Implementing Scientific Method to Strengthen the Student's Scientific Attitude: A Study on Grade8 Students of Cheasim Samaky High Schools in Biology

ការអនុវត្តវិធីវិទ្យាសាស្ត្រដើម្បីជំរុញអាកប្បកិរិយាវិទ្យាសាស្ត្ររបស់សិស្ស៖ ការសិក្សាទៅលើមុខវិជ្ជាជីវវិទ្យា របស់សិស្សថ្នាក់ទី៨ នៃវិទ្យាល័យជាស៊ីមសាមគ្គី

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ABSTRACT

This study is to implement scientific method to strengthen the student's scientific attitude: A case study of Class 8 students in Biology. The main objective of this research is, how the implementation of scientific method affects scientific attitude of grade 8 students in Biology.

This research used qualitative method, which involved with18 students for observation and 3 students for interviewing. The students were chosen from class8 for data collection. The data analyzing in this research was used Thematic Analysis method with the variation of observation.

Based on the observation, the students were not familiar with the scientific method yet at the first time of class compared with the last observation, students processed activities at higher level. All of the criteria of scientific attitudes were contributed. Moreover, the result from interview is supported to the improvement of students' scientific attitudes by implementing scientific method. Therefore, it can be concluded that, the implementation of scientific method imposed scientific attitudes in the classroom. The findings identified that scientific method strengthen students' scientific attitude toward learning such as: curiosity, honesty and objectivity, critical resonating, open minded and cooperation, and responsibility.

The further research should apply scientific method for a longer period to make students to be familiar with the method. Moreover, the researcher should spend more time observing or interviewing teachers to get the result more accurately.

Keywords: *Biology Subject; Scientific Attitude; Scientific Method*

សង្ខិត្តន័យ

ការស្រាវជ្រាវនេះគឺ សិក្សាអំពី ការអនុវត្តវិធីវិទ្យាសាស្ត្រ ដើម្បីជំរុញអាកប្បកិរិយាវិទ្យាសាស្ត្រ របស់សិស្សសិក្សាទៅលើមុខវិជ្ជាជីវិទ្យា របស់សិស្សថ្នាក់ទី៨នៃវិទ្យាល័យជាស៊ីមសាមគ្គី។ ការស្រាវជ្រាវនេះមានគោលបំណងសំខាន់គឺ ចង់សិក្សាថាការអនុវត្តវិធីវិទ្យាសាស្ត្រអាចជំរុញអាកប្បកិរិយាវិទ្យាសាស្ត្ររបស់សិស្សសិក្សាទៅលើមុខវិជ្ជាជីវិទ្យា របស់សិស្សថ្នាក់ទី៨បានយ៉ាងដូចម្តេច។

ការស្រាវជ្រាវនេះគឺធ្វើឡើងតាមរបៀបគុណវិស័យដោយបានជ្រើសរើសតំណាងគំរូចំនួន១៨នាក់ ដោយចែងឆ្យដើម្បីសង្កេត និងជ្រើសរើសសិស្ស៣នាក់ដើម្បីសម្ភាស។ សិស្សទាំងអស់គឺត្រូវបានជ្រើសរើសចេញពីថ្នាក់៨និង សិក្សាលើមុខវិជ្ជាជីវិទ្យា។ ចំពោះការវិភាគទិន្នន័យ ការស្រាវជ្រាវនេះប្រើរបៀប Thematic Analysis សម្រាប់វិភាគទិន្នន័យសង្កេត និងសម្ភាសន៍។

ការសិក្សានេះបានបង្ហាញថា គឺមានទំនាក់ទំនងគ្នាកាន់តែល្អក្នុងពេលសង្កេតដែល ការសង្កេតដំបូង សិស្សធ្វើសកម្មភាពផ្សេងៗដែលទាក់ទងនឹងអាកប្បកិរិយាវិទ្យាសាស្ត្រនៅកម្រិតទាប។ ផ្ទុយទៅវិញ នៅលើកចុងក្រោយនៃការសង្កេត គ្រប់ចំណុចវិនិច្ឆ័យរបស់អាកប្បកិរិយាវិទ្យាសាស្ត្រត្រូវបានសង្កេតឃើញ។ ម្យ៉ាងទៀត ការសម្ភាសគឺគាំទ្រទៅនឹងការពង្រឹងអាកប្បកិរិយាវិទ្យាសាស្ត្ររបស់ពួកគេ។ យោងទៅតាមលទ្ធផលដែលទទួលបាន ការស្រាវជ្រាវនេះអាចសន្និដ្ឋានបានថា ការអនុវត្តវិធីវិទ្យាសាស្ត្រអាចជំរុញអាកប្បកិរិយាវិទ្យាសាស្ត្ររបស់សិស្សនៅក្នុងថ្នាក់រៀន។ ការជំរុញអាកប្បកិរិយាវិទ្យាសាស្ត្រគឺជំរុញទៅលើ ភាពចង់ចេះចង់ដឹង ភាពស្មោះត្រង់និងភាពច្បាស់លាស់ ការផ្តល់ហេតុផលប្រកបដោយការគ្រិះរិះ ការបើកចិត្តនិងការសហការ និង ទំនួលខុសត្រូវ។

