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Teachers' Views on Science Learning and Students' Environmental Awareness and Conservation: A Comparative Study

Thetipat Phajan
Mahasarakham University, Thailand

Patcharabhorn Thongkorn
Mahasarakham University, Thailand

Kanyarat Cojorn
Mahasarakham University, Thailand
https://orcid.org/0000-0002-1237-2798

Kanyarat Sonsupap
Mahasarakham University, Thailand
https://orcid.org/0000-0002-3810-1988

Abstract
This study investigates the differences in attitudes and awareness among science teachers regarding the design of instructional activities and their influence on students' environmental awareness and conservation. It compares large provincial secondary schools with medium-sized secondary schools, collecting data from 41 teachers and 88 students through questionnaires and semi-structured interviews. The findings reveal distinct instructional priorities between the two school types. In large provincial secondary schools, most teachers prioritize disseminating scientific knowledge (57.00%), followed by developing scientific process skills (43.00%), while cultivating scientific attitudes is not a focus (0.00%). In contrast, medium-sized secondary schools emphasize scientific process skills (69.00%), followed by knowledge dissemination (31.00%), with no emphasis on scientific attitudes (0.00%).Students in medium-sized secondary schools demonstrated higher levels of environmental awareness and conservation. Interviews suggest that in large provincial schools, social context, parental expectations for higher education, and student preparedness lead teachers to focus on knowledge-based instruction. Meanwhile, in medium-sized schools, the environmental context and parental expectations favor practical applications and employment, with the school's natural surroundings reinforcing this approach. As a result, these schools emphasize scientific process skills and real-world applications, leading to positive outcomes such as fostering scientific and environmental attitudes and encouraging students to actively engage in solving environmental issues.

Keywords: Teachers Awareness, Teachers Perception, Environmental Awareness, Environmental Problems, Environmental Conservation

Introduction

In today's era of rapid technological advancement, daily life has become more convenient and efficient. However, this progress has also led to significant environmental damage. The expanding worldwide environmental crises are seen in increasingly unpredictable climate patterns and the worsening effects of global warming year after year (Abbass et al., 2022; IPCC, 2021; Naceur & Rahmani, 2024). It's clear we're facing major challenges. To tackle them, we need everyone to act, and we need to act fast (UNEP, 2019). Therefore, science education plays a crucial role as it is essential for understanding global changes, promoting knowledge, and developing sustainable solutions to environmental issues (National Research Council, 2012). It equips children and youth with the

essential skills to address these challenges, while teachers, as facilitators of science education, play a crucial role in enhancing students' ability to apply scientific concepts to real-world environmental problem-solving (Bybee, 2010).

Science education consists of 3 fundamental components: The three main elements of science education consist of scientific knowledge together with scientific process skills and scientific attitudes. According to Bybee (2010), effective science instruction requires the combination of scientific knowledge, process skills, and scientific attitudes to help students achieve deep conceptual understanding while developing their investigative skills and fostering positive scientific attitudes. Hands-on experiences remain essential because they actively engage students in scientific concepts while providing opportunities to practice scientific skills in practical settings (National Research Council, 2012). Educating students to value and understand the importance of science through positive scientific attitudes enables them to apply their scientific knowledge effectively when solving real-world problems (Osborne et al., 2003). The knowledge teachers possess about science instruction shapes their teaching methods and perceptions which serves as a fundamental element in science teaching. Students' comprehension of science concepts and their effectiveness in application depend directly upon these factors according to Tobin and Tippins (2012). The development of scientific literacy requires an integrated approach that encompasses cognitive, procedural, and affective domains. This comprehensive approach both deepens students' scientific understanding while providing them with necessary skills and attitudes for practical knowledge application. Studies show that instructional practices which use real-life problems to foster student critical thinking and problem-solving through methods like inquiry-based learning create effective learning environments that improve environmental awareness. Students experience enhanced motivation and develop environmental awareness which strengthens their emotional ties to environmental challenges through this educational approach resulting in improved understanding of these issues (Lee, 2023). Because teachers play a vital role in developing student perspectives the research examines how teachers perceive science learning and their impact on students' environmental consciousness and conservation minds. Many researches have examined the impact of environmental education programs, few studies have directly linked teachers' pedagogical beliefs and practices to students' environmental attitudes. Moreover, comparative research across different educational contexts remains scarce, particularly in regions like Thailand, where educational approaches and societal values are deeply interconnected.

