Present & Discuss – EAPRIL2021

Factors Affecting the Teaching of Computational Thinking in Fundamental Schools: A Path Analysis

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Abstract

Computational thinking (CT) in fundamental education is an emerging topic in research about educational policies and practices around the globe. In Luxembourg, CT was introduced as a learning topic in fundamental schools in 2020. This situation offers a unique opportunity to investigate how various factors influence emerging CT teaching practices.

Based on a revised version of the Technology Acceptance Model (Inan & Lowther, 2010), a research-based path model of CT teaching was developed, emphasising the influence of teachers' beliefs and readiness on CT teaching practices. It investigated the effects of demographic factors, teaching approaches, ICT proficiency, previous CT experience, and overall support for technology integration on readiness, beliefs, and CT teaching practices.

The current study reveals that teachers are interested in teaching CT. However, they hold a widespread misconception (Fessakis & Prantsoudi, 2019), confusing CT with programming or technology use. ICT proficiency is indeed associated with beliefs about CT and readiness for teaching CT. Readiness for teaching CT, beliefs about CT, and previous CT experience are the strongest predictors for CT teaching practices.

In line with Cuny et al. (2010), the current study highlights the importance of training teachers to accurately define CT and to identify good practices.

Extended Summary

Computational thinking (CT) was gaining in political and scientific interest during the last decade. More and more governments worldwide have already integrated CT in some form in their curricula (Bower et al., 2017). Bocconi et al. (2016) identified two main reasons in European countries: a)a growing need of qualified ICT related employees, b) fostering out-of-the-box thinking of the students by solving real-world problems with and without using digital media. In Luxembourg, CT was introduced as defined by Wing (2006) under the name "coding" as a learning topic in fundamental schools (pre-K – K6) in 2020.

This offers a unique opportunity to investigate the teachers' perceptions and attitudes towards a newly introduced curricular objective. According to Fessakis and Prantsoudi (2019), there is indeed a widespread misunderstanding of teachers, that CT and technology integration are interdependent. In order to study the hypothesised causal relationship between various previously identified factors and CT, the revised version

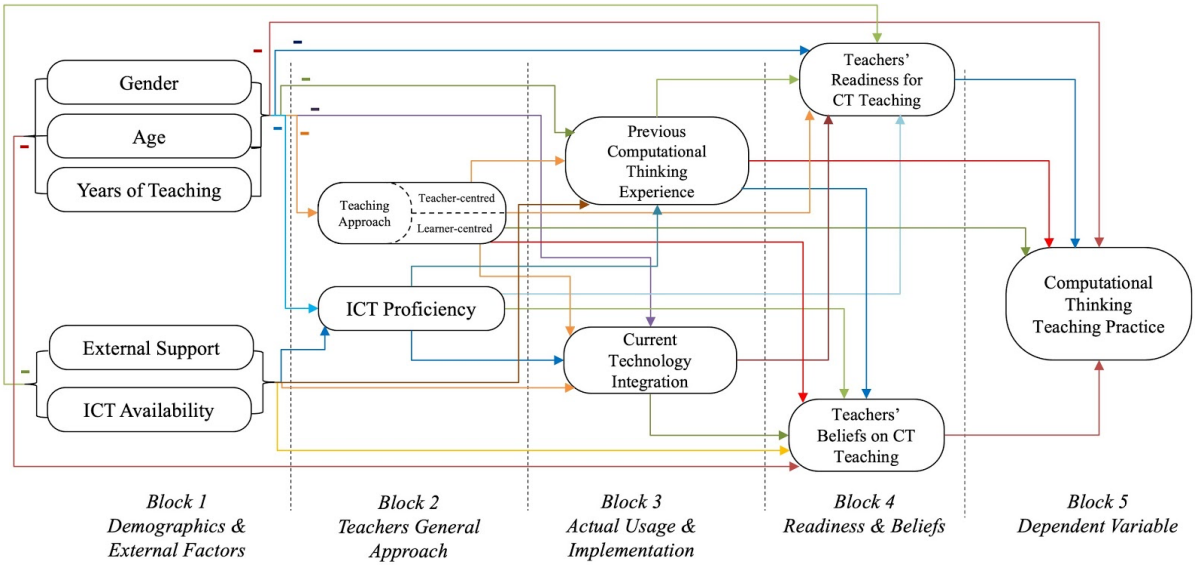
of the Technology Acceptance Model of Inan and Lowther (2010) was used here to establish a path model (see figure 1).

