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EFFECTS OF HIGH SCHOOL–LED CAMP ON ELEMENTARY STUDENTS' SCIENCE LEARNING MOTIVATION: A PRETEST–POSTTEST STUDY

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Abstract

This study aimed to investigate the effects of a high school–led academic camp on elementary students' science learning motivation and their inspiration to pursue further education in science. A one-group pretest–posttest quasi-experimental design was employed. The participants consisted of 53 volunteer elementary students (26 boys and 27 girls), aged 7–8 years. Data were collected using a self-report questionnaire based on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree), measuring five dimensions: intrinsic motivation, extrinsic motivation, science

self-efficacy, interaction in science learning, and attitude toward science. The research procedure included seven sessions: administration of a pre-activity survey (pre-test), participation in ice-breaking recreational activities, engagement in integrated science-based learning stations designed in a game-based format, participation in ice-breaking recreational activities, summary of activity, administration of a post-activity survey (post-test), and statistical data analysis. All learning activities were facilitated by high school students from a science-focused school. The findings indicated that post-test mean scores were significantly higher than pre-test scores ($p < 0.05$). The results suggest that participation in a high school–led academic camp is associated with increased science learning motivation and positive attitudes toward science. As a pilot study, these findings provide preliminary evidence supporting the potential of high school–led academic camps as an approach to fostering science learning motivation among young learners.

Keywords:
Science Learning Motivation, Academic Camp, Peer-Led Learning, Cross-Age Mentoring, Quasi-Experimental Design

1. Introduction

Elementary school students represent an important group who will become a key workforce in the development of innovation, science, and technology in developing countries in the future. Early learning experiences play a crucial role in shaping students' interests, attitudes, and long-term educational goals. Therefore, fostering inspiration, awareness, and positive attitudes toward science during the elementary years help to generate both intrinsic and extrinsic motivation, which could influence students' decisions to continue their studies or pursue careers in science and technology.

However, science instruction in many elementary schools remains largely teacher centered. Lessons are often delivered through lectures, supported by instructional media or small classroom experiments. While these approaches provide fundamental knowledge, they rarely create strong engagement or sustained motivation. Previous study has suggested that activity-based learning and academic camps can be effective in enhancing students' learning experiences. In particular, peer-led learning, in which instructors are closer in age to learners, has been shown to reduce anxiety and increase participation and engagement (Nielsen, 2023).

Based on the perspective, this study investigates the effects of a High School–Led Academic Camp designed and conducted by senior high school students from a specialized science school for elementary students. Using a pretest–posttest quasi-experimental design, the study aims to examine changes in students' science learning motivation, awareness, and attitudes toward science after participating in the camp. The findings are expected to provide evidence on whether a peer-led academic camp can serve as an effective alternative approach to strengthen science learning motivation among elementary school students.

2. Related Studies

2.1 Academic Camp

Academic camps, educational programs designed to supplement traditional schools with intensive, theme-based learning experiences defined as structured, out-of-school environments where students engage in academic content and skill development beyond the regular curriculum (Kaplan-Sayi, 2017). Generally, characterizes these active learning that blend experiential, peer-based learning with academic enrichment. Empirical studies indicated that participation in academic camps were supported to improve academic performance in core subjects, attributed to their interactive pedagogy, curriculum design, and extracurricular reinforcement of content knowledge. Therefore, this approach's considered as an effective supplementary educational intervention that positively influences students' learning outcomes and engagement (Tembo & Jibrea, 2024). In addition, Wilson & Sibthorp opined that summer and youth camps encouraged the significance of camp for developing social-emotional and academic readiness skills, which are transferable to formal learning and life contexts, highlighting camps' broader (Wilson & Sibthorp, 2018).

There are various forms of academic camps in elementary school, they indicated that these immersive learning experiences can support both academic outcomes and attitudinal development in young learners. The recent empirical study on science-focused elementary camps showed that participation can significantly enhance students' interest in science and their understanding of scientific practices, leading to stronger identification with STEM subjects and more positive attitudes toward STEM careers (Seung & Park, 2025). In contrast, large-scale randomized trials suggested that intensive learning camps produce modest academic gains in subjects such as mathematics, the evidence for consistent effects on non-cognitive

outcomes remains mixed, underscoring the need for careful curriculum design and sufficient duration (Hvidman et al., 2024). Moreover, broader study on summer learning programs that include academic components highlights their potential to mitigate learning loss and promote continuous engagement with curricular content during breaks from formal school (Rachmawati et al., 2020).

