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Teachers' Experiences Regarding Science Learning Management during the Post-COVID-19 Era

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Abstract

The aim of this research was to study teachers' learning management experience in teaching science after the COVID-19 pandemic. The sample consisted of 66 senior pre-service science teachers, who carried out fieldwork in the school, and 53 in-service science teachers; the selection was conducted by purposive sampling. The instrument of this research was a questionnaire consisting of five open-ended items. Data were collected through qualitative and then quantitative data analysis. The results revealed that pre-service and in-service science teachers chose the 5E instructional model for science learning management post COVID-19.

Regarding the second research question, active learning was chosen by pre-service and in-service science teachers to suit the science learning approach. Science instructors in pre-service and in-service programs recommend that classrooms be fun-oriented. The limitations in terms of equipment, media, and technology were identified as a problem and an obstacle to science learning management. Science teachers desired to improve themselves in the issues of game and activity development, teaching technique, modern technology, and learning attraction.

Keywords: teachers' learning experience, pre-service science teachers, in-service science teachers, post-COVID-19, learning loss

1. Introduction

The COVID-19 pandemic has disrupted schooling and planned examinations (Adebisi et al., 2020; Gupta et al., 2020). Given this unexpected situation, UNESCO (2021) estimated that almost 1.6 billion pupils in over 190 nations, accounting for 94% of the world's students, have been affected. Both the students and management were prepared for this transformation imposed on them. Emergency remote learning systems were practically instantaneously activated in reaction to this disruption. The influence of these school closures on student learning progress or absences is still being studied by education researchers (Borazon & Chuang, 2023).

Interruptions can harm organizations and systems, with the most severe consequences affecting people in vulnerable positions (Borazon & Chuang, 2023). According to Asian Development Bank (2021), learning losses in developing Asia range from 8% to 55% in places with the most prolonged closures. Low numeracy and literacy outcomes in low- and lower-middle-income nations also resulted in school dropouts by 2020 (Alban Conto et al., 2021).

Learning loss in Thailand has significant and wide-reaching implications for students and the country. This situation affects students by causing a small number of children to leave the education system. This will affect society in the future, because these students will not have been educated or will have received a poor-quality education and will therefore lack the skills needed to learn at a higher level, including the skills to develop their potential (Bangkokbiznews, 2022; Equitable Education Fund, 2022)

The Equitable Education Fund (EEF) survey found that elementary school students in grades 1–3 showed the most significant recession, accounting for 72.2% compared to other grades in the basic education level. The reason why these learners regressed the most was the subject equipment shortage and lack of concentration in online learning. The teachers believed that the students' learning deterioration partly comes from parents not having time to follow up on their studies, an inability to guide their homework, and a relationship to poverty (Equitable Education Fund, 2022).

In addition, it was observed that during the opening of the new semester, learners in Thailand face the risk of dropping out of the school system for various reasons: some attended classes, while others did not (85.40%), some resigned (7.40%), and some could not be reached (7.20%). Per the usual practice, follow-ups were conducted with 51% of the students, but they have yet to return to school. These stories are significant and require thorough investigation to find answers and develop effective solutions to this problem (Equitable Education Fund, 2022).

Science as a school subject requires cognitive knowledge and practical skills. Students may have learning difficulties due to the discontinuity of learning. In contrast, several factors are related to much of the content and the opportunity to access different learning environments. Knowledge has value as part of a process for altering individual behavior due to interaction with the environment (Pane & Dasopang, 2017). However, the adoption of online learning, which has been ongoing for more than two years, since March 2020, has caused either an attachment to the practice in all students or a change in their behavior due to it (Ilyas, 2021).

Official studies and documentation of COVID-19's impact on the student learning progress are only now beginning to surface. Since the worldwide education system continues to be disrupted by the pandemic, a thorough understanding of how COVID-19 school closures affect student learning progress will better equip educators, policymakers, and researchers in the future (Donnelly & Patrinos, 2022).

According to Recch et al. (2023), information should be gathered and prepared with an emphasis on assisting educators and other professionals working in the field when children return to private education under challenging circumstances following prolonged school cancellations. Schools must be able to assess the students' learning level variability and react to it. Future years will see a significant increase in the urgency of aiding policymakers to reduce the learning losses brought on by school closures and address the more significant learning issues.

For the above reasons, it is essential to study the learning management experience of science teachers to identify the problems with science learning management that occur in schools in the context of the COVID-19 pandemic to benefit future research, especially learning recovery. Thus, the aim of this research was to study teachers' experiences in science learning management post COVID-19.