យ៉ាងណាមិញ ការស្រាវជ្រាវនេះគឺមិនទាន់មានលក្ខណៈល្អប្រសើរគ្រប់ចំណុចនៅឡើយ ដូច្នេះអ្នកស្រាវជ្រាវបន្ទាប់ អាចបន្តការសិក្សាស្រាវជ្រាវលើប្រធានបទនេះបានដោយអនុវត្តវិធីវិទ្យាសាស្ត្រឱ្យបានរយៈពេលយូរជាងនេះដើម្បីឱ្យសិស្សអាចយល់ដឹងបានកាន់តែប្រសើរក្នុងវិធីសាស្ត្រនេះ។ មួយវិញទៀត ការស្រាវជ្រាវគួរតែសង្កេតឱ្យបានច្រើនដងជាងនេះដើម្បីសិក្សាពីការប្រែប្រួលសកម្មភាព ឬអាកប្បកិរិយាកាន់តែច្បាស់ និងគួរសម្ភាសន៍ជាមួយគ្រូបង្រៀនបន្ថែមដើម្បីសិក្សាពីប្រធានបទនេះកាន់តែស៊ីជម្រៅ។

ពាក្យគន្លឹះ៖ *មុខវិជ្ជាជីវិទ្យាវិធីវិទ្យាសាស្ត្រ និ ,ង អាកប្បកិរិយាវិទ្យាសាស្ត្រ*

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1. INTRODUCTION

The Ministry of Education Youth and Sport committed to achieving the first goal of, "Improving the Quality of Education, Science, and Technology" by including "teacher and improving learning environment" as the major reform among others reform priorities (MoEYS, 2019). The Secondary Education Improvement Project

(SEIP) aims to strengthen the quality of teaching and learning at the classroom level by improving the qualifications of teachers. Within this, they also conclude about changing traditional teaching methods in the education requires teachers to fluent understanding of the lesson content, knowledge of appropriate instructing methods, and motivated students to actively participate during the process (VVOB, 2016). Science content integrates students to reflect directly for what they have learned to the environment around them or something that happens daily lives (Susilo & Atun, 2017). Students struggled to provide reasonable arguments since their teacher did not educate them on how to select the best option and deal with an issue efficiently (Suarniati et al., 2018).

The Scientific Method is the main approach for teachers to teach in science classes. It teaches students how to respond logically towords their wondering about and comprehend all the pieces of information they are given. Through the Scientific Method, students in middle school can engage with the fundamentals of the scientific process through practical, inquiry-based activities. Middle school pupils should get chances to process the experiment to make them imprint this procedure in their minds and then they perform in real-world situations (Elemental science team, 2019). With the Scientific Method also assists scientific attitude to students (Pitafi & Farooq, 2012). Student attitudes influence personal behavior, primarily the scientific practices they select and the choices that they make (Jho et al., 2014).

According to the PISA assessment highlighted that only 1.4% of Cambodian student at age15 got the baseline level of performance in science. The baseline level of proficiency in science is the point at which students can use their understanding of fundamental scientific concepts and methods to analyze data, identify the question that a straightforward experiment is trying to answer, or determine whether a conclusion is acceptable in considering the data collected (MoEYS, 2018). The level of performance as a scientist of Cambodian students are remarkably low, with only 5% getting the minimum level (Level 2), reviewing that a small number of students have general basic skills (Heng et al., 2019).

The researcher also experienced with the issue related to the performance of student. Through the experience of a pedagogical internship in the academic year

2021 - 2022 at Cheasim Samaky High School for grade 8 in Biology subject, there are many significant challenges that students have the habit of studying traditional methods. The students act as listeners and respond by finding textbook answers. In addition, students can't study lessons by researching and reflecting on lessons as observing phenomena in daily life. Meanwhile, teaching student with the scientific method proved that they don't know the steps of the experiment and they have never experienced the scientific method (Intern, 2022). Thus, researchers are based on this issue focusing on the topic "Implementing scientific method to strengthen the scientific attitudes of grade 8 students in Biology". The purpose of this research is to find, how scientific method affect scientific attitude of grade 8 students in Biology?

The history of scientific method

In the late 19th century, the scientific method was first implemented into American science instruction as a focus on formalistic laboratory procedures that led to scientific facts (Rudolph, 2005). Scientific Method has been promoted in book of MoEYS about the student center approach for science education in Cambodia publish in 2012 (VVOB, 2012).

