** planned the experimental steps and methods by themselves by freely selecting the equipment and form of presentation along the group's consensus.
3. Explanation	**The teachers** led the discussion on the result using the post-experiment question leading to the conclusion. **The students** responded to the post- experiment questions and collaboratively conclude the results.	**The teachers** chose 2 groups of the students that had the most complete work or unique work to present each week and used questions to lead to the discussion to derived the conclusion. **The students** of every group presented the work assigned opening for everybody to study the work done by other groups and raised the question on what they had doubt with.

Table 4.2 (cont.)

Instructional Steps	Old learning Management Plan	New learning Management Plan
4. Elaboration	**The teachers and the students** worked together to conclude by adding more knowledge via variety of media and materials.	**The teachers** encouraged the students to take part in the discussion on their learning results. **The students** worked together to conclude the knowledge and propose the guideline for their application of it.
5. Evaluation	**The teachers** evaluated the student's work.	Evaluated by **the teachers**, **the students**, and **classmates** in other groups.

From Table 4.2 it is found that the new learning managing plans which the teachers had collaboratively developed along the lesson study process has change on the teacher's roles and the learning activities which now opened for the students to think and put into practice to build up one's own knowledge. The sharp difference is at the level on exploration as the students now have more autonomy in setting up the procedure and method of the experiment, choosing the equipment and model of the presentation of the experiment by themselves.

Step 2 – Implementing the plans in the classroom and classroom observing

In this step, there was one teacher taking part in setting up the learning management plan at step 1. This was the teacher who would teach. She had utilized the learning management plans to set up the learning activities in the classroom while other planning participating teachers would come in to observe the classroom. They had come up with the issues through their note taking and motion pictures. The issues

would be presented below separately between those the teacher who had taught the class and the teachers who came in to observe the class as follows:

2.2.1 The teacher who had taught

Unit 1 (Weeks 1-2) - The teacher who taught had put the learning management plan into teaching in the classroom. Most of the activities were carried out in front of the class. The teacher had not walked around to observe the students while engaging in the activities. This might be due to the fact that there were others who came in to already observe the students.

After the school administrators had reflected and suggested the teaching teacher to walk around observing students engaging in the activities as there might be students in some groups having questions or carrying the activities with misunderstanding. The teacher who taught should use the question to assure the correct understanding on part of the students and walked around to observe the students engaging the activities to collect information for choosing group of students to come to present their work in front of the class for the week.

In weeks 13 – 14, the teacher who regularly taught was sick and could not come to teach as usual. Another Mathayom Suksa 3 teacher then took her charge to teach in the classroom and could carry out the instruction as normal.

2.2.1 The classroom observing teachers

Unit 1 (weeks 1-2) – The classroom observers had not well understood their role. Sometimes, they would walk up to some students and encourage them to answer the question or carry out the studying activities. When some students asked question, the observer would explain to make sure the students understand. Every teacher had made note on the observation and recorded the student's behavior in general than along the ones that reflected the scientific thinking of students, such as *" The students have not responded to the question* or "*The female students who sat at the back rows sat still not engaging in the experiment…*" for example.

Units 2 -5 – After the reflection, understanding assurance, and agreement mutually made concerning things to be carried out by everyone in the classroom observation, every teacher had changed her behavior and methods on classroom observation. Every week, before entering the class for the observation, the teachers would study the learning management plan, prepare a notebook to record the findings

from classroom observation. Some brought a camera along to take photo to record the student's behavior or works to be used for reflecting in step 3. While observing the classroom, the teachers would not get close to the student to ask nor to advise them while they were engaging in the activities. Everyone had the goal for observation which was to clearly notice the student's learning behavior and record it down onto her notebook to be used in the reflective process such as:

> "…*Group 2 students worked together to solve the problems as follows...*"
>
> *"...Experimental procedure of Group 1 was..but that Group5 would differ. It was..."*
>
> *"... The students in Group 3 had drafted the procedural steps of the experiment before actually doing it... "*
>
> *"...After carrying out the experiment along the procedural steps, 2 of the students had done it in addition to what had been designed by using the scarf and winter cloth as the surface..."*
>
> *...etc.*

Step 3 – Reflecting and concluding the learning results

The information recorded in the notebook and the analysis on motion pictures reveal roles of the teachers in reflecting and concluding the learning results as follows:

Units 1 - 2 – From the reflection on learning management in this phase, it was found that every research participating teacher had anxiety and uncertainty on her role in using lesson study process. Consequently, they had not sufficient issues to reflect. Most classroom observation would reflect on the activities and the teacher's instructional process than the student's learning behavior. The principal then concluded the important issues and emphasized on the classroom observation focusing on the student's studying behavior.

Units 3 -5 – Reflective process had been more **clearly** carried out. Through it, every teacher would use her notes to reflect on the student's learning and found that the students had begun to get used to the learning management process that focused on the scientific thinking skill. Everyone had similarly reflected that in carrying out most of

the activities, the students from the smart group would finish their task first while other groups particularly that of the male students who sat in the back would wait to copy from the work of other groups. The teachers then agreed to readjust the grouping by distributing divert ability students in each group which would now have strong, moderate, and weak students in.

The reflection on thinking behavior of the students reveals that most students had not analyzed the questions on the scenario but token action right away. Some of them did not know what to do with the equipment provided by the teachers. Thus they came to agree that the teacher would be the one who stressed the crucial issues to be pursued by the students who had to think about and design their own experiment with clear procedural steps before taking action.

The reflection had eventually clearer. Everyone would reflect on the issue on the scientific thinking behavior along the steps basing on the notes from their notebook and the recorded photo on it. Photo taken on the student's works were presented as well in the session assuring the effective reflection. When any problems were sensed, everyone would discussion on them and recommend the solution. In Week **1 5 ,** a participant had reflected about the space which was a difficulty matter to explain. It was observable that most students were confused and could not finish the assigned activities in time. Each teacher proposed the ways to help students to understand the content better. These included the supplementary teaching using extra period showing clips on the space and space technology. The session also reviewed the old content for the students. Consequently, the learning plans for Week 16 then started with the review of old knowledge. Every teacher had collaboratively raised the questions for content review. Clips concerning space available in the internet were used to help the students review the contents previously learned before moving to the new content.