Although there have been studies on the impact of COVID-19 on education, there has been limited research focused on the specific experiences of science teachers in managing learning after the pandemic. Understanding the learning management practices, challenges, and opportunities for improvement in science education can help in the development of effective learning recovery strategies and inform policymakers in how to mitigate the negative effects of prolonged school closures. Therefore, this study aimed to fill the research gap by examining science teachers' experiences of learning management after COVID-19.

Research questions

RQ1: What kind of learning approaches are most frequently chosen post COVID-19?

RQ2: What kind of learning management is suitable for science courses?

RQ3: How do teachers organize science classes after COVID-19?

RQ4: What are the problems and obstacles in learning management after COVID-19?

RQ5: What do teachers need to improve themselves the most?

1.1 Literature Review

Numerous studies have investigated how the COVID-19 epidemic has affected education in various nations. A transition toward a 21st-century curriculum that encourages critical thinking, integrative learning, and practical skills was predicted by Reimers (2022). They emphasized the necessity for flexible engagement, immersive learning experiences, and interactive and hybrid learning approaches. Malaysia was the setting of a study by Azid et al. (2022), who emphasized the use of Web 2.0 tools to promote teaching during the pandemic. They discovered that using these technologies improved students' performance and motivation in science, especially when used with a blended learning strategy. Widarti et al. (2022), in Indonesia, looked at the difficulties science instructors encountered when preparing for the Minimum Competency Assessment (AKM) during the pandemic. They found that although teachers had adopted AKM-oriented learning, there needed to be stronger links to the student's learning objectives. The report recommended addressing obstacles relating to readiness, facilities, and learning time and place, and providing additional training and support for teachers. In order to address the learning gaps brought on by the pandemic, Indonesia established the Prototype Curriculum, which was discussed by Firman et al. (2022). With a particular emphasis on the qualities of Pancasila pupils, this curriculum strongly

emphasizes project-based learning, soft skills, and character development. The research demonstrated how the Prototype Curriculum greatly improves character education. Mateus et al. (2022) examined the transition to distance learning in Argentina, Ecuador, Chile, and Peru, among other Latin American nations. They proposed a media literacy agenda and stressed the significance of controlling job overload, dealing with connectivity challenges, and offering ICT training. The effects of gamification on undergraduate engineering and economics/social science students in Mexico during the pandemic were investigated by Rincon-Flores et al. in 2022. They discovered that gamification increased motivation and involvement, with engineering students showing a greater correlation. The effectiveness of a workshop on middle school science teachers' capacity to instruct on COVID-19 and pandemics was assessed by Alghamdi et al. in 2022. In addition to good effects such as improved student participation, the study revealed considerable cognitive improvements among teachers, but with difficulties such as time restrictions and administrative reluctance. The negative consequences of the pandemic on academic achievement, particularly for disadvantaged children, were highlighted by Betthäuser et al. (2022), who also emphasized the need for more inclusive and egalitarian educational systems.

Based on student feedback and the characteristics of the academic setting, Salvo-Garrido et al. (2022) studied effective teaching techniques in STEM fields. While a qualitative examination of the student comments revealed five groups, the quantitative analysis found only four. The research highlighted the value of student interaction and pedagogical improvement for STEM teachers. Enhancing pedagogical expertise, building a pleasant classroom climate, and fostering inclusive learning settings should be the main goals of initiatives to improve teaching. The study also showed that the classroom assessment tool needs to be improved. The effect of the COVID-19 pandemic on teachers, particularly during the last wave, was examined in a study by Ynon et al. (2023) in Israel. The results of interviews with 58 elementary school teachers revealed a significantly lower sense of efficacy due to multiple changes and increased emotional and social issues among children. Long-term change is required, as seen from the teachers' voiced discontent and their growing willingness to exit the educational system. The data were examined in light of organizational commitment and staff competency theories, and suggestions for teacher professional development were given. A behavioral paradigm based on teaching analytics was suggested by Bennacer et al. (2022) to improve instructors' technological pedagogical expertise and involvement with learning management systems (LMSs). The concept involves quantitative analysis of teachers' LMS actions and qualitative analysis of interviews with instructional designers. The authors developed indicators for instructional analysis and introduced a peer recommendation system to encourage skill development in LMS usage.

