Computer Science in Early Childhood Education – Pedagogical Beliefs and Perceived Self-Efficacy in Preschool Teachers

Extended Abstract[†]

ABSTRACT

Children should have the opportunity to explore and understand their surrounding world. Nowadays computers are a major part of it, even if children are not using technical devices by themselves. Children are seeing their parents, siblings etc. using those devices. Preschool teachers play an important role in making these often complex environments understandable for children. By creating child-oriented learning environments and courses for relevant topics in kindergarten, they foster the child´s understanding. For the selection of treated topics, pedagogical beliefs and perceived self-efficacy of preschool teachers play a crucial role. In our field-study we examine the influence of pedagogical beliefs and perceived self-efficacy of future preschool teachers on computer science education. As first results suggests, pedagogical beliefs are especially important for including computer science as a kindergarten topic. Furthermore, there seems to be a connection between perceived self-efficacy of teachers and experience with computer science in their own childhood. Further research has to focus on the causes and mechanisms for changing pedagogical beliefs and perceived self-efficacy in computer science, so more preschool teacher include computer science in their daily work.

CCS CONCEPTS

• **Social and professional topics** → **Professional topics** → computing education → computer science education

KEYWORDS

Computer science, pedagogical beliefs, perceived self-efficacy

ACM Reference format:

1 INTRODUCTION

Educational programmes[1] that impart elementary mathematical, scientific and technological knowledge to children aged 3 to 6 years have been launched in Germany many years ago. These initiatives reveal that young children are highly interested in experimenting and capable to understand and adequately interpret scientific experiments [1][2][3]. Nowadays, computer science influences our everyday life. In order to enable children to explore and understand the digital world they are living in, the focus also shifts to the development of concepts and materials that allow preschool children to gain insights in computer science topics [4] [5]. However, preschool children will not get in touch with these materials if educators do not integrate computational topics in early childhood education. Computer science and early childhood education is a just emerging field of research. Therefore, little is known about preschool teachers` attitudes, pedagogical beliefs and self-efficacy beliefs related to teaching computer sciences. However, studies related to teaching mathematical, scientific, and technological topics show that curricular and pedagogical beliefs as well as self-efficacy beliefs of elementary teachers influence the selection and integration of topics [6][7][8] If teachers see no pedagogical need to teach the topics or lack confidence in teaching, STEM-related topics will not or only rarely be integrated in early education. The findings also suggest that STEM-teaching can be fostered by integrating hands-on inquiry activities in preservice vocational trainings of teachers [8] the participation in long-term professional development programs, the provision of curriculum materials [9] and sensitizing teachers for scientifically valuable situations in everyday life [7].

The goal of this paper is to contribute to the research and constitution of elementary computer science education within early childhood education. Therefore, influential factors on the willingness of preschool teachers to deal with computational topics are investigated.

2 EXPERIMENTAL DETAILS

2.1 Goals of the study

In our study we examined how pedagogical beliefs, perceived self-efficacy, the provision of teaching materials, and preservice vocational training may influence attitudes related to teaching computer science in early childhood and practical actions of preschool teachers. Therefore, we conducted a survey among students of an academy for social pedagogy (school for preschool teachers), gave a short introductory course to the field of computer sciences and its relevance for everyday life,

[1] See for example https://www.haus-der-kleinen-forscher.de/ or https://www.siemens-stiftung.org/en/projects/experimento/.

demonstrated materials that can be used to teach computer sciences in kindergarten, and offered hands-on activities.
The study was driven by the following questions:
- Do preschool teachers attach importance to teaching computer sciences in kindergarten?
- Do they see valuable situations for integrating computational topics?
- Do own computer sciences experiences of preschool teachers during childhood influence pedagogical beliefs?
- Do preschool teachers feel competent to teach elementary computer sciences?
- Does the demonstration of teaching materials that work out of the box combined with hands-on activities influence perceived self-efficacy and pedagogical beliefs?

2.2 Participants

60 students for the first measurement and 61 students for the second measurement of the academy for social pedagogy (school for preschool teachers) take part on this field-study. All students were in the fourth (i. e. penultimate) year of training. Demographical details are shown in Table 1.

