



ວາລະສານການສຶກສາສາລາວແບບຍືນຍົງ

ວິທະຍາໄລສາລາວະວັນ

<https://www.sttcjournal.edu.la>

ດຳເນີນການວາລະສານໂດຍ ວິທະຍາໄລສາລາວະວັນ

ການສ້າງຂີດຄວາມສາມາດໂດຍຜ່ານການສຶກສາຄຸນນະພາບນ້ຳ: ກໍລະນີ ສຶກສາວິທະຍາໄລສາລາວະວັນ ສປປ ລາວ

Capacity Building of Teachers through Water Quality Education: A Case Study of Salavan Teachers Training College, Lao PDR

ຄາຊີໂນລີ ເອບາຕາ¹, ມະລິນະ ທະຄະຫະຊີ², ແລະ ສຸລິພອນ ສິວິໄຊ³

Kazunori EBATA¹, Marina TAKAHASHI², & Souliphone SIVIXAY³

ບົດຄັດຫຍໍ້

ການເຂົ້າເຖິງນ້ຳທີ່ສະອາດ ແລະ ປອດໄພຍັງຄົງເປັນສິ່ງທ້າທາຍທີ່ສຳຄັນໃນປະເທດກຳລັງພັດທະນາ ລວມທັງ ສາທາລະນະລັດປະຊາທິປະໄຕປະຊາຊົນລາວ ເຊິ່ງການຊົມໃຊ້ນ້ຳທີ່ບໍ່ຜ່ານການບຳບັດ ແລະ ການປົນເປື້ອນ ຂອງເຊື້ອຈຸລິນຊີຍັງຄົງມີຢູ່ຢ່າງຕໍ່ເນື່ອງ. ການສຶກສານີ້ມີເປົ້າໝາຍເພື່ອປະເມີນໂຄງການສ້າງຂີດຄວາມສາມາດໂດຍ ຜ່ານການສຶກສາດ້ານຄຸນນະພາບນ້ຳ ຢູ່ວິທະຍາໄລສາລາວະວັນຂອງປະເທດລາວ. ໂຄງການດັ່ງກ່າວ ປະກອບດ້ວຍການຝຶກອົບຮົມໃຫ້ຄູສອນວິທະຍາສາດ ແລະ ນັກສຶກສາຄູສາຍຊີວະສາດ ທີ່ນຳພາໂດຍອາສາສະໝັກ ແລະ ຕາມດ້ວຍການສອນທົດລອງທີ່ໂຮງຮຽນມັດທະຍົມສາທິດຂອງວິທະຍາໄລສາລາວະວັນ ເຊິ່ງແມ່ນຄູຜູ້ທີ່ຜ່ານການຝຶກ ອົບຮົມໃນຫົວຂໍ້ດັ່ງກ່າວ. ຄວາມເຂົ້າໃຈ, ຄວາມເຊື່ອໝັ້ນໃນຄວາມສາມາດຂອງຕົນເອງ, ແຮງຈູງໃຈ, ແລະ ຄວາມ ຕັ້ງໃຈໃນການເຜີຍແຜ່ຄວາມຮູ້ຂອງຄູ-ອາຈານ ແມ່ນໄດ້ຮັບການປະເມີນໂດຍການນຳໃຊ້ແບບສອບຖາມແບບ ມາດຕາສ່ວນປະມານຄ່າ 5 ລະດັບ ແລະ ວິເຄາະດ້ວຍສະຖິຕິ. ຜົນການສຶກສາພົບວ່າ ທັງສອງກຸ່ມມີລະດັບຄວາມ ເຂົ້າໃຈ ຄວາມເຊື່ອໝັ້ນໃນຕົນເອງ ແລະ ແຮງຈູງໃຈຢູ່ໃນລະດັບສູງ ໂດຍບໍ່ມີຄວາມແຕກຕ່າງທີ່ສຳຄັນ ຄວາມ ເຂົ້າໃຈມີອິດທິພົນຢ່າງຫຼວງຫຼາຍ ຕໍ່ຄວາມເຊື່ອໝັ້ນໃນຕົນເອງ, ໃນຂະນະດຽວກັນຄວາມເຂົ້າໃຈຍັງຄົງເປັນປັດໄຈ ສຳຄັນຂອງແຮງຈູງໃຈໃນການວິເຄາະຫຼາຍຕົວແປ. ທັງສາມປັດໄຈແມ່ນກ່ຽວຂ້ອງໃນທາງບວກກັບການເຜີຍແຜ່ ຄວາມຮູ້, ໂດຍແຮງຈູງໃຈສະແດງໃຫ້ເຫັນຜົນກະທົບທີ່ເຂັ້ມແຂງທີ່ສຸດ. ສິ່ງທ້າທາຍທີ່ສຳຄັນລວມມີການຂາດ