In Thailand, schools are categorized into four sizes based on student enrollment and available resources: 1) Extra-large schools accommodate 1,680 students or more, while 2) Large schools have enrollments ranging from 720 to 1,679 students, 3) Medium-sized schools cater to 120 to 719 students, and 4) Small schools serve 119 students or fewer. This classification reflects the varying capacities and resource allocations among schools in the country. The large schools are typically well-equipped with financial resources and facilities. They often boast modern buildings, diverse equipment, laboratories, and a broad range of curricula designed to meet students' needs effectively. Additionally, they benefit from a strong foundation of qualified teachers and substantial support from the community, society, and families, ensuring comprehensive assistance for teaching and learning activities (Usaho, 2023). Medium-sized schools face considerable resource-related difficulties including teacher shortages which require multi-grade teaching approaches. Educational needs frequently surpass the available teaching materials and laboratory facilities. Small schools sometimes operate within social and community environments that fail to provide sufficient support or motivation for student learning. Educators face distinct challenges when they try to meet academic objectives while addressing the social context realities around them to provide effective instruction. Social influences together with local contexts significantly shape educational outcomes. Large provincial secondary schools experience societal and parental expectations that center around academic achievement and preparing students for university. Medium-sized schools

located in rural areas face unique expectations which prioritize teaching students practical skills that support stable employment and sustainable living. The results of Thailand's 2022 PISA demonstrate substantial differences in science literacy scores across the educational system. Schools with strong socioeconomic backgrounds produced students who consistently attained high scores, while small schools from lower socioeconomic environments produced students with significantly lower scores (OECD, 2023a; 2023b). The performance gaps reveal how socioeconomic conditions create educational inequalities by affecting educational quality. The average math literacy scores of small and remote schools were significantly lower compared to those of large and extra-large schools (Equitable Education Fund, 2022). The research conducted a comparative analysis between large provincial secondary schools and medium-sized secondary schools to explore differences in their educational goals. Students' understanding and readiness to use scientific principles for environmental problem-solving is influenced by these educational distinctions. The identification and analysis of these educational differences must guide the creation of science learning strategies which prioritize scientific skill development and attitude cultivation in addition to knowledge acquisition. The research emphasizes that students need to develop awareness and proficiency in scientific knowledge to address urgent environmental problems. Research that investigates educational goals and outcomes across different school types in Thailand seeks to develop science teaching methods appropriate for the country's varied educational settings. The educational approach achieves better results by combining knowledge with practical skills and real-world applications to solve urgent environmental problems.

Research Objective

The purpose of this study was to look into how science teachers' attitudes and perceptions about designing science teaching and learning activities differed across large and medium-sized schools. Furthermore, it investigated students' environmental awareness and conservation mindset in both educational environments.

Methodology

Participants

The study involved 41 secondary school science teachers, comprising 28 from large provincial secondary schools and 13 from medium-sized secondary schools. Additionally, 32 students from science classes in medium-sized schools and 56 students from large schools were randomly selected to participate voluntarily.