The main roles of the teachers in carrying out the lesson study cover the behaviors whose details had been synthesized as follows:

1) Working together in setting up the learning management plans

In each week before every session on setting up the learning management plans, the teachers would help one another analyze the learning standards and indicators for Mathayom Suksa 3 science strand to organize the learning activities to achieve along the indicators by using the old learning managing plans on the same or

similar content as the guideline for the operation. The process also included the discussion on the contents and learning activities carried out at Mathayom Suksa 1 and 2 to review the content and design the activities to assure the continuity of learning. These were reflected in the teacher's comments on the important issue as shown below.

In the weekly session taken part by all the teachers to organize the learning management plan, a teacher would come up with the leading role in carrying out various activities including the research process to check on the colleague teachers on the knowledge on and the details of the activities that corresponded the content to be used for setting up the learning management plan for each learning unit to assure the clarification and continuity of and avoid overlapping on the contents. Some of the conversations in the session are as follows:

> *"...So far, what have we taught in M.S. 1 and M.S. 2 so that we could set up the activities in a continuous way..."*
>
> Teacher 1, November 11, 2012

> "*... This class of M.S.3 is the first class to use the 2008 core curriculum which has the learning substances along the learning standards distributed at all grades. The learning substance on force, for example, are leaned from M.S. 1 to M.S. 3 though they might differ in their complication and depth of the contents which are usually more complex at higher level. Why don't to use the indicators to analyze and set up the activities for it?...*"
>
> Teacher 1, November 11, 2012

When everyone had analyzed the learning standards and indicator and found the activities prescribed the indicators were about scientific experiment, they worked together in identifying the methods and equipment to be used such as:

> *"...This indictor expects the students who are to carry out the experiment have to have the experimental equipment. What equipment do we have? There are enough of them in the science lab. If not, the*

principal has told us to file a request to buy them through the materials and supplies section..."

Teacher 2, November 18, 2011

"...I could help check it out what we have in the lab to see if we need something else..."

Teacher 3, November 18, 2012

"*...I think this experiment is interesting. We could find other equipment for the students to think about some experiments in addition to those already decides. Any of you who has a good idea, please help think it out..."*

Teacher 1, December 16, 2011

2) Building up the network to facilitate the collaborative operation

Every week, the teachers would get together in team to find the information volunteer to find/prepare the equipment to be used in organizing the activities. Each of the teachers would express opinion and sometimes when there was some disagreement, they would discuss to fine the conclusion for the week. While the teachers were mutually setting up the learning management plan for unit 1 on acceleration, 3 of them had reflected on the ambiguity of the scenario prescribed making students in many groups unable to conduct the experiment to answer the question posed by the scenario. Every teacher then helped one another to come up with ways to deal with the situation as shown in the following quotations.

"*...So far, most students had not understood the questions posed by the scenario. Next time, we should check their understanding and ask other teachers before having the student actually work on the experiment. We could then try out our equipment too....*"

Teacher 1, November 25, 2011

"*...Yes, I agree. I also saw the students in Group 4 conducting the experiment with trial and error. Yet, we have forgotten the matter of variable control on the direction of the object....*"

Teacher 3, November 25, 2011

" ...Now that we have had the scenario, let's think about the experimental equipment. What do we need o need? Let's also guess what the methods possibly used by the students are..."

Teacher 2, November 25, 2011

In Unit 3 on the universe carried out in the 15th week, there was the content on space. Most teachers reflected that the students had not involved in the activities as the content was complicated and it is the matter not clearly visible. There were some recommendations for modifying the activities of the week as follows:

"..This matter is quite hard to understand. So far, the students have not been interested in carrying out the activities. Thus next week, we should review their existing knowledge. Let's find some interesting motion media to stimulate them. What do you think?..."

Teacher 1, January 13, 2012

3) Working together to reflect on and conclude the results of organizing the learning activities

Though in the beginning, the teachers still had not done well on the reflection as they had focused on general learning behavior of the students than on those that showed their scientific thinking process. The Principal then had reflected this out and pointed to the significant goal of the classroom observation and the notes on the occurring events while the students were engaging in the learning activities. Consequently, in every week, every teacher had to bring along the notes, photos, and other recordings done during each of the classroom observations to reflect on it in the session. If it was found that there were some issues to be further developed, some would recommend the session participants should work together to deal with them such as shown in the following excerpts.

"... The students had not analyzed the questions on the scenario. When the teacher finished her explanation, they started doing it right away. Some didn't even know why the teacher brought it such equipment..."

Teacher 4, November 18, 2011

In the experiment for Unit 1 on friction, when an observant teacher observed that the students in certain group had used other materials beyond what supplied by the teacher, the observer had noted down and later on reflected on it as follows:

"... The students in Group 4, after conducted the experiment using the material given out by the teacher, they used their scarf to pave down as the surface. Everybody seemed very excited about it..."

Teachers 1, November 25, 2011

Besides reflecting on the activity engagement at each session, the teachers would also reflect the picture of change resulted from their participation in the lesson study, for example:

"..Nowadays, the students are not concerned with us. They have begun to talk loudly. After the teacher had them start doing the activities, they worked together to design the plans and enjoyed their experimentation and were very excited when they got new materials to experiment on...."

Teacher 2, February 10, 2012

After every teacher had brought along their notes and photos taken during the classroom observation to the reflecting session, all teachers would help conclude the issues of significant learning and findings from the lesson study to improve and solve the problem occurring during the process of setting up the learning management plans for the weeks to come such as:

In the experiment on buoyant force, the teacher had students tried it with materials of various form and put it in eureka cup filled fully with water and observe the change occurring. This experiment, Chao Phraya eggplant was an object used. The teachers reflected on it as follows:

" ...In this experiment, we use Chao Phraya eggplant in which we could not control the variable on shape nor size of it. The result could be erroneous. Next time, we should control the variable on size and shape of the object too..."