¹ ວິທະຍາໄລເຕັກນິກຂັ້ນສູງ ໂຕໂຢຕ້າ, ອາສາສະໝັກໄຈກາ/ຍີ່ປຸ່ນ

² ອາສາສະໝັກໄຈກາ, ວິທະຍາໄລສາລາວະວັນ/ຍີ່ປຸ່ນ

³ ວິທະຍາໄລສາລາວະວັນ/ສປປ ລາວ

Corresponding author, e-mail: ebata.kazunori@toyota.kosen-ac.jp, Tel.+85620 5164 2083

ອຸປະກອນ ແລະ ຂໍ້ຈຳກັດດ້ານເວລາ, ເຊິ່ງອາດຈະຈຳກັດການຖ່າຍທອດຄວາມຮູ້ໄປສູ່ການປະຕິບັດ. ຜົນການສຶກສາ ເຫຼົ່ານີ້ຊີ້ໃຫ້ເຫັນ ຄວາມສຳຄັນຂອງການບຸລະນາການຄວາມຮູ້ ຄວາມເຊື່ອໝັ້ນໃນໂຕເອງ ແລະ ແຮງຈູງໃຈໃນ ໂຄງການສ້າງຂີດຄວາມສາມາດ ເພື່ອສົ່ງເສີມການສຶກສາດ້ານຄຸນນະພາບນ້ຳທີ່ຍືນຍົງ ແລະ ການດຳເນີນການໂດຍຄູ ໃນບໍລິບົດທີ່ມີຊັບພະຍາກອນຈຳກັດ.

ຄໍາສັບທີ່ສຳຄັນ: ການສ້າງຂີດຄວາມສາມາດ, ການສຶກສາຄຸນນະພາບນ້ຳ, ການເຜີຍແຜ່ຄວາມຮູ້, ຄວາມເຊື່ອໝັ້ນ ໃນຄວາມສາມາດຕົນເອງ.

Abstract

Access to safe water remains a critical challenge in developing countries, including Lao PDR, where reliance on untreated water and microbial contamination persists. This study evaluates a capacity-building teacher program on water quality education at teachers training college in Salavan Province, Lao PDR. The program consisted of a volunteer-led training followed by teacher-led instruction. Teachers' understanding, self-efficacy, motivation, and dissemination intention were assessed using a five-point Likert-scale questionnaire, and statistical analyses were conducted. Results showed high levels of understanding, self-efficacy, and motivation in both sessions, with no significant differences. Understanding significantly influenced self-efficacy, while only understanding remained a significant factor of motivation in multivariate analysis. All three factors were positively associated with knowledge dissemination, with motivation showing the strongest effect. Key challenges included lack of equipment and time constraints, which may limit the translation of knowledge into practice. These findings highlight the importance of integrating knowledge, self-efficacy, and motivation in capacity-building programs to support sustainable and teacher-led water quality education in low-resource settings.

Keywords: Capacity building, Knowledge dissemination, Self-efficacy, Water quality education

Introduction

Ensuring access to safe and sustainable water supply and sanitation is recognized as one of the key development challenges under the Sustainable Development Goals (SDGs) (United Nations, 2015). In developing countries, although progress has been made in expanding water supply infrastructure and improving access to safe water, insufficient understanding of water quality and persistent distrust of tap water remain significant issues in many regions. In particular, reliance on untreated water sources, such as groundwater, surface water, and rainwater, remains widespread, especially in rural areas in the Lao People's Democratic Republic (hereinafter referred to as Laos). The proportion of the population with access to safely managed drinking water remains limited, at approximately 35% (World Health Organization (WHO) and the United Nations Children's Fund (UNICEF), 2025). Against this background of water use, concerns regarding water quality safety have become increasingly evident. According to the national survey in Laos, *Escherichia coli* (E. coli) was detected in 70.4% of household water samples (Lao Statistics Bureau and United Nations Children's Fund (UNICEF), 2025). It is well known that E. coli in water sources originates from livestock waste and human fecal contamination, and microbial contamination is considered a significant health risk, particularly in areas relying on untreated surface water (Nakhle et al., 2021). Such water quality risks are closely associated with the occurrence of waterborne diseases and may have serious implications for public health. Despite ongoing improvements in water supply infrastructure, dissemination of knowledge on water quality management and

safe water use remains insufficient, underscoring the need to enhance public understanding of water safety.

