Exploring Peer Teaching in Science Education: Youth Volunteers' Roles and Impacts

Sumethawee Kongmai
Mahasarakham University, Thailand
https://orcid.org/0009-0004-7170-749X

Warisa Sakuntanat
Mahasarakham University, Thailand
https://orcid.org/0009-0000-2498-6263

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

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

OPEN ACCESS

Volume: 13

Special Issue: 1

Month: February

Year: 2025

P-ISSN: 2320-2653

E-ISSN: 2582-1334

Received: 01.01.2025

Accepted: 14.02.2025

Published Online: 22.02.2025

Citation:
Kongmai, S., Sakuntant, W., Sonsupap, K., & Cojorn, K. (2025). Exploring Peer Teaching in Science Education: Youth Volunteers' Roles and Impacts. *Shanlax International Journal of Education, 13*(S1), 19-28.

DOI:
https://doi.org/10.34293/education.v13iS1-Feb.8501

Abstract
The qualitative study undertook an exploration of how the activities of youth volunteering and peer teaching provided opportunities for student development during engagement in a science research project within the school setting at a secondary school, Thailand. The themes being explored were relative to the following aspects: 1) educational opportunities, 2) challenges and support, 3) engagement and motivation, 4) feedback and interactions, 5) impact on interest, and 6) suggestions for improvement. Using a qualitative research approach, data were collected through semi-structured interviews with two project teachers and nine students (five Grade 11 and four Grade 12 students), selected through purposive sampling. The interview data were analyzed using thematic analysis to identify patterns in participants' experiences. Results proved to be significant where professors and junior-senior students established a healthy peer-teaching environment. The senior students got ample opportunity for teaching and leadership through the above-mentioned roles. They were also implementing innovative teaching methodology like practical demonstrations and informal discussions to explain complicated concepts. Their communication and problem-solving skills had also improved. Senior students were resilient and helped one another in dealing with some challenges such as a lack of equipment and occasional breakdowns in communication; they approached the teachers for assistance when there was a need. Resources were available, observing of the process of learning and activities facilitated, hence the role of the teachers was very important. They concluded that peer teaching enhances the efficiency and involvement of students in learning, though they recommended increasing incentive activities to take care of diverse interests among students. The results show that peer teaching does indeed provide a stimulating, inclusive learning environment with substantial advantages for both academic and personal growth. Some suggestions for further refining the peer teaching method include the solving of logistical problems, maintenance of effective incentive schemes, and improvement of feedback systems. These findings point to how peer interactions, student leadership, and teacher support through a scientific framework can change science education.

Keywords: Peer Teaching, Mentor, Student Motivation

Introduction

In educational settings, peer teaching has emerged as a powerful instructional strategy, fostering collaborative learning and enhancing student engagement. This study investigates the impact of peer teaching within the context of science research projects among junior and senior high school

students. The role of peer teaching in these settings is particularly pertinent as it encourages mutual support, knowledge exchange, and the development of critical thinking skills essential for scientific inquiry. Peer-teaching provides an atmosphere that promotes the improvement of communication skills, encourages independent learning, and helps to develop self-confidence. Because peer-teaching actively engages students in the learning process, students gain a sense of purpose with regard to the course (Lim, 2014). Additionally, the concept of youth volunteers - senior students who volunteer their time and expertise to mentor their junior peers - plays a significant role in this dynamic, further enriching the learning experience.

However, there is a research gap in the lack of comparison of peer teaching with other forms of teaching, which restrains a fuller understanding of its relative effectiveness (Ghio, 2023). Also, qualitative studies are needed which can afford insights regarding various contextual factors that influence the level and nature of student participation and specific outcomes of peer teaching (Thomson et al., 2014).

Peer dialogue enables students to restructure and elaborate their thoughts and is, therefore, a very useful tool in the process of knowledge construction in classroom learning. The studies conducted so far have established the importance of peer interaction in science classrooms. The emphasis is on getting students to work together on a problem or task in small heterogeneous groups in order to achieve a common goal and support one another (Essiam et al., 2020).