Teacher 1, December 29, 2011

Meanwhile, Teacher 4 added that:

"Not only eggplant that has problem. Oil clay also has problem. If we have the students use it but forgot to mention about the mass. Some of them put two blocks together and work on it..."

Teacher 4, December 29, 2011

After the teachers had collaboratively carried out the lesson study for a semester, the teacher who taught had brought learning management plan collectively developed by everyone to carry out the learning activities in the classroom had reflected her feeling as follows:

"...So far, I have to thank all my senior colleague teachers who had helped set up the plans and suggested how to solve the problem occurred. I have to admit that before when we made the plans ourselves and teach them ourselves, without anybody coming in to look at, we sometimes lacked of comprehensive view and could not get all the details on the students. This semester, there are friends coming in to help. Thank them a lot...."

Teachers 3, February 24, 2012

2.3 Roles of the students in learning through the scientific process

At this time, role taking of the students on learning through the scientific process occurred only at the step of implementing the plans in the classroom and classroom observation. The focus would be on studying the student's learning behavior in the classroom in 5 learning units consecutively carried out for 20 weeks.

The details of role taking of the students synthesized from the notes and motion pictures as follows:

Units 1 & 2 - Concerning **t**he student's learning behavior performed during the initial phases, it was found that the students were excited and confused with the change that went on in the classroom. This might be because there were many teachers including the principal and the deputy principal on academic affairs coming in to observe the class making it quiet. Most students sat still and had not responded much to the questions. They had not talked. When the teacher had students work out the activities which they had designed themselves, most of them would not do anything but waited for the teacher's order. There would be only 2 groups which could carry out activities by themselves thought they had to keep asking the teacher about the procedures. While they were engaging in the activities, if an observer came close to observe, the students would draw back whatever they were doing, facing down, dared not speak, write, nor do any activity.

Unit3 - After the students began to get used to organizing the learning activities focusing on scientific thinking process along the learning management plan teachers had collaboratively and classroom observation by the group of teachers and school administrators, the student's learning behavior had changed. The students now had not paid attention to the classroom observers. They would play, teased one another, talked loudly, etc. When the teachers asked any question, they would right away answer. Nonetheless, there were some issues to be developed further. That was the scientific process skill. Students jumped to do the activity without having studied the questions in the scenario assigned by the teacher. They had not displayed the methods nor steps of learning along the scientific process having shown no clear behavior of scientific thinking. Consequently, in most activities, the high achievement student would lead and act out the scientific experiment for the learning unit making the group activities coming up in arbitrary way without any planned process or consultation within the group. Concerning the presentation design, every group would focus on decorating their work causing the delay of the group work.

Unit4 & 5 – After the teacher had stressed on the working process having the students evaluate the group process of the nearby group and take action on the activities along the scientific process, the students' learning behavior reflecting scientific

thinking skills were more evident. After the teacher had assigned the scenario or topic on which the students had to examine, the students would begin to discuss within the group to find the conclusion on main questions posed by the scenario. After having identified the scenario questions, everybody would helped one another in proposing idea, planning the experiment, and attempting to find out the answer to the questions and set up the procedural steps to collectively perform the tasks. The process included the sequential procedural steps and drawing of the operational procedure before helping one another in carrying out the activities along the procedure set by the group after which the results were recorded. Those who were talented in art would volunteer the group to design and decorate the work for the presentation in the proud way. The works created by the students for the presentation would come up in many forms such as table which included both horizon and vertical dimensions. Students in certain group presented their work by descriptive essay or drew picture or chart to supplement the description, for example.

When the teacher had students do the experiment giving variety of equipment for the students to choose to use in the experiment along the scenario. The students had designed their learning process by prescribing the equipment for the group to use in the experiment. When they actually conducted the experiment of the group, some students conducted additional experiment using the equipment other than the ones chosen. Some group used other equipment other than those prescribed by the teacher, such as in the experiment on effect of surface. After the students conducted the experiment using the equipment prescribed by the teacher and had some time left, the students tested with other kinds of surface such as book cover, scarf, and winter cloth and the likes. After every group had finished the activities, the teachers would ask 2 volunteers from each group to make the presentation. Many students raised hand to volunteer to do it. The teachers then chose the group that had the most perfect performance or the group that differed from the rest. The students from every group had to post their works on the board back of the classroom to open the opportunity for every student to study their classmate's work. They could write the question or statement of appreciation on the work on a small piece of paper attached near the work. These would be counted as the score given to the work as well. It was apparent that the students were active in carrying out the activities of their group while students in some groups had begun to modify

their group presentation method from previous in easy form to be with tables drawing to supplement the learning activities. Students had consulted among one another in the group and had designed the process of carrying out activities with clear procedural steps. They drafted the experimental model before put it into practice. They also divided labor among members of the group and followed the steps as planned.

The student's scientific thinking skill had developed step by step. In the beginning, the students ask and follow the advice given by the teachers every time before putting it into practice. They had carried out the activities on trial and error basis. They had not studied any information nor designed the procedural steps in advance. They dared not express opinion nor took action with confidence. When the teacher had opened the opportunity for the students to think and put into practice themselves encouraging everyone to follow the scientific process, the students had begun to have self-confidence and had acquire scientific thinking skill which was clearly evident when they were studying in the learning units on biodiversity. The students had divided themselves into groups to study the community's problems and set up the scientific projects to solve them which was level 4 of the knowledge inquiry process – open approach in which the students were to identify the problem and design the inquiry process themselves. They had come up with 4 projects, namely, 1) Smog reduction, 2) Organic fish food, 3) Check dam, and, 4) Wastewater herbal treatment. Students in every group had proceeded the operation as follows.