Designing activities for academic camps should consider to the generation gap between organizers and participants. High school–led academic camps highlight both the educational potential and the value of learning experiences beyond the regular classroom. Previous programs such as Fokum demonstrated that camps organized by high school students can successfully deliver advanced computing content while fostering technical skills (Fokum et al., 2023). Similarly, QCaMP, a summer camp in the United States focusing on quantum information science and technology, showed that specialized camps can enhance students' academic preparedness and career orientation (Ivory et al., 2025). Overall, the study on STEM camp experiences suggests that high school-level camps can meaningfully improve students' understanding of STEM learning (Thibodeaux et al., 2025).

2.2 Peer-Led Learning

Peer-led learning in education is defined as instructional and learning practices in which students take on facilitative or teaching roles to support their peers' understanding, with the aim that peers learn with and from one another rather than solely from teachers (Cortidor et al., 2023). This approach is grounded in social constructivist theory and emphasizes active, collaborative engagement among learners at similar levels of study (Bai & Gu, 2025). Meador opined that peer-led approaches are significant in educational settings because they can enhance academic achievement, deepen conceptual understanding, increase student motivation and engagement (Meador et al., 2024).

According to the significance of Peer-led learning in various aspect of definition, Nevertheless, Peer-led learning has been widely studied for its pedagogical advantages and limitations in educational contexts. Zhang & Maconochie opined that peer-led approaches can enhance academic performance and skill development (Zhang & Maconochie, 2022). Moreover, structured peer-led formats like Peer-Led Team Learning have been found to support learners in STEM disciplines and boost confidence and motivation, especially when teaching is aligned with curriculum goals (Meador et al., 2024). Despite these strengths, limitations are also documented:

some studies report that peer-led strategies rarely produce superior long-term retention of complex conceptual knowledge when compared to traditional instruction, suggesting that benefits may be context-specific or comparable rather than universally greater (Young et al., 2024).

The development of peer-led learning evolved from early traditions of students helping one another informally to more structured and research-based practices; one influential model, Peer-Led Team Learning (PLTL) (A.E. Dreyfuss, 2012). In the latest decade, it extended these foundations by examining diverse peer-assisted learning (PAL) strategies across disciplines and contexts, such as, STEM community college (Paul Harvie et al., 2024). Meta-analytic evidence from medical education further indicates that peer-assisted learning (PAL) remains an effective educational strategy across clinical training contexts, demonstrating overall positive effects on learners' acquisition of knowledge and skills when compared with traditional instruction (Jin et al., 2025).

2.3 Science Learning Motivation

Science learning is defined in educational research as the psychological force that initiates, guides, and sustains students' engagement with science content, tasks, and activities. Interest in Science is often conceptualized through motivational frameworks like Self-Determination Theory (SDT) (Ramos et al., 2025). Motivation is significant in science education because it not only influences students' academic engagement and persistence but also their achievement, aspirations, and decisions to pursue further science study or careers (LIbao et al., 2016). Moreover, motivation shapes how students interact with scientific content and learning environments, affecting long-term attitudes toward science, conceptual understanding, and sustained involvement in scientific inquiry, making it a central construct in understanding and improving science teaching and learning outcomes (MacIntosh & Asghar, 2025).

In 21st century, science learning motivation illustrates how motivation functions in authentic educational settings and its implications for teaching. Kurniawan examined lower secondary students showed a moderate-high level of science motivation correlated with students' self-concept, suggesting that interventions to enhance active learning strategies and confidence could strengthen motivation and engagement in science (Kurniawan et al., 2025). Additionally, a recent study exploring motivations of gifted science and mathematics students in a Thai flipped-classroom context reported that structured pre-reading tasks significantly increased preparatory engagement, providing evidence that pedagogical design can meaningfully influence students'

motivation toward science learning (Nantaburom, 2024). Lastly, peer-led learning showed how structured reciprocal peer-led collaboratively supports cognitive and affective engagement among young learners (Thurston et al., 2007).

3. Description of Overall Framework

3.1 Background and Overall Structure

The Peer-Led Academic Camp Project is one of the activities included in the student development curriculum of the Engineering Science College affiliated by King Mongkut's University of Technology Thonburi. This camp is designed to allow Grade 10th students to develop and organize an academic camp based on the integration of knowledge in science, mathematics, and technology. Concepts that are often perceived as difficult in regular classroom lessons are redesigned and presented in the form of interactive games and activity-based learning. The camp is organized for nearby elementary school students, who are invited to participate in these learning activities. The main objectives of the project aims to create inspiration, cultivate awareness, and promote positive attitudes toward science learning among the participating students. Through engaging and age-appropriate activities led by senior students, the program aims to encourage interest and motivation in science from an early stage. The overall structure and examples of the camp activities are illustrated in Figure 1.