The definitions of scientific method and scientific attitude

The scientific method was actually defined in many different ways up to the contextual of learning or researching. According to a research state that, the scientific method was commonly emphasized as a way of learning for students to investigate the circumstances, get new experiences, and fulfill their existing experiences (Stefaan et al., 2012). In the same way, in the context of education in Cambodia, the scientific method is a method that scientists use in their daily work to find answers, reasons, or solutions to questions or problems that they have encountered or raised. This method can be applied to teaching and learning science at all levels (VVOB, 2016). Finally, we can conclude that the scientific method is the procedure that can be applied to teaching and learning science by conducting science experiment to investigate scientific issues and fulfill student's existing experiences.

Scientific attitude was commonly conceptualized in many ways. Scientific attitude looks over to what student think and act as scientifcial (Pitafi & Farooq, 2012). Curiosity and a critical, realistic, objective, truthful, and open-mindedness are

characteristics of scientific attitudes (Ali et al., 2013). A scientist must create a variety of abilities necessary for their field, including curiosity, collaboration, attitude of openness, critical reasoning, objectivity, truthfulness, and generosity (Mahulae et al., 2017). According to the reviews of scientific attitude, we can terminate that scientific attitudes is the ability of student to work through the process when learning science such curiosity, honesty and objectivity, critical reasoning, open minded and cooperation, and responsibility.

The methods to develop scientific attitudes

Based on the study show that, there are several ways to improve student's scientific attitude. According to the analysis, junior high school students' critical thinking and scientific attitude could be improve through worksheet-based inquiries into science issues, which is a very good category (Hastuti et al., 2018). Another research state that, research-based instruction enable to improve students'attitude according to all steps of learning practices (Firdaus & Darmadi, 2017). It was determined that the science domain-based learning tools that were combined with evolved local wisdom were appropriate for use with the learning tool with the theme of object change surrounding us for students and effective in enhancing students' science process skills and scientific attitudes (Dwianto et al., 2017). The experimental plan significantly enhanced the majority of the student's explanation for correcting the measurement model. Students frequently discard the theory and compare it to the experimental techniques. Students will engage in various tasks as a result of distinct lab work styles. Problem solving by lab work is an effective way to advance scientific attitudes and behaviors (Hadiati et al., 2019).

The processes of scientific method

Scientific method in teaching science lessons is always carried out in a simple way and follow up to the principles of pedagogy. The teacher is very flexible to adapt the process of scientific method depending on the materials required and the time limited (VVOB, 2012). However, scientific method usually takes 5 steps: demonstrating phenomena or forming key questions, predicting tests or hypotheses, experiments, gathering results, and drawing conclusions. 1) Problem identification: Generally, in teaching the observation and question can be led by teacher, anyway pushing student

should be the best recommend. Teacher is the one who create the environment to lead student observe and clearly comprehended about issues or topic that we're going to experiment (VVOB, 2016). The question is what we carry out in order to learn more about issues that could not be fully comprehended from observation (Kurniasih & Sani, 2014). Students and teacher works together to find out the key question that reflect with the objective of lesson to plan the activities of experiment (Khin et al., 2019). 2) Secondly, predicting or formulating hypothesis is answering to the question or explaining to the process of phenomena and it will reflect by the result of experiment in the next step (MoEYS, 2012). The hypothesis is the reasonable answer which conducted based on the existing knowledge and experience of student. Hypotheses must be clear and testable (VVOB, 2018). 3) Experiments: To test hypotheses, scientists often perform practical experiments using materials and experimental processes based on the meaning of the hypothesis. In the science class, the teacher has to re-explain how to use the materials, how to install the equipment and the experimental process, as well as how to record the data to calculate the experimental results in advance so that the students can do the experiments on their own. The format of recording is up to the worksheet design of teacher or student's creating (VVOB, 2012). 4) Measurement and analysis of results: After collecting data, the results are measured or calculated, a specific experimental result is obtained. In the science class at this stage, students are asked to present the experimental results in their own groups. If one group gets an abnormal result, teacher ask them to state their experiment process and the other group of students to help improve or find the gaps (NIE, 2018). 5) Conclusions: After collecting the results, the students analyze the results to see if the hypothesis supports the hypothesis or not, whether it is supported by experiments or not supported by experiments. At this point in the science class, the teacher has to ask the question, "Through your experimental results, what do you find?" By finding the content of the experimental results, students can answer the questions themselves, and finally they can draw conclusions from the lesson content that reflecting the objectives of the lesson (Khin et al., 2019). The conclusion is conducted by student, but teacher always roles as facilitator to raise them in a good conclusion (VVOB, 2012).

2. METHODOLOGY

This research is based on a qualitative approach designed to determine how scientific method enhance grade 8 students' scientific attitudes. All the data from respondent were inserted and classified into theme and sub-theme.

This research is involved students who are in grade 8 of Cheasim Samaky high school. The research chose a class among 8 classes of grade 8 to study. The observant has been selected randomly for 18 students in that class. There are 13 female student and 5 male students. In selecting sample, this research used Microsoft excel to random. In addition, there were 3 students among the observant had been selected randomly to interview. This research focus on the Biology subject in 2022-2023 academic year. The participants will be selected and observed unconsciously during data collecting to prove about the effectiveness of scientific method process toward their scientific attitudes.

