The Effects of a professional development on teachers’ self-efficacy in promoting thinking and problem-solving skills

A Tongchai
The Institute for the Promotion of Teaching Science and Technology, Ministry of Education, Bangkok, Thailand

E-mail: a.tongchai@gmail.com

Abstract. People’s beliefs in their capabilities to complete tasks, achieve goals or produce desirable outcomes is known as self-efficacy. Teachers’ self-efficacy is crucial in terms of influencing their effective teaching and resulting in student achievement. This paper aimed to report the effects of a professional development program on teachers’ self-efficacy toward promoting student’s thinking and problem-solving skills. The training program aimed to support Science, Mathematics and Technology teachers. Ninety-five in-service teachers had participated in this training program. The participating teachers completed a Google form of the five-point Likert scale of the self-efficacy survey which mainly focused on teachers’ beliefs in their understanding of thinking and problem-solving and self-efficacy in teaching thinking and problem-solving. The survey was first given to the participating teachers at the beginning of the workshop. At the end of the training program, three months later, the participating teachers had to present teaching experiences. The survey was then given to the participating teachers to complete after they presented their teaching experiences. The data completed via google form were analyzed and reported. The results showed that teachers’ self-efficacy had significantly improved after attending the training program. However, teachers with different teaching experiences had differently improved their self-efficacy in teaching thinking and problem-solving. Interestingly, education degrees of teachers did not have an effect on efficacy in teaching student’s thinking and problem-solving. These findings suggested that professional development programs should be carefully designed in order to accommodate different participants.

1. Introduction
Teachers have always been the key persons who plays a crucial role in enhancing student’s learning and results in student’s achievement. Hence, a teacher professional development program is important in terms of preparing a proper course for specific purposes and groups of teachers [1]. Many research scholars have reported that teachers’ self-efficacy is a crucial factor influencing their teaching and learning [2, 3-6]. It is important to explore teachers’ self-efficacy in order to effectively design a teacher professional development program [4] especially when promoting specific essential skills such as thinking and problem solving. Although many research scholars in teacher education explored pre-service and in-service teachers’ self-efficacy [7-9] very little research have examined teachers’ self-efficacy in specific areas of higher order thinking aspects. The higher-order thinking is perceived as providing students to relate what they have learned to beyond associated elements [5]. This research paper aims to explore the impacts of a professional development program on teachers’ self-efficacy
2. **Research questions**

This research paper aimed to answer the following two questions.

- Can the professional development program significantly improve teachers’ self-efficacy toward enhancing student's thinking and problem-solving skills?
- Do teachers’ experience and education degrees have an impact on their self-efficacy toward enhancing student's thinking and problem-solving skills?

3. **Methods**

3.1. **Participants**

The participants in this study consisted of 95 in-service Thai teachers, 34 male (35.79%) and 61 female (64.21%). The teachers have participated in a professional development program aiming at improving teachers’ capability of nurturing student’s thinking and problem-solving skills through teaching Science, Mathematics and Technology. There were 54 primary school teachers (56.84%) and 41 secondary school teachers (43.16%) who come from different schools across the country. The participants had at least five years of teaching experience either in Science, Mathematics or Technology subjects. Of all 95 teachers, there were 35 Science teachers (36.84%), 31 Mathematics teachers (32.63%) and 29 Technology teachers (30.53%). Most of the participating teachers had 10-15 years of teaching experience and over eighty percent hold master’s degree in education. Among these, six teachers graduated doctoral degree in education, i.e., curriculum and instruction, assessment and evaluation, science education.

3.2. **The Professional development program.**

The professional development program aimed to enhance Science, Mathematics and Technology teachers’ capability of promoting student’s thinking and problem-solving skills. The training course was designed and implemented by both university professors, who were specialized in different areas of the training course, and experienced teachers who have been awarded in Science, Mathematics and Technology education. The training program comprised three main phases as described below.