In response to these challenges, the EcoHealth approach, which integrates ecosystems and human health, emphasizes the importance of comprehensive strategies that account for the interconnections among environmental, social, and health factors. It has been suggested that incorporating EcoHealth perspectives into education is essential for achieving sustainable health outcomes (Asakura et al., 2015). Laos has taken a pioneering step by integrating EcoHealth education into its national curriculum, and water quality education plays a crucial role in promoting both public health and sustainable water use. Previous studies have reported that school-based public health education and WASH (Water, Sanitation, and Hygiene) interventions contribute to improvements in students' hygiene behaviors and practices (Chard et al., 2018, Chard et al., 2019). Developing students' basic understanding of water quality and risk perception through school education is expected not only to enhance their own hygiene awareness but also to generate spillover effects to households and local communities. However, if teachers responsible for delivering such education lack sufficient knowledge of water quality, practical skills for experiments and measurements, and the ability to effectively communicate these concepts, the impact of education may be limited. In low- and middle-income countries, it has been noted that teachers often lack the knowledge and pedagogical skills necessary for effective teaching (Agormedah et al., 2022). Therefore, the importance of teacher capacity building has been widely recognized. In this context, it is essential not only to provide knowledge but also to ensure that such knowledge is applied in actual teaching practice. Training programs that include expert support, feedback, and collaborative elements have been shown to improve teachers' practical competencies and the retention of learning outcomes (Popova et al., 2022). Clarifying the process by which knowledge acquisition leads to practical application and, subsequently, to sustained educational activities is therefore crucial for evaluating the effectiveness of educational programs. Previous studies have identified teachers' subject knowledge, self-efficacy, and motivation as key factors influencing improvements in educational practice (Nimante et al., 2025). However, many existing studies on teacher training have pointed out that there is still limited understanding of how training translates into actual teaching practice and leads to continuous improvement in instruction (Sims et al., 2025). In other words, while knowledge-level outcomes such as improved understanding have been widely assessed, practical-level outcomes have not been sufficiently examined. Moreover, there is a lack of empirical research focusing on teachers' intrinsic motivation to sustain teaching activities and the sustainability of educational interventions.

Research objectives

1. To implement a capacity-building program on water quality education for teachers at a teacher training college in Salavane Province, southern Laos
2. To empirically evaluate changes in teachers' competencies, including their understanding, self-efficacy, and practical teaching abilities, by comparing outcomes after classes conducted by external volunteers with those after teachers themselves delivered lessons to students.

Methodology

Research Design

This study employed a comparative educational intervention design to evaluate the effectiveness of a water quality education capacity-building program for teachers at the Salavan Teachers Training College in southern Laos. The study consisted of two sequential

stages: a “volunteer-led session” conducted by a Japan Overseas Cooperation Volunteer (JOCV) of the Japan International Cooperation Agency (JICA) and a subsequent “teacher-led session” conducted by participating teachers themselves. The volunteer-led session included lectures on water quality indicators, practical water quality measurements, and a field visit to the Salavan water supply state enterprise. The teacher-led session replicated the same instructional contents, except for the field visit, and was delivered to high school students by the trained teachers. The study compared teachers’ evaluations between the two sessions to assess the transition from knowledge acquisition to practical application.

Participants

The participants were chemistry teachers at the Salavan Teachers Training College located in Salavan Province, southern Laos. A total of seven teachers participated in each session. These teachers first attended the volunteer-led session and later conducted their own lessons during the teacher-led session. Participation in the study was voluntary, and ethical considerations were addressed through anonymization of data and protection of participant confidentiality.

