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A NEED ASSESSMENT OF SCIENCE TEACHER TO DEVELOP UPPER SECONDARY STUDENTS IN SCIENCE PROCESS SKILLS: A $PNI_{MODIFIED}$ STUDY

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ABSTRACT

The pandemic has slowed down students' learning of science, as well as science process skills and other necessary learning skills. This research aimed to study the current and desirable conditions in promoting science process skills for upper secondary students. The samples were 184 science teachers affiliated to the Mahasarakham Secondary Education Area Office. The data used in the data analysis were frequency, mean, standard deviation, and PNImodified. The study found that the desirable condition of the science process skills is at a high level. But the current condition is generally moderate to high levels. The need to develop science process skills for students based on the opinions of science teachers showed the highest priority that needs to be developed is modeling skill, defining operationally skill, experimenting skill, identifying and controlling variables skill, and formulating hypotheses skill in respectively. The enrichment program about science process skills and instructional strategies should be developed and implemented in the future.

KEYWORDS: Feasibility, Learning Loss, Science Process Skills, Need Assessment.

1. INTRODUCTION

Science and technology is an important branch of education management (Triplett, 2023). The management of science teaching and learning must emphasize that students are encouraged to develop their thinking processes (Sutiani, 2021; Anggraeni et al., 2023). They must have the ability to learn the process of seeking knowledge and the process of solving problems. Also, they should have loved learning and having scientific attributes, leading learners to become knowledgeable in this era. Therefore, the nature of science teaching contributes to helping learners to know science and habits of mind (Chick et al., 2023; Gurung et al., 2023; Russell & Martin, 2023). Science requires finding solutions, collecting data, investigating, summarizing, analyzing, synthesizing, and building into own knowledge through practice in science (Ermel et al., 2021; Kite et al., 2021; Gericke et al., 2023). It will lead to the permanence of knowledge and may acquire new knowledge or new methods of acquiring knowledge. Science teaching and learning management in the 21st Century focusing on teacher quality. They can manage their teaching and learning based on student-centered approach and help students to success in learning process. Teachers must evaluate the learning outcomes of students to deal with problem-solving with creatively. This can consider the development of students to have the ability to think analytically, think rationally, and be able to apply knowledge effectively in real life situations. One of the key tools is science process skills that engage students understanding scientific content deeply and systematically. However, COVID-19 has severely impacted the education system (Eickelmann et al., 2021; Moss et al., 2021; Thongbunma et al., 2021; Phanchamlong et al., 2022). The post-pandemic era, students have to adjust their learning time and methods for construction knowledge.

It is necessary to learn at home and also online learning. It was found that students whose families were not economically ready. They also pay less attention to hands-on learning. It has a direct impact on students due to distance learning or online learning for a long period of time. In addition, it has been found that distance learning or online allows students to receive less practical skills training. The COVID-19 pandemic’s widespread school closures and shift to remote learning presented major obstacles to acquiring these skills.

The disruption of hands-on learning in the science classroom negatively affected students' science process skills. The abrupt move to virtual schooling eliminated most in-person laboratory and field activities, reducing opportunities for real-time observation and experimentation. Global teaching insights by the OECD reported that teachers struggled to adapt practical science activities online but found that well-designed digital resources could partially compensate (Kirchgasler & Caride, 2025). Also, UNESCO-monitored school closures brought attention to policies ensuring all students can engage in hands-on or simulated science experiences, even under movement restrictions (Hardy, 2024). Learning in the science subject has a unique characteristic that emphasizes the experimental process (Sastria et al, 2023; Spencer, 2024; Sari et al., 2024; Kusuma et al., 2024; Qadar et al; 2022; Haryadi & Pujiastuti, 2022; Phan et al, 2022). Students can seek knowledge and gain more critical thinking skills. In addition, Gajderowicz et al. (2025) data analyzed from the International Assessment Project (TIMSS 2023) found that the average score of students in the science continued to decline after the school closure. In particular, critical thinking skills and science process skills which are important skills in learning modern science (Dolapcioglu & Subasi, 2022; Gizaw & Sota, 2023; Safkolam et al., 2023). This problem reflects the urgent need to restore and develop the scientific skills through the suitable strategies. Therefore, science teachers need to find new ways to restore and promote science process skills for learners.