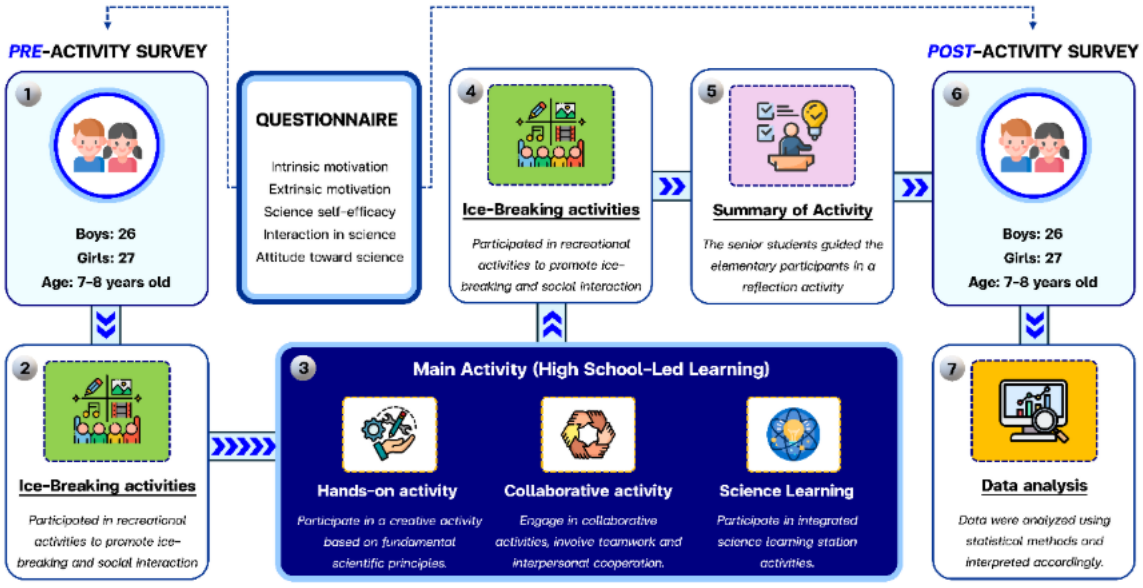


Figure 1. *Overall Process of High School–Led Academic Camp on Elementary Students' Science Learning Motivation*

3.2 Design of Learning Activity Process

The study design in this research applied the concept of peer-led learning by assigning Grade 10th students to design all camp activities under the supervision of their teachers. Every activity included in the academic camp was carefully rehearsed and prepared for more than three months. All activities were reviewed and approved by the project advisors before implementation to ensure their appropriateness and academic quality. Finally, the academic camp was conducted over one full day for the participating elementary students, without an overnight stay. The program was divided into seven sessions, as presented in Table 1.

3.3 Research Design

3.3.1 Participants

The participants in this study consisted of 53 elementary school students who voluntarily agreed to join the activity. Among them, 26 are boys and 27 are girls, with ages ranging from 7 to 8 years old. All participants had no prior experience attending an academic camp. In addition, their previous academic performance in science was at a moderate level, with grade point averages ranging from 1.5 to 2.5. All participants were required to complete a science interest assessment covering several dimensions related to science learning. The assessment was administered both before and after participation in the camp in order to compare changes in their levels of interest and motivation toward science.

3.3.2 Procedures

The procedures of this study were divided into seven main sessions which were presented in figure 2.

In figure 2, shows the pre-activity assessment completed by the participating students in order to collect baseline data on several dimensions before the start of the camp activities (A). It also presents the recreational ice-breaking activities designed to help reduce social barriers and encourage interaction between the senior students and the younger participants (B–C).

Figure 2: *Main Academic Activities (High School - Led Learning)*

In figure 2, shows the academic activity stations, in which scientific concepts that elementary students were currently learning, integrated into game-based activities. These activities included a hands-on activity in which students constructed small darts and used them to pop balloons, integrating concepts of force and motion (A–B). Another activity was the paper cup telephone game, which represented a collaborative activity designed to demonstrate concepts related to sound, vibration, and the medium of sound transmission (C–D). In addition, the camp included a science show, where scientific concepts were presented through a short drama performance focusing on the theme of acids and bases. This activity was followed by a coloring activity using natural pigments extracted from flowers, allowing students to observe how different solutions can produce various color changes (E–F).

After completing the main activities, the participants joined Ice-breaking Activity II to help create a relax and enjoyable environment. Following this session, a summary of activities was conducted, during students reflected on what they had learned from the camp. Lastly, all participants completed the post-activity survey. The data collected from the pre- and post-activity assessments were then used for data analysis in order to examine the development in students' responses. The overall procedure of the study is illustrated in Table 1.

3.3.3 Data Collection and Data Analysis

Data collection in this study was conducted by using a survey administered to the participant. Each question in the survey was rated on a five-point Likert scale, ranging from 1 to 5, where 1 represented the lowest level and 5 represented the highest level. The questionnaire consisted of five dimensions, including intrinsic motivation, extrinsic motivation, science self-efficacy, interaction in science learning, and attitude toward science. The items used in this survey were adapted from previous studies conducted by (İnce, 2023). After data collection was completed, all responses were analyzed using statistical software. A paired t-test was employed to compare the results obtained before and after participation in the activities in order to interpret the outcomes of this study.

