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Evaluation of the Effectiveness of Unplugged Computational Thinking Training Program for Teachers using ABCD Discrepancy Model

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Abstract
The ABCD discrepancy evaluation technique is used in this study to assess the efficacy of Computational Thinking (CT) Unplugged instruction at the school level. In order to find discrepancies between anticipated and actual training outcomes, the study looked into the four model components: trainers and program implementers, program and its execution, objectives, and impact. We conducted in-depth interviews with trainee teachers to learn more about the procedure, issues, and difficulties encountered while putting CT into practice. Purposive sampling was employed in this study to examine the effects of CT training on trainee teachers' personal experiences and outcomes. The findings demonstrate that while CT can raise teaching's effectiveness and efficiency, its performance in classrooms can be enhanced by instructors' attitudes toward and commitment to training, as well as by the organizers' technical support and deliberate program monitoring. On the basis of these conclusions, suggestions are presented to enhance the way that CT is used in schools. This study helps us comprehend the opportunities and difficulties of integrating CT in classrooms.
Keywords: *Computational Thinking Training, Discrepancy Model, ABCD evaluation model, Unplugged CT*

INTRODUCTION

PISA 2018 ranked Indonesia 74th for literacy, 73rd for math and 71st for science (Schleicher, 2019; Zahid, 2020). The PISA framework demonstrates how computational thinking contributes to the process of problem-solving. (Fenanlampir et al., n.d.; Nugrahanto & Zuchdi, 2019). In addition, in the PISA framework, the ability to develop algorithms is part of computational thinking.

The world is undergoing rapid digital transformation. Preparing young people with computational thinking will enable them to contribute effectively in the digital world (Angeli & Giannakos, 2020; Cetin & Dubinsky, 2017). Equipping students with CT will help them develop skills relevant to the future job market.

Indonesia needs to increase innovation in various sectors, such as agricultural education, health, energy, and so on. CT has strong potential to help solve complex problems and develop innovative solutions (Broza et al., 2023; Del Olmo-Muñoz et al., 2020). Using CT, Indonesians can be more independent in addressing local problems. In addition, training people with CT will help Indonesia compete on a global level. CT helps individuals to solve complex problems, whether in scientific, engineering, or social fields (Agbo et al., 2019; Arastoopour Irgens et al., 2020; Brackmann et al., 2017).

UIN Salatiga in collaboration with Bebras Indonesia and with support from Google.org in 2023 organized a Computatinal Thinking training program for teachers in Central Java. Nationally, the program aims to spread and teach mastery of Computational Thinking to 2 million students, through 22,000 teachers of various subjects in 22 regions in Indonesia (Avizenna et al., 2022; Ayub et al., 2023; Kartarina et al., 2021; Madani et al., n.d.). Bebras Biro UIN Salatiga took one training package with the target of training 200 teachers from various subjects on CT mastery so that it can be taught and transmitted to students through each teacher's subject.

The use of CT in schools will be aided by this research, which is crucial. Teachers who desire to include CT into their lesson plans and advance their instructional strategies might also benefit from it. This study uses the ABCD dicrepancy evaluation approach to assess the Computational Thinking course offered by Biro Bebras UIN Salatiga in 2023. ABCD dicrepancy evaluation model in this research, specifically with:

A: identify the intended beneficiaries of the training

B: explore training operations and processes, including funders, nature of support, resources used and monitoring of training.

C: determine the impact of the training on the school, based on the objective to increase teachers' use of CTs

D: recognize the impact of CT training

Theoretical Framework

Ochave's (2010) ABCD model is a framework for evaluating the effectiveness of education programs. It provides a structured approach to assessing and improving education programs (Del Rosario et al., 2023; Mahinay Jr, 2019). This paradigm has four parts: (A) Participants or beneficiaries, (B) Activities and procedures, (C) Results, and (D) Impact. (Castellano, 2019). Component A refers to the participants of the training program in question, in this CT training there are primary and secondary school teachers. The method and implementation of the program/training are covered in Component B, including the resources employed, the assistance given, and the tracking of program progress. Component C refers to the training's outcomes, especially in terms of teachers' improved comprehension of employing CT in classroom instruction. Component D also looks at how the program affected student learning outcomes and enhanced learning effectiveness.

Three theories that are connected to the ABCD model are also discussed in the review: the Diffusion of Innovations Theory, the Goal Setting Theory, and the Self-Determination Theory. These theories are anticipated to guide the design and execution of CT training, aid in the understanding of the variables that may affect the adoption and usage of flexible CTs in classroom instruction, and offer assistance and resources that improve self-determination, competence, and connectivity.