The current research seeks to understand the dynamics of peer teaching from multiple perspectives, focusing on junior students, senior students, and supervised teachers. Through qualitative interviews, this study explores the initial impressions, learning experiences, teaching methods, challenges, support mechanisms, and the overall impact of peer teaching on students' academic and personal growth.

The perspectives of junior students highlight the initial pressure and excitement associated with the course, the collaborative learning environment fostered by senior students, and the positive impact on their motivation and career interests. Senior students' viewpoints provide insights into their roles as mentors and the strategies they employ to facilitate effective peer learning. As youth volunteers, these senior students not only enhance their leadership skills but also contribute to a supportive and motivating learning environment. Teachers' observations and reflections underscore the importance of guidance, structured support, and the integration of interdisciplinary knowledge for successful learning outcomes.

By examining these varied perspectives, this research aims to contribute to a deeper understanding of the benefits and challenges of peer teaching and youth volunteering in science education. The findings are expected to inform educators, policymakers, and curriculum developers on best practices for implementing peer teaching models that enhance student learning and engagement in scientific research projects.

Literature Review

Peer teaching has also attracted a lot of interest as one of the newer ways of learning in education, where students themselves serve as instructors. In most circles, it is believed to encourage collaboration, improve understanding, and promote interpersonal skills in individuals. This literature review investigates theoretical perspectives, important benefits, challenges, and empirical findings regarding peer teaching.

Peer teaching has been defined as an activity whereby students facilitate the learning process of others through activities including discussion, teaching, and mentorship. There is mutual teaching and learning where there is a change of roles between the teacher and learner. The basis of this method lies in social constructivism whereby learning happens through interaction and occurs in a social context. According to Vygotsky (1978), the learning of individuals takes place essentially through interaction with other people. The underpinning for the peer teaching pedagogy comes from Piaget's work, where he regarded socialization and collaboration as part of meaningful learning (Secomb, 2008). His cognitive development theory supports the idea that peer interaction can effectively challenge established norms, creating a state of disequilibrium that fosters

learning (Palincsar, 1998; Piaget, 1965). In contrast, in formal classroom teaching, most activities that are meant to encourage learner participation often evoke a sense of obligation and constraint. However, De Lisi (2002) comments that peer interaction among equals encourages cooperation and engagement.

The cognitive, social, and emotional advantages of peer teaching significantly improve the educational process for both tutors and tutees. Teaching others helps the instructor retain and comprehend the information better on a cognitive level; elucidating concepts necessitates a deeper level of cognitive engagement (Roscoe & Chi, 2007). Peer teaching fosters social and emotional empathy, teamwork, and communication, all of which contribute to a positive learning environment. According to Topping (2005), students are more inclined to seek clarification from their peers than from teachers. Peer teaching also increases motivation and engagement as students become more engaged and interested in their study (Fantuzzo et al., 1989).

Methodology

This research was conducted using semi-structured interviews as the tool for data collection.

Semi-Structured Interview

A semi-structured interview is a qualitative research method that combines aspects of both structured and unstructured interviews. It involves asking participants a set of predetermined open-ended questions, while still allowing flexibility to explore relevant ideas that arise during the conversation.

To conduct a semi-structured interview:

- Determine the objectives and scope
- Design open-ended interview questions
- Identify target participants
- Obtain consent and schedule interviews
- Conduct interviews, listening attentively to responses and non-verbal cues
- Transcribe audio recordings
- Code data to identify patterns and themes
- Analyze coded data to draw insights
- Present results as a research paper or report

Participants

The population studied comprised teachers and students from the Special SMTE Classroom at a secondary school in the Northeast of Thailand. This included two biology teachers, one male and one female. Additionally, the group consisted of four senior students (Grade 12), three male and one female, as well as five junior students (Grade 11), four male and one female.