Table 1: Demographic characteristics

Measurement		1	2
N		60	61
Gender			
	male	6	6
	female	52	54
	missing	2	1
Age		*M*(20.06), *SD*(3.25)	*M*(21.38), *SD*(2.56)
Highest education degree			
	secondary school	54	-
	high school	5	-
	missing	1	-

2.3 Workshop

On the day of the first measurement students take an introduction course about computer science. This introduction gave an overview about historical parts of computer science until nowadays. The versatility of computer science nowadays and importance in our everyday life was explained and illustrated by examples. Before this introduction participants were asked about their attitudes about computer science education and media education and about their experiences in practical use in kindergartens. All questions were answered in a questionnaire. On the day of the second measurement, which took place 8 months after the first measurement, we demonstrated the concept and materials of a Computer Science Kit (CSKit) and gave an overview about the CSKit topics like the vocational field of computer sciences, digital representation and algorithmic thinking [4]. The topics are motivated by starting with everyday experiences of preschool children such as painting, taking photographs or building with bricks. So the students should be sensitized for everyday situations that can be used to impart first computational knowledge to preschool children. The students could choose a topic. In groups of up to 12 people they were first introduced in the chosen topic by one of the members of the research team. Second they had the opportunity to try out the CSKit material of their topic and give their feedback and impressions about the material. In a third step they produced new ideas to improve the existing material or to design new material for their topic. At the end of the workshop, every topic-group gave a short presentation about their topic and developed material in the plenum. At the end, a questionnaire were filled out about their attitudes for computer science and media pedagogic, their experience with the CSKit Questions about pedagogical beliefs and perceived self-efficacy were the same in all measurements to make sure that answers in different dates of measurements are comparable. Pedagogical beliefs were recorded by the answers of the questions “Children should have the opportunity to acquire first knowledge about computer science”, “Kindergartens have the task to convey computer science knowledge” and “Children can induce by targeted learning offers to deal with questions about computer science”. Perceived self-efficacy were recorded by the answers of the questions “I feel competent in dealing with topics of computer science” and “I trust that I can teach children about computer science”.

3 RESULTS AND DISCUSSION

3.1 Descriptive results

Already at the first measurement 74% of the participants (n = 60, 6 missing) see useful possibilities to include computer science topics in practical work in kindergarten. 87% stated that preschool teachers should have background knowledge about computer science (n = 60, 2 missing) (see Fig. 1).

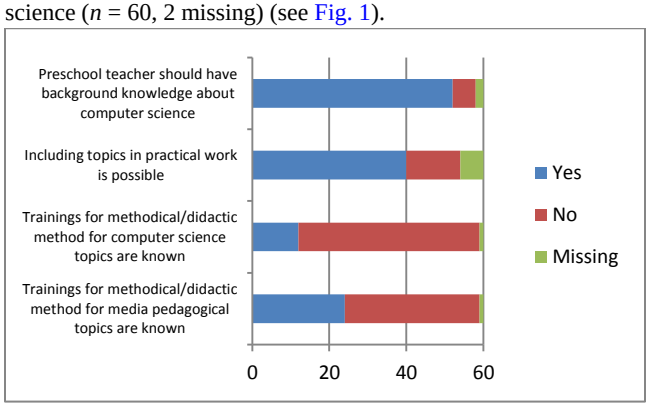

Figure 1: Rating of computer science education in general

At measurement 1 participants were asked about the relevance of different topics in kindergarten work (n = 60) (see Fig. 2). Questions were rated on a 5-point Likert Scale (1= not relevant at all; 5= extremely relevant).

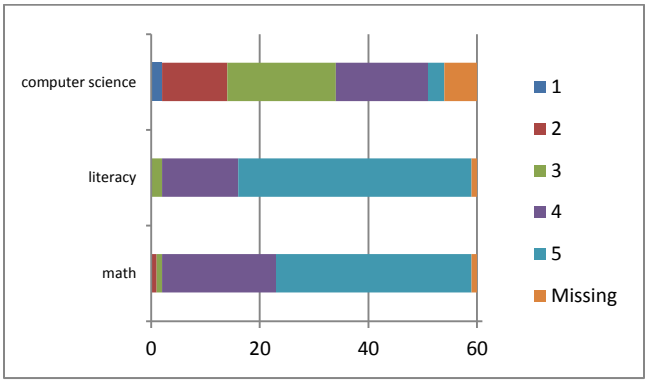

Figure 2: Rating of topics for kindergarten work (measurement 1)

3.2 Childhood experiences

Own childhood experiences of participants with computer science are correlated with perceived self-efficacy, $t(51) = 5.96$, $p < .001$, 95% KI [.41, .82] but not with pedagogical beliefs, $t(50) = 1.46$, $p = .150$.