Data Collection

Data were collected using questionnaire surveys administered after each session as below:

Table 1: Questionnaires survey and construction

Category	Survey Item	Response format	Volunteer-led	Teacher-led
Understanding	Understanding of turbidity	Likert (1-5)	Yes	Yes
	Understanding of color	Likert (1-5)	Yes	Yes
	Understanding of microbial risk (e.g., E. coli)	Likert (1-5)	Yes	Yes
Self-efficacy	Ability to explain water quality indicators to students	Likert (1-5)	Yes	Yes
	Ability to conduct water quality testing (e.g., pack tests)	Likert (1-5)	Yes	Yes
	Ability to interpret test results with students	Likert (1-5)	Yes	Yes
	Ability to respond to students’ questions	Likert (1-5)	Yes	Yes
Motivation	Willingness to conduct water quality lessons independently	Likert (1-5)	Yes	No
	Applicability of the training content to regular classes	Likert (1-5)	Yes	No
	Perceived importance of water quality education	Likert (1-5)	Yes	Yes
	Willingness to continue conducting water quality lessons	Likert (1-5)	No	Yes
	Feasibility of implementing this lesson in school settings	Likert (1-5)	No	Yes
Dissemination	Willingness to share this content with other teachers	Likert (1-5)	No	Yes
Barriers	Concerns when implementing lessons	Multiple choice (multiple responses allowed)	Yes	Yes
Support needs	Required support for implementation	Open-ended (free description)	Yes	Yes

Data Analysis

For quantitative analysis, mean values and standard deviations were calculated for each Likert-scale construct. Welch's t-test was used to compare differences between the volunteer-led and teacher-led sessions. For multiple-response items related to implementation barriers, the number and proportion of responses were calculated to identify major challenges. Open-ended responses regarding support needs were analyzed using content analysis and categorized into themes such as equipment support, teaching materials, and training opportunities, with frequencies reported. Furthermore, simple and multiple regression analyses were conducted to examine relationships among constructs, and multicollinearity in the multiple regression models was assessed using variance inflation factors (VIFs). Finally, this study was conducted on a voluntary basis, and ethical considerations were ensured by anonymizing data and preventing the identification of individual participants.

Results

Changes in Understanding, Self-efficacy, and Motivation Before and After the Intervention

Table 2 presents the mean values and standard deviations for each category in the volunteer-led and teacher-led sessions shown in the table 2 below:

Table 2: Results on understanding, practice, and motivation in lesson implementation in the volunteer-led session and the teacher-led session

Construction	Volunteer-led		Teacher-led		p-value
	Mean	SD	Mean	SD	
Understanding	4.67	0.43	4.48	0.89	0.62
Self-efficacy	4.57	0.40	4.50	0.72	0.82
Motivation	4.67	0.39	4.62	0.62	0.86

In the volunteer-led session, comparisons across categories showed that both understanding and motivation had mean values of 4.67, which were higher than self-efficacy (4.57). In the teacher-led session, motivation was the highest (4.62), followed by self-efficacy (4.57) and understanding (4.48). In both sessions, all categories showed high levels, with mean values exceeding 4.5. These results indicate that participants generally demonstrated high levels of awareness and competence in water quality education following both the training and the teaching implementation. Furthermore, comparisons between the volunteer-led and teacher-led sessions revealed no statistically significant differences in understanding ($p = 0.62$), self-efficacy ($p = 0.82$), or motivation ($p = 0.86$). Correlation analysis showed strong positive relationships among understanding, self-efficacy, and motivation, with coefficients of determination (R^2) ranging from 0.76 to 0.91. In particular, a very strong correlation was observed between understanding and motivation ($r = 0.91$), suggesting a close relationship between knowledge acquisition and motivational factors.

Structure of Understanding, Self-efficacy, and Motivation and Their Effects on Knowledge Dissemination

Table 3 presents the results of simple and multiple regression analyses examining the effects on self-efficacy and motivation following the volunteer-led and teacher-led sessions. In the volunteer-led group, simple regression analysis showed that understanding had a significant positive effect on self-efficacy ($\beta = 0.80$, $p = 0.007$). In contrast, the effect of self-efficacy on motivation was not statistically significant ($\beta = 0.69$, $p = 0.070$). In the multiple regression analysis, neither the effect of understanding on self-efficacy nor that of self-efficacy on motivation was statistically significant ($p = 0.051$ and $p = 0.418$, respectively).

In the teacher-led session, simple regression analysis showed that understanding had a significant positive effect on self-efficacy ($\beta = 0.66$, $p = 0.003$). Similarly, self-efficacy had a significant positive effect on motivation ($\beta = 0.75$, $p = 0.011$). However, in the multiple regression analysis, only understanding remained a significant predictor ($p = 0.002$), while self-efficacy was no longer significant ($p = 0.070$).

