Developing a Self-efficacy Scale for Computational Thinking (CT-SES)

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ABSTRACT

Self-efficacy is an important construct in education, as it can influence (among other aspects) perseverance, engagement and success on educational tasks. As such, a student's Computational Thinking (CT) self-efficacy can have an important influence on, and may be a predictor for, the development and use of CT skills. This poster abstract provides the details of an in-progress study in which we develop a scale to measure CT self-efficacy in different contexts.

CCS CONCEPTS

• **Social and professional topics → Student assessment**; **Computational thinking**.

KEYWORDS

self-efficacy, computational thinking, scale development

ACM Reference Format:
Imke de Jong and Johan Jeuring. 2022. Developing a Self-efficacy Scale for Computational Thinking (CT-SES). In *Koli Calling '22: 22nd Koli Calling International Conference on Computing Education Research (Koli 2022), November 17–20, 2022, Koli, Finland*. ACM, New York, NY, USA, 2 pages. https://doi.org/10.1145/3564721.3565954

1 INTRODUCTION

Ever since Jeannette Wing advocated the importance of Computational Thinking (CT) skills for everyone [14], the aim of educators and researchers has been to help students in all levels of education develop their CT skills. Different types of interventions and assignments are created, and the skills are integrated in different (local and national) school curricula. To evaluate the effects of these efforts, different ways to assess students' CT skill levels are developed [4, 7, 12, 13]. Self-efficacy is one of the constructs receiving attention. Psychologist Albert Bandura defined self-efficacy as "a belief about what one can do under different sets of conditions with whatever skills one possesses" and as "people's beliefs in their capabilities to produce given attainments" [1]. As such, self-efficacy refers not to ones belief in possessing a particular skill (e.g., I possess the skill algorithmic thinking), but it refers to whether one believes they can complete a given task under specific circumstances (e.g., I can create an algorithm to solve a programming task). The influence of self-efficacy on a skill or task is substantial. It has been shown to be a predictor for perseverance, engagement and success on educational tasks [10]. When helping students develop their CT skills, it is therefore important to take into account their CT self-efficacy. We are currently working on creating a scale that can be used to measure CT self-efficacy.

2 COMPUTATIONAL THINKING SELF-EFFICACY

Measuring CT self-efficacy is not a trivial task. CT skills themselves are often seen as skills related to computer programming but not limited to use in that context [9]. Self-efficacy, however, is a construct very much dependent on the specific situation or context in which a student needs to perform a task or use a skill [1]. To effectively measure self-efficacy, the domain of interest and the capabilities necessary to complete a task of interest in the domain successfully have to be well defined [2]. Some CT self-efficacy scales (or scales with self-efficacy related items) have been created in previous studies [6, 8, 15]. The items in these scales are mostly phrased very generically however. They often refer to the ability to solve "a problem". We believe that, to effectively measure CT self-efficacy, one should incorporate the context in which the skills are applied and the type of problem one has to solve. Next to the generic wording of the items, some of the items in the existing scales are at times not appropriately phrased to measure self-efficacy. These questions target knowledge or ask whether one would take a particular action. Self-efficacy, however, concerns whether one believes one could take action, not if one would actually do perform a particular action nor on the estimate of the knowledge one has [2]. Our aim is therefore to combine, refine and extend the existing self-efficacy scales, creating a comprehensive CT self-efficacy scale of which the items can be adjusted to different contexts.

3 CREATING A SELF-EFFICACY SCALE FOR COMPUTATIONAL THINKING: CURRENT PROGRESS

To measure CT self-efficacy, one has to define what elements CT consists of. To do so, we examined existing typologies for CT. When talking about CT, different sets of skills have been proposed. Some skills are common to many of the typologies, however. These skills are: abstraction, algorithmic thinking, decomposition, evaluation and generalization. For the CT self-efficacy scale, we use these skills as a basis, with definitions adapted from Selby [11]. To make the self-efficacy items for each skill more concrete, we use the categorization created by Dagienė et al. [5] who provide concrete

Koli 2022, November 17–20, 2022, Koli, Finland

ACM ISBN 978-1-4503-9616-5/22/11.
https://doi.org/10.1145/3564721.3565954

examples of how the different skills manifest themselves during problem-solving.

The steps and phases for developing a reliable measurement scale as described by Boateng et al. [3] are used to guide the scale development. This means we distinguish three phases: (1) item development, (2) scale development, and (3) scale evaluation. We are currently in the item development phase. For the design of items for the CT self-efficacy scale, inspiration was taken from the existing CT self-efficacy assessments [6, 8, 15]. From these scales, items related to problem solving and algorithmic thinking were categorized under the appropriate CT skills and reformulated to the "I can" format. The items were rephrased in such a way that they could easily be adapted to different contexts. The items were then classified according to the categorization provided by Dagienė et al. [5]. Because the items from the existing scales do not cover all the skills or their sub-categorization, new items were formulated. Finally, to increase the item pool, we created alternative items with a slightly different wording for each of the items created up to this point.

4 FUTURE STEPS

As next step in the item development phase, the content validity of the items will be determined by asking experts for their opinion on the appropriateness of the items for a CT self-efficacy scale. For this validation, we will ask input from experts in both educational sciences and computational thinking / computing sciences. This should lead to a selection of items with which the CT self-efficacy scale can be formed. In subsequent phases (scale development and evaluation), the resulting items will be administered to a wide participant pool. The validity of the individual items and the relation between them will be checked using (among other methods) factor analysis. This should lead to a further decrease in number of items, keeping only the most distinctive ones to create the final self-efficacy scale.

We aim to create an instrument that researchers and educators can use to examine the self-efficacy of students. The results of our efforts should be a comprehensive, context-adjustable CT self-efficacy scale. Insight into self-efficacy is important when determining what interventions to apply and what the effects of the interventions on students' perceptions of their capabilities are. Also, it might provide insight into why an intervention does not have the desired effect, or what elements of CT (or CT self-efficacy) need extra attention.

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