Step 1 - Identifying problem

1) The student worked together to survey the problems on environment found in their community.
2) The students searched for and analyzed the information to choose the problem best interested the group members.

Step 2 – Thinking about setting up the hypothesis

3) The students searched for and concluded the main causes of the problem from the documents and the consultation with persons who had been well-informed on the issue in the areas interesting to the students.
4) The students anticipated the methods to solve the problem.

Step 3 - Thinking about hypothesis testing

5) The student examined the information concerning solving the problem from the documents, discussing with the experts in the field, and searched for other concerning information from the internet using key words related to the problem and the nearby ones.

6) The students determined the method for solving the problem.

7) The students carried out the problem solving along the steps set.

8) The students compiled the information and recording the results of problem solving.

Step 4 – Thinking for interpreting the information and concluding the results

9) The students analyzed the results of problem solving.

10) The class discussed and concluding the problem solving results.

In organizing learning activities to promote scientific thinking of the students using lesson study process, every week the teachers would collectively set up the learning management plans, implement them in the classroom, carry out the classroom observation and reflect on the results, and and concluding the learning. The learning activities facilitating the students to think and put into practice in this research were carried out step 3 of knowledge inquiry – the guided inquiry and step 4 open approach inquiry which would guide and open opportunity for the students to design learning activities of by themselves in an independent way particularly on the learning units on biodiversity. The students would be the one who set up the topic of the scientific project on environment in the community along the problem conditions and interest of the students. Learning through scientific project was the process of open inquiry.

From the information recorded on the learning behavior of the students and reflection by the teachers and the school administrators, it could be concluded about the crucial roles and behaviors the students as follows:

1) Examining the information concerning the scenario to identify the problem and the main learning goals

Problem identification or the main learning goals of the students would clearly showed in units 4 and 5 as during the beginning period of units 1-2, most students had stuck with the old learning management approach in which the teacher prescribed the

experimental method, result recording table, and format of the presentation along the clear steps before having the students to carry out the activities along the definite procedure. After switching the learning method to be the one in which the students worked together to design the learning and plans on the experiment, initially, the students dared not think, plan, design, and implement the activities by themselves. Most of them would sit still waiting for the teacher to instruct. Nonetheless, there were about 3 – 4 students who came up and asked the teacher about the experimental method. When she guided the learning process, they would come back to explained to their classmates in the group through which the high achievement students would take the role to lead the activities and tell their group-mates to follow. 12 ก.ค. 58 อาทิตย์

In unit 3, the students had analyzed the scenario prescribed by the teacher and consulted among the group members and began to design the learning plans along their own procedural steps and the guide provided by the smarter friends in the group before working together in analyzing and concluding the main points of the group.

In units 4 &5 , one could see the change in learning behavior which was now clearer when the teacher had students engage in the learning activities. The students in each group would bring up the main issues or scenarios assigned by the teacher to share and discuss within the group. There are some questions raised or comments made in the session, for example, like:

"...For this one, what were the question the teacher had asked?..."

"...Wait, don't do it now. Let's help conclude the question first...."

"...Let's set up the objectives first so that we know what we have to do..."

The sampled pictures on students engaging in the learning activities reflects their planning process and information compiling to design the learning plans of the students, such as:

Picture 4.1- Students discussed to conclude the question issues

Picture 4 . 1 shows that after the teacher had assigned the tasks, the students would work together to carrying out the tasks. There were opinions raised and discussion in which some disagreement might occur while engaging in the activities. Each student would use the document or reference to support their points. If the conclusion could not be reached, they would turn to the teacher to consult or observe other groups.

2) **Setting up hypothesis and designing the learning activities**

Each week, after the teacher had prescribed the scenario, the students would analyze it and work together to set up the hypothesis and the experimental steps. They also designed the form for recording the experiment results before carrying out the activities. The behavior is apparent during the engagement on units 4 and 5.

When the students began to understand their learning roles in unit 4 & 5, there were students from the other 4 groups from seven of them, namely, groups 3 ,5, 6 and 7 came to help set the learning plans by writing up the procedure of the experiment and draft the model for presenting the results before actually conducting it while students in other groups would help one another in setting up the Experimental procedure but had not set up the plan for presentation in advance. There would be some expressions the students made during the learning plan preparation after the teacher had explained the scenario for the students in every group to carry out the activities, such as:

"...What is our hypothesis?..."

"...What are the independent and dependent variables?..."

"...What are there in the basket? Let's look up..."

"...In what way will be record the experiment results?..."

3) **Learning activities on hypothesis testing**

In the beginning at unit 1 & 2, the students would take action in trial and error way as they had planned or designed the activities in advance. The students would put into practice along their idea. When they saw other group could succeed the task, they would follow them.

In unit 3, the students began to have clearer direction for carrying out the activities because they had set up the plan to do the activities in advance to a certain extent.

In units 4 & 5, the students began to carry out the learning activities along the procedural steps as they had discussed and designed the learning method in advance. When they put it into practice, however, they encountered with some problems but they could work together to solve the problem to derive the best result such as in the learning activities on reaction and reaction in which the students had tied a balloon on a toy car and then let the air suddenly out of the balloon to observe the movement of the car. Afterward, the students had collectively discussed as follows:

" ...There is no space here. If we let the cars run here, they would collide. Let's put them in front of the classroom. The space is larger there ..."

A student in Group 2, November 29, 2011

"... I think if we try it with the small and big balloons. The distance they go would not he same. This means there are many variables related..."

