Learning Loss in Science Process Skills: A Case Study of Grade 10 Students

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Abstract
The pandemic era affected schooling and students' learning in widely distributed. Students had less time to go school and face to classroom activities. This research aim to study the learning loss in science process skills of grade 10 students. The informants were sampled from Mahasarakham Secondary Education Area Office for the 2024 academic year with 321 students. The tools used in the research include a 14-skill scale for science process skills, the test measured 14 science process skills with 42 questions. The results showed that the science process skills were ranged fair-not good levels. The formulating model skill (52.97%), observing skill (51.50%), using numbers skill (51.10%), interpreting data skill (47.67%), measuring skill (47.13%), predicting skill (47.13%), classifying skill (39.30%), formulating hypotheses skill (38.20%), defining operationally skill (34.87%), experimenting skill (34.47%), and identifying and controlling variables skill (31.07%). These findings indicated that they needed to gain level of science process skills in the loss of learning time. They need to enhance hands-on experiences and inquiry-based learning in the science classroom. Also, they should have more training or practicing science process skills through enrichment program.

Keywords: Hands-on Experience, Science Process Skills, Process of Science

Introduction

At present, science teaching and learning management is an important thing that must be accelerated to increase the country's scientific competitiveness. As stated in the National Economic and Social Development Plan No. 12 (2017-2021), which supports the development of science along with the development of people to become complete people of all ages by improving the quality of education, learning, and skill development.

The Core Curriculum of Buddhist Basic Education 2008 (Revised 2017) Science and Technology learning area focuses on students learning science. It supports students to have important skills in research and create knowledge appropriate to the grade level. It is also placed on students not only to learn scientific content, but also to focus on teachers to manage teaching and learning. Teachers encourage students to learn and develop themselves to their full potential (Werder & Otis, 2023).

The COVID-19 pandemic has profoundly disrupted education systems worldwide, leading to unprecedented challenges in science classrooms. In Thailand, prolonged school closures and the sudden shift to remote learning. It is significantly impacted towards students' academic development, particularly in subjects requiring hands-on experiences and critical thinking. Science process skills are fundamental for fostering scientific literacy and inquiry-based learning required (Sutiani, 2021; Eymur & Çetin, 2024).

Science process skills, which is an important part of training students to be able to think, analyze, and solve scientific problems systematically and logically. It is not only help students have a deep understanding of science subject content. But it is also a useful skill in everyday life for systematically solving various problems (Irwanto, 2023). Science process skills consist of 14 skills, divided into basic science process skills include observing, classifying, measuring, using numbers, using space/ time relationships, communicating, inferring, and predicting. Integrated science process skills include formulating hypotheses, defining operationally, identifying and controlling variables, experimenting, interpreting data, and formulating models. Each of these skills is important in helping to develop students' scientific thinking processes (Kurniawan & Haka, 2023; Susilawati et al., 2024).

Additionally, these skills are significant tools that scientists use to conduct scientific research effectively. Therefore, it is extremely important to measure students' scientific process skills because they can help assess their ability to think critically. Experiments and problem solving of students. Moreover, such skill measurements can help teachers know the level of proficiency of students in each area and use the information obtained to improve teaching methods to better suit the needs of students.

As we know, the classroom can be conducted onsite learning activities during pandemic period. All teachers adjusted the teaching format to online teaching, which resulted in the management of experiments. Science classrooms have less practice, or an inability to manage experimental learning or scientific operations for students. They lack advanced or integrated science process skills. Teachers have to create a quality science process skills to students for closing the gap learning recession on science process skills. This research aims to study the learning loss in science process skills of grade 10 students. Therefore, science process skills are an important foundation that will help students better understand scientific content and nature of science.

Methodology

The informants consisted of grade 10 students, Semester 1, academic year 2024 from Sarakham Pittayakhom School, Mahasarakham Secondary Education Area Office, Thailand. The study employed a science process skills test which developed through the reliable method. Document analysis from relevant documents to understand the definition. Science process skills are the fundamental abilities and cognitive skills that scientists and students use to investigate phenomena, solve problems, and construct scientific knowledge. Science process skills are typically categorized into two groups: Basic science process skills include observing, classifying, measuring, using numbers, using space/ time relationships, communicating, inferring, and predicting. Integrated science process skills include formulating hypotheses, defining operationally, identifying and controlling variables, experimenting, interpreting data, and formulating models. Research tools constructed based on the purpose of measurement and evaluation. It consisted of 14 skills, totaling 59 items. It is used for measuring and evaluating the basic and integrated science process skills. It indicates that the index of congruence which assessed by experts with a consistency value of 0.80-1.00 and with 0.94 of reliability.