Table 3: Results of simple and multiple regression analyses on self-efficacy and motivation in the volunteer-led and teacher-led sessions

Dependent variable	Independent variable	Volunteer-led (Univariate) β(p-value)	Volunteer-led (Multivariate) β(p-value)	Teacher-led (Univariate) β(p-value)	Teacher-led (Multivariate) β(p-value)
Self-efficacy	Understanding	0.80(0.007**)	–	0.66(0.003**)	–
Motivation	Understanding	–	0.66(0.051)	–	0.50(0.002**)
Motivation	Self-efficacy	0.69(0.070)	0.23(0.418)	0.75(0.011*)	0.29(0.070)

*p<0.05, * *p<0.01, * * *p<0.001

Table 4: Results of regression analysis on factors influencing dissemination in lesson implementation in the volunteer-led and teacher-led sessions

Dependent variable	Independent variable	β (Standardized)	p-value	R ²
Dissemination	Understanding	0.391	0.005**	0.82
Dissemination	Self-efficacy	0.480	0.004**	0.84
Dissemination	Motivation	0.553	0.004**	0.83

*p<0.05, * *p<0.01, * * *p<0.001

Table 4 above presents the results of regression analyses examining factors influencing knowledge dissemination. In the simple regression analysis, all three categories showed significant positive effects on dissemination: understanding ($\beta = 0.391$, $p = 0.005$), self-efficacy ($\beta = 0.480$, $p = 0.004$), and motivation ($\beta = 0.553$, $p = 0.004$). However, in the multiple regression analysis including all variables simultaneously, none of the variables showed significant effects. The variance inflation factor (VIF) values were high, with motivation reaching 11.2 and other variables exceeding 5, indicating strong multicollinearity among the explanatory variables.

Challenges in the Implementation of Water Quality Education

Participants were asked to identify challenges encountered during lesson implementation using a multiple-response format, and the results were categorized accordingly (Figure 1). In the volunteer-led session, securing equipment was the most frequently reported challenge (75.0%), followed by lesson design (18.8%) and difficulty in explaining content to students (6.3%). In the teacher-led session, the proportion reporting equipment-related challenges decreased to 43.8%. This was followed by lesson design (25.0%), difficulty in explaining content (18.8%), and time constraints (12.5%). Comparing the two groups, all categories showed an increase in reported proportions. In addition, time constraints emerged as a new challenge in the Teacher-led group (12.5%), indicating issues that became more apparent during independent teaching practice.

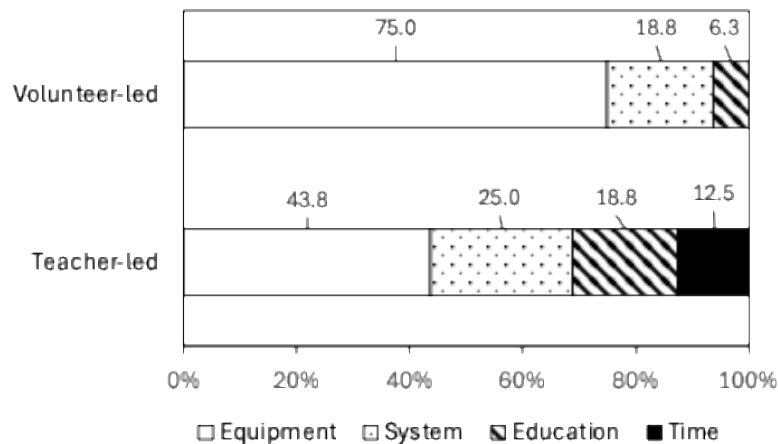


Figure 1: Comparison of challenges after the lessons in the volunteer-led and teacher-led sessions

Discussion

Teachers' Competency Development through Water Quality Education

The results of evaluating understanding, self-efficacy, and motivation in both the volunteer-led and teacher-led sessions (Table 2 and Table 3) showed consistently high levels across all constructs. In the teacher-led session, learning outcomes and competency levels comparable to those achieved under external volunteer support were maintained, suggesting that teachers' competencies can be sustained without reliance on external instructors. These findings indicate that training initiated by external experts, followed by teacher-led implementation, plays an important role in promoting retention of learning content and transfer to practice, thereby enhancing the reproducibility of competencies (Popova et al., 2022). Furthermore, simple regression analysis revealed that understanding had a positive effect on self-efficacy in both volunteer-led and teacher-led sessions. In particular, the teacher-led session, understanding was clearly identified as a primary determinant of self-efficacy. This finding reflects a process in which deeper knowledge of water quality fosters teachers' confidence in their ability to deliver instruction to students, thereby enhancing their self-efficacy as educators. These results are consistent with theories of self-efficacy in educational psychology (Bandura, 1977) and support previous findings that mastery experiences strengthen teachers' self-efficacy (Agormedah et al, 2022).