A student in Group 1, November 29, 2011

Picture 4.2 - Students analyzing information and searching for reference information to make the presentation

Picture above shows the student's learning activities. They had worked together in carrying out the learning activities by using information from various sources to analyze and discussed among them such as:

4) Concluding the learn results and presenting the work done

In early period, units 1 & 2, the students had not dare to come out to do the presentation. They were not confident in their work. There were 2 or 3 groups of the students that could not finish the work in time available. This might be because they spent most of the time for doing the activities and did it on trial and error. When the students had increasingly understood their roles and had the plan to carry out their activities on a clear procedure. Later in units 4 and 5 , every group could finish the activities in time and they had helped one another in decorating their work and got set for the presentation. When the teacher asked the representative of each group to do it, each group would volunteer to present their group's work with pride. This is evident in the conversation they had among friends in the same group during engaging in activities in the classroom as in the following statement and pictures.

> *" ... How could we present the results of the experiment? Should we better draw the object and the arrow showing its moving direction?..."*
>
> A student in Group 4, November 29, 2011

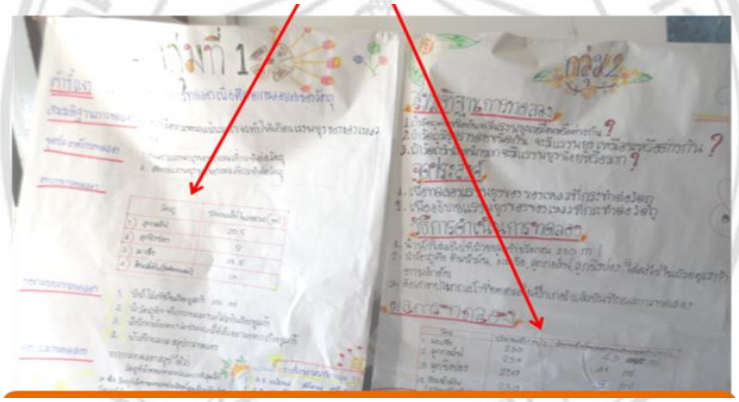
> *" ...When teacher asks us to do the make the presentation, let's we raise out hand. Our group has done well. I would like to show it off..."*
>
> A student group 6, December 23, 2011

The presentation made by the students had come out in variety of ways such as in presenting on motion of an object in unit 3 – universe included both the picture and mind maps as below:

Picture 4.3 – Samples of the work used in the presentation coming in various forms

From picture 4.3, we can see that when the teachers had opened opportunity for the students to design the learning activities by themselves, the students in each group would present their work in various ways. The left picture was the presentation on the direction of the motion displayed by using arrows to show the directions. The picture on the right side shows the connection among the motions and had been concluded in term of mind map.

Besides learning about the characteristic of heredity in unit 4, the students from 2 different groups could present in form of table but their tables differed as in picture 4.4.



Picture 4.4 – Samples of table learning results

In picture 4.4, we could see that the tables shown had differed. On the left side, the table showing learning results was of many rows and 2 columns while the one on right hand was of many rows and 3 columns. This reflects the student's freedom in designing their learning and the presentation in carrying out the learning activities. For the same assigned scenario, the students could choose to present the results in many different ways. This is clearly different from the previous time when the students of every group had to have the same format of presentation using eh form to record the experiment as assigned by the teachers. In the new model of presentation, the students were free to plan and design their group's work.

Concerning the presentation of the students, the teacher would ask the students to come out and present their work for 2 groups each week. The selection was done basing on the group's volunteer and their work which was perfect and had the issue to be added up and discussed by the teacher had led the class for discussion on the part diverted from the main scientific principles in each topic. The teacher also encourage the class to follow up the work of every group by examining the works which were on show at the space at the back of the classroom so that everyone could study the learning products and processed of classmates in other groups. During the period of carrying out the activities or after the presentation of each group, if the students had found that other groups had the methods and outcomes differing than those of their group, they would come back and consult their group-mates. Sometimes, they would insist on their work or the information having been used. Some other groups, however, had changed and revised their group's work to be congruent with the results of the experiment in the classroom as voiced up by a student and shown in the picture as follows:

> *" ...Our experiment results could be erroneous as they are different from that of other groups. What should we do? Should we ask the teacher for a new experiment? ..."*
>
> A student in group 6, November, 29, 2011

> *"...The presentation of group 5 was in table form. It is easy to read. Next time we'd better use the table..."*
>
> A student in group 2, December 16, 2011

Sample pictures on the student's works and presentation

Picture 4.5 - Presentation and studying on works of other groups

In the picture, the teachers had students in each group put up their works on the wall for the classmates from other groups could examine, question, or make comments on the works. Meanwhile, most students had noted down what they had observed and brought the issues to be discussed in their group to improve their work.

Main roles of the students in learning along the scientific process came up in 4 following forms:

1) Studying the scenario to identify the problem and main goals of the learning
2) Setting up the hypothesis and designing the learning activities
3) Testing the hypothesis
4) Concluding the learning results and presenting the work done

Lesson Opening

The lesson opening was the activity organized after the completing through the 3 steps of teaching profession development process using lesson study process for the whole semester and teachers as well as the administrators had jointly developed knowledge and understanding on lesson study process and could organize the learning activities that promoted scientific thinking achieving the goals set of Jae Hom Wittaya School. The research target group included the school principal, the deputy principal on

academic affairs, and 4 lower secondary education science teachers had organized the lesson opening activity on March 2 , 2 5 1 2 at Romchart Meeting Room, Jae Hom Wittaya School, to publicize the learning organizing process that promoted scientific thinking using lesson study for the concerned individuals and interested others to come and see the results of the lesson study which administrators and the teachers had collaboratively set up the learning managing plans and implementing them in the classroom observation and reflected on it to improve for effectiveness for the classroom instruction in the periods to come. In the lesson opening activity, there were 48 personnel from the schools in Payawang School Cluster, Office of Secondary Education Service Area 35 including 6 administrators and 42 teachers.