The purpose of this study is to examine the effects of teachers' personal characteristics and external factors on their CT teaching practices. The focus is set on teachers' readiness and beliefs about CT teaching and learning. These factors should then allow making predictions about teachers' future CT practices. Furthermore, the path model approach allows explaining relationships between the factors, including direct, indirect, and total effects towards each other, as shown in figure 1. Our research questions were:
RQ1. What are the teachers' beliefs on CT?
RQ2. What are the teachers' attitudes towards CT?
RQ3. What are the teachers' beliefs on the integration of CT in education?

Methodology

A research-based path model of CT teaching was developed, emphasising the influence of teachers' beliefs and readiness on (self-declared) CT teaching practices. It investigated the effects of demographic factors, teaching approaches, ICT proficiency, previous CT experience, and overall support for technology integration on readiness, beliefs, and CT teaching practices.

Figure 1
Hypothesised Path Model



A specially designed questionnaire was developed containing 41 items, subdivided into the six categories. The items were taken from previously used questionnaires covering the respective research sub-concepts (Admiraal, 2017; Fessakis & Prantsoudi, 2019; Lowther et al., 2008; Papanastasiou & Angeli, 2008; Wozney et al., 2006). The research sample consisted of 63 fundamental school teachers in Luxembourg, including kindergarten teachers.

Results and Discussion

Similar to previous research, teachers have a strong interest in implementing CT into their teaching (Fessakis & Prantsoudi, 2019). Many teachers understand CT as a way of solving problems. Additionally, the teachers' freely formulated definitions show a strong connection to logical reasoning, problem decomposition, and algorithmic thinking. Considering more general beliefs about CT, most of the respondents seem to understand that CT can promote creativity and innovation and helps develop general problem-solving principles applicable in an interdisciplinary context.

Regarding the educational grade in which CT should be integrated, nearly all teachers acknowledge K5-K6 education as the most appropriate. The lower the educational grade, the fewer teachers perceived an integration as useful. Even though CT teaching practices fit the pre-K context perfectly (González & Muñoz-Repiso, 2017), less than half of the teachers perceived an integration as useful. However, the current study shows that a higher experience with CT practices leads to higher perceived usefulness of integration in lower grades (pre-K – K4).

External support variables had a strong direct influence on previous CT experiences and a moderate indirect effect on teachers' beliefs and readiness (Inan & Lowther, 2010; Mumtaz, 2000). According to Hernandez-Ramos (2005), strong external support makes the teachers feel more competent and therefore, more likely to implement teaching practices.

As predicted, the most common misconception about CT among the teachers was the confusion with computer programming or technology use (Corradini et al., 2017; Ling et al., 2017; Yadav et al., 2017).

In contrast, technology integration showed no significant influence neither on teachers' readiness or beliefs, nor on CT teaching practices. By this means, the confusion of CT and technology integration seems to play a different role than expected (Ling et al., 2017). However, strong self-efficacy towards technology seems to influence the CT related readiness and beliefs positively.

Previous CT experiences were found to have the most substantial effects on teachers' readiness, beliefs and planned CT teaching practices. The current study supports previous research findings that successful incorporation of CT teaching practices needs opportunities for practical and relevant experiences (Barr & Stephenson, 2011).

Besides the teachers' beliefs, their readiness for CT teaching was one of the model's most critical factors. According to Kanaya et al. (2005), teachers are more likely to implement a particular practice if they feel ready and confident. As illustrated by the current study, these findings also apply to CT practices. By this means, increased readiness for CT teaching can be caused by a higher ICT proficiency, by illustrating the benefits of specific tools or practices for the students' learning processes (Snoeyink & Ertmer, 2001).

Conclusion

Before implementing CT teaching practices, it is recommendable to help teachers accurately identify CT dimensions and practices. According to Cuny et al. (2010), this prerequisite for the integration is from greater importance than the simple availability

of relevant material. It is crucial to clarify the persisting misconception and confusion of CT with technology use or programming in this context.

In analogy to Barr and Stephenson (2011), we claim that it is indispensable for successfully integrating CT into teaching practices to expose teachers to various relevant examples. The current study's presented findings supported this by demonstrating that previous CT experiences indicated the most substantial influence on CT teaching practices. Consequently, creating such experience opportunities for pre-service teachers and active teachers with lower perceived self-efficacy beliefs is a steady possibility to positively influence their readiness for and beliefs on CT teaching.

Interactivity

We will ensure interactivity in our presentation (1) by telling the audience to ask questions at any moment during the session and showing that we are open to their questions, (2) by asking the audience about their own experiences with CT in fundamental education, and (3) by asking the audience for their opinions about our research approach.