In addition, a multiple regression analysis examining the effects of understanding and self-efficacy on motivation showed that understanding had a significant effect on motivation, whereas self-efficacy, although positive, did not reach statistical significance. This suggests that teachers' motivation cannot be explained by a single factor alone. Rather, multiple factors such as the applicability of educational content in practice, time and curriculum constraints, institutional priorities, and the perceived importance of water-related issues in the community may interact to shape motivation. Therefore, enhancing self-efficacy alone is insufficient, and environmental and institutional support that enables teachers to recognize the value and necessity of educational practice is essential.

Teacher-Led Capacity Building and Implications for Knowledge Dissemination

This study further examined how the effects of water quality education contribute to knowledge dissemination (Table 4). Understanding, self-efficacy, and motivation all showed significant effects on dissemination, with motivation exhibiting the strongest association. These findings indicate that conventional evaluation approaches focusing solely on knowledge acquisition are insufficient for promoting knowledge transfer. In other words,

educational outcomes are likely to extend to others only when learners not only understand the content but are also motivated to apply and share it. In addition, Sun et al. (2022) demonstrated that intrinsic motivation significantly promotes knowledge-sharing behavior, supporting the strong role of motivation in dissemination observed in this study. However, when the regression results are considered comprehensively, the relationships among understanding, self-efficacy, and motivation were not purely linear. While simple regression analysis showed significant relationships from understanding to self-efficacy and from self-efficacy to motivation, these relationships weakened in multiple regression analysis, with only understanding remaining a significant direct predictor of motivation. This suggests that self-efficacy may not function as an independent predictor of motivation but rather as a mediating or supportive factor in the relationship between understanding and motivation.

Nevertheless, insufficient development of self-efficacy may hinder the translation of understanding into motivation. Therefore, strengthening self-efficacy in the process of converting understanding into motivation remains an important challenge. Issues such as lack of equipment and time constraints identified in Figure 1 may act as barriers to the development of self-efficacy. In low-resource educational settings, shortages of teaching materials, equipment, and institutional support have been reported to constrain the quality of educational practice (Castillo & Haßler, 2022).

Moreover, when sufficient opportunities for practical application and supportive learning environments are lacking, teachers may find it difficult to develop confidence in their ability to implement lessons, even if their understanding has improved. As a result, motivation may also be limited. The finding that motivation has the strongest effect on dissemination suggests that intrinsic motivation is a key driver in the process through which educational effects spread. When motivation is enhanced, learners are more likely to voluntarily share knowledge and skills with others, thereby facilitating broader dissemination of educational content.

In conclusion, achieving sustainable and widespread impact of water quality education requires not only improving understanding but also appropriately fostering self-efficacy and linking it to motivation through well-designed educational programs. Such approaches are particularly important for capacity building and provide a foundation for effective knowledge dissemination in resource-limited settings.

Conclusion

This study demonstrated that the implementation of a water quality education capacity-building program at a teachers training college in Salavan Province, Laos, contributed to improvements in teachers' understanding, self-efficacy, and motivation related to water quality education. The findings indicated that understanding positively influenced self-efficacy, while motivation was affected by multiple factors beyond self-efficacy alone. Furthermore, understanding, self-efficacy, and motivation were all significantly associated with knowledge dissemination, with motivation identified as the strongest predictor. These results suggest that intrinsic motivation plays a crucial role in sustaining educational activities and promoting the spread of educational outcomes. However, several barriers, including limited equipment and time constraints, were identified as challenges that may restrict the development of teachers' self-efficacy and hinder effective dissemination. Although the study provides important insights into teacher capacity building in water quality education, the relatively small sample size limits the generalizability of the findings, indicating the need for further research in broader educational settings.

