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The Implementation of Computational Thinking Books and Materials Set for Lower Primary School Students

Thidarat Tannirat [1], Noawanit Songkram [2], Valen Dulyakorn [3], Supattraporn Upapong* [4]

[1] Assistant Professor, Faculty of Education, Bansomdejchaopraya Rajabhat University, Bangkok, Thailand.
[2] Professor, Education technology and communications, Faculty of Education, Chulalongkorn University, Bangkok Thailand.
[3] Curriculum and Education Technology Consultant, Banjongrat School, Lopburi, Thailand
[4] Postdoctoral Fellowship, Faculty of Education, Chulalongkorn University, Bangkok, Thailand.

Abstract

The purpose of this study was to examine the implementation of the computational thinking books and materials set for lower primary school students. The sample groups were grade 1-3 students with a total of *74*, *73*, and *71* students respectively. The research instrument was computational thinking books and materials set for lower primary school students which include 6 books each book for one semester in each grade and time duration of studying in each book is 10 hours per semester. The statistical analysis was mean, SD, t-test, and the results found that after implementing each book in each grade level in one semester and 6 books in total, students' post-test scores were statistically significantly higher than pre-test at the *.05* level.

Keywords: Computational Thinking, Educational Resources, Primary School Students.

1.   Introduction

Recently, the ministry of education and demonstration schools have added computing science into the common core curriculum due to The Institute for the Promotion of Teaching Science and Technology (IPST) introducing computing science curriculum and standards. The purpose of incorporating computing science into the common core curriculum was to teach students the knowledge and skills necessary to solve real-world problems, create inventions, and apply technical knowledge to daily life.

Computing science is comprised of knowledge and skills in Computer Science (CS) Information Communication Technology (ICT) and Digital Literacy (DL) to promote critical thinking, complexed problem solving skills in a methodical and sequential manners and skills in information retrieval, evaluation, organization, analysis, synthesis, and application including creative collaboration with manners and ethical for society benefit. These knowledges and skills are crucial for daily life and career future. As the consequence, teachers from other subjects such as computer science are shifted to teach this course and most of them were graduated indirectly majored in this profession. To address the problem Wanida Prakunkul (2015), examined the solutions of primary school teachers whose majors do not correspond to their teaching positions. She found that high quality books and materials with cleared explanations, guidelines and assessments can support teachers to create and convey their instruction more effective. Consequently, the Program Management Unit for Human Resources & Institutional Development, Research and Innovation value on promoting computational thinking knowledges and skills for students so the project was granted to conduct research to create computational thinking books and materials for primary school students.

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2.   Research Purpose

The purpose of the study was to examine the implementation of the computational thinking books and materials set for lower primary school students

3.   Research Methodology

The research populations were grade1-3 students and the sample groups were selected using the purposive sampling random method. The selected school was a school equipped with technical facilities and the other was a school that sorely has adequate technology infrastructure. The sample groups were grade1-3 students with a total of 74, 73, and 71 students in the group respectively. The research instrument was computational thinking books and materials set for lower primary school students and pre-test and post-test evaluation. The data were analyzed using mean, standard deviation (SD), and t-test.

4.   Results

1. Pictures of implementation of computational thinking books and materials set for primary school students on off-line and online resources

Figure 1 Pictures of the implementation of computational thinking books and materials set for lower primary school students with offline learning materials

Figure 1, the examples of instructional activities to promote computational thinking activities with offline learning materials. Prior to each instruction, teachers were required to read the descriptions and explored the ways to integrate content knowledge from various subjects into the activities including arranging spaces, explaining the rules, and demonstrating how to do activities. Moreover, as a reinforcement, rewards are advisable to be given to the winning team to encourage students' engagement. Managing instructional activities can be challenging, however, well preparation can be beneficial for instruction.