3.2.1. **Phase I: Four-day training.** The four-day training program consisted of several critical concepts, which are crucial for improving teachers’ understanding and ability in promoting student’s thinking and problem-solving skills, such as principles of thinking and problem-solving, questioning, assessing, and evaluating, learning activities and lesson design. During the workshop, certain sessions were specially designed for specific teachers based on their subject areas, which were Science, Mathematics, and Technology.

3.2.2. **Phase II: Following up.** After the four-day training, the participating teachers designed a lesson plan based on their subject areas taught and school level. The designed lesson had to aligned with the goals of the workshop, i.e., explicitly promotes thinking and/or problem-solving skills, requires about 2 hours of teaching. While teaching their students, the teacher needs to collect data such as student behaviour, photos, student’s work, so that they can write a summary of what they have found and learned during the class. These data will be used for reporting and sharing with the trainers as well as their peers at the end of the training course as explained in Phase III.

3.2.3. **Phase III: Sharing and reflecting.** In this part of the training program, all participating teachers presented their classroom practices and lesson learned to the trainers as well as their peers. The sharing session was organized for two days at a convention centre. The presenters had a choice of either 20-minute oral or poster presentations. This conference phase allowed the trainers to give feedbacks whereby the trainees learned from other presenters also.
3.3. Instrument and data collection
At the beginning of the four-day workshop, the participating teachers completed the Google form of the five-point Likert scales of the self-efficacy survey which mainly focused on teachers’ beliefs in their capability of promoting thinking and problem-solving skills. The survey was also delivered to the participating teachers to complete at the end of the training program. The validity of the questionnaire was carried out by three academic officers and three science educators in order to verify both content and construct validities as well as the readability of all items. The data were analysed using descriptive statistics: mean, standard deviation, and t-test.

4. Results and Discussion
As shown in table 1, the results revealed that the training program significantly improved teachers’ self-efficacy in promoting student’s thinking and problem-solving skills. Furthermore, the results showed that teachers had high confidence in enhancing student’s thinking and problem-solving skills (mean = 4.08).

Table 1. Comparison of teachers’ beliefs in their capability of enhancing thinking and problem-solving skills before and after attending the training program.

| Belief in ability and confidence to promote student's thinking and problem-solving skills | Number | Mean | Standard Deviation | Degree of freedom | t - test (2 - tailed) | p - value |
|---------------------------------|--------|------|-------------------|------------------|---------------------|-----------|
| Before                          | 95     | 3.55 | 0.64              |                  |                     |           |
| After                           | 95     | 4.08 | 0.52              |                  | -5.912              | 0.000*    |

* p < .05

Table 2. Comparison of teachers’ beliefs in their capability of enhancing thinking and problem-solving skills before and after attending the training program according to their teaching experiences.

| Question: Teaching experience (year) | Before | After | Chi-square | d.f. | p - value |
|-------------------------------------|--------|-------|------------|------|-----------|
| 5-10                                | (S.D.) | (S.D.) |            |      |           |
|                                     | (5.10) | (11.15) | (16-20) | (>20) | (5.10) | (11.15) | (16-20) | (>20) |
| Belief in ability and confidence    | 3.73   | 3.44  | 3.42       | 3.65 | 4.13      | 4.06     | 4.00     | 4.15   |
| to promote student's thinking and   | (0.42) | (0.63) | (0.85)    | (0.88) | (0.49) | (0.61) | (0.37) | (0.53) |
| problem-solving skills              |        |        |            |      |           |

*p < .05

The results as shown in table 2 revealed that the training program had significantly (p < .05) improved teachers’ beliefs in their ability and confidence to promote student's thinking and problem thinking. In addition, the results also showed that, of all teachers’ different teaching experiences, teachers who had highest years of teaching experiences (> 20 years) had high confidence in enhancing student’s thinking and problem-solving skills after the training program. However, the other three groups of teaching experiences seem to have uneven levels of confidence to in enhancing student’s thinking and problem-solv-
solving skills after the training program. This was an interesting finding which could be explored more carefully in order to find out the reason behind.