Recommendation

1. Utilization of Research Findings

Based on the findings of this study, it is recommended that future water quality education programs focus not only on improving teachers' knowledge but also on strengthening their self-efficacy and intrinsic motivation, as these factors are essential for sustaining educational practices and facilitating knowledge dissemination. In addition, supportive educational environments should be established by addressing practical barriers such as insufficient equipment and limited instructional time. Institutional support, including continuous training opportunities, technical assistance, and access to educational materials, is also necessary to maintain and enhance teachers' competencies over time. Furthermore, integrating water quality education into formal educational curricula may contribute to the long-term sustainability and wider dissemination of educational outcomes.

2. Suggestions for Future Research

Future studies should involve larger sample sizes and diverse educational contexts to validate and expand upon the findings of this study. Comparative studies across different regions, school types, and educational levels may provide a broader understanding of the effectiveness and applicability of water quality education programs. In addition, longitudinal studies are needed to examine whether improvements in teachers' understanding, self-efficacy, and motivation can be sustained over time and translated into continuous educational practices. Future research should also investigate the impacts of teacher capacity-building programs on students' learning outcomes, hygiene behaviors, and community-level knowledge dissemination. Furthermore, examining the relationships among institutional support, educational environments, and teachers' practical implementation abilities may contribute to the development of more effective and sustainable educational models for water quality education.

Acknowledgements

The authors would like to express their sincere gratitude to the faculty of chemistry teachers at the Salavan teachers training college who participated in the questionnaire survey. The authors also greatly appreciate the support and cooperation provided by the JICA Laos office.

References

- Agormedah, E. K et al. (2022). Investigating teachers' experience and self-efficacy beliefs across gender in implementing the new standards-based curriculum in Ghana. *Frontiers in Education*, 7, 932447.
- Asakura, T., Mallee, H., Tomokawa, S., Moji, K., & Kobayashi, J. (2015). The ecosystem approach to health is a promising strategy in international development: lessons from Japan and Laos. *Globalization and Health*, 11, 3.
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191–215.
- Castillo, N., Adam, T., & Haßler, B. (2022). Improving the impact of educational technologies on learning within low-income contexts. *Learning, Marginalization, and Improving the Quality of Education in Low-income Countries*. 113-148.
- Chard, A. N., Freeman, M.C. (2018). Design, intervention fidelity, and behavioral outcomes of a school-based water, sanitation, and hygiene cluster-randomized trial in Laos. *International Journal of Environmental Research and Public Health*, 15(4), 570.
- Chard, A. N., Garn, J. V., Chang, H. H., Clasen, T., Freeman, M.C. (2019). Impact of a school-based water, sanitation, and hygiene intervention on school absence, diarrhea,

- respiratory infection, and soil-transmitted helminths: results from the WASH HELPS cluster-randomized trial. *Journal of global health*, 9(2), 020402.
- Lao Statistics Bureau and United Nations Children's Fund (UNICEF) (2025). Lao Social Indicator Survey III, 2023, Survey Findings Report. Vientiane, Lao PDR, Lao Statistics Bureau and UNICEF.
- Nakhle, P et al. (2021). Effects of hydrological regime and land use on in-stream *Escherichia coli* concentration in the Mekong basin, Lao PDR. *Scientific Reports*, 11, 3460.
- Nimante, D., Kokare, M., Baranova, S., Surikova, S. (2025). Transferring results of professional development into practice: A scoping review. *Education Sciences*, 15(1), 95.
- Popova, A., Evans, D. K., Breeding, M. E., Arancibia, V. (2022). Teacher professional development around the world: The gap between evidence and practice. *The World Bank Research Observer*, 37(1), 107–136.
- Sims, S., Fletcher-Wood, H., O'Mara-Eves, A., Cottingham, S., Stansfield, C., Goodrich, J., Van Herwegen, J., & Anders, J. (2025). Effective teacher professional development: New theory and a meta-analytic test. *Review of Educational Research*, 95(2), 213–254.
- Sun, Y., Hong, J.-C., & Ye, J.-H. (2022). The effects of employees' perceived intrinsic motivation on knowledge sharing and creative self-efficacy. *Frontiers in Psychology*, 12, 762994.
- United Nations. (2015). *THE 17 GOALS | Sustainable Development – SDGs*. Department of Economic and Social Affairs. <https://sdgs.un.org/goals> (Apr. 8th 2025 access)
- World Health Organization (WHO) and the United Nations Children's Fund (UNICEF): (2025). *Progress on household drinking water, sanitation and hygiene 2000-2024: special focus on inequalities*.