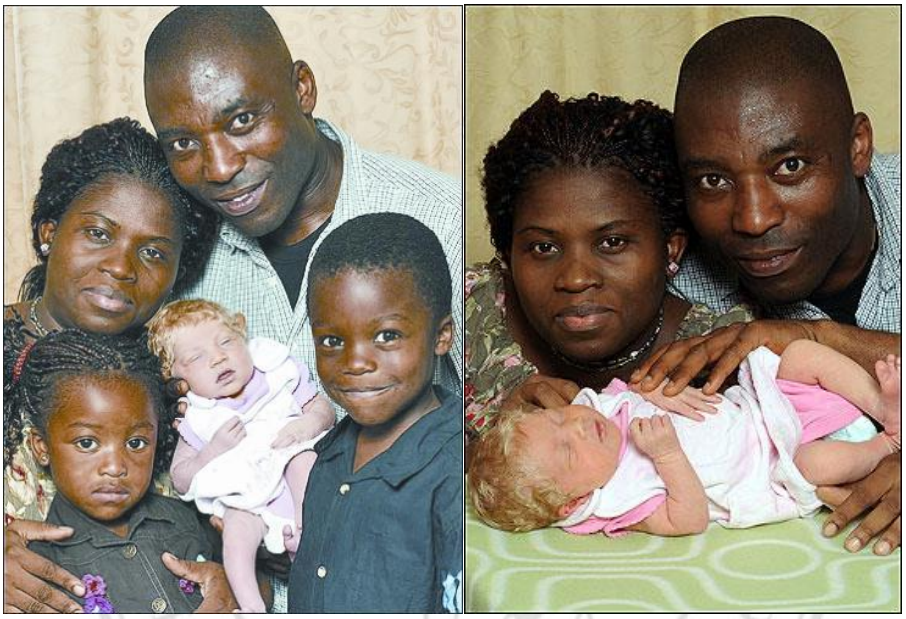
Before organizing the lesson opening activity, every teacher had discussed and agreed to use the content on heredity malfunction as the content for organizing the learning activities as it was the content whose scenario and method could be designed and allow the students to enquire knowledge in variety of ways enabling them to link to the knowledge previously acquired - the Learning Unit 4 on heredity

The activities would be set along the 3 steps of lesson study process, namely, Step 1- Learning managing planning, Step 2 – Implementing the plans in classroom and classroom observation, and Step 3 - Reflecting on and concluding the learning. The details of the operation are as follows:

The learning managing planning was the step in which the teachers had worked together in setting up the learning managing plans help on February, 17 2512, 01.00 – 05 .00 p.m. The session was carried out before the lesson opening activity for which the teachers had selected the content on heredity malfunction as the content for setting up the lesson opening activity as it was the content that could link to the knowledge previously acquired and had not been taught to the students in 3/9.

The researcher had observed and noted down the behavior of the target group individuals and found that when the appointing time came, every teacher had brought up the information and learning media on heredity malfunction to present and identified the issues of common interest. There were discussions on the scenario and media to be used in organizing the activities such as heredity-related and genetic disorder, mutation of living things, gene, and melanin malfunction and dwarf, for example. After everyone had presented the topic and media to be used for the learning activity prepared by

him/herself, the forum had agreed to use the term melanin malfunction as the seminar topic and use the scenario of Ihegboro family that had 3 children – the first and second of whom had black skin but having birth to the 3rd child with white skin as in Picture 4.6.



Picture 4.6 – Photo of Ihegboro family – a scenario for organizing the lesson opening activity

Using picture 4 . 6 made every teacher confident that the scenario set could stimulate the students to express ideas, set hypothesis, design the learning, etc. more than in other contents.

After a scenario was designed, every teacher helped one another in setting the questions such as what the student think about the photo of Ihegboro family, what were the crucial questions the students wanted to raise about Ihegboro family, students wondered why the 3rd child was with different skin color than everybody else, what hypothesis students had concerning the 3rd child of this family, etc. They the teacher had students to work together to design the method to get the answer for their hypothesis and collect the information to conclude the answer in a reasonable way. During organizing the learning plans, one of the teachers had asked her colleagues " From this photo, what do you think the student should answer the question?" The teachers had guessed the student's responses in various ways such as it was from the

melanin malfunction resulting from recessive gene that had just shown up. Other responses included generally white baby could be born with the mother who had married with white husband or simply the baby adopted. Afterward, the teacher had facilitated the class in setting up the learning plan starting from stimulating the interest of the learners by showing the photo and providing basic information about Ihegboro family. Then she had the students discuss and respond to the question raised from the scenario, set up the plan, and design their own learning through the 4 steps of scientific process, namely, problem identifying, setting hypothesis, testing the hypothesis, and concluding the results and reporting the work done.

After obtaining the learning plans with all needed learning processes, they were presented to the administrators and both of them approved the learning organizing process as set in the plans and expressed their appreciation to the teachers who had together worked out the learning plans which came out well for every week. Besides, the school principal had expressed his appreciation to and provided moral supports for all the teachers that:

"*...This set of learning managing plans should be the best plans we have done so far at everybody had total readiness. I have seen the list of answers expected of the students. Such expectation could serve well as the framework for the lesson study making it clearer...*"

Before spreading apart, the Principal had enquired about the division of functions and responsibilities of the teachers in each of the lesson opening activities. The division of labor was as follows: Teachers 1 and 2 were the ones who had prepared the media and equipment to be used in carrying out the learning activities. Teacher 4 prepared the documents on the learning managing plans and other ones for distributing to the participants and Teacher 3 who would lead the implement of the instructional plans would be the one who explain the details and procedural steps of carrying out the activities in the learning managing plans to make the participants well-informed before actually use them in the classroom.

The lesson opening activity was held on March 2, 2512, starting with the school principal welcoming speech and then introducing to teaching profession development to promote scientific thinking using lesson study process having been operated at Jae Hom Wittaya School in the passing semester. There were variety of development forms

such as focus group to reflect on the result of learning management for science subject, workshop led by experts to build up knowledge and understanding on learning management to promote scientific thinking of the students, study tour on lesson study process at Thongchai Wittaya School, and the seminar to build up the clarification on the lesson study process, suggesting, and responding to the questions raised by the audiences and the experts. The essential points of the lesson study were summarized for one more time before continuing it consecutively for 2 0 weeks covering 5 learning units. After that, the researcher had explained the details and agreements on various steps of the operation of the lesson study, particularly that on classroom observation in which the teacher would allow the classroom observer to come in to the class to observe the student's learning behavior by noting or taking photos but would not talk or question anything to the students.

