

Investigating Teachers' Diagnostic and Intervention Skills in Debugging

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ABSTRACT

Students often struggle with debugging in the K-12 classroom. Supporting them individually provides a huge challenge for teachers, as they have to grasp the problem, diagnose why the student is stuck, and react with an appropriate intervention without simply specifying the solution in a very short amount of time. To this end, teachers need corresponding diagnostic and intervention skills, a core component of pedagogical content knowledge (PCK). However, such skills – as well as debugging in general – typically only play a minor role in teacher education. Therefore, we present a research project to investigate and foster teachers' diagnostic and intervention skills in debugging. As a first step, we analyzed teachers' perceptions of typical problems students have in debugging and how teachers support them using a persona approach. The first findings reveal some common problems and a spectrum of interventions and feedback teachers use to support students.

CCS CONCEPTS

• **Social and professional topics** → **K-12 education**.

KEYWORDS

debugging, K12, computer science education, teacher perspectives, diagnostic and intervention skills

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1 INTRODUCTION

Debugging is a core problem of teaching programming, as novice programmers in the K-12 classroom often struggle with finding and fixing errors on their own [4, 7]. In consequence, this provides a challenge for teachers as well. If they are called for help by the students, they have to understand their problem and react with an appropriate intervention. Meanwhile, more students wait for help.

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As a result, teachers commonly rush from one student to the next, trying to do justice to all the students [9].

The diagnostic and intervention processes involved in this short amount of time are complex: the teachers have to locate the programming error, understand why the student made it, and identify why the student is unable to solve the problem on his own. Afterward, they have to choose an intervention tailored to the student's abilities and level of knowledge, which helps to fix the bug on the one hand and foster self-reliance in debugging on the other hand.

However, teachers have typically not learned debugging systematically, and PCK on debugging is no common content of teacher education [10]. Therefore, their diagnostic and intervention skills result from their teaching practice. Furthermore, empirical results on effective diagnostic and intervention processes are lacking. This raises questions, such as: How is the quality of teachers' diagnostic skills? Do they recognize why students are unable to solve the problem? Which interventions do they apply? Are these interventions efficient? Are there more efficient ones? Addressing these issues we present a research project investigating the diagnostic and intervention skills of teachers in debugging.

2 RELATED WORK

Debugging describes the process of finding and fixing errors in programming. Previous studies have shown that debugging differs from general programming knowledge [1]. Additional skills, such as applying debugging strategies and heuristics for typical bugs are necessary [6]. There is evidence, that explicitly conveying those skills in the classroom successfully fosters students debugging performance and self-reliance [4].

However, for teachers, such content knowledge is not sufficient for improving the quality of their teaching. Additionally, they require PCK [11] for diagnosing students' processes and how to intervene in a particular debugging situation. Tsan et al. [13] investigate teachers' PCK on debugging after professional development using Scratch. They found, that teachers would support their students mostly with a focus on a code level solution, when confronted with buggy code. However, diagnostic processes were not taken into account so far and intervention skills were only investigated in special debugging tasks.

Diagnostic skills can be defined as the ability to accurately judge student characteristics relevant to learning and to appropriately assess the demands of learning activities and tasks [2]. Thus, diagnostic skills are necessary for monitoring students' understanding during the learning process and are relevant for student progress. Concerning debugging, knowledge of students' typical problems is one component relevant in the diagnostic processes. As individual

