Debugging Assessment Workshop

A Game-Based Debugging Assessment for Accessible and Scalable K-12 Evaluation

Kunal Massé[1], Francesco Mondada[1], and Alberto Piatti[2]

[1] EPFL, Lausanne, Vaud, Switzerland
[2] SUPSI, Locarno, Ticino, Switzerland

Abstract

Debugging is a critical component of computational thinking and an essential skill for problem-solving. Over the past decade, national school curricula have started to include debugging practices, underscoring its importance, but to date there is no standardized assessment method available. Similarly, research on debugging assessment is scarce and the solutions brought forth lack scalability and accessibility to be applied in K-12 education. This workshop addresses this gap by introducing a novel game-based debugging assessment tool that enables students across a wide range of ages and skill levels to engage in realistic debugging tasks without requiring any prior programming knowledge. The tool focuses on the actual debugging aspect of problem-solving and programming by guiding students to check for bugs, locate them, and experiment with different solutions to effectively resolve the issue and achieve the desired outcome. The assessment strives to provide realistic debugging features with multiple valid solutions, interdependent variables, and time constraints, while distinguishing between superficial fixes and root-cause resolutions to mimic real-world debugging challenges. Implemented as a cross-platform tablet application, the assessment was developed iteratively with learners aged 5 to 18+, to ensure appropriate engagement across the K-12 age range. In this workshop, participants will be able to try this novel debugging assessment tool first-hand, share feedback on its debugging principles, discuss strategies for integrating such assessments into classrooms, and explore opportunities for collaboration.

Tools, Skills and Materials: iPads (brought by us), white board for notetaking, big screen to project results.

Keywords and Phrases: debugging, K-12 education, assessment, computational thinking.

Massé, K., Mondada, F., & Piatti, A. (2025). Debugging Assessment Workshop. A Game-Based Debugging Assessment for Accessible and Scalable K-12 Evaluation. *Constructionism Conference Proceedings, 8/2025*, 553–555. https://doi.org/10.21240/constr/2025/25.X

Workshop Description: Scope, Motivation, and Background

Computational Thinking (CT) has become an essential part of contemporary education, with **debugging recognized as a core component** (Shute et al., 2017; Wing, 2006). Most professional developers spend 20-40% of their time debugging (Perscheid et al., 2017), and it is equally relevant to general problem-solving (Katz & Anderson, 1989). While previously limited to higher education**, debugging has gained traction in K-12 curricula**, both explicitly (e.g., UK, Sweden) and mainly implicitly through programming instruction (e.g., Japan, Switzerland). However, programming skills alone do not necessarily translate into debugging abilities (Ahmadzadeh et al., 2005), highlighting **the need for dedicated debugging instruction and assessment**.

Although evaluation is central to education, there is **no standardized way to assess debugging skills in K-12 education**, and only a few studies address this challenge (Carver & Klahr, 1986; Wang & Souders, 2012; Michaeli & Romeike, 2021). Existing methods are limited by their reliance on prior programming knowledge, narrow applicability in terms of age- and skill-range, or scalability issues. This raises key questions: **can debugging be assessed accessibly without requiring programming expertise? Can an approach be both simple for young learners and robust across skill levels?**

To address these questions, **we propose a game-based debugging assessment platform**. This framework is designed to meet a defined set of criteria in the domains of **accessibility, authenticity, and integration** relative to K–12 classrooms without being strictly aligned with any specific national curriculum. The goal is for the activity mechanisms be such as to accommodate levels across the entire K-12 spectrum.

The tool presents students with a **series of debugging challenges** framed as an engaging narrative; students act as astronauts troubleshooting a rover on a distant planet. Each mission consists of a given setup where the student must identify if and where there are errors and attempt to correct these. This approach **focuses on the debugging process itself** (check if there is a problem, isolate and fix it) without the overhead of learning complex programming syntax. Nonetheless, it strives to keep realism by **incorporating authentic debugging elements**: multiple solutions for each mission, multiple and interdependent parameters (akin to managing several files in professional programming), testing fixes, time constraints, and a solution efficacy measurement (distinguishing workarounds from root cause identification).

The assessment is implemented as a **cross-platform tablet application**. Developed in Flutter, it provides a consistent experience across devices, ensuring easy deployment in schools. The prototype, expected to be fully functional by May 2025, was developed through an iterative process, alternating conceptualization and validation with volunteers (to date 13 individuals between 5 and 18+ years old).

In this workshop, participants will **try the assessment firsthand on tablets**. We invite **feedback on classroom integration**, **debugging evaluation criteria** and **possible collaborations with educators for school trials**. This feedback could directly influence further development of the tool. With consent, we will also collect data on interactions with the tool and participant debugging expertise.

References

Ahmadzadeh, M., Elliman, D., & Higgins, C. (2005). An analysis of patterns of debugging among novice computer science students. *ACM SIGCSE Bulletin*, *37*(3), 84–88. https://doi.org/10.1145/1151954.1067472

Carver, S. M., & Klahr, D. (1986). Assessing Children's Logo Debugging Skills with a Formal Model. *Journal of Educational Computing Research*, *2*(4), 487–525. https://doi.org/10.2190/KRD4-YNHH-X283-3P5V

Katz, I. R., & Anderson, J. R. (1989). Debugging: An Analysis of Bug-Location Strategies (Abstract Only). *ACM SIGCHI Bulletin*, *21*(1), 123. https://doi.org/10.1145/67880.1046598

Michaeli, T., & Romeike, R. (2021). Developing a Real World Escape Room for Assessing Preexisting Debugging Experience of K12 Students. *2021 IEEE Global Engineering Education Conference (EDUCON)*, 521–529. https://doi.org/10.1109/EDUCON46332.2021.9453972

Perscheid, M., Siegmund, B., Taeumel, M., & Hirschfeld, R. (2017). Studying the advancement in debugging practice of professional software developers. *Software Quality Journal*, *25*(1), 83–110. https://doi.org/10.1007/s11219-015-9294-2

Shute, V. J., Sun, C., & Asbell-Clarke, J. (2017). Demystifying computational thinking. *Educational Research Review*, *22*, 142–158. https://doi.org/10.1016/j.edurev.2017.09.003

Wang, X. (Sophie), & Souders, J. (2012). Improving debugging education through applied learning. *J. Comput. Sci. Coll.*, *27*(3), 138–145. https://dl.acm.org/doi/10.5555/2038772.2038801

Wing, J. M. (2006). Computational thinking. *Communications of the ACM*, *49*(3), 33–35. https://doi.org/10.1145/1118178.1118215