Table 3. Comparison of teachers’ beliefs in their capability of enhancing thinking and problem-solving skills before and after attending the training program according to their highest education degrees.

| Question/highest education degree | Before          | After           | Pearson's correlation |
|----------------------------------|-----------------|-----------------|-----------------------|
|                                  | Bachelor (S.D.) | Master (S.D.)   | Ph.D. (S.D.)          | Bachelor (S.D.) | Master (S.D.) | Ph.D. (S.D.) | Chi-square | d.f. | p-value |
| Beliefs in ability and confidence to promote student's thinking and problem-solving skills | 3.41 (0.50)     | 3.60 (0.62)     | 3.06 (0.96)           | 3.97 (0.73)     | 4.08 (0.51)   | 4.19 (0.33)  | 4.532      | 8    | 0.806   |

*p < 0.05

Table 3 showed that teachers with higher degree of education seems to have more confidence in promoting student’s thinking and problem-solving skills. However, although teachers have higher education degrees, e.g., Ph.D. and master’s degrees in education, their self-efficacy toward promoting student’s thinking and problem-solving did not significantly different (p < .05). This is an interesting finding which might be crucial for educators to find out the factors affecting teachers’ confidence in promoting student's thinking and problem-solving skills.

5. Conclusion
Teachers’ self-efficacy has been reported to be a crucial factor that largely affects teachers’ classroom practices and, thus, results in students’ learning outcome [3, 4, 7]. In any professional development program, self-efficacy should be concerned and addressed when designing a training program [8,10]. Therefore, this study explored the effect of the professional development program on the participating teachers’ self-efficacy toward teaching thinking and problem-solving skills. This research findings revealed that the professional development program had significantly improved teachers’ self-efficacy toward enhancing thinking and problem-solving skills as stated in the first research question. Moreover, interestingly that teachers’ education degrees did not significantly have an effect on their self-efficacy while teachers’ teaching experiences significantly have an impact. These findings might help educators considerably oversee the participating trainees when designing a professional development program so that it would help improve its effectiveness and meet the goal as expected.

6. References
[1] Tongchai A, Wichaidit P R and Koocharoenpisal N 2019 A professional development program to enhance thinking and problem solving skills for thai science, mathematics and technology (SMT) teachers. J. of Sci. and Math. Educ. in Southeast Asia 42 1-25
[2] Bandura A 1977 Self-efficacy: toward a unifying theory of behavioral change. Psychological Review 84 191–215
[3] Baysala Z N, Arkanb K and Yildirimb A 2010 Pre-service elementary teachers’ perceptions of their self-efficacy in teaching thinking skills. Procedia Social and Behavioral Sciences 2 4250–54
[4] Bray-Clark N and Bates R 2003 Self-efficacy beliefs and teacher effectiveness: Implications for professional development Professional Educator 26 13-22
[5] Brookhart S M 2010 How to Assess Higher-Order Thinking Skills in Your Classroom. (Alexandria, VA: ASCD)
[6] Chester M D and Beaudin B Q 1996 Efficacy beliefs of newly hired teachers in urban schools. American Educational Research J. 33 233–57
[7] Christina M, Norris, Julia E M and Geoffrey W L 2018 Pre-service teachers’ self-efficacy to teach primary science based on ‘science learner’ typology Int. J. of Sci. Educ. 40 2292-308
[8] Ross J and Bruce C 2007 Professional development effects on teacher efficacy: Results of randomized field trial J. of Educ. Research 101 50–60
[9] Sawtelle V, Brewe E and Kramer H L 2012 Exploring the relationship between self-efficacy and retention in introductory Physics J. of Res. in Sci. Teach. 49 1096–121
[10] Tebbs T J 2000 Assessing Teachers’ Self-Efficacy towards Teaching Thinking Skills: Unpublished Doctoral Dissertation (Connecticut: University of Connecticut)

Acknowledgements
The author would like to express our deep gratitude to the Institute for The Promotion of Teaching Science and Technology (IPST), the Ministry of Education, Thailand, for supporting and funding this professional development program. The author would like to specially thank to all the trainers and Thai teachers who participated in the project.