Discovering the impact of “learning by doing” in STEM education with physical/digital programmable devices and humanoid robots for children with special needs

Mots clés :
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Résumé du projet de recherche (Langue 1)

Nowadays, lots of social attention is put on the importance of learning programming and STEM (Science, Technology, Engineering and Mathematics). Several approaches can be used; two of the most adopted approaches are based on designing and programming digital/virtual environments or on observing and manipulating physical programmable objects such as robots. However, few works explore the cognitive impacts resulting from different types of interactions during the learning experience and the understanding of new concepts. Research in Computer Science Education (CSE) has long tried to introduce robots in programming courses. Oftentimes, the objective is to foster students’ interest and creativity through “the design of tangible and interactive object using programmable hardware” [1]. In this regard, results indicate that students experience an increase in motivation [2, 3] and that underrepresented populations in Computer Science (CS) courses feel empowered [4]. However, learning gains can vary depending on the context and course taught [5, 6]. In our previous works [7, 8], we investigated the differences in learning gains when programming beginners design small programs with a block-based language and execute these programs on either a tangible object or its digital simulation [8]. In this thesis, we aim to further investigate the impact of “learning by doing” [9, 10, 11]. This study will involve the use of physical devices, in particular humanoid robots. The goal is to see whether the use of easily programmable robots in specific learning scenarios helps learners to understand STEM related notions. Furthermore, the analysis of interactions during learning experiences will let us retrieve specific learning patterns. Those interactions will be also studied through the analysis of the social signals captured by sensors (microphones, cameras, EEG headsets, and eye-trackers [14]). This analysis will also allow us to explore the metacognitive [15, 16] impacts of this learning experiences and to investigate whether physical computing is more beneficial than digital computing, in respect to metacognitive aspects and computing and STEM education. These experiments will be applied in two different research contexts: either to explore the use of such tools and sensors for the development of cognitive and social skills for children with special needs, or to distinguish the learning strategies that children might apply when learning with humanoid robots.

Informations complémentaires (Langue 1)

- Keywords: Learning Analytics, Educational Data Mining, Computer Science Education, STEM Education - Partnership between the University Sacro Cuore Milan (Italy) and ISEP (Institut Supérieur d’Electronique de Paris).