Teachers rated themselves as having an upper intermediate level of digital teaching competency in the study by Prieto-Ballester et al. (2021), which looked at Spanish secondary school teachers' self-perceptions of their digital teaching competencies and their knowledge and usage of ICT technologies. To completely include digital competence in the teaching and learning process, there is still room for development. Altogether, this work shed light on the post-COVID-19 structure of science courses by addressing the study issues and underlining the significance of pedagogical growth, inclusive learning settings, and the development of teaching abilities.

Regarding the changing demands of education in the post-pandemic age, the referenced studies emphasize the need for long-term transformation, teacher professional development, improvement in digital teaching competencies, and ICT tool utilization. Actions to lessen the pandemic's effects on learning outcomes should be prioritized, and education systems should be encouraged to become more resilient and adaptable. Efforts to understand which learning approaches are most favored after COVID-19 have so far fallen short. However, each study offers insightful information on facets of learning strategies, such as curricular modifications, the application of technology, and modes of assessment, and their influence on the academic performance and motivation of students. To ensure that everyone receives a high-quality education, it is critical to further research and discover the most efficient and inclusive learning methodologies in the post-pandemic era.

2. Method

This research was conducted in February 2023 and included 119 respondents: 66 (55.46%) pre-service science teachers (PSTs) of the Department of General Science, Faculty of Education and Educational Innovation, Kalasin University, who conducted fieldwork in the first semester of 2022, and 53 (44.54%) in-service science teachers (ISTs) who taught science courses in several public schools in the northeast area of Thailand. The participants were selected by purposive sampling. The obtained data were subjected to qualitative and quantitative data analysis. A questionnaire was constructed as a measuring instrument consisting of five open-ended items. The questions were as follows: 1) What kind of science learning approach was used after the COVID-19 pandemic? 2) What kind of learning management is suitable for science subjects? 3) How is the classroom learning organized? 4) What are the difficulties/obstacles encountered in managing science learning

post COVID-19? 5) How do you want to improve your science learning management? The open-ended questionnaires were evaluated by five experts in science education, educational measurement and evaluation, educational guidance, and psychology education, resulting in an IOC with a mean value of 1. Following the above method, the IOC assessment forms were scored in a range from −1 (obviously not measuring) to 1 (obviously measuring), with 0 indicating that the content area is unknown.

The qualitative findings obtained from the answers to the open-ended questions by the PSTs and ISTs were grouped. Repetition in these qualitative findings was identified, and repeated themes were confirmed as being significant through triangulation. Subsequently, the qualitative results were subjected to an analysis combining quantitative elements such as numbers, standard deviations, and percentages to produce quantitative findings.

3. Results

Our objective was to examine the teachers' experience with science learning management post COVID-19. The results are presented based on the research questions as follows.

RQ1: What kind of learning approaches are most frequently chosen post COVID-19?

Based on Figure 1, the top five teaching approaches chosen by the PSTs consisted of the 5E instructional model (51.52%), creative-based learning (6.06%), game-based learning (6.06%), blended learning (6.06%), and others (6.06%). Meanwhile, ISTs selected active learning (24.53%), student-centered learning (16.98%), the 5E instructional model (15.09%), blended learning (11.32%), and cooperative learning (9.43%).