4. Result and Discussion

4.1 Self-Assessment Results of the Participants

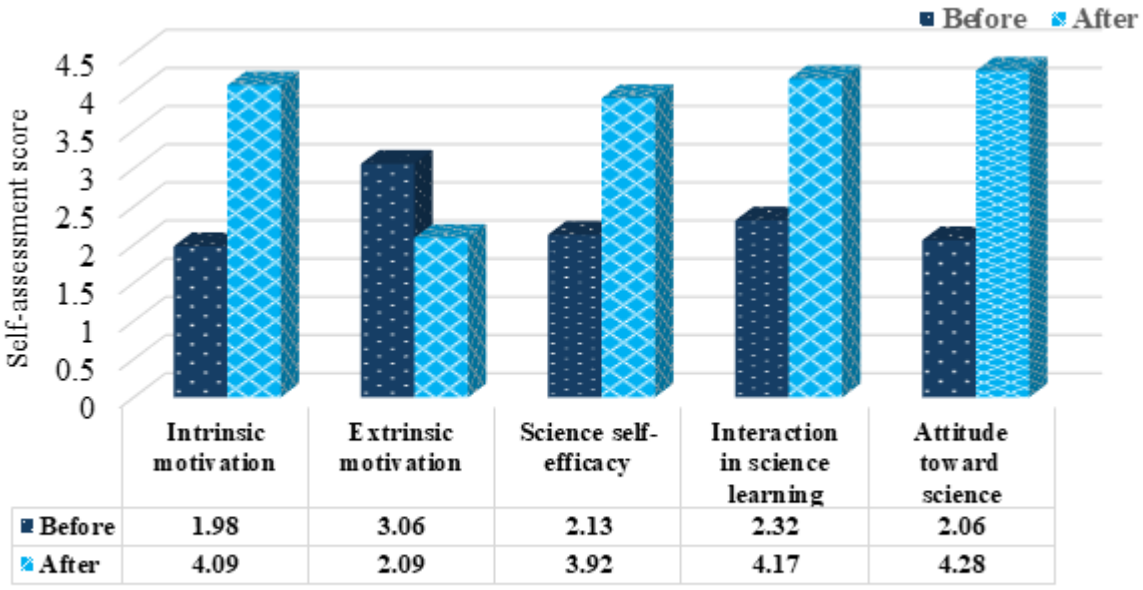
The survey results indicated that the students' self-assessment scores after participating in the activities were generally higher than those recorded before participation. However, the average score for extrinsic motivation decreased slightly after the activities compared with the pre-activity assessment. The detailed results are presented in Table 2 and Figure 4.

Table 1: *Self-Assessment Score of the Participants*

Motivational Factors	**Experiment**	***n***	**Mean±SD**	***t***	**P**
Intrinsic motivation	Before	53	1.98±0.44	15.49	*<0.001*
	After		4.09±0.93		
Extrinsic motivation	Before	53	3.06±1.32	-0.76	*0.223*
	After		2.09±0.66		
Science self-efficacy	Before	53	2.13±0.54	10.11	*<0.001*
	After		3.92±0.72		
Interaction in science learning	Before	53	2.32±0.79	10.19	*<0.001*
	After		4.17±0.84		
	Before	53	2.06±0.55	14.04	*<0.001*

Attitude toward science	After		4.28±0.71		

**P<0.05*



	Intrinsic motivation	Extrinsic motivation	Science self-efficacy	Interaction in science learning	Attitude toward science
Before	1.98	3.06	2.13	2.32	2.06
After	4.09	2.09	3.92	4.17	4.28

Figure 3: *Self-Assessment Score of the Participants*

5. Conclusion

The results of this study indicate that organizing an academic camp led by senior students (High School–Led Academic Camp) can effectively promote several science-related learning factors among elementary school students. One possible explanation is that camp-based activities provide a learning environment in which students feel relax and free from pressure. In such an environment, students are less afraid of making mistakes and are more willing to try new activities and engage in hands-on learning. In addition, in case the activities are conducted by senior students rather than teachers, the participants feel more comfortable and less constrained by the authority typically associated with teacher-led instruction. This environment encourages students to ask questions, express their ideas, and actively participate in the learning process. As a result, student tend to interested in learning new thing. Therefore, learning through a peer-led approach, in which senior students facilitate the activities, can effectively enhance students' learning motivation, foster positive attitudes toward science, and strengthen their self-confidence.

This approach may also be suitable for further development as an alternative instructional strategy that could be applied to other academic subjects in the future.

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