This research has been conducted in 10 weeks during practicum year 4, starting from the 25th of January 2023 to 4th of April 2023. There are 2 ways to collect data. (1)The primary data is gathered using interview and observation sheet to collect data. To collect the data, the observation had conducted without informing to students, and also record as the video. (2)The secondary data used in this research were cited from other existing study such as: books, journals, and other websites in the internet.

This research used the qualitative research, so researcher has defined observation list) Annex 1) and interview(Annex 2) as the research instruments. The researchers tend to observe directly toward student's scientific attitudes from the first time till the fifth time of implementing scientific method in teaching. There are 5 times of observation. The observation started in week4 to week 8 when implement scientific method process in teaching. The observation was started in the phase2 (Review), phase3 (New lesson) and phase4 (restating lesson). The lesson plan were designed for 5 contents applied scientific method (Annex7). The researcher started collecting data from interview in week 8 and week9. The interview selected randomly 3 students among 18 students that were observed.

This study used two research instruments to collect data: Semi-structured interview and observation. A recorded discussion from the interview and observation

sheet were then transcribed and coded in each of the five analysis frameworks following Thematic Approach (Braun and Clarke, 2006).

3. RESULTS AND DISCUSSION

In this chapter showed about analyzing and discussion of research result. The data were collected from found two tools such as interview and observation.

Table 4.1 Sampling for each tool in the research

No	Description	sex	Sample	population
1	Observant	F=13	18	50
2	Interviewee	F= 2	3	18

The data in table 4.1 showed about the sample size of research. There are 18 students among 50 students in class 8D2 were observed in 5 times of observations. Moreover, 3 students among 18 students were observed has been selected for interviewing at the end of practicum.

Table 4.2: The indicator of observation

Curiosity
The pupils observe for object, phenomena, environment that teacher provided.
The pupils ask what they wonder or their problem related to that object or phenomena
The pupil asks questions about the material or phenomena being studied
The pupils observe for answers
Student shares or asks to clarify their problem related to the topic of experiment
The pupils complete all scientific activities until end
Critical reasoning
Student observes the specific points of materials and procedure before the experiment.
Observe and record the fact from the experiment
Catch up the point that meets the answer of the questions
Recording the changing of object or phenomena

Determine the relationship between cause and effect

Do not rush to draw conclusions before enough evidence collected

Their conclusion always answers the question of the problem.

Honesty and Objectivity
Make observations on the results of the experiment Students use all the finding data for discuss to prove their hypothesis or conclude their answer In interpreting the results of observations are not influenced by others. Present or record the result with the prove of experiment to the class (don't use fake result)
Open minded and cooperation
Students change their existing idea if it isn't support from the observation Do not immediately accept conclusions without strong evidence. Receive advice and recommendation the advice from others in their learning process. Listen to the other group's presentation and correct their own answer after facilitating from teacher.(Respect the opinion / findings of others) Listen and record when the members in group or class share. (Not necessarily reject the opinions of others) Students participates and helps each-others in their learning process. Share what they think to the group
Responsibility
The fact data had been used for conclusion Renew their opinions and conclusions if the data is insufficient. Follow up all steps of experiment, do not cheat or skip the step. Clean and prepare the materials after the experiment ended. Process and finish on time The students take note the safety recommendations

Theme: curiosity

To know about the scientific attitude of student which, related to curiosity of student, the researcher has observed 6 activities of student. Firstly, the pupil observes for object, phenomena, environment that teacher provided. First time and the second time of observation showed the same when implement scientific method, there are 15 among 18 students observed the object or phenomenon teacher demonstrated. From the third till the fifth time observation, all student observed the object or phenomena that teacher provided. Secondly, the pupil asks what they wonder or their problem related to that object or phenomena when teacher provided. It has changed from: first time 2, second time 3, third time 4, fourth time 14, and the last time 16. Additionally, the pupil asks questions about the material or phenomena being studied is completely different in 5 times of observation such as: first time 9, second 7, third 10, fourth 17, and the fifth 17. Similarly, the activities of pupils are changed when they observe objects teacher provided for answers. There are only 8 students for the first time, 9 for the second time, 13 for the third time, 17 for the fourth time, and the last time is 17. Another action is, students also share or ask to clarify their problem related to the topic of experiment. There are 3 students for the first time, 6 for the second time, 7 for the third time, 13 for the fourth time, and 15 for the fifth time. Last criteria is, the pupil who completes all scientific activities (experiment) until end are: 7 for the first time, 10 for the second time, 12 for the third time, 18 for the fourth time and 18 for the last time of observation. The data above state that, all students were adapted to scientific activities and improve their action in scientific method from the first the second until the fifth observation. We also note that, each student had increased their activities in every week of observation. The students improved in interesting in observing, attention to the object or phenomena, finding answer, and enthusiastic in practicing activities.