Result

Junior Students' Perspectives on Peer Teaching for Science Research Projects

Junior students describe their senior peers as pivotal leaders in the science research course. The roles of these seniors encompass being group leaders, finding and presenting concepts, and assisting their junior peers throughout the project. Senior Student 1 emphasizes their role in conceptualizing ideas and collaborating with peers: "…act as group leaders, finding concepts to present to friends and help them think together" (June 24, 2024). This role extends to refining and innovating existing work, as Senior Student 2 states: "…find concepts, methods, or innovations to solve problems or develop and build upon existing work, correcting flaws in old projects" (June 24, 2024). The seniors also engage in experimental work, documentation, and motivational activities within the group, ensuring an all-encompassing support system (Senior Student 3, June 24, 2024). Task assignment and oversight further solidify their leadership roles, as highlighted by Senior Student 4: "…assign tasks to friends and help oversee and check the work" (June 24, 2024).

Seniors prepare meticulously before sharing knowledge or advising juniors. This preparation involves gathering relevant information, understanding personal interests, and fostering creative thinking. Senior Student 1 mentions, "…gather information beforehand about what knowledge is needed or what needs to be done first" (June 24, 2024). This preparation is thorough, often involving internet research and methodical planning to ensure clarity and comprehension (Senior Student 2, June 24, 2024). Evaluating the feasibility of projects and understanding existing work is a crucial part of this process, as Senior Student 3 notes: "…

study a lot of work and assess the feasibility of each project, choosing the most feasible one" (June 24, 2024). Effective communication and summarization of information are also key components, highlighted by Senior Student 4 (June 24, 2024).

Effective teaching methods as perceived by juniors revolve around hands-on practice and practical engagement. Senior Student 1 asserts the value of hands-on practice: "…hands-on practice is better. When doing it, I feel I understand better than just learning the content" (June 24, 2024). Visual aids and simplified language are also instrumental in making the learning process more concrete and understandable (Senior Student 2 and 3, June 24, 2024). Collaborative review of materials, such as slides, is another method employed to facilitate discussion and understanding (Senior Student 4, June 24, 2024).

Juniors note that seniors face several challenges in knowledge transmission, including differing opinions, misunderstandings, equipment shortages, and communication barriers. Senior Student 1 mentions, "Differing opinions, friends not agreeing with the advice given" (June 24, 2024). To overcome these challenges, seniors employ strategies such as finding mutual agreements, seeking additional information, consulting experts, and using alternative communication methods (Senior Student 1-4, June 24, 2024).

As mentors, seniors take proactive steps such as preparing thoroughly, giving thoughtful advice, and consulting with experts to ensure effective knowledge transfer. The satisfaction derived from successful mentoring is a common sentiment among seniors, with Senior Student 1 stating: "First, you need to take action, then see if it goes as expected. If not, keep trying. It's satisfying when the advised person succeeds" (June 24, 2024). Understanding experimental methods and related documents is crucial to avoiding time wastage, as noted by Senior Student 3 (June 24, 2024).

Engagement in the course is driven by various activities that align with the students' interests, such as participating in competitions and hands-on workshops. Senior Student 1 emphasizes the practical application and personal interest in research: "It allows us to practice in real life and research information that we genuinely like" (June 24, 2024). Competitions provide a platform for presenting work and developing systematic teamwork skills (Senior Student 2, June 24, 2024). Motivation also stems from the autonomy in exploring personal interests and practicing discipline (Senior Student 3, June 24, 2024).

Feedback from peers is a critical component of the learning process, leading to adjustments in teaching methods to enhance understanding. Senior Student 1 highlights the importance of discussion and peer input: "It's impossible for two people to understand the same thing. We need to discuss whether others understand what we're saying" (June 24, 2024). Detailed explanations and iterative improvements based on feedback help clarify doubts and improve communication (Senior Student 2-4, June 24, 2024).

