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Physical Computing with Plug-And-Play Toolkits: Key Recommendations for Collaborative Learning Implementations

Abstract

Physical computing toolkits have long been used in educational contexts to learn about computational concepts by engaging in the making of interactive projects. This paper presents a comprehensive toolkit that can help educators teach programming with an emphasis on collaboration, and provides suggestions for its effective pedagogical implementation. The toolkit comprises the Talkoo kit with physical computing plug-and-play modules and a visual programming environment. The key suggestions are inspired by the results of the evaluation studies which show that children (aged 14 to 18 in a sample group of 34 students) are well motivated when working with the toolkit but lack confidence in the kit's support for collaborative learning. If the intention is to move beyond tools and code in computer education to community and context, thus encouraging computational participation, collaboration should be considered as a key aspect of physical computing activities. Our approach expands the field of programming with physical computing for teenage children with a focus on empowering teachers and students with not only a kit but also its appropriate classroom implementation for collaborative learning.

Keywords

Collaborative learning; education; motivation; physical computing; programming; toolkit

1. Introduction

While physical computing toolkits have long been used in educational contexts for learning about computational concepts by engaging in the making of interactive projects [1][26], their implementation in the classroom remains challenging. Common hardware components require skilled tutors and continuous guidance, especially for novice users. Struggling with hardware assembly and textual programming syntax prevents students from becoming deeply involved in computational concepts [2]. Appropriate kit designs that allow children to build projects within a short time frame without having to struggle with bad connections or

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