Theme: honesty and objectivity

In theme honesty and objectivity, there are main 4 activities observed. Firstly, students make observation on the results of the experiment. According to the observation state that, there are 14 students for the first time, 15 for the second, 18 students for each of the third the fourth and the fifth. Secondly, students use all the finding data for discuss to prove their hypothesis or to conclude their answer in

observation are: 11 students for the first time, 15 for the second, 16 for the third and 18 for each of the fourth and the fifth. Additionally, in interpreting the results of observation students are not influenced by others. The tables showed the relevant of observation such as: the first time 6, the second 12, the third 16 and 18 for each of the fourth and the fifth. The last item represents that, student present or record the result with the prove of experiment to the class (don't use fake result). The variation of observation shows that, the first time 10, the second 14, the third 16, the fourth 18 and the last time is 18. To sum up, the student do the activities in scientific method process and all their activities that related to their believing in the experiment, believing in data from experiment, recording accurately and follow up the data from experiment. Their activities had improved in each time of observation. Some activities had disappeared in the first or the second time of observation, but they tend to make it in the fourth and the last week of practicum.

Theme: critical thinking

According to the table above, there are 7 criterions in theme critical reasoning. Firstly, students observe the specific points of materials and procedure before the experiment. There are 14 students for the first, 17 for the fourth time and 18 for the second third and the fifth. Additionally, the observation clarified about the activities of students observing and recording the fact from the experiment. There are 18 for the first time, 17 for each of the second and third, and 18 for each of the fourth and the fifth. Moreover, there is relation from week to week that student catch up the point that meet the answer of the questions. There are 8students for the first, 13 for the second, 14 for the third, 15 for each the fourth and the fifth. In addition, the observation expressed how is the variation of students to record the changing of object or phenomena such as: first time 11, the second 11, the third 11, the fourth 15 and the fifth 17. Further, students determined the relationship between cause and effect in the experiment. There are only 5 students for the first time, 6 for the second, 12 for the third, 13 for the fourth and 14 for the fifth. Besides, students never rush to draw conclusions before enough evidence collected are also switched from every week of observation. For instance, the first time there are 6 students, the second 12, the third 12, the fourth 18 and the fifth 18. The last item of this theme, their conclusion always

answer the question of the problem, is also relevant in all 5 times of observation. There are 5 for the first time, 15 for the second, 15 for the third, 17 for the fourth and 18 for the fifth. Consequently, all students were adapted to scientific activities and improve their action in scientific activities such as observation, analyzing, concluding, using fact data and no ignoring data in the process of experiment. These activities have improved from the first, second until the fifth observation.

Theme: Open minded and cooperation

There are 7 items connection to According to open minded and cooperation of students. According the table above state that, students change their existing idea if it isn't support from the observation. There are 6 students do it for the first time, 9 for the second, 12 for the third, 12 for the fourth and 12 for the fifth. Further, students do not immediately accept conclusions without strong evidence. There are 4 for the first time, 14 for the second, 15 for the third, 16 for the fourth, and 17 for the last. Additionally, when teacher divided group and ask them to work in group, students received advice and recommendation from others in their learning process. There are 6 students for the first time, 12 for the second, 10 for the third, 10 for the fourth, and 13 for the last time. Further, working in group in experiment, students listen to the other group's presentation and correct their answer after facilitating from teacher. The table state that, there are 8 students for the first time, 11 for the second, 13 for the third, 17 for the fourth, and 15 for the last time. In the same way, students listen and record when the members in group or class share. (Not necessarily reject the opinions of others). In that case, there are 8 students at the first time, 5 for the second, 14 for the third, 15 for the fourth, and still 15 at the last time of observation. Likewise, students participate and helps each other in their learning process. It follows that, there are 16 for the first time, 13 for the second time, 17 for the third, 18 for the fourth, and still 18 at the last time. Another idea from observation is that, students share what they think to the group. The table provided that, there are 16 for the first time, 15 for the second, 15 for the third, 16 for each of the fourth and the fifth. In short, all 7 items in this theme are improved from week to week. From the observation, students improve their willingness in changing unreasonable idea, respecting to other's opinion, respecting other's finding, and

assuming each conclusion is tentative. Within this, students improving sharing to others and participating actively in group works.

Theme: Responsibility

There are 6 items related to the responsibility of students when scientific method was adopted to biology class. Firstly, students used the fact data for conclusion. There are 9 students for the first time, 15 for the second, 17 for the third, 17 for the fourth and 18 for the last. Moreover, students renew their opinions and conclusions if the data is insufficient. There are a student for the first time, 2 students for the second time, 6 students for the third, 8 for the fourth time and 7 for the last time of observation. In addition, students follow up all steps of experiment, do not cheat or skip the step. There are 8 for the first, 10 for the second, 16 for the third, 17 for the fourth, and 18 for the last time of observation. Further, students clean and prepare the materials after the experiment ended. There is a student for the first time, 2 for the second, 9 for the third, 15 for the fourth, and 16 for the last time of observation. Similarly, students process and finish on time. There are 10 for the first, 16 for the second, 18 for each of the third fourth and the last. In the same case, the students take note the safety recommendations. There are 11 for the first, 9 for the second, 18 for each of the third, the fourth, and the last. According to all 6 items of this theme, we can conclude that, students had improved their activities in responsibility such as: accepting their result, working their own roles, doing all tasks provided, working on time, and carefulness in process. Despite, students who renew their opinions and conclusions if the data is insufficient are only 7 at the last time of observation (Check worksheet and interview).