Peer teaching is perceived to have a significant impact on learning, fostering a more approachable and engaging environment compared to teacher-led instruction. Seniors believe that peer teaching encourages open communication, trust, and a more friendly atmosphere, making it easier for juniors to express themselves and engage actively in the learning process (Senior Student 1-4, June 24, 2024). The success of peer teaching is measured by the juniors' ability to understand and apply the concepts taught, as evidenced by the success of their projects (Senior Student 1-4, June 24, 2024).

In summary, the interviews reveal that senior students play a vital role in leading and mentoring juniors in science research projects, employing various strategies to overcome challenges and enhance learning. Their preparation, teaching methods, and the motivational environment they create significantly contribute to the juniors' understanding and engagement in the projects.

Junior students initially experienced a mix of pressure, stress, excitement, and uncertainty when engaging in the science research course. Many expressed feelings of pressure and fear of failure. For instance, Junior Student 1 mentioned feeling pressured due to the workload: "...I felt pressured because there was work, and if I couldn't do it..." (June 24, 2024). Junior Student 2 echoed this sentiment, stating: "...A bit pressured and stressed because I've never taken this course before" (June

24, 2024). Despite these pressures, some students found the course exciting and saw it as an opportunity to develop new skills, as noted by Junior Student 4: "...Very excited to learn because I've never taken it before, developing new skills, it's an interesting subject, and I can improve myself" (June 24, 2024).

Junior students perceived that the involvement of senior students significantly impacted their learning environment positively. They appreciated the leadership and guidance provided by the seniors. Junior Student 1 highlighted this impact: "...It has an impact, like having a leader who helps us work better" (June 24, 2024). The collaborative environment fostered by senior students, which included discussions and idea sharing, was also valued, as Junior Student 2 stated: "...Mostly, there are discussions, sharing ideas together, finding information from various sources, and even though we are in different groups, we can still talk" (June 24, 2024). The mentorship from seniors also provided practical recommendations and knowledge exchange, contributing to a richer learning experience (Junior Student 3 and 4, June 24, 2024).

The teaching methods employed by senior students were seen as effective and beneficial for the learning environment. Junior students appreciated the guidance on presenting information and asking questions. Junior Student 1 noted: "...Guidance on how to do it well" (June 24, 2024). Senior students' approach of using examples, encouraging small problem-solving steps, and collaborative brainstorming was particularly valued, as Junior Student 3 mentioned: "...Teaching how to ask questions, advising to think from small problems first, then gradually find solutions, and providing examples" (June 24, 2024). The use of collaborative methods helped junior students acquire new skills and expand their perspectives (Junior Student 4 and 5, June 24, 2024).

Junior students found that the support provided by senior students during challenges significantly reduced pressure and enhanced the learning environment. Junior Student 1 expressed relief from pressure due to senior support: "...It feels good, it greatly reduces pressure because there is someone to help" (June 24, 2024). The detailed explanations and willingness of seniors to assist were also appreciated. Junior Student 4 highlighted the benefits of asking friends for help: "...Explanations are detailed, if I don't understand, I can ask friends. They can explain it again and in more depth" (June 24, 2024). The proximity and availability of seniors as "nearby helpers" who share their experiences were also beneficial (Junior Student 5, June 24, 2024).

While some junior students did not find the course activities particularly motivating, others recognized the value in the training and projects led by seniors. Junior Student 1 mentioned a lack of motivational activities: "...There are no activities that create motivation. Honestly, I don't want to study, but studying is good because it helps me practice thinking" (June 24, 2024). However, the structured goals set by seniors during training were seen as helpful in maintaining engagement (Junior Student 2, June 24, 2024). Additionally, presenting work and participating in non-tense projects contributed to a positive learning atmosphere (Junior Student 3, June 24, 2024).