Instruments

The study employed 3 primary data collection instruments. First, a questionnaire was developed to assess teachers' perspectives on the design of science learning activities which including 3 aspects; 1) scientific knowledge, 2) scientific method, and 3) scientific mind. This instrument underwent expert validation in the disciplines of science education and educational psychology, yielding an and a content validity index (CVI) was 0.95and a suitability range of 4.33 to 5.00. Following expert recommendations, the revised questionnaire was administered to the sample group. Second,the environmental awareness and conservation assessment for students is a 5-point likert scale instrument designed to evaluate 5 key dimensions according to Kollmuss & Agyeman (2002) and Stern (2000): 1) knowledge of environmental issues, 2) attitudes toward addressing environmental challenges, 3) behavioral readiness for change, 4) conservation-oriented mindset, and 5) the application of scientific knowledge in classroom contexts to promote environmental conservation. The assessment instrument was developed and subjected to a quality evaluation, yielding suitability scores in the range of 4.60 to 5.00 and a content validity index (CVI) was 0.86, indicating a high level of reliability and validity. Third, a semi-structured interview was conducted to examine the objectives and implementation of science learning activities within classrooms. This interview protocol was also validated by experts, achieving a suitability range of 4.67 to 5.00, ensuring its relevance and appropriateness for the study.

Data Collection

In this study, ethical guidelines related to human research were strictly followed. The details and

objectives of the research were thoroughly explained to the teachers providing the data, ensuring they understood the purpose and had sufficient time to independently decide whether to participate. As for the students, the information was conveyed through the teachers, who also provided the students with an opportunity to ask any questions before making their own decision to participate. The entire process adhered to strict ethical standards for human research to ensure the safety and rights of all participants. During the data collection, the researcher utilized Google Forms to distribute 70 questionnaires. Teacher participation was voluntary, and a total of 41 completed questionnaires were received, accounting for 60% of those distributed. Additionally, data collection from students will be facilitated by the respective science teachers, who will administer the assessment via Google Forms.

Data Analysis

The data collected from the questionnaire, particularly the checklist questions, were analyzed using frequency and percentage calculations. The assessment of students' environmental awareness and conservation is conducted through the calculation of the mean score. The interview data were analyzed using content analysis. Participant teachers from large provincial secondary schools were assigned identifiers based on the sequence of their interviews and labeled as 'LS1, LS2, ..., LS28'. Conversely, participant teachers from medium-sized secondary schools were designated as 'MS1, MS2, ..., MS13'.

Results

The survey results on science teachers' perspectives and attitudes, based on responses from 41 participants, can be categorized by school size as follows:

The Perspectives and Attitudes of Science Teachers at Large Provincial Secondary Schools

Figure 1 depicts data obtained from 28 teachers from large provincial secondary schools on their perspectives and impressions of scientific learning.

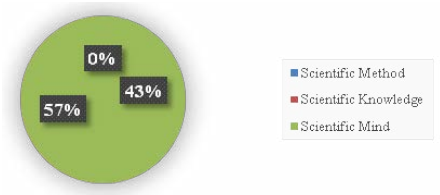

Figure 1 The Main Objective of Science Learning for Teachers at Large Provincial Secondary Schools

As shown in Figure 1, the majority of teachers, 16 (57%), prioritize scientific knowledge as the main focus of science education. This is followed by 12 (43%) teachers who emphasize scientific process skills. None of the science teachers in these schools view the development of scientific mindset and psychology as a primary goal of science education.

Furthermore, insights gained from interviews with science teachers can be summarized as follows:

1) Teachers prioritize delivering theoretical content through lectures, followed by having students conduct experiments to reinforce and deepen their understanding of the material. This approach is reflected in the interview responses.

LS1: The majority of them will begin teaching with lectures. Then, for topics where experiments are practical, students will undertake experiments and discuss them as a classroom group. This allows students to witness firsthand the reality of what they have studied.

LS4: I teach the theory to help pupils build fundamental knowledge first. Students will then do experiments because lectures alone may not provide them with a complete understanding of the material.

LS10:I often start with a lecture, then engage students in activities like games, quiz competitions, or experiments. They will concentrate on issues that are relevant to everyday life or practical applications, allowing students to readily relate to and grasp.

LS11: It should highlight lectures by improving teaching materials, as this helps students understand the present information and allows them to conduct experiments with a better comprehension of what they are doing.

LS21: With little teaching time and a large amount of content, it should focus mostly on knowledge.

LS24: Due to limited teaching time and students' need to prepare for university admission examinations rapidly, the emphasis should be on information acquisition first.