A theoretical and practical framework for assessing educational programs is provided by the ABCD model, particularly in the context of increased flexible learning employing CT. Ochave's ABCD model emphasizes the importance of aligning program goals and objectives with expected behaviors and considering the conditions that influence the learning process (Abella & Cutamora, 2019). By collecting and analyzing data, educators and program developers can make informed decisions regarding program strengths and weaknesses and make improvements as needed. It is important to note that the ABCD Model is a useful tool for program evaluation in educational settings, and can help educators and institutions ensure that their programs meet their intended goals and objectives (Weigard et al., 2023).

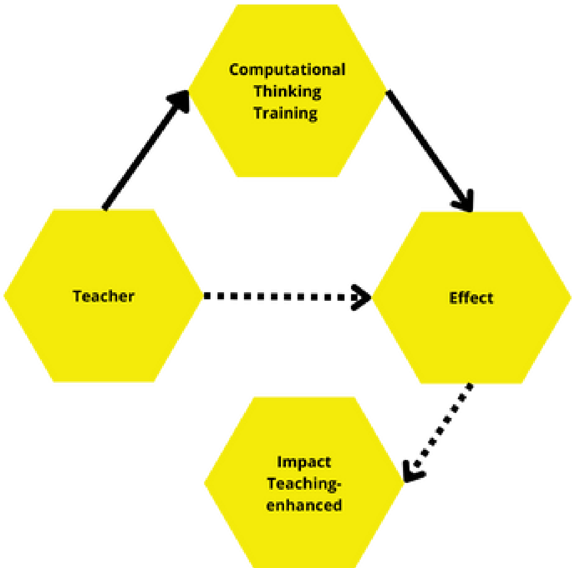

Figure 1. Flow of ABCD Model used in CT Training Program Evaluation

METHODS

Design and Locale

A descriptive-evaluative design was employed in this investigation. matching the actual program implementation events, called "actuality", with the objectives of the Computational Thinking Training, called "intent", makes this research evaluative.

The results of the investigation were used to determine its implementation to the delivery of training in each training location/school and the possibility of improving the quality of teaching-learning using Compotational Thinking. The research was conducted in schools in Central Java province.

Research Participants and Sampling

Purposive sampling was employed in the study to evaluate participants' personal effects and the effects of CT training. To calculate the necessary number of trainees for the study, data saturation was used. 200 teachers in all from different schools in Central Java volunteered to take part in this study.

Research Instrumen

The validity and reliability of the data collection tools utilized in this study were confirmed through a number of tests. The Self-Assessment Questionnaire was first used to gather information on ABCD model component A. Validity and reliability tests for the instrument have already been conducted. The questionnaire's target measurement, namely the number of instructors who required CT training at schools, was verified using the validity test. This was accomplished by contrasting the questionnaire's findings with outside standards, such as the facilitator of the CT training program's records. The questionnaire's results will be consistent over time thanks to the reliability test. The results were compared after the questionnaire was given to a group of participants twice, separated by time.

The semi-structured interview method employed in the key informant interviews was validated for components B and D. To confirm that the interview questions measured what they were meant to measure, a validity test was done (Harun et al., 2022; Kullan et al., 2022), i.e. the operation and impact of the CT training. In order to make sure the interview questions were pertinent and appropriate, subject-matter specialists had to review them. To make sure they produced the needed information, a small sample of participants served as a pilot group for the interview questions.

The interview instrument's dependability was estimated in addition to demonstrating its validity. When estimating reliability, the identical interview question is given to a group of participants twice, separated by a time interval, and the answers are compared. (Alwadood et al., 2023; Korkmaz et al., 2017; Suranto et al., 2014). This is done to guarantee that the interview questions consistently yield reliable findings throughout time.

The data collection tools used in this study underwent validity and reliability testing to help guarantee that the data obtained are reliable, accurate, and pertinent to the study's research goals. (Retnowati et al., 2017; Riscaputantri & Wening, 2018). This must be done in order to improve the research's overall quality and the reliability and credibility of its findings.

Data Gathering Procedure

Interviews with training participants and focus group discussions (FGDs) were done during in-person and online meetings. With the participants' consent, FGDs were audio recorded using a recorder called an auido. Following the interviews, the data collected was converted into text format to show the challenges and impediments that the training's execution faced.