Result from interview

To support the result of observation checklist, researcher used interviewing with students. The result from interview showed the effectiveness of scientific method in improving student's scientific attitude. There are 4 main themes was given by students toward this interview.

Theme: curiosity

According to the interview, student was interesting in observation with the phenomena or object being study. In this case student A1 explained that, "*when I see it then I feel so different style of learning from what I have done. Then, I start*

answering with teacher.". Additionally, student was interesting and happy with the object being studied when teacher gave those materials to them. As proof, student A2 expressed that, "*yes it's interesting and happy*." and student A1 said that, "*Emm, yes, I think "maybe teacher want the group to observe and think about how to process those materials. Similarly, teacher also want me to understand the whole experiment*." As well as that, student doubt and interest in finding answer with the object being used in the experiment. Student are agreed that, they all doubt when teacher provide the object to them and they all curious to find the answer. Along with this idea, student A1 said that, "*Err, I want to know about it and keep in mind to find the answer*." and A2 "*Err, I pay attention to it and observe it*.". For student A3 "*Err, I listened to introduction from teacher and observed it*.". Lastly, student is enthusiastic in practicing activities of experiment and clearly understand their aim to do all processes. For instance, student A2 expressed that, "*Yes teacher, I did all 5 steps of experiment. If we skip a step or two steps, our experiment tend to be pause or stop. I mean the experiment doesn't goes smoothly*." and student A1 added that, "*If we skip a step, our processes will be not good and never get the answer correctly.".*

Theme: honesty and objectivity

Based on the answer of 3 students in interview showed that, student aim clearly in the experiment. Student know their main idea to get from experiment. Particularly, student A2 state that, "*Question is important. When we have question, it guides what we want to know and we can research about it then, err errr, we also improve our knowledge. Without question, we don't know how to do experiment." and student A3 said that," It makes us answer to what we doubt more clearly. In short, it make the experiment started".* Moreover, students used fact result from experiment and related question to make conclusion. They focus on what they curios about and use their own result to analyze. As seen the, student A2 stated that. "*Yes, to record data, I focus on the question that have been asked, then think about the hypothesis, and what we want to know about the experiment and the changing of object being studied was used to analyzed.* Similarly, student A1 said that, "*I record result based on what I really need in conclusion.".* Further, students set their next experiment aim to use scientific method to answer what they question. Student A2 mentioned that,

"*Yes of course. It can be experiment and we can find the answer from that.*" and student A3 said that, "*Yes of course. We can find the materials and process on it.*".

Theme: Critical thinking

Based on the interview, students practice scientific method process in their Biology subject and helping them better understand. As proof, student A2 stated that, "*When we practice experiment in class, we will get new ideas that make different from what we use to do. It's also make us clearly understand, observe it directly by ourselves, and do the activities on it.*" and studentA3 mentioned that, "*I think, it's a new method for us, it makes me better understand.*". Furthermore, students interest and critic to the characteristic of the object or phenomena to create question for experiment. For instance, student A1, "*In class, the question makes from the picture which teacher provided and also everything around us that we curios about.*" and student A3 expressed that, "*It make from the lesson content and what teacher provided then we doubt about it. It can be picture or other objects. Sometimes, when we see something interesting then we study it, it's also be an experiment.*". In addition, student used sufficient data to make conclusion. In fact, A1 pointed out that, "*Yes, I can give the reason based on what I have observed directly*" and A3 pointed out that, "*Yes, I can give the reason, example: the small plant had been changed from Withered to fresh, that because of water absorption from root to stem and leaf.*". In a similar manner, students used facts result to analyze. As seen, student A1 said that, "*Because during processes, the object has change its characteristics. If we don't record it, we don't know what can we use to analyze.*". Lastly, student pay attention and doubt the friends' findings like A1 stated that, "*different process provides different result, different result was analyzed by different way and all group's reason are good.*".