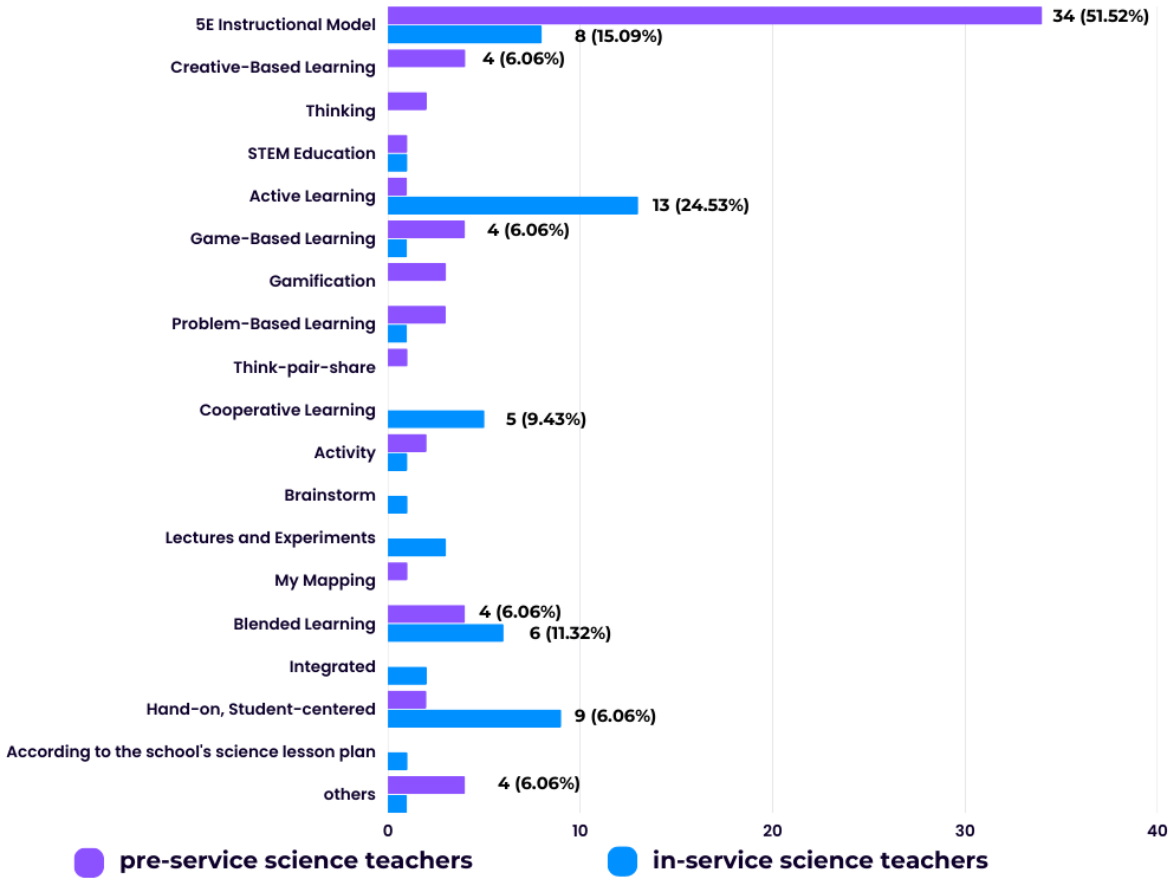

Figure 1. The learning approaches chosen by PSTs and ISTs post COVID-19

Typically, the most popular science learning style in Thai countries is 5E inquiry-based learning (IQL). It can be seen that even in the context of the COVID-19 pandemic, PSTs and ISTs still chose this type of learning management as the main one. Jerrim et al. (2022) stated that one well-known school of thought holds that science instruction should be based on inquiry. However, ISTs chose IQL as second only to active learning. Interestingly, the top three learning management models chosen by PSTs are based on constructivism: inquiry-based game-based, or creative-based learning. Meanwhile, ISTs use learner-centered learning

management and focus on blended and cooperative learning; this is because ISTs have experience managing education in real-world situations and considering each school's different learner characteristics and context.

RQ2: What kind of learning management is suitable for science courses?

Regarding RQ2, 16 (24.24%) of the PSTs agreed that the active learning model was suitable for science learning, while another 16 (24.24%) decided that the 5E instructional model was the most appropriate. In addition, 10 (15.15%) PSTs commented that other learning arrangements should be used. Meanwhile, 25 (47.17%) ISTs expressed that active learning was the most suitable for science learning management. In contrast, 7 (13.21%) said that the 5E instructional model was the most suitable, and a further 7 (13.21%) said that blended learning was ideal for science learning (Figure 2).