Data Analysis

The congruence and gaps between aims and actual facts are found using the ABCD evaluation approach. The appraisal becomes less positive the wider the disparity or gap. These discrepancies are signs of how well a program is working. The data was presented using an information summary matrix, which had columns for each component's intended purpose, actuality, appropriateness, and any gaps. Based on the congruence and non-congruence of various components, analysis was carried out.

2.6 Ethical Consideration

Ethics were taken seriously in this work, and the researcher adhered to Licthman's guidelines for moral conduct (Lichtman, 2023). Making certain that no harm was done to the subjects was one of the study's primary ethical considerations. The researcher took steps to address this, including using pseudonyms to preserve participant confidentiality. This made it possible to guarantee that nobody was hurt and that their privacy was protected.

Another significant ethical issue covered in this study is confidentiality. The researcher gave pseudonyms to safeguard participants' identities, and each participant was issued a random number. This procedure made sure that participants' identities were kept a secret and that their confidentiality was upheld. Furthermore, all research-related materials, including transcripts, audio recordings, and participant data, were kept private.

Finally, the researcher made sure that the study covered the idea of informed consent. Participants were made aware that their participation was completely voluntary and that they could end it whenever they wanted. With their rights fully understood, participants were better able to decide whether or not to participate in the study thanks to this measure.

RESULTS AND DISCUSSION

Based on information gathered and organized into four components from secondary data, interviews, surveys, and other sources (program administrators (Biro Bebras UIN Salatiga), Computational Thinking training, effectiveness, and impact) and analyzed the objectives, implementation, and gaps/conformities. The following is the data from the analysis:

Table 1. Component A - Program Executor

Intents	Actualities
- Train primary and secondary school teachers in Computational Thinking training to increase flexibility and quality of learning. - Target: 200 primary and secondary school teachers within 12 months	- The training was conducted in 4 different times and 4 different locations, each implementation consisting of two sessions. The first session was CT concept training, and the second session was implementation. - Actual: Training session 200 teachers (100%), implementation session 124 teachers (64%)
- Target teachers are teachers in Central Java	- Participants came from schools in Salatiga City, Magelang City, Semarang Regency, & Demak Regency.
- Teachers are committed to completing the training up to the implementation stage	- Some teachers have not yet reached the implementation stage. 36% of teachers have not implemented CT into their learning.
Discrepancies	
- There are 76 teachers (36%) who have not yet carried out the implementation stage. Some of the difficulties encountered are that they have difficulty finding the right design or lesson plan to be associated with CT. - Some teachers decided not to continue the training until the implementation stage. This is because the teachers' workload is already too much and it is not possible to adopt CT into learning due to time constraints.	

The Merdeka Curriculum in Indonesia, instructs that Computational Thinking be integrated in language learning, mathematics, and Natural and Social Sciences (Avizenna et al., 2022; Kartarina et al., 2021). The integration of CT is to encourage students' reasoning skills that are connected to technological developments. Therefore, schools and colleges started training on CT to improve students' computational thinking while encouraging students' reasoning. The implementation and benefits of CT in teaching can still be improved in classroom practice.

The following are the trainee teachers' responses to the problems they encountered in utilizing CT in subject teaching.

"*To have more practice than theory so that it is more enthusiastic*" (R1)

"*time allocation is too short*" (R2)

"*Good training, but should provide some questions of various levels*" (R3)

"Not so interesting because the time is too short and there is still too much theory instead of direct practice." (R4)

"*If there can be mentoring, able to increase critical reasoning power*" (R5)

Table 2. Component B - Implementation of Computational Thinking Training

Intents	Actualities
- Helping teachers improve the use of CT in learning, especially in preparing lesson plans integrated with CT.	- Some teachers are eager to participate in the follow-up mentoring that is carried out through online methods
- Training organizers should introduce CT as a necessity in the current curriculum and convince participants that CT can improve students' reasoning skills.	- Organizers present curriculum policy documents that clearly call for integrating CT into language, mathematics, and natural and social science subjects
- Trainers must accompany teachers in the implementation of CT	- The organizers set up a regular mentoring schedule once a week online. Participants/teachers are welcome to join when they encounter difficulties.
Discerpancies	
- Trainee teachers have difficulty understanding the technique of integrating CT into learning - Teachers still understand that CT learning must be connected to a computer device - The four components of CT (decomposition, pattern discovery, abstraction, and algorithm) are not yet fully understood by teachers - Trainers provide special time regularly once a week every Friday from 08.00 to 11.00 to facilitate teachers who have difficulties online. - The trainer prepares an example of CT learning scheme integrated into subjects	

The following are the responses of CT trainee teachers regarding learning using CT.