3.3 Changes in pedagogical beliefs and perceived self-efficacy

Changes in pedagogical beliefs and perceived self-efficacy were calculated by t-test. Perceived self-efficacy didn´t change significantly with the workshop, $t(44) = -1.15$, $p = .256$ (see Fig. 3), neither pedagogical beliefs, $t(43) = .63$, $p = .535$ and $t(43) = .94$, $p = .351$ (see Fig. 4).

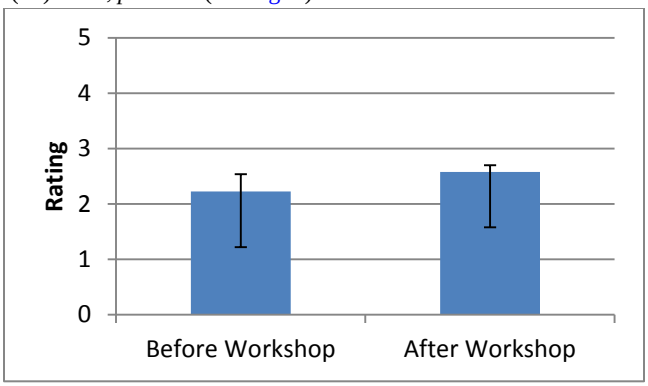

Figure 3: Changes in perceived self-efficacy (Rating: 1=doesn´t apply at all; 5= fully applies)

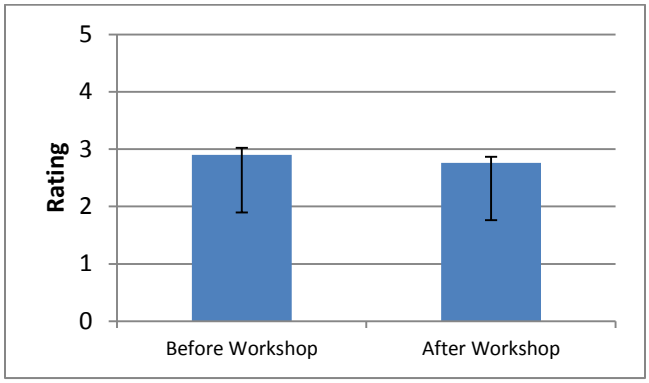

Figure 4: Changes in pedagogical beliefs (Rating: 1=doesn´t apply at all; 5= fully applies)

4 CONCLUSIONS

4.1 Descriptive results

Participants see the importance of having background knowledge about computer science. To implement computer science education in kindergartens easier, role models are important. These are missing in practice. One hint for this could be the missing or not perceived training offers for computer science for preschool teachers. Compared to media pedagogical courses, a bigger lack is here. The results are similar to [10] where 57.8% of the preschool teachers didn´t know trainings for media pedagogic in kindergarten. This lack of knowledge could be result of a lack of computer science course offers. In 2011, just a quarter of institutions offered courses for media pedagogic [11]. Topics from the STEM field are not present in actual courses neither recognized as own topic in unmet needs [11]. [12] point out that without grounded concepts no mediation of media pedagogic competence is possible. Similar reasons will hold for computer science topics. Most of the participants highest school education was secondary school. Although computer science is part of the curriculum of secondary school [13], participants showed relatively low ratings of perceived self-efficacy in computer science.

4.2 Childhood experiences

First results give a hint that own childhood experiences with computer science are correlated to perceived self-efficacy.

4.3 Changes in pedagogical beliefs and perceived self-efficacy

Short-term vocational training is not sufficient to change pedagogical beliefs and perceived self-efficacy. If computer sciences education shall be integrated in early childhood education, in accordance with [9] long term training of preschool teachers seems to be necessary. Our results suggest that there seems to be the need of integrating computer sciences supplementary to media pedagogy in the training curriculum of preschool teachers.

4.2 Future research

Perceived self-efficacy is different between women and men in male-dominated professions [16]. The sample of this field-study includes a higher part of women than men. Further research is important to see if the results for men in perceived self-efficacy obtained in computer science are similar to women.

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ACKNOWLEDGMENTS

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