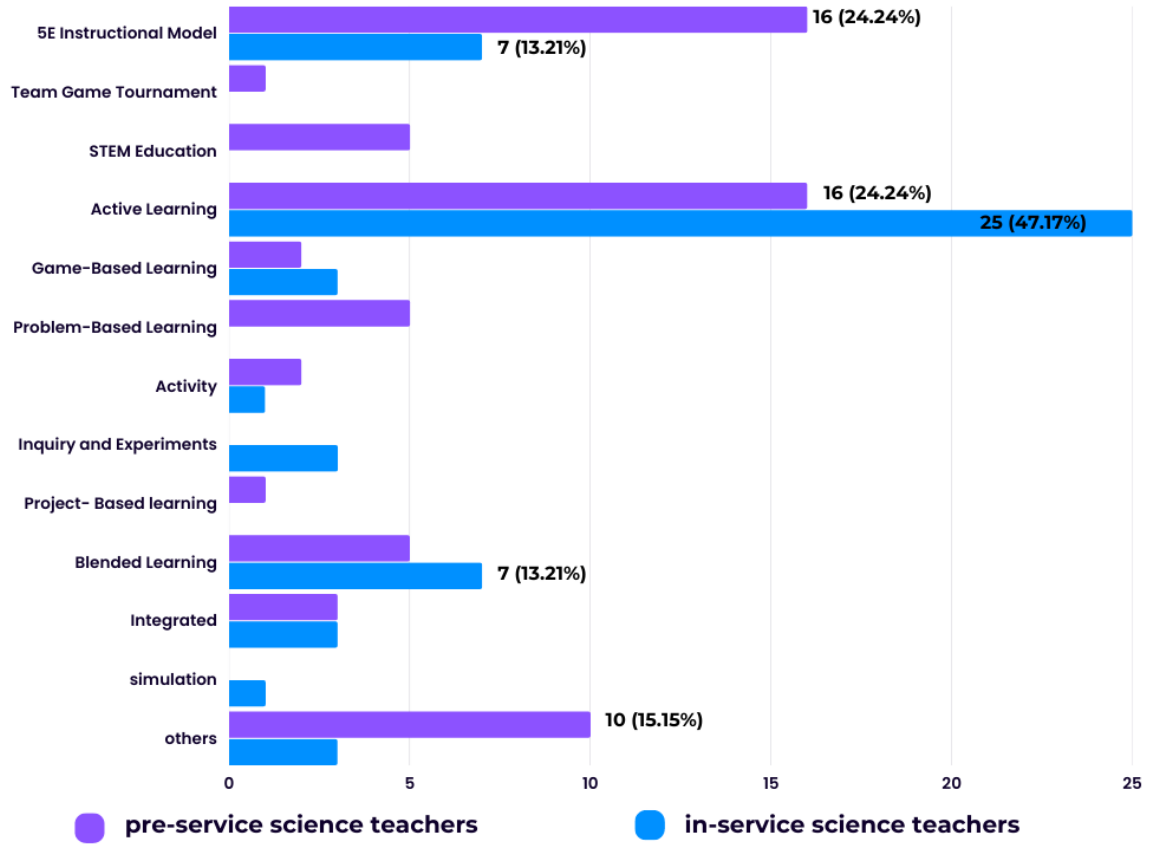

Figure 2. PSTs' and ISTs' opinions regarding which learning management styles suit science courses

In the case of the learning approaches suitable for science learning, an interesting point was that the PSTs chose to use the 5E instructional model as the priority to manage learning after the COVID-19 pandemic, but when asked about the methods most appropriate for science learning, 24.24% thought that active learning was more reasonable than other approaches. However, a few agreed that this learning management style is equivalent to the 5E instructional model. Meanwhile ISTs identified active learning as the most appropriate learning arrangement style for science subjects; this is in line with the results for RQ1, in which this approach was cited as the method used to manage learning after COVID-19 by 47.17% of all respondents. The 5E instructional model and blended learning were each identified as the most suitable approaches for science learning by 13.21% of the 53 respondents. It can be seen that the ISTs, who are full-time teachers who teach in schools, gave their opinions in line with RQ1 on the learning management model used after COVID-19; this may be because ISTs have the flexibility to choose hands-on, independent student learning arrangements, which are in line with ideal science learning arrangements. Regarding necessary measures such as engagement, test scores, and self-efficacy, students who have had high-quality, hands-on learning experiences do better than their peers who have not (Baele, 2017; DeBoer et al., 2017).

RQ3: How do teachers organize science classes after COVID-19?

According to Figure 3, 20 (30.30%) out of 66 PSTs agreed that science classes should be "fun-oriented and

friendly, engaging, not blocking learners' opinions, freedom of learning". Another 15 (22.73%) said they should "use activities, games, or teaching materials or videos to accompany content to stimulate students' interest", and 9 (13.64%) said that classrooms should "create an environment suitable for everyday life". Regarding the ISTs, the top three comments were "fun-oriented and friendly, engaging, not blocking learners' opinions, freedom of learning", mentioned by 17 (32.08%) out of 53 people; that classrooms should "create an environment suitable for everyday life", mentioned by 11 (20.75%) respondents; and to "use activities, games, or teaching materials or videos to accompany content to stimulate students' interest", mentioned by 8 (15.09%) respondents.

The environment in the classroom may affect students' interaction (Van Hien et al., 2020). Thus, the science classes organized by teachers should be discussed. According to the survey results, PSTs and ISTs choose "a friendly atmosphere, not blocking learners' opinions and giving students the freedom to learn". Moreover, the PSTs and ISTs selected the same second and third priorities: that classrooms should "create an environment suitable for everyday life" and "use activities, games, or teaching materials or videos to accompany content to stimulate students' interest", respectively. Interestingly, PSTs, with less teaching experience than ISTs, chose the order of classroom management considering the needs of the learners and their ages. They also considered the importance of science, which should be useful. That is, the learner should be able to put their knowledge into practice. They also considered that media should arouse the learner's interest and be current.