Junior students recommended choosing subjects of personal interest to enhance engagement and interaction with seniors. They appreciated the kindness and readiness of seniors to provide guidance. Junior Student 1 advised: "...Choose subjects that you are good at so that you can enjoy doing them" (June 24, 2024). The supportive nature of seniors, their willingness to answer questions, and their encouraging words were highlighted as positive aspects of their interactions (Junior Student 2 and 3, June 24, 2024). Senior students' ability to stimulate thinking and share experiences further enhanced the juniors' learning experience (Junior Student 4 and 5, June 24, 2024).

The course had a generally positive impact on the junior students' career interests, with many expressing increased eagerness to continue studying and apply what they learned. Junior Student 1 stated: "...More interested, want to continue studying continuously" (June 24, 2024). The ability to use projects as part of their portfolios and the inspiration to pursue related fields in the future were also noted (Junior Student 2 and 4, June 24, 2024). Some students, however, were still undecided about the impact on their career interests (Junior Student 3, June 24, 2024).

Junior students overwhelmingly felt that peer or senior recommendations were more beneficial than solely relying on teacher instruction. They found it easier to communicate with peers and seniors, leading to a more comfortable and effective learning environment. Junior Student 1 emphasized: "... Much better because they are peers, making it easier to talk to each other. But with teachers, it's not as comfortable" (June 24, 2024). The genuine and close interactions with seniors allowed for more prolonged discussions and deeper learning (Junior Student 2, June 24, 2024). Additionally, collaborative problem-solving and brainstorming sessions with peers and seniors were highly valued (Junior Student 4 and 5, June 24, 2024).

In summary, junior students highlighted the positive influence of senior students' leadership, support, and teaching methods on their learning experience. Despite initial pressures and challenges, the collaborative and supportive environment fostered by seniors significantly enhanced their engagement, motivation, and understanding of the course material. The preference for peer and senior interactions over solely teacher-led instruction further underscores the value of peer teaching in the learning process.

Teachers view their role as providing guidance, suggesting directions, and inspiring students in their studies. Teacher 1 described their role as acting as an advisor: "… act as an advisor, guiding to find the appropriateness of the work" (June 25, 2024). Teacher 2 emphasized the importance of encouragement and motivation: "… encourage, provide guidance, inspire, and give positive energy to motivate students, and tell them what they will gain in the end" (June 25, 2024).

The effectiveness of peer teaching was acknowledged by teachers, who observed efficient work processes and positive learning outcomes. Teacher 1 noted the benefits of information exchange and group work: "… observed the exchange of information, group work, and mutual learning of various information. They also shared and modified new ideas together" (June 25, 2024). Teacher 2 highlighted the importance of preparation and time management for successful learning: "… to learn successfully, preparation is necessary. Planning work systematically is essential. During the process, various problems will be encountered, the main one being time, as we cannot control time to fit our needs. Therefore, it is crucial to plan and use time efficiently, not to waste or let it pass idly" (June 25, 2024).

Teachers provide support through both on-campus and off-campus activities, facilitating opportunities for juniors to exchange information and gain practical insights. Teacher 1 mentioned activities like Science Day exhibitions and off-campus studies: "… on Science Day, exhibitions are held where juniors or interested peers come to inquire about concepts or work processes. Sometimes, there are hours where teachers let juniors listen to information about the work, identify parts of the seniors' projects that need improvement or modification to develop the work. Juniors listen and ask questions about the work to understand the work process better. They are also taken to study off-campus, such as in laboratories or academic conferences, to listen to experts in various fields" (June 25, 2024). Teacher 2 added support for off-campus studies at places like the Innovation Center or National Science Museum: "… support for off-campus studies, such as at the Innovation Center or the National Science Museum, to learn about current ideas and interesting research areas. Projects enhancing environmental experiences involve trips to national parks to study plants and animals, identifying any issues encountered. There is also a budget to support these activities appropriately" (June 25, 2024).