Theme: open minded and cooperation

There are 4 ideas which was gotten from interview. Firstly, students respect other's opinion and result. In this case, when teacher ask that, if your friends experimented with different results, how wouldthey feel about other'sanswers . A3 pointed out that, "*Yes that's also good. They have different result based on their processes and the amount of substance that used, so it's completely has the different result, but both results are correct.*". Secondly, when teacher assigned group work to

go through the worksheet, student shared to each other in the progress of the experiment. To illustrate, A1 also expressed that, "*I'm prefer to work in group rather than individual because I can discuss what I have seen in experiment and ask them for what I don't know. Sometimes, I share what I have known to them. They also help preparing materials and the processes, and document the worksheet. Something special about group work, finish on time.".* Moreover, students enjoyed in working in group when experiment. For instance, A2 and A3 stated that, "*working in group is happy and excited because we have many times discussion, also confident with the worksheet conducted*". Last but not least from interview is, student were actively participate and help each other. As seen, A1 A2 and A3 are all collaborated in the process. They said "*I observe, record, and make decision with group about what to fill in worksheet.".*

Theme: responsibility

There are 4 mains criteria in interview which related to the responsibility of student when using scientific method. Firstly, student processed carefully in experiment. As seen, A1 stated that, "*I ask for recommendation from teacher and I process it with my group.*". Furthermore, student was interested in implement scientific method in the next study by themselves. They are familiar with scientific method's processes and tend to use it when they doubt about something. For instance, A1 said that, "*yes of course, I can create it with simple experiment by using simple objects in my kitchen*." and A3 added that, : "*I can create it with simple experiment by using simple object and process*.". Additionally, student accept their result and use the result to make conclusion. In this case A2 and A3 stated that, "*the conclusion was contributed based on the result we collected in worksheet and Based on the question we formulated*.". Lastly, student process their work on time, that means time management in experiment is in line with content. To illustrated, A1 said that, "*Yes, it's acceptable, I enjoy studying by experiment, it's not wasting my time.*" and A2 provided that, "*Yes, that is in line with the content. It doesn't take much time. It's available*."

Based on the result, this research showed the effectiveness of implementation scientific method in 8th grade Biology to enhance student scientific attitudes. There are

main 5 criteria of scientific attitude such as : curiosity, honesty and objectivity, critical resonating, open minded and cooperation, and responsibility

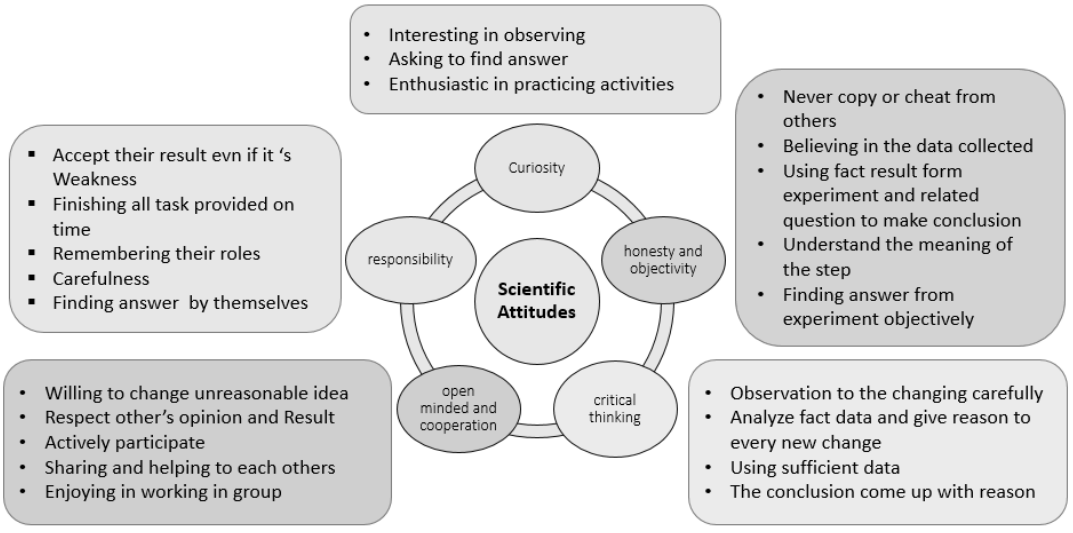


Figure2: Finding diagram

Further, scientific method gains student's curiosity in learning. There are 4 main items such as: interesting in observing, asking to find answers, attention to the phenomena, and enthusiastic in practicing activities. These activities are in line with the research of Kaleka & Nur (2018). Kaleka & Nur (2018) had used the activities in observing, asking, attention to the object or phenomena, and enthusiastic in processes to measure student's curiosity in learning Biology. Another researcher, Sener Türk & Tas (2015) stated that student was having fun in observing, and handing on activities improved their curiosity.

Implement scientific method improve attitude of honesty and objectivity. According to the result above, students present or record the result with the prove of experiment to the class or they don't use fake result and interpret the results of observations are not influenced by others. This finding is completely similar to the finding of Ekawati (2017) which showed that, recording the fact result of experiment and analyzing fact data represent student's objectivity and honesty. Moreover, students make observations on the results of the experiment and use all the finding data for discuss to prove their hypothesis or conclude their answer. In this case another research stated that, it was fun to observe, doing activities by their hand improved curiosity; learning by touching in laboratory was effective (Sener & Tas,

2015). That means, student believed in their process, their data and follow up the data finding in the experiment. These activities similar to measurement of student's honesty in learning science of Rampean and others (2021). In addition, Heryadi and Sundari (2018) stated that scientific method improves student's honesty which student dare to express the data as it is and being honest in processes.