One of the guidelines to serve as a basis for developing science process skillss is to study the current conditions and desirable conditions. The needs assessment for the development of science process skills for upper secondary school students is important to help teachers design and develop learning activities that meet their potential and condition.

This research aims to study the current and desirable conditions in promoting science process skills for upper secondary students. It also prepares learners with the skills necessary to live in the modern world, driven by knowledge, technology, and innovation, as well as being able to effectively cope with changes in society and the global economy.

2. METHOD

The amount of science teachers affiliated with the Mahasarakham Secondary Education Area Office were 347 teachers. The respondents used in this research was 184 science teachers through convenience sampling (Table 1).

Table 1: Respondents' Information.

General information	(n=184)	
	Amount	Percent
1. Gender		
1.1 Male	45	24.5
1.2 Female	139	75.5
2. Academic Status		
2.1 Expertise	16	8.7
2.2 Specialties	164	89.1
2.3 Mastery	-	-
2.4 Others	4	2.2
3. Educational Qualifications		
3.1 Bachelor degree	40	21.7
3.2 Master degree	142	77.2
3.3 Doctoral degree	2	1.1
4. Working Experience		
4.1 Less than 3 years old	1	0.5
4.2 3 - 6 years	5	2.7
4.3 6 - 9 years	9	4.9
4.4 9 - 12 years	27	14.7
4.5 Over 12 years	142	77.2
5. Course		
5.1 Science	28	15.2
5.2 Physics	57	31.0
5.3 Chemistry	44	23.9
5.4 Physiology	46	25.0
5.5 Others	9	4.9
combine	184	100

Table 1 shows the number and percentage of respondents by gender. It was found that 139 respondents were female, accounting for 75.5 percent, and 45 were male, accounting for 24.5 percent. It was found that there are 164 people, accounting for 89.1 percent, 142 people had a master's degree or 77.2 percent, 40 people had a bachelor's degree or 21.7 percent, 142 people had more than 12 years of work experience or 77.2 percent, and 27 people had a 9-12 year degree or 14.7 percent. Physics Course has 57 students or 31.0 percent, Biology Course has 46 students or 25.0 percent, Chemistry Course has 44 students or 23.9 percent, and Science Course has 28 students or 15.2 percent.

The tools used in the research include a questionnaire on the current condition and desirable conditions for the development of science process skills for high school students of science teachers: Part 1 General status of respondents and Part 2: Current and desirable Conditions, which is characterized by a 5-level rating scale of 44 questions. Creation and quality determination of the tools used in the research, including: Study documents, concepts, and theories related to process skill development. Scientifically, the conceptual framework for research is determined to determine the behavioral indications of skills. The questions used in the 3 parts of the exam are clear and comprehensive with the conceptual framework of the research. Instrument Inspection by means of content structure coverage. Consistency between the questions and the desired objective (IOC) and the appropriateness of the number of questions by the qualified 5 person. Improvement of the tool by considering the IOC values obtained from qualified 5 persons. The IOC value is > 0.5 and the question question has an IOC □ value of 0.5. The researcher made improvements according to the suggestions of the experts. The questionnaire was published through presentation to the thesis advisor and a book to ask for courtesy in further data collection. Data collection is in accordance with the science teacher under the Mahasarakham Secondary Education Area Office. The research collected data manually and used Google form to create an online questionnaire. For remote schools, check the completeness of the questionnaire, then use the questionnaire to score according to the criteria and analyze the data. Data were analyzed by the data in Part 1 of the questionnaire in the form of a checklist. The check list analyzed by frequency distribution and percentage. Data analysis n Part 2, the rating scale is analyzed by finding the mean and standard deviation. The level of current and desirables conditions can be interpreted as the mean ranges 1.00-1.50: Lowest, 1.51-2.50: Low, 2.51-3.50: Moderate, 3.51-4.50: High, and 4.51-5.00: Highest. The results are used to analyze the Modified Priority Need Index (PNImodified) by ranking the necessary needs in descending order, ranking the necessary needs using the method of determining the difference between the desirable condition (I) and the current condition (D). PNImodified = (I–D) / D The criteria used in the data analysis considered the PNImodified value of 0.15 or more and the top 5 priorities of the need to develop science process skills for upper secondary school students.