When all the participants had gained understanding on the operation, the lesson opening activity began by the teachers showing the learning managing plans set in advance to ask the participants to explain about the scenario to be used for the learning activities and the step of the learning management to be operated in the lessons study opening session. The process would open opportunity for every participant to observe the class in which the activities would start from the teacher had students analyze the scenario of Ihegboro family set and asked students in each group to discuss and design the learning activities of their group. As the study had learned through all steps of the scientific process, the study had learned to think and put their designed model into practice assuring their scientific thinking skills including the thinking to identify the problem, to set up the hypothesis, to test the hypothesis, and to interpret the information, and to conclude the results.

From the observation and synthesis of the information having been recorded, it was found that after the teachers had presented the scenario and had the students carry out the learning activities of their own group, every student help one another in discussing to identify the problem to be studies such as why the second child of this family had white skin, what had happened to this third child of the family, whether gender had anything to do with the skin color, whether any ancestors of this family had an white skin, etc. When the key questions were raised in each group, every group member would help set up the hypothesis of the group such as it could be because of

the malfunction of the gene that determined the skin color, the hereditary transmission of the recessive genes, the white skin parents, adopting a child from other family, for example. When the group's hypothesis had been settled down, the students would divide labor among them to enquire the information to support their hypothesis from variety of sources such as textbooks, internet, chart on cell division and genetics, etc. Then basing on the analyzed information, they made the conclusion to respond to the issue to test the hypothesis of their group reasonable and reliable bases. Student in Group3 and Group 7 could not find any information to support their group's hypothesis stating that *The third child was born to another father who had white skin* and *She was a child of other family adopted by this family.* They then consulted and changed the hypothesis to it could be due to the hereditary transmission of recessive gene. This newly obtained hypothesis of Group 3 was probably because of their notice on the activity out carrying of the nearby groups. The new hypothesis Group 7 , meanwhile, wad obtained through their discussion for one more time basing on the former hypothesis proposed on the genetic malfunction but had not been accepted as the hypothesis of the group at that time. When students in every group had got the hypothesis and searched for the information to support their explanation, they helped one another to make conclusion. Majority of them wrote up the family chart to respond to the hypothesis which had assumed that the abnormality of the 3rd child of Ihegboro family was due to the genetic transmission of the recessive gene from the ancestors to the descendants on and on and clearly shown on this child. Part of the students, however, proposed the answer by writing to show the reasoning of their group.

During the teachers and students were carrying out the learning activities in the classroom, there would be the classroom observation carried out by the co-researchers and other participants. From the observation and notes on the behavior of the classroom co-observers, it was found that every co-researchers had come in to observe the student's learning behavior and note down the information onto the notebook while some other participants would come close to the students to observe their activity carrying out and there was one participant walked to or ask students on the activity being carried out. Another classroom observer had walked to the person and told him/her not to ask nor advise anything to the student who were engaging in an activity making the students of such group continued carrying out the learning activity of their

group as normal. They designed, planned, discussed, and expressed ideas and tried to find the informatioto support their hypothesis in reasonable way not caring if there would be other persons besides their teacher coming in to observe their class as in Picture 4.7.

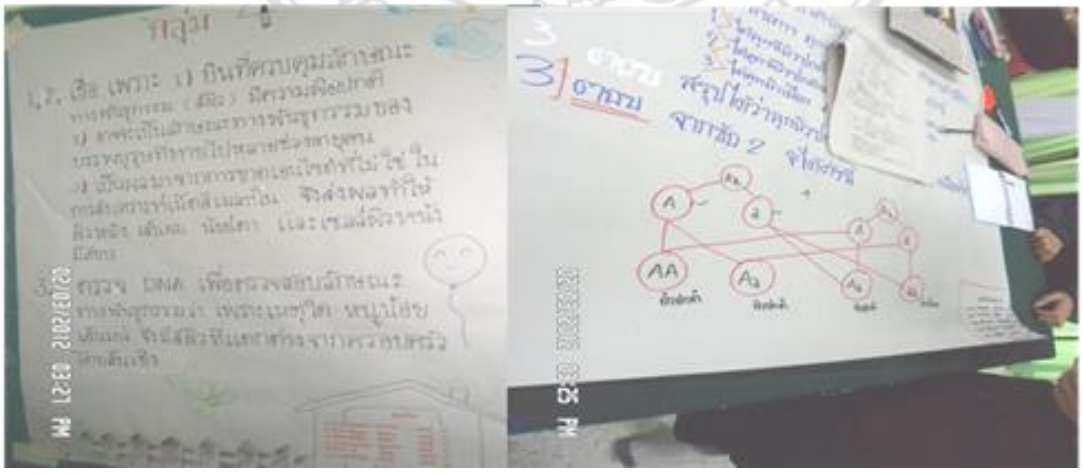
Picture 4.7 – Students discussed together and expressed their opinion to make the conclusion for their group

From Picture 4.7, it is shown that when the students had seen the photo on the scenario assigned by the teacher, they had discussed and expressed their ideas. While a friend was discussing, some students in the group would try to search for the information from the documents or internet to support the ideas and worked together to go on making conclusion for their group with determination without paying attention to the classroom observer as in Picture 4.8.

Picture 4.8 – Students continuously engaging in their activities without paying attention to the classroom observers

From Picture 4.8, it could be seen that the teachers had the students carry out the learning activities on the assigned scenario on which the students in every group would help one another in analyzing the scenario, identifying problem, and setting variety of hypotheses. After they could settle down on the hypothesis of the group, the students would help one another plan and enquire for the information from various sources such as documents and internet to support their discussion in the group. While carrying out the learning activities, the students paid attention to their activities ignoring the individuals who had come in for the classroom observation though most of the classroom observers were strangers and had never come in to their class before.