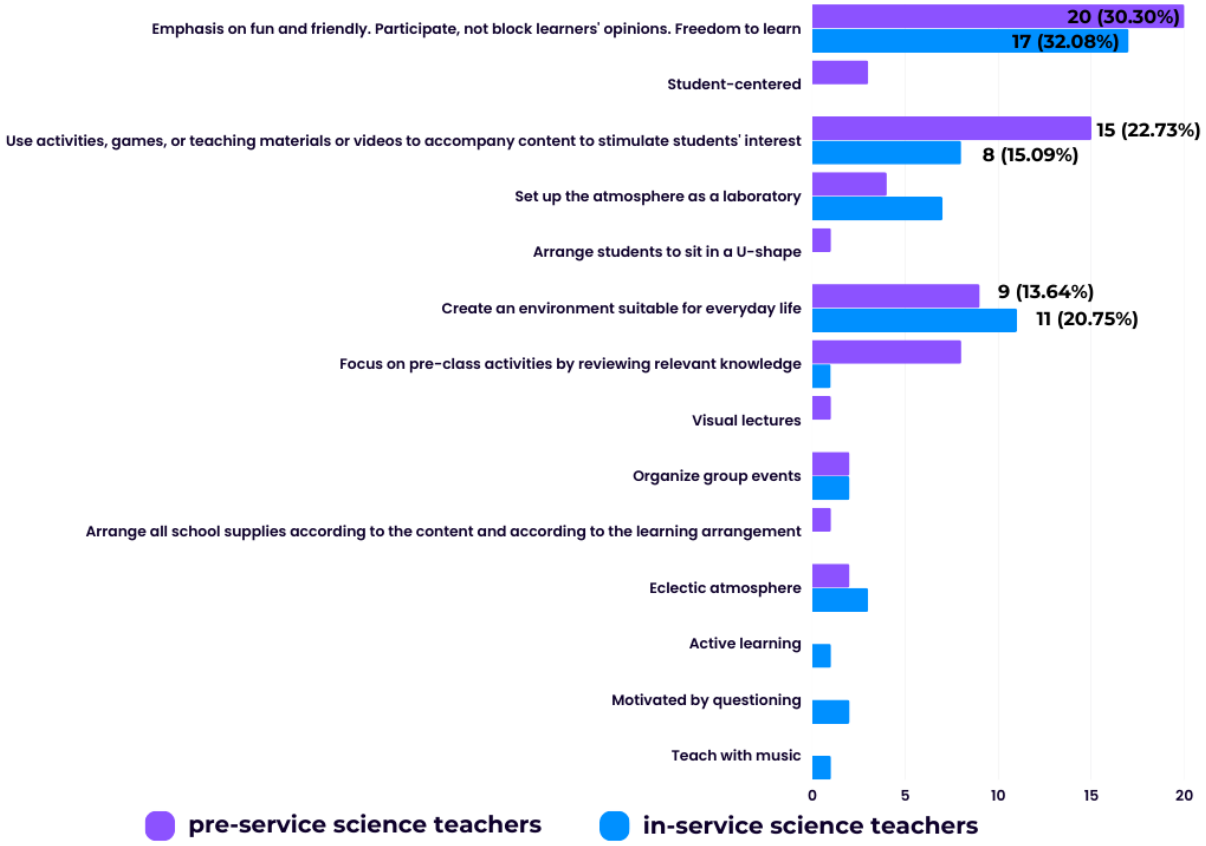

Figure 3. The survey results of post-COVID-19 classroom environment management

RQ4: What are the problems and obstacles in learning management after COVID-19?

The results regarding RQ4 show that the most common problems and obstacles in post-COVID science learning management faced by PSTs and ISTs are limitations on equipment, media, technology, and teachers, with 13 (19.70%) of 66 PSTs respondents mentioning this issue. In comparison, 32 (60.38%) of 53 IST respondents mentioned this issue. As for the second barrier in the PSTs' comments, the same numbers of respondents spoke on two issues: 1) learners being addicted to phones or interested in gaming on their phones (10, 15.15%), and 2) the appropriateness of the time, not having enough time, or having to adapt to learning (10, 15.15%). The second most frequent opinion among ISTs was regarding a large amount of content and boring content. The third most

frequent opinion among PSTs was that learners talked to each other excessively during class time. The third most frequent opinion among ISTs was the appropriateness of the time, insufficient time for teaching, and students having to adapt to learning (Figure 4).