"*Because it is very optimal in building the mindset of students to think critically*" (R6)

"*Because the previous curriculum was too monotonous and mostly relied on trivial questions that were not useful for daily life.*" (R7)

"*Because it focuses more on essential materials such as literacy and numeracy, and encourages students to create projects.*" (R8)

"*CT teaches students how to think the way computer scientists think, to solve real-world problems.*" (R9)

"*Great and challenging*" (R10)

"*There is follow-up after this training*" (R11)

Table 3. Component C - Effectiveness

Intents	Actualities
- All participating teachers completed the CT training up to the implementation stage	Average teacher participation in CT training - Magelang: session 1 100%, session 2 73% - Salatiga: session 1 100%, session 2 65% - Semarang: session 1 100%, session 2 50% - Demak: session 1 100%, session 2 52%
- In the implementation stage teachers apply CT learning to students	- 64% of teachers who implemented CT learning in the classroom - About 3000 students have experienced learning using CT
Discerpancies	
- There are still teachers who are still not skilled in using CT in learning - Some teachers were not fully convinced that they had used CT correctly in the classroom. - According to the teacher, students are enthusiastic when given questions about CT and are interested in learning using CT.	

The following are the CT trainee teachers' responses to the effectiveness of CT training in promoting more effective and flexible learning.

"*I want to apply CT so that students not only hear, respond, but are also able to apply it in daily life, and CT is very capable of helping them to think logically, rationally, systematically and be able to solve problems.*" (R11, R12)

"I would like to apply CT to the lessons I teach. Because it will shape students' reasoning more critically through the existing bebras questions." (R13)

"*To think fast or reason fast and correctly.*" (R14, R15, R16)

"*So that Arabic language learning is not monotonous which only reads and memorizes, but also trains students to think computationally.*" (R17)

"*So that students can solve a problem in a lesson by breaking the problem into smaller parts so that it can be easier to find solutions to solve the problem.*" (R18)

Table 4. Component D - Impact

Intents	Actualities
- Improve teachers' ability to facilitate students to think critically and computationally	- Teachers successfully use various ways to integrate CT into their learning. - The teacher sees students' enthusiasm, especially, when given questions about CT
- Realizing education that is sensitive to technological change	- Schools can implement CT learning without being connected to a computer device, by applying the 4 main components of computational thinking in classroom learning.
Discerpancies	
- There are teachers who still refuse to implement CT into their learning. - There is an opportunity to improve students' reasoning skills through CT. - This can be achieved by emphasizing that CT is needed to improve students' competitiveness in the future, especially in the field of technology. There is a need for expansion of the program implementation and further assistance so that more students can experience CT learning in their teaching and learning process.	

The following are CT trainee teachers' responses to the impact of CT training in promoting more effective and flexible learning.

"*In order for learning to be more differentiated and develop according to the times*" (R19)

"*simplifying the previous curriculum that seemed complicated and could not meet the competency achievements of students*" (R20)

"*Students will quickly think logically and step by step solve the problem.*" (R21)

"*Students can train their mindset to be creative, logical, and structured.*" (R22)

"*I want to lead learning that leads students to apply Computational Thinking (CT) in their lives.*" (R23)

CONCLUSION

The evaluation of the ABCD model revealed that the school-level Computational Thinking training was successful. The four components that were assessed, namely the Biro Bebras UIN Salatiga, the Computational Thinking training, the effectiveness, and the impact, aligned with the actual results. However, there were some challenges encountered before, during, and after the implementation of the Computational Thinking Training in the Teacher community. Teachers reported difficulties in integrating CT into non-exact subjects, and the training did not provide technical support to teachers regarding the implementation of CT in each subject. In addition, although most participants have completed the Computational Thinking Training, some participants still need further assistance regarding the technical implementation in each subject, especially non-exact subjects.

The following suggestions are made to enhance the use of computational thinking training in classrooms: (1) Extend the training period by two days, with details of the first day is training on the concept of CT in learning, and the second day is the preparation of a technical plan for implementing CT in each subject taught by the trainees; (2) It is necessary to compile a timeline for post-training Computational Thinking activities in more detail with its targets; (3) it is necessary to prepare a follow-up mentoring program for teachers who have not succeeded in implementing CT in learning; (4) involve experts in the exact and non-exact fields in every training implementation; and (5) Evaluate the training to identify promising practices or pressing issues related to the implementation of CT training.

Schools can successfully incorporate CT concepts into classroom instruction in both academic and extracurricular disciplines by putting these guidelines into practice.

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