When students in each group had acquired their answer, they would work together to decorate the work to present it in front of the class. The presentation was done in various ways with various media including the descriptive writing, the display of the cell division and genetics chart, and drawings. Every group would present their work in form of posters attached on the wall on the spot prescribed by the teacher. When every group had posted on their work, the teacher would call up a representative of 3 groups to make the presentation. The groups were selected basing on their complete display of their group's work and the diversity of these three selected groups as shown in Picture 4.9.



Picture 4.9 – Presentation of the students in the forms that differed

After every student had walked up to study the work of their classmates, if they had noted the difference from that of their group, they would come back to their group

and discuss and expressed their unique idea. Students in Group 5 returned to the group and rewrote the cell division and genetics chart after having observed the works done by other groups.

At the end of the learning activities in the classroom, the students would walk out to study other subjects. The school principal had continued the activity at the step on reflecting the results of the learning management starting by the teachers who had reflected on the learning as follows:

" …Students in every group had displayed the process of their learning along the step in a perfect way. Students in Groups 4 and 6 had the hypothesis that differed leading to the discussion and searching for the information to support their answer..."

After that, other teachers had reflected on the student's process of obtaining the answer, such as:

"...A student in Group 1, after obtaining the hypothesis, had searched for the answer by typing the family the teacher prescribed in the scenario to search by google and the student could get the answer right away. Next time, we should use pseudonym instead…"

A teacher, March 2, 2512

" …When students had made the conclusion that it was due to the genetic transmission through many generations, to insist with the answer, students in every group would write the chart to show the hereditary transmission with pride…"

Teachers 4, March 2, 2512

After all of the administrators, teachers, and researcher had reflected results of the classroom observation, the school principal had the teachers to conclude together their learning results. Everyone agreed that, in this learning management, the students had demonstrated their scientific thinking skill by having been able to set up the plans, implement them, engage in the learning activities, and conclude the results of their learning on logical basis.

Moreover, the school principal had opened the opportunity for the other participants of the lesson opening activity to reflect and express their ideas or ask something about various issues

" …Does it take a long time to have the students carrying out the activities to ignore those who came to classroom to observe...."

" … If the teacher was few and had not had time to collectively set the plan, what should be done?..."

"...In art subject, what method did you use to have the students think and do it by themselves?..."

"*...If the teacher had not told nor wrote down and most students did not do anything, what should we do to have students to set up the plan and learn by themselves like this?..."*

"...Having had opportunity to teach students in this class, I feel that later on now, when having thing to do, the students would have issue to discuss and have not easily believe in anything as they did before...."

As the time was limited, the school principal tried to respond to the issues raised by talking about the lesson study process that had been tried all along the semester. He compared the learning behavior of the students from sitting still saying nothing nor playing nor expressing any idea at the beginning. After the teacher had assigned the activities in which the smart students could lead the activities and others followed. Any time, if they found something wrong during the classroom observation, everyone would note down and reflected on it for the improvement such as the change in grouping students from before to the new one with students of mixed ability to open the opportunity for the students to see and learn from their friend's work and bring it to improve their own work. They then got the reinforcement or rewarding from evaluation by themselves, friends, or teachers, for example. This kind of learning organization had been carried out continuously making the students familiar with the process and eventually changed their learning behavior. The result had eventually been clearer particularly in the learning managing activities in Learning Units 4 -5 . The Principal was confident that the lesson study process could help the teachers to develop their instructional activities utilizing team work and it could be used as well in every subject.

Phase 3 – Results of the studying the opinion of the educational personnel concerning the teaching profession development on learning management using lesson study

At this step, the researcher had used the focus group to conclude the operational results and ask the opinion of every research participant concerning the teaching profession development on learning management using lesson study on the results and concept of the teaching profession development using lesson study process. After carrying out the science teaching profession development using lesson study for a semester, the reflective session was held on March 7, 2512, at Pittyasan Meeting Room, Jae Hom Wittaya School. The conclusions drawn from this forum as as follows:

Both administrators had agreed that the teaching profession development using the lesson study process had been operated resulting the following points:

1) The participation of the administrators in the lesson study had led to the significant change on their roles. Formerly, they focused mostly on approving the learning activities to be on supporting, promoting, and facilitating as well as helping solve the problems occurring in the learning organizing process of the teachers relevant to the problem and the real conditions of the school.

2) This science teaching profession development using lesson study could be used as the guideline for developing the learning provision for other subjects as well. The teachers had got together to discuss the impacts on the teachers after using lesson study process. The teachers had agreed that:

1) The teachers had developed learning organizing process, particularly on the instructional planning in which they worked together to find resources, media, and equipment for learning differing from the guideline previous used by each individual teacher making the instruction more effective than that thought and planned individually.

2) The teachers had working network by which everyone had collaborated in planning and solving the problems and managing the learning provision on weekly basis. Moreover, the teachers had implemented the instructional plans had on the results of science teaching profession development using lesson study process they had encountered with as follows:

1) They had more confidence in providing learning to the students as the learning management plans had been collaboratively thought out and planned by members of the teacher group and had been approved by the school administrators.

2) They had motivation to carry out the learning management as the administrators and their colleague teachers had paid attention to every detail in every operational step.

Besides, every administrator and teacher had agreeable opinion on the student's learning behavioral change which contended that:

1) The learning provision that opened the opportunity for the students to think and put into practice by themselves would make them dare to express ideas and present their work with confidence.

2) The learning activities through lesson study process developed so far could facilitate the students in building up scientific thinking skill, carrying out planning, and implementing along the procedural steps on systematic basis. They had accepted opinions of others and used the information and reasons to support their decision making.