Data were collected by sending a permission from the Faculty of Education, Mahasarakham University to collect data. The science process skills test is in Google Form. Interpretation of the results of the study can be referred to the percentage interpretation criteria as shown in Table 1.

Table 1 Interpretation Criteria

Percentage	Interpretation
More than 80	Very good
70-79	Good
40-69	Fair
30-39	Not good
20-29	Not very good
less than 20	Needs to be improved

Result and Discussion

The science process skills were ranged fair-not good levels. The formulating model skill (52.97%), observing skill (51.50%), using numbers skill (51.10%),interpreting data skill (47.67%), measuring skill (47.13%), predicting skill (47.13%),classifying skill (39.30%), formulating hypotheses skill (38.20%), defining operationally skill (34.87%),

experimenting skill (34.47%), and identifying and controlling variables skill (31.07%).The details can be shown in Table 2.

Table 2 Science Process Skills Grade 10 Students

Scientific process skills	%	Level
Observing skill	51.50	Fair
Measuring skill	47.13	Fair
Classifying skill	39.30	Not good
Using space / time relationships	43.83	Fair
Using numbers skill	51.10	Fair
Interpreting data skill	47.67	Fair
Inferring skill	33.97	Not good
Predicting skill	47.13	Fair
Formulating hypotheses skill	38.20	Not good
Defining operationally skill	34.87	Not good
Identifying and controlling variables skill	31.07	Not good
Experimenting skill	34.47	Not good
Interpreting data skill	45.97	Fair
Formulating model skills	52.97	Fair

Formulating model skill (52.97%) was the skill that students have the highest average scores. It shows that students can use their understanding of scientific content to effectively create models or models that explain scientific phenomena. But, they have the level of science process skills between not good and fair. Observing skill (51.50%) and using numbers skill (51.10%) had similar averages. It reflects the ability to observe things in a scientific environment and use computation to analyze data, which is an important skill in the study of science. Interpreting data skill (47.67%) and measuring skill (47.13%) were in the fair skill group, where students can interpret from the information obtained. Students should develop their skills in data management to be more accurate. Predicting skill (47.13%) was another skill that students have a fair level of ability, it showed that students can use data to predict future phenomena to a certain extent.

However, the less average skills can be summarized as interpreting data skill (45.97%) that require analytical thinking and knowledge integration. Classifying skill (39.30%), formulating hypotheses skill (38.20%), and experimenting skills (34.47%) were still low or not good. It indicated that students still lacked proficiency in hypothesis formulation and hypothesis testing, as well as conducting experiments to confirm hypotheses. Also, defining operationally skill (34.87%) and identifying and controlling variables skill (31.07%) were important skills in the process of scientific research and experiments. Guidelines for promoting science process skills with low average may be achieved by using technology and simulation, allowing students to learn through more complex modeling. Developing skills in interpreting and interpreting information should use activities that focus on analyzing and interpreting data.

Grade 10 students (aged 15-16) are theoretically in Piaget's formal operational stage, capable of hypothetical-deductive reasoning. However, the study suggests that many are not yet proficient in higher-order scientific reasoning. This gap may indicate they are still transitioning between concrete operational and formal operational thinking. The low scores in skills like experimenting and controlling variables suggest limited experience with inquiry-based learning, where students actively engage in scientific investigations (Chu et al., 2016; Idris et al., 2022; Gizaw & Sota, 2023).

The teaching and learning should focus on implementation, more student-led investigations, and project-based learning to enhance integrated process skills (Syukri et al., 2021). Teachers can use graphic organizers or structured inquiry to support hypothesizing, experiment design, and variable identification. Students should have continuous feedback during inquiry activities to help them develop metacognition about their scientific reasoning (Dolapcioglu & Subasi, 2022). Moreover, teachers should encourage peer discussions to improve argumentation, inference, and data interpretation skills (Wanloh & Nuangchalerm, 2022; Phanchamlong et al., 2023).

Conclusion

The study emphasizes the notable learning loss in science process abilities among grade 10 students resulting from the epidemic's effect on education. The results indicate that students had only fair to poor ability across several scientific abilities; the lowest performance was shown in defining concepts, identifying and controlling variables, and

experimenting. They had the level of science process skills between not good and fair levels in basic science process skills, such as observing, measuring, and using numbers. However, the integrated science process skills remain at a low level. They need to enhance hands-on experiences and inquiry-based learning in the science classroom. The effective instructional strategies may include opportunities for student-led investigations, promoting collaborative learning, and integrating modeling and simulation tools to facilitate conceptual understanding. In addition, they require more practical exercises and inquiry-based learning approaches in the scientific classroom will help close some of these gaps. Furthermore, enrichment initiatives emphasizing the acquisition of useful skills should be carried out to enable students to recover and improve their science process skills.

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