2) The design of learning activities focused on practical experiments is limited by time constraints,

content requirements, and increased expectations for upcoming exams. This is reflected in the following examples of the responses:

LS2: Time constraints limit the focus on process skills in learning, leading to fewer experiments and a reliance on lectures. As a result, students develop and apply skills less effectively.

LS4: I teach concept first, then look for intriguing phenomena in everyday life that relate to the content. Following that, each group of students will develop hypotheses and execute experiments before discussing the results. However, this technique is not applicable to all topics.

LS13: The conception, or knowledge, is critical and must be taught thoroughly since parents and students expect it. If there is enough time or substance, additional experiments can be carried out.

3) Implementing activities that promote scientific attitudes and desirable attributes might be problematic due to the subject's emphasis on knowledge and procedural abilities, as well as time constraints. As a result, they are frequently integrated into numerous duties, as seen by the following interview excerpt:

LS1: Science learning activities place limited emphasis on developing scientific thinking and psychological attributes due to the lecture-based nature of some teaching. As a result, students' desirable characteristics and social skills are not prioritized. However, conducting experiments can help foster some social skills and desirable traits.

LS18: Some examples include illustrating circumstances relevant to the topic being studied, such as the environmental effects of factories dumping waste into rivers, which can also incorporate debates on ethics and desirable features.

LS15: Because the subject matter concentrates on knowledge material, there is less emphasis on scientific attitudes and desirable attributes, and students prefer practicing exercises to prepare for university entrance tests. As a result, students are not particularly interested in activities that take time or have no direct impact on understanding.

4) Science teaching and learning activities, such as projects and STEM initiatives, should be incorporated to provide students with comprehensive knowledge, as well as practical and social skills.This is shown in the following examples of responses:

LS7: STEM, Because it requires students to work in groups to collaborate and solve problems by combining information from other fields. This promotes a knowledge of the value of several courses, supports a holistic perspective, and prepares students to face societal and global concerns.

LS8: Projects are beneficial because they allow students to apply what they have learnt. At the same time, they must seek new information to further their interests. They also improve their communication and social skills by participating in group presentations and collaboration.

LS10: Doing projects allows students to participate in the entire process, from identifying issues of interest, arranging experiments, and completing and presenting their findings or problem-solving ideas. Additionally, they learn cooperation skills through joint work.

The Perspectives and Attitudes of Science Teachers at Medium-sized Secondary Schools

Data on science teaching perceptions from teachers at large provincial schools (N=13) were collected, as detailed in Figure 2.

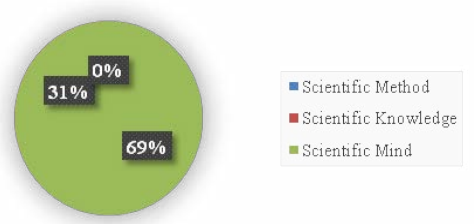

Figure 2 The Main Objective of Science Learning for Teachers at Medium-sized Secondary Schools

Figure 2 shows that science teachers in medium-sized schools prioritize scientific process skills as the main goal of science education, with 9 (69%) teachers selecting this focus. This is followed by scientific knowledge, chosen by 4 (31%) teachers. None of the science teachers in these schools view the development of scientific mindset and desired characteristics as a primary goal of science education.

Interviews with teachers revealed that the social context impacts their perspectives on science learning. Key findings can be summarized as follows:

1) To promote effective science learning, students should participate in hands-on activities and experiments to develop various process skills, thereby enhancing their knowledge. This approach is reflected in the teachers' perspectives, as illustrated in the following examples:

MS1: In science education, it is critical to emphasize process skill development. Hands-on exercises assist students to obtain a better comprehension of the material.

MS2: Experimentation should be prioritized in science education since it allows students to engage hands-on, developing their skills in designing and executing learning activities, resulting in the generation of new knowledge.

MS8: Students must engage in practical hands-on tasks to acquire process skills, which promotes knowledge generation among students.

