

From Curricula to Classrooms: Primary School Teachers' First Experiences and Challenges in Teaching CS

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Abstract. Traffic lights, robot vacuum cleaners or the first smartphone – in today’s society even young children grow up in an increasingly digital networked world and experience digital systems in their everyday lives. To empower them as active participants and contributors rather than mere passive consumers in this digital world, education must equip them with the necessary competencies from an early age. In some federal states in Germany, selected computer science (CS) competencies have already been integrated into the primary school curricula. These include topics such as first programming skills as well as a basic understanding of computer systems. However, primary school teachers have not yet been systematically prepared to teach these contents. This poses a significant challenge, particularly for older teachers, who presumably had little or no contact with CS during their own school education either. This paper presents the development and design of an online survey conducted among primary school teachers. The survey explores various aspects, such as teachers’ beliefs about CS, their current teaching practices regarding the consideration of CS competencies, as well as their CS-related attitudes, growth mindset, and self-efficacy. In addition, the teachers are also asked about their individual preferences for professional development offers. The insights gained from the study will be used to develop interventions, including teaching materials and professional development courses. Initial results from the pilot study are still pending, but will be shown on the poster.

Keywords: Primary School · Material Development · Professional Development · Online Survey.

1 Introduction

Digital technology increasingly influences children’s lives. In many countries, computer science (CS) is already an essential part of primary school curricula. Also in Germany, some competencies in media literacy as well as in CS have been integrated into primary school curricula in various federal states in recent years. The aim is not only to teach children how to use technology, but also how

it works. In North Rhine-Westphalia (NRW), Germany’s most populous federal state, the following CS contents are now expected to be included in maths and science lessons:

- Conversion of numbers between decimal and binary system
- Differentiation between coding and encoding of data
- Possibilities for protecting personal data
- Input-process-output as a basic principle of data processing in informatics systems
- Programming a sequence [5].

Since CS as compulsory subject was just added to the higher grades in NRW in 2021, it is reasonable to assume that neither primary school student teachers nor current primary school teachers in NRW have basic knowledge in CS yet. Nevertheless, systematic support for current and future primary school teachers is still lacking. A research and development project funded by the Federal Ministry of Schools and Education in NRW aims to address this need by developing CS-related professional development courses as well as teaching materials, that are ready for immediate use. Due to the current challenges, it is not clear to what extent and in what way primary school teachers include CS concepts into their teaching at this moment. In order to take the schools’ and teachers’ needs into account in this project as well as to evaluate the impact of the interventions, they will be asked to participate in an online survey at the beginning of the project. In the following, conditions for successful CS education in primary schools are examined and used to derive the design of this survey.

2 Success Criteria for CS Education in Primary Schools

In order for CS education to succeed at the primary level, various conditions must be met at both the individual and institutional level. At the *individual* level, this includes CS competencies and knowledge in teaching CS as well as positive attitudes towards CS [1]. However, research shows that primary school teachers often have misconceptions about CS education. In addition to methodological support in the form of educational resources and more practical examples, more fundamental CS knowledge is needed [3], especially as misconceptions can foster stereotypical thinking [2].

At the *institutional* level, cooperation between educational institutions and families is particularly important, as children have different personal backgrounds in terms of the way they use digital media. The aim should be to familiarise parents with the creative potential of digital media and how CS education contributes to this [1]. Another important aspect is the equipment available at the educational institution. Although CS concepts can also be taught without the use of computers (‘unplugged’), computer systems are particularly useful for enhancing children’s motivation, e.g. by allowing them to physically and visually observe the execution of an algorithm using a programmable robot [6].

3 Survey Design

Our goal is to encourage teachers from as many primary schools from NRW as possible to take part in the survey in order to get a representative insight into the current consideration of CS competencies in primary schools. Therefore, the survey will be carried out using an online questionnaire, because of its flexibility in terms of time and location. Table 1 shows the structure of the questionnaire. If any existing scales are used, they are mentioned in the ‘References’ column.

Table 1. Structure of the Questionnaire

ID	Category	References
1	Introduction and Data Policy	-
2	CS-related Beliefs	-
3	Teaching Practice	-
4	Knowledge in CS	-
5	Knowledge in Teaching CS	-
6	CS-related Attitudes and Growth Mindset	T-ABC [7]
7	Self-Efficacy in Teaching CS	OSTES [8]
8	Preferences regarding Professional Development	-
9	Personal Information	-

After introducing the purpose of the survey and its privacy policy, CS-related beliefs of the teachers are examined by asking them to name a few keywords they associate with CS and to identify CS-related competencies. This is followed by questions about their teaching practice. Among other things, this includes information on the amount of time, resources and media they use to include CS content in their lessons. Teachers are then asked to estimate their knowledge of CS in general as well as their knowledge of teaching it. These items were developed taking into account the CS competencies included in the primary school curricula of NRW and the recommendations by [1].

In order to assess the teachers’ CS-related attitudes and their self-efficacy in teaching CS, items from two existing scales were adapted and integrated into our questionnaire. One of these scales is the Teacher attitudes & beliefs in CS scale (T-ABC), which aims to measure the following factors: *Equity*, *CS Epistemology*, *Career Outcomes*, *Mindset* and *Self-Efficacy* [7]. The other one is the Ohio State teacher efficacy scale (OSTES), which is supposed to measure the following factors: *Efficacy for instructional strategies*, *Efficacy for classroom management* and *Efficacy for student engagement* [8] and has a high level of internal consistency, even across different countries [4]. To ensure that the questionnaire is of an adequate length, it was necessary to take a subset of items from these scales. During the decision process, particular consideration was given to the factor loadings of the items, described in the respective publications. The remaining sections of the questionnaire cover individual preferences regarding professional development courses as well as personal data, so that differences between subgroups can be analysed.

4 Future Work

Upcoming steps will include piloting the questionnaire to determine whether the questions and answer options are understandable, as well as investigating its validity and reliability. Once the questionnaire has been validated, it will be rolled out on a larger scale. The results will then be used to develop teaching materials and professional development courses. In addition, the collected data can be used to evaluate the impact of the interventions by comparing participants' teaching practices, self-efficacy, and CS-related attitudes before and after it.

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