Figure 2 Pictures of the implementation of computational thinking books and materials set for lower primary school students with online learning materials

The application results of the computational thinking books and materials set for lower primary school students showed that the students' post-test scores on computational thinking were statistically significantly higher than the pre-test score at .05 as data presented in the table 1

Table 1 Comparison between pre-test and pro-test scores of implementations of computational thinking books and materials set for lower primary school students

Computational thinking score	$\bar{x}$	SD	t	df	Sig
The computational thinking book and materials for Grade 1 Volume 1					
Pre-test Score	6.78	2.63	17.304	44	0.000*
Post-test Score	10.47	1.36	51.685		
The computational thinking book and materials for Grade 1 Volume 2					
Pre-test Score	6.96	2.34	19.899	44	0.000*
Post-test Score	10.69	1.26	56.993		
The computational thinking book and materials for Grade 2 Volume 1					
Pre-test Score	7.08	2.62	17.109	39	0.000*
Post-test Score	10.18	2.04	31.597		
The computational thinking book and materials for Grade 2 Volume 2					
Pre-test Score	7.83	2.23	22.202	39	0.000*
Post-test Score	10.53	1.45	45.914		
The computational thinking book and materials for Grade 3 Volume 1					
Pre-test Score	7.68	2.14	23.773	43	0.000*
Post-test Score	10.64	1.14	61.724		
The computational thinking book and materials for Grade 3 Volume 2					
Pre-test Score	7.30	2.24	21.634	43	0.000*
Post-test Score	10.77	1.16	61.673		

*$p < .05$

5.   Discussion

The computational thinking books and materials set for primary school students were designed based on multiple learning theories and comprised of various activities. Moreover, the knowledge content, exercises, and activities in the set correspondence with indicators under standards of computing science, so, students have opportunities to learn in-depth and practice computational thinking skills efficiently Tannirat (2019, 2022). According to research, it was found that the computational thinking books and materials set for primary school students were suitable for schools where meager of various technological equipment such as computers, the internet, and so on. Employing the set can reduce the disadvantages of the restrictions in terms of technical infrastructure which is consistent with Tannirat (2020). Besides, Kritsakorn Phasuk (2018) found that when integrating STEM into computing science instruction, the student's academic post-test scores ($\bar{x}$ = 13.37, S.D. = 1.78) were significantly higher than pre-test scores

($\bar{x}$ = 5.07, S.D. = 1.33) at .05 level. In addition, Games, challenging activities, and exercises that are included in the set also support computational thinking skills and is consistent with research by Kanita Sagan (2021) which found that students who practiced their skills with google coding games when training in problem-solving or algorithm designed activities could enhance their problem-solving skills and programming. Furthermore, this is also consistent with Vieira, Magana, Roy, & Falk (2019) studied that students with coding experiences can write simple code for self-introduction effectively and inexperienced students were able to write code more efficiently due to participating in learning activities integrated with coding. To encourage the learning process for success from the set, teachers should organize their instructions based on learner reaction theory and according to Chase and Hynd (1987) stated that students should concentrate on practice. In addition, teachers should integrate learning reflection into the instructions due to the reflection has been suggested that it is an effective way that can support students to gain a deeper understanding of challenging activities and it is consistent with the research by He, Z., Wu, X., Wang, Q., & Huang, C. (2021) which found that critical reflection could essentially advance computation thinking skills. Organizing small or large group interactions, ensuring a secure classroom environment, and allowing students to reflect on their own thoughts excluding punitive actions strengthen students' learning performances.

6.   Suggestions for future implementation

1. In terms of learning management for teachers, the computational thinking books and materials set are created in e-book file and distribute to schools. Teachers can use the set as learning materials in their instruction to promote computational thinking skills for students. The material set can be printed out and equipped with descriptions and videos to explain how to utilize in the classroom. Moreover, there are answer keys and assessment for teachers to evaluate students' learning.

2. In development of knowledge in computational thinking for learners, students can expand their knowledge and practice their computational thinking skills from self-study using the set. The package provides cleared descriptions and explanations to assist students, parents and educators to use conveniently and effectively.

7.   Acknowledgements

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