Teachers identified additional resource needs that would enhance the learning process, such as opportunities to participate in competitions and access to laboratory instruments. Teacher 1 expressed the need for more opportunities: "… opportunities to participate in competitions, visit exhibitions, and study the use of laboratory instruments" (June 25, 2024). Teacher 2 emphasized the potential for developing innovations: "… opportunities to participate in competitions at various levels. Ultimately, we might develop innovations that can be further advanced because we still lack a comprehensive collection of innovations" (June 25, 2024).

Teachers currently monitor and adjust the peer teaching process but lack a concrete method for collecting and applying feedback. Teacher 1 described their approach: "… teachers monitor and listen while seniors are teaching juniors, and they adjust the teaching and give advice on the spot if there are any mistakes" (June 25, 2024). Teacher 2 acknowledged the absence of a formal feedback collection process: "… there is no process yet to collect the methods seniors use to advise juniors or the information shared among peers" (June 25, 2024).

Teachers observed both positive and negative impacts of the course on students' interest and performance, noting that good interaction between seniors and juniors is crucial for success. Teacher 1 observed that students' comfort and happiness in learning increased with senior guidance: "… teachers always say that not every student is inherently talented, but rather that they have an increasing ability to learn. It has been observed that when seniors provide guidance, students feel more comfortable and happier to learn. Good interaction is an important factor in the learning and success of both seniors and juniors" (June 25, 2024). Teacher 2 highlighted the need for integration of knowledge from various disciplines and the challenge urban students face: "… there are both positive and negative impacts. Solving problems in each area cannot be addressed with knowledge from a single discipline, so integration of knowledge is necessary. Presenting innovations involves using language, which helps students develop various skills. Ultimately, they undergo development without realizing it. On the negative side, most students in this course are from urban areas and are unaware of local or nearby problems, unlike students from suburban areas who are closer to nature and can identify problems more easily. The goal of urban students is often to get into university, which shifts their focus to intense exam preparation and studying, conflicting with the time-intensive nature of this course that requires extensive research. This can make students feel exhausted" (June 25, 2024).

Teachers suggested using the outcomes of work and rubric scores to measure the success of peer teaching, while controlling for other variables that might affect assessment. Teacher 1 stated: "… if juniors study the concepts from seniors and can effectively and successfully build upon them as intended, it is considered a success in teaching and mutual support" (June 25, 2024). Teacher 2 noted the challenge of measuring success due to external guidance: "… it might have to be within research work that excludes other variables, such as others providing guidance during the learning process, which makes it difficult to measure. If measurement is necessary, teachers might use rubric scores for evaluation and ensure no one provides advice during that time" (June 25, 2024).

In summary, teachers play a crucial role in guiding, inspiring, and supporting students in their studies. They acknowledge the effectiveness of peer teaching, observe positive impacts on learning and performance, and suggest improvements in resource allocation and feedback collection. The integration of various disciplines and managing time efficiently are highlighted as key factors for successful learning and innovation development.

Conclusion and Discussion

The interview data from junior students, senior students, and teachers reveal valuable insights into the dynamics and efficacy of peer teaching and youth volunteering in the context of school science research projects. The analysis highlights several key themes: the initial experiences of junior students, the roles and preparation of senior students, teaching methods, challenges and support mechanisms, participation and motivation, feedback and improvement, and the overall impact on learning.

Junior students reported mixed initial feelings, including pressure, stress, excitement, and uncertainty. These emotions underscore the initial challenges students face when embarking on new academic endeavors. However, the presence of senior students as peer mentors seems to mitigate these feelings by providing a supportive structure. This aligns with previous research suggesting that peer support can reduce anxiety and build confidence among younger students (Topping, 2005).