3. RESULT AND DISCUSSION

The current and desirable conditions in promoteing science process skills for upper secondary school students based on science teachers, affiliated to the Mahasarakham Secondary Education Area Office as shown in Table 2.

Table 2: Levels of Needs in Science Process Skills.

Science process skills	Current (D)			Desirable (I)			$PNI_{modified}$	Sequence of necessary requirements
	$\bar{X}$	SD	level	$\bar{X}$	SD	level		
1. Observing	3.99	0.82	High	4.20	0.83	High	0.053	14
2. Measuring	3.67	0.79	High	4.22	0.82	High	0.150	9
3. Classifying	3.80	0.77	High	4.24	0.79	High	0.116	12
4. Using space/time relationships	3.62	0.84	High	4.16	0.83	High	0.149	10
5. Using numbers	3.64	0.86	High	4.18	0.83	High	0.154	8
6. Interpreting data	3.69	0.76	High	4.27	0.82	High	0.159	7
7. Inferring	3.87	0.73	High	4.29	0.74	High	0.109	13
8. Predicting	3.63	0.71	High	4.24	0.80	High	0.170	6
9. Formulating hypotheses	3.68	0.74	High	4.30	0.82	High	0.170	5
10. Defining operationally	3.50	0.70	Moderate	4.22	0.79	High	0.207	2
11. Identifying and controlling variables	3.64	0.72	High	4.26	0.82	High	0.170	4
12. Experimenting	3.58	0.72	High	4.21	0.81	High	0.177	3
13. Interpreting data	3.76	0.75	High	4.24	0.83	High	0.126	11
14. Formulating model	3.46	0.74	Moderate	4.28	0.82	High	0.235	1
Average	3.68	0.76	High	4.24	0.81	High	0.153	

The development of science process skills is fundamental in science education. These skills help students to gain more of their ability to think critically, conduct investigations, and engage in scientific inquiry. Scientific inquiry fosters a more profound understanding of natural phenomena and encourages students to ask questions, formulate hypotheses, and analyze data. Students become more adept at solving real-world problems and making informed decisions based on scientific evidence.

The information from Table 2 shows a comprehensive assessment of current and desirable levels of science process skills. The Modified Priority Needs Index identifies areas requiring focused improvement. The analysis reveals that all 14 science process skills assessed are currently rated at a high level of competency, with an overall mean of 3.68 (SD = 0.76). The result indicates a strong foundation in science process skills among students. Educators can further empower students to conceptualize in their scientific endeavors. It also foster a more profound understanding of complex concepts. However, the desirable level significantly increases to a mean of 4.24 (SD = 0.81). This variation can explain a collective aspiration for improvement across all areas.

This gap points of the study need to enhance students engage science process skills. Teachers can bridge this divide and fostering a deeper understanding of scientific concepts among students through various kind of instructional strategies. Among all skills, formulating models emerges as the highest priority need (PNImodified = 0.235), with a current condition in moderate level and a desirable condition in high level.