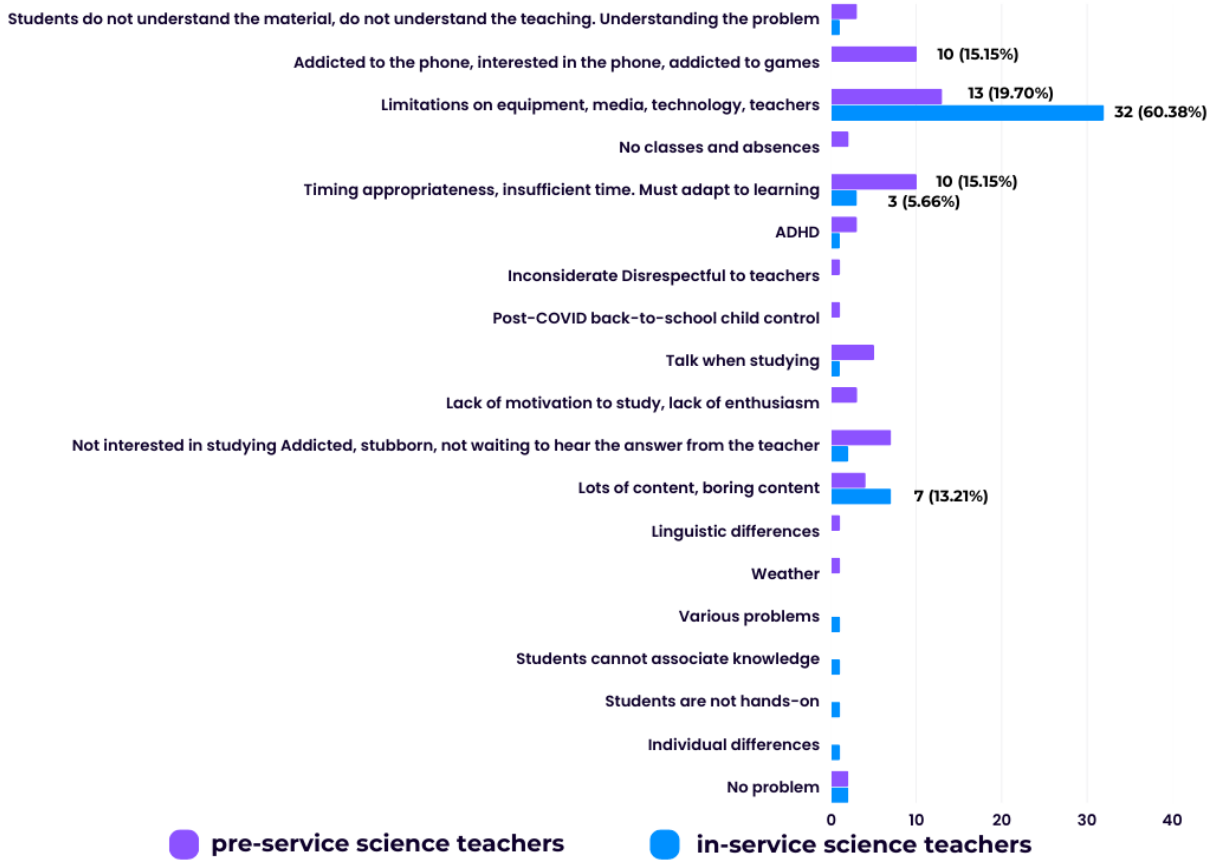

Figure 4. The problems and obstacles in learning management post COVID-19

Considering the results of the PSTs' and ISTs' questionnaires, it was found that for the two groups of teachers, the most common problems and obstacles were in sync: limitations on equipment, media, technology, and teachers. In all, 60.38%, 32 out of 53, of the studied ISTs teaching in northeast Thailand in public schools face this problem. Another similar problem is that the time spent on learning management needs to be increased because there is much content to teach. The difference is that PSTs need help with classroom management because students talk excessively to each other during class hours; ISTs, who are more experienced and senior full-time teachers, found this less of a problem. In addition, ISTs indicated that learners are bored with science content, which is one of the obstacles for science teachers. In prior research, primary school teachers with more vital organizational abilities had students who were more interested in their lessons (Rimm-Kaufman et al., 2015). Furthermore, researchers observed that children were more likely to stay on target and persevere through challenging activities when kindergarten instructors adopted effective classroom management tactics (Rimm-Kaufman et al., 2009).