The junior students' reflections emphasize the positive impact of having senior students guide and support them. The collaborative environment, where

ideas are shared and discussed, fosters a deeper understanding and encourages active participation. The teaching methods employed by senior students, such as hands-on practice, visual aids, and casual language, are particularly effective in making complex scientific concepts more accessible. These findings are consistent with the literature on peer-assisted learning, which highlights the benefits of peer interactions in enhancing comprehension and retention of knowledge (Schwartz & Gurung, 2016).

Both junior and senior students identified several challenges, including differing opinions, misunderstandings, insufficient equipment, and communication issues. Senior students addressed these challenges by finding mutual agreements, seeking additional information, and consulting subject experts. This problem-solving approach not only improves the learning process but also develops critical thinking and interpersonal skills among senior students, further validating the positive role of peer teaching (Falchikov, 2003).

Teachers play a crucial role in providing additional support, such as organizing off-campus activities and facilitating resource access. This support is essential in creating a conducive learning environment where students can explore and experiment without the constraints of limited resources. Teachers' observations confirm the effectiveness of peer teaching, noting that it promotes efficient work processes and enhances student engagement.

Engaging activities and projects are pivotal in maintaining student motivation. Junior students highlighted the role of senior students in setting goals and facilitating project-based learning, which keeps them motivated and interested. However, some juniors expressed a lack of motivational activities, indicating a potential area for improvement. This suggests that while peer teaching is beneficial, there needs to be a continuous effort to design activities that cater to diverse interests and maintain high levels of engagement.

Feedback mechanisms are crucial for the continuous improvement of the peer teaching process. Senior students adapt their teaching methods based on feedback from their peers, which enhances the effectiveness of knowledge transmission. Teachers, while monitoring these interactions, provide immediate adjustments to ensure the accuracy and clarity of information shared. This iterative process of feedback and adjustment is vital for refining teaching strategies and ensuring the successful transfer of knowledge (Hattie & Timperley, 2007).

The overall impact of peer teaching on learning is significantly positive. Junior students reported that learning from senior peers is more relatable and less intimidating than learning from teachers alone. The trust and camaraderie among peers create an environment where students feel more comfortable to speak, think, and act, leading to better academic performance and personal growth. Additionally, the senior students, as youth volunteers, gain valuable leadership and teaching experience, which benefits their own learning and development.

Teachers observed both positive and negative impacts on students' interest and performance. While the peer teaching model fosters better interaction and understanding, the demanding nature of research projects can conflict with other academic responsibilities, especially for students preparing for university entrance exams. This highlights the need for a balanced approach that accommodates the rigorous demands of research while supporting students' broader academic goals.

The findings from this study underscore the multifaceted benefits of peer teaching and youth volunteering in science education. By leveraging the strengths of peer interactions and structured support from teachers, educational institutions can create a more engaging and effective learning environment. Future research should explore ways to optimize peer teaching models, address identified challenges, and ensure that motivational activities are inclusive and diverse. The integration of feedback mechanisms and continuous support from teachers will be critical in sustaining the success of peer teaching initiativesus support from teachers will be critical in sustaining the success of peer teaching initiatives.

These findings represent the various added values that peer teaching and youth volunteering contribute to science education. Embedding strengths of peer interaction with structured support by the teacher has thus enabled the educational establishment to create a more engaging and effective learning environment. As Cheng (2024) further elucidates, peer teaching

enhances conceptual learning among students; it bridges educational policy and classroom practice, hence giving useful insights to curriculum designers and teacher training programs. According to Johnson and Burns (2023), effective classroom demonstrations that are integrated with peer teaching can reinforce conceptual learning through hands-on, interactive experiences that deepen students' comprehension. Furthermore, Arquilla et al. (2016) introduces the concept of open and peer educational models, arguing that collaborative learning environments foster creativity, adaptability, and knowledge co-construction, which are essential for modern science education. Future research should explore ways to optimize peer teaching models, address identified challenges, and ensure that motivational activities are inclusive and diverse. Success in such peer teaching initiatives will require the integration of a feedback mechanism and continuous support from teachers.