2) Science education should involve real-world activities that emphasize active learning, helping students develop process skills and apply their knowledge to everyday life. This approach aligns well with the school context, as reflected in the following teacher perspectives.

MS2: The 5E instructional methodology, paired with media and real-life scenarios that students frequently experience, improves their comprehension through hands-on exercises. This strategy is more effective and interesting than standard didactic instruction, which frequently fails to pique students' interest and results in limited learning outcomes.

MS7: Learning through real-world situations, where students may practice hands-on, is most suited to their context. Because these students are not primarily concerned with passing tests for future education, but rather with graduating and finding work, strengthening process and thinking skills is critical.

MS10: Higher-order thinking, hands-on practice, and real-world application are all important components of effective science learning activities. Students benefit more by applying their newly acquired abilities in their daily lives than from receiving only direct instruction.

3) The development of scientific mind, desirable traits, and social skills can be incorporated into various activities, such as group work, by setting rules and using reinforcement to encourage engagement. This approach helps students recognize the value of knowledge and link it to real-world applications. This is evident in the following examples of teachers' perspectives:

MS2: Science learning for the formation of the scientific mind can be integrated into classroom activities such as applying norms and regulations for class attendance with clear grading standards, working in groups, and assigning projects to students.

MS1: Group activities, the use of incentive, positive reinforcement, additional points, and rewards, as well as the establishment of regulations, can all help to nurture desirable attributes in a scientific classroom. However, focusing on or developing activities for direct development may not be appropriate for the topic matter.

MS9: Group work encourages students to collaborate and share ideas, which promotes critical thinking and the application of knowledge in real-world circumstances. Frequent participation in group activities helps students integrate these values, allowing them to recognize their importance and eventually develop them as personal characteristics.

The Students' Environmental Awareness and Conservation

The data collection on students' environmental awareness and conservation from two school sizes large provincial secondary schools and medium-sized secondary schools was conducted across five dimensions: Dimension 1: knowledge of environmental issues, Dimension 2: attitudes toward addressing environmental challenges, Dimension 3: behavioral readiness for change, Dimension 4: conservation-oriented mindset, and Dimension 5: the application of scientific knowledge in classroom contexts to promote environmental conservation. The results of the assessment are shown in Figure 3.

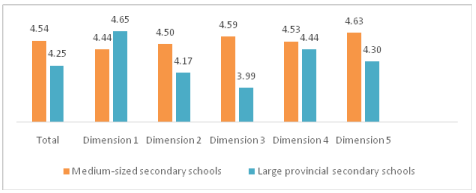

Figure 3 The Average Scores for Each Dimension of Environmental Awareness and Conservation between Large and Medium-sized Secondary Schools

An assessment of students' environmental awareness and conservation revealed that, on average, students from medium-sized secondary schools outperformed their counterparts from large provincial secondary schools, with mean scores of 4.54 and 4.25, respectively. A dimension-specific analysis indicated that students from medium-sized secondary schools achieved higher average scores in dimensions 2, 3, 4, and 5. In dimension 1, students from large provincial secondary schools exhibited superior performance, with a higher mean score than those from medium-sized secondary schools.

Conclusion and Discussion

This study found that teachers' perspectives and perceptions of science learning goals have a