RQ5: What do teachers need to improve themselves the most?

The results of RQ5 showed that the three areas that PSTs want to improve upon the most are "Game development, activities, recreation, media, technology, rich and modern", followed by "Develop appropriate learning arrangements for learners stimulate learners' interest and diversify risks" and, finally, "none" (Table 1). Meanwhile, most ISTs want to improve themselves most in the areas of game development, recreation activities, media, technology, diversity, modernity, and appropriate learning arrangements, much the same as PSTs. Secondly, the same numbers of people answered "The study develops learning management, learning management that is suitable for learners, stimulates students' interest, and is suitable for daily life" and "Act and experiment, connected to everyday life, allocate equipment development to suit". The third most common

response was to “Develop teaching techniques” (Table 2).

Table 1. The results of Research Question 5, “How do you want to improve your science learning management in managing science learning post-COVID-19?”, among PSTs

Order	Answer	Number of PSTs	Percentage
1	Prepare for teaching	3	4.55
2	Rich and modern activity and game development, recreation, media, and technology	25	37.88
3	Manage time appropriately	4	6.06
4	Have fun, be happy, and educate	2	3.03
5	Activities outside the classroom	2	3.03
6	Develop learning arrangements that are appropriate for learners, stimulate interest in learners, and diversify	12	18.18
7	Focus on creativity	1	1.52
8	Act, experiment, and allocate equipment appropriately	4	6.06
9	No emphasis on lectures	1	1.52
10	Organize a game-based learning management process	1	1.52
11	Develop new techniques for teaching	2	3.03
12	Apply a 5E inquiry-based teaching style to the concept map	1	1.52
13	Focus on teamwork, helping each other	1	1.52
14	Classroom development	1	1.52
15	Improve communication skills	1	1.52
16	None	5	7.58
Total		66	100.00
S.D.		7.87	11.93

Table 2. The results of Research Question 5, “How do you want to improve your science learning management in managing science learning post-COVID-19?”, among ISTs

Order	Answer	Number of ISTs	Percentage
1	Students learn at their own pace, based on their interests.	1	1.89
2	Activity development, games, recreation, media, technology: innovative, diverse, modern, and appropriate	12	22.64
3	Have fun, be happy, and educate, improved academic achievement	3	5.66
4	Focus on experiential learning	1	1.89
5	Study and develop learning management that is suitable for learners, stimulates students' interest, and is ideal for daily life	11	20.75
6	Create a learning atmosphere that captures students' attention	1	1.89
7	Act and experiment. Learning connected to everyday life. Allocate equipment development to suit	11	20.75
8	Organize the process of content learning to be able to link with activities	1	1.89
9	Develop teaching techniques	4	7.55
10	Focus on teamwork, as a group, helping each other. Everyone contributing	2	3.77
11	Develop scientific process skills, cognitive skills	2	3.77
12	Training in new teaching and learning developments	3	5.66
13	None	1	1.89
Total		53	100.00
S.D.		4.60	8.68

The respondents were surveyed about their desire to improve their science learning arrangements. It was found that both PSTs and ISTs wanted to enhance their game-making, activity design, and modern media format skills. In addition, the second most frequent response was similar, namely, the need to improve the subject and develop learning management styles to stimulate the learner’s interest. However, the issue of the development of scientific activities that learners can implement and that relate to their daily lives was also mentioned in the self-development of ISTs, with the same number of respondents as the previous point. Finally, the third most

frequent issue was the need to develop learning management techniques.

4. Conclusions

It must be acknowledged that the COVID-19 pandemic had an impact on education around the world. Education systems around the world responded to the pandemic by organizing online learning, but this came with problems regarding a lack of access to the required equipment, parental attention, teacher difficulties in attracting learners' attention, and learning regression. Although the main impact of COVID-19 has passed, researchers and educators must now explore opportunities for learning recovery. Teachers are the education workers most likely to be affected, whether in past situations or in future situations of learner learning recovery. Therefore, studying teachers' learning management experience will help them plan for learning recovery in a return to typical conditions. This research benefits teachers and educational personnel by providing information that allows them to design learning management strategies to solve the problems of learners affected by COVID-19. Furthermore, it assists school administrators in devising strategies for teacher development to provide support and address the needs of learners impacted by these circumstances.

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