This aligns with literature emphasizing modelling as central to scientific reasoning (Windschitl et al., 2008). The underdevelopment may reflect a curriculum overly focused on factual recall rather than epistemic practices. This suggests that while modeling is a critical component of scientific thinking, it remains underdeveloped among learners and requires urgent instruction. The targeted interventions and professional development for teachers are essential to enhance modeling skills and ultimately improve student outcomes in science education. The skills of defining operationally (PNImodified = 0.207) and experimenting (PNImodified = 0.177) closely follow. It can be indicated that students need more support in their understanding. Defining variables operationally and engaging in experimentation are both foundational components of scientific inquiry. These skills are integral to formulating testable questions and designing empirical investigations. If students lack competence in these areas, they may struggle to engage in higher-order inquiry tasks such as hypothesis testing or data interpretation. Therefore, educators should prioritize strategies that enhance students' abilities to define problems operationally and engage in hands-on experimentation, as these skills are vital for their overall scientific literacy.

Other high-priority needs include identifying and controlling variables, formulating hypotheses, and predicting, each with a PNI modified by 0.170. These skills are integral to designing and interpreting scientific experiments, underscoring the necessity for inquiry-based learning strategies that foster such competencies. Conversely, the skills with the lowest priority needs include observing (PNImodified = 0.053), inferring (0.109), and classifying (0.116). These lower-priority skills, while still important, may benefit from integration into broader hands-on experiences and critical thinking to science.

Skills such as identifying variables, formulating hypotheses, and predicting are essential to the design and interpretation of experiments. Importantly, these skills also support argumentation in science where students must make claims based on evidence (Phimthong et al., 2024). Despite the lower priority ranking of observing, inferring, and classifying. These skills continue to play a crucial role as fundamental components of early science education. Instead of neglecting these lower-priority skills, teachers should integrate them into broader, inquiry-driven activities to sustain cognitive engagement without taking up excessive instructional time.

These findings have serious implications for both classroom instruction and teacher professional development. The new paradigm of teaching and learning science to promote science process skills should deal hybrid learning (Sarıer & Uysal, 2022; Chohan et al., 2024). Online learning may be suitable for contents and self-learning through understanding, but practical learning is important for social and hands-on experiences (Ram et al., 2025).

Workshops and professional learning communities should focus on inquiry approach and assessment based on process skills (AbdulRab, 2023; Ekkuaboon, 2024). Curriculum planners should ensure alignment between learning outcomes, teaching strategies, and assessment tools to reflect the importance of science process skills beyond factual knowledge.

4. LIMITATIONS

The study identifies some inferred limitations regarding the convenience sampling. It might limit the generalizability of the findings to all science teachers in the region or beyond. The study emphasizes teacher needs and perceptions but may not directly evaluate actual classroom practices or student outcomes. These inferred limitations indicate considerations about sampling, data collection methods, and contextual scope.

4.1. Future Research

The future research is related to science process skills development and science education. It could evaluate the impact of specific inquiry-driven instructional strategies and professional development programs on enhancing students' science process skills. Curriculum design in science subjects can better integrate science process skills, especially modelling and hypothesis formulation, to promote epistemic practices alongside factual knowledge. Furthermore, complement self-report questionnaires with direct observations of classroom practices to validate the alignment between perceived needs and actual instructional behaviours. Actual student achievement and scientific reasoning capabilities correlate with teachers' perceptions of science process skills priorities. These future directions aim to deepen understanding and enhance practical strategies for cultivating essential scientific skills among students.

5. CONCLUSION

The study found that the desirable condition of the science process skills is at a high level, but the current condition is generally moderate to high levels. It represents significant developmental gaps and offers critical opportunities for enhancing science process skills. Strategic curriculum adjustments and teacher training aimed at these specific skills can bridge the gap between current competencies and desired outcomes, thereby advancing the quality of science education. As a result, teachers may focus on enhancing higher-ordered thinking skills that promote more profound engagement with scientific concepts. Teachers can better prepare students to tackle complex scientific inquiries and foster a more robust understanding of the scientific method.

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