significant impact on the design of science learning activities. In large provincial schools, teachers prioritize knowledge acquisition in their teaching approach. As a result, classroom activities primarily consist of lectures to deliver content, followed by practice sessions to develop process skills, promoting deeper learning. Due to content-focused teaching and time constraints, teachers should adopt more effective and diverse techniques and strategies to manage learning efficiently (Koolnapadol et al., 2019). In contrast, science teachers in medium-sized schools prioritize the development of scientific process skills rather than just knowledge acquisition. As a result, classroom activities in these schools focus on hands-on practice to strengthen process skills. The instructional approach that encourages students to think critically, experiment, and engage in practical activities bridges the gap between knowledge and problem-solving, especially when real-world issues from students' daily lives are incorporated. This method not only enhances understanding of core content and develops scientific process skills but also effectively nurtures positive character traits and attitudes. Therefore, if teachers can integrate real-life scenarios that prompt students to think, solve problems, and cultivate attitudes toward various issues, it will foster both awareness and positive attitudes. This is consistent with the findings of this study, which revealed that in medium-sized schools, where teachers emphasize designing learning activities focused on developing scientific process skills, students exhibited higher environmental awareness in dimensions of attitudes toward addressing environmental challenges, behavioral readiness for change, conservation-oriented mindsets, and the application of scientific knowledge in classroom contexts to promote environmental conservation compared to those in large provincial schools, where the emphasis was primarily on enhancing knowledge and understanding. Conversely, in the dimension of knowledge of environmental issues, students from large provincial secondary schools exhibited superior performance. Thus, it can be concluded that the design and delivery of instructional activities by teachers significantly influence students' attitudes and perceptions especially in environmental awareness and environmental attitude (Shobeiri et al., 2007). Moreover, Gunawan et al. (2019) demonstrated that students' science process skills receive significant improvement through the guided inquiry model in virtual laboratories. This educational method promotes scientific learning by developing students' critical thinking skills while enhancing their problem-solving capabilities and real-world situation awareness.

Students frequently lack enough practice time to solve problems due to time limitations. Teaching methods in both school settings overlook psychological factors and essential personal qualities that lead to students lacking both character development and comprehension of scientific education and its real-world applications (Viro et al., 2020). Educators who show positive behavior and enthusiasm play a key role in shaping students' positive reactions to science and environmental studies. Future generations' climate literacy depends on how teachers design lessons and organize knowledge because their teaching methods stem from their personal attitudes and views. Teacher attitude research holds fundamental importance in advancing science and environmental education (Liu et al., 2015). The method enables students to become active learners as they use their understanding to address environmental challenges. The combination of research-backed instructional methods with active student involvement in problem-solving exercises enhances their analytical thinking abilities as well as their problem-solving skills. Teachers who show disinterest towards environmental issues contribute to students' diminished ability and interest in using scientific knowledge for environmental problem-solving (Mao et al., 2021; Twizeyimana et al., 2024). Understanding teachers' views about plastic waste's environmental effects is vital because they greatly influence the environmental attitudes and behaviors of future generations (Anokye et al., 2024). By exploring educators' perspectives we can uncover opportunities to integrate environmental education into curricula while promoting environmental awareness. Many environmental education experts believe that environmental education serves as a vital instrument for public instruction on global environmental concerns (Potter, 2010). The

comparative study shows how crucial teachers are for inspiring students to prepare against upcoming environmental problems.

This study indicates that teachers need targeted professional development to acquire environmental knowledge and attitudes which are essential. Educational initiatives aimed at science instruction play a pivotal role in enhancing student learning outcomes while developing their pro-environmental mindset towards scientific problem-solving. The study demonstrates that teachers must acquire essential skills and knowledge to motivate students and prepare them for future environmental obstacles. Policymakers need to fund professional development programs to prepare teachers for sustainability-centered education. Instructors must embrace inquiry-based teaching techniques to actively involve students in studying environmental topics. Education programs must incorporate sustainability across various subjects to promote comprehensive understanding. Teacher training programs must include complete practice-oriented modules on environmental science and sustainability. The method improves teachers' skills in leading discussions that require critical thinking while developing students' problem-solving abilities and enabling teachers and students to participate in sustainable solution creation.

This research took place under the Thai educational system which follows national curriculum standards while being shaped by cultural values that differ from other educational contexts. The small number of participants restricts how broadly the results can be applied and indicates the necessity for additional studies involving bigger and more varied groups to improve the usefulness of the findings across multiple educational environments.

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Author Details

Thetipat Phajan, *Mahasarakham University, Thailand*

Patcharabhorn Thongkorn, *Mahasarakham University, Thailand*

Kanyarat Cojorn, *Mahasarakham University, Thailand,* ***Email ID****: kanyarat.c@msu.ac.th*

Kanyarat Sonsupap, *Mahasarakham University, Thailand*