Recommendations

The selection of interesting topics relevant to the students' interests and connected with real-life applications is essential to optimize peer teaching; this ensures that students are active and participate meaningfully. A supportive environment provides an avenue for positive interaction whereby students feel safe to share their ideas and learn collaboratively. The teacher should, however, act as an advisor in providing guidance and resources, allowing students to take responsibility for the process. Various teaching techniques also ensure that multiple learning styles are engaged, including the utilization of group discussions and manipulative activities. Finally, addressing such challenges as asymmetries in participation or subject knowledge, by use of training and clear expectations, helps maintain effectiveness of peer teaching for smooth progress and processes of learning.

Acknowledgements

This research project was financially supported by Faculty of Education, Mahasarakham University.

References

Arquilla, V., Simonelli, G., Genco, D., & Guaricci, F. (2016). New perspectives for an open and peer educational model in design field: The co. meta project. In *INTED2016 Proceedings*.

Cheng, X. (2024). Peer instruction: Assisting active learning in science education. *Science Insights Education Frontiers, 23*(1), 3633-3635.

De Lisi, R. (2002). From marbles to instant messenger: Implications of Piaget's ideas about peer learning. *Theory Into Practice*, *41*(1), 5-12.

Essiam, C., Arthur-Baidoo, F., Quansah, R., & Osei-Antwi, D. (2020). The impact of peer learning approach of teaching in a photosynthesis class. *Journal of Teacher Action Research, 6*(3), 42-57.

Falchikov, N. (2003). *Learning Together: Peer Tutoring in Higher Education*. Taylor and Francis.

Fantuzzo, J. W., Riggio, R. E., Connelly, S., & Dimeff, L. A. (1989). Effects of reciprocal peer tutoring on academic achievement and psychological adjustment: A component analysis. *Journal of Educational Psychology, 81*(2), 173-177.

Ghio, S. (2023). Peer teaching in vocational education: A qualitative analysis of student perceptions of learning by teaching. *MCAST Journal of Applied Research & Practice, 7*(1), 92-117.

Schwartz, B. M., & Gurung, R. A. (2012). *Evidence-based Teaching and Higher Education*. American Psychological Association.

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research, 77*(1), 81-112.

Johnson, M. L., & Burns, E. (2023). Characteristics of effective models for classroom demonstrations. *Theory Into Practice, 62*(3), 207-218.

Lim, L. (2014). A case study on peer-teaching. *Open Journal of Social Sciences, 2*(8), 35-40.

Palincsar, A. S. (1998). Social constructivist perspectives on teaching and learning. *Annual Review of Psychology, 49*(1), 345-375.

Piaget, J. (1965). *The Moral Judgment of the Child*. Free Press.

Roscoe, R. D., & Chi, M. T. H. (2007). Understanding tutor learning: Knowledge-building and knowledge-telling in peer tutors' explanations and questions. *Review of Educational Research, 77*(4), 534-574.

Secomb, J. (2008). A systematic review of peer teaching and learning in clinical education. *Journal of Clinical Nursing, 17*(6), 703-716.

Thomson, P., Smith, A., & Annesley, S. (2014). Exploration of the effects of peer teaching of research on students in an undergraduate nursing programme. *Journal of Research in Nursing, 19*(5), 415-430.

Topping, K. J. (2005). Trends in peer learning. *Educational Psychology, 25*(6), 631-645.

Vygotsky, L. S. (1978). *Mind in Society*. Harvard University Press.

Author Details

Sumethawee Kongmai, *Mahasarakham University, Thailand,* ***Email ID****: 66010554012@msu.ac.th*

Warisa Sakuntanat, *Mahasarakham University, Thailand,* ***Email ID****: 66010552023@msu.ac.th*

Kanyarat Sonsupap, *Mahasarakham University, Thailand,* ***Email ID****: kanyarat.s@msu.ac.th*

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