Another effectiveness of scientific method is critical thinking. There are main 7 activities in this theme. Student observe the specific points of materials and procedure before the experiment started, observe and record the fact from the experiment, and catch up the point that meets the answer of the questions. These items emphasize that, student find the result as much as possible and no ignore data even if it's small. Moreover, the data state that, students recording the changing of object or phenomena, determine the relationship between cause and effect, and do not rush to draw conclusions before enough evidence collected. We can see that, students are using sufficient data, analyzing to find the reason and critic to the variation in experiment. Similarly, Rampean Roheti & Lengkong (2021) showed the activities such as : finding data as much as possible, pay attention to all data even if it's small and don't accept conclusion without strong evidence can be used to identify student's critical thinking in learning. Within this, Kaleka & Nur (2018). Provided some similar activities related to critical thinking of students such as : no ignoring data and critic to what have changed. Something we can add more from observation is in student's conclusion toward question always come up with reason even if it's different from other group or the same to others. That means student present different result to class based on their observation and it's in line with Rampean Roheti & Lengkong (2021). For curiosity and critical thinking was improved when using experiment based scientific approach or scientific method based on finding of Kaleka & Nur (2018).

Another effectiveness of scientific method is open minded and cooperation. There are 7 activities of student in learning processes which, related to open minded and cooperation. Students change their existing idea if it isn't support from the observation and do not immediately accept conclusions without strong evidence. That show about willingness to change their idea if the result is not supported by experiment. The next item are, receiving advice and recommendation from others in

their learning process and listening to the other group's presentation and teacher. These two activities identified respect the opinion or result of others. Another item is , listening and recording when the members in group or class share. That means, it isn't necessary to reject the opinions of others and assuming the idea is tentative. Similarly, Kaleka & Nur (2018) also share many criteria related open minded and cooperation such as: respecting the opinion or finding of others, tending to change opinion if the data is insufficient, getting the advice from others, assuming each conclusion is tentative, and never feeling that always right. The last items are: participating, helping each-others in their learning process, and sharing what they think to the group. That is in line with Wilson (2023), which said, collaboration provide scientists to combine their idea and resources to forming concept that helps them to work faster then leads to better result rather than isolative work. Based on Piper & Hough (1979) and Kaleka & Nur (2018) stated that, open-mindedness of students improved following a science methods course that student actively and participatory learning role.

Scientific method also effect on student's responsibility in learning. Students use their fact data for conclusion, means that, they accept their own result. Moreover, student Renew their opinions and conclusions if the data is insufficient, show that, they dare to correct if their own weaknesses. Furthermore, student follow up all steps of experiment, do not cheat or skip the step. After all, student finishes all activities provided. Additionally, students clean and prepare the materials after the experiment ended. As the matter of fact, students knew their roles after the experiment. In addition, students process and finish on time, mean that, they are being good in time management. Last but not least, students take note and ask for recommendation from teacher for the safety processes. As follows, students have carefulness in the experiment. These activities align with the study of Rampean Roheti & Lengkong (2021) which state that, daring to defend opinions about the results of practicum, gathering reports and assignments on time, cleaning materials, and laboratories after class practice are the characteristic of responsibility. In addition, Heryadi and Sundari (2018) stated that student behavior increased step by step learning when practiced frequently. Scientific method increases attitude of student toward responsibility.

4. CONCLUSION

Implementation scientific method impose scientific attitudes in the classroom. Findings show that scientific strengthen students' scientific toward learning such as: curiosity, honesty and objectivity, critical resonating, open minded and cooperation, and responsibility. Based on the data observed and interview, the researchers found that there was a variation from the first time till the fifth time of observation. The first time, students were not familiar with the scientific method yet. Therefore, student perform activities of scientific attitude at low level. Despite, the fifth of observation, student processes activities at higher level. All of the criteria of scientific attitude were contributed. Moreover, student pointed out clearly in the interview about their activities in the experiment's processes. The data from interview is supported to the improvement of student's scientific attitudes. Especially, the attitude toward responsibility was not fully increased yet in observation, but we can see in interview which provided by student themselves when they expressed their own idea toward practicing scientific method. Through discussion, we can prove that scientific method helps solving students' inappropriate attitude in scientific class and increases the attitudes that teachers want in the classroom, as well as motivating students to learn too.

In this research study was conducted for a short period of time during the internship and only adapt using scientific method's processes which mostly used in Cambodia not focus in all detail steps due to the condition of student in intern class. On the other hand, this research tool only observes the 8^{th} grade students of a secondary school in Cambodia and only Biology subject of that class. Therefore, the next study should continue adding strategies more detail and other activities, and spend more time observing or interviewing teachers, as well as being careful when implement the process of scientific method.

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