

Engaging and Supporting Students in Exploratory and Collaborative Activities: The Use of e-ECLiP and ACT Environments in Learning Programming

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ABSTRACT

e-ECLiP aims to establish a learning environment which promotes students' active involvement, contributes to the knowledge construction and the development of skills in programming through students' engagement in exploratory and collaborative activities. The collaboration is facilitated through the ACT tool, a synchronous communication tool that supports mechanisms for adaptation and personalization of the communication as well as for students' self-regulation. In the study presented, students of secondary education worked with e-ECLiP and collaborated through ACT in the context of a programming course. The results revealed that the educational setting used, the proposed didactical approach, and the context of the activities contributed positively in the comprehension of the loop construct and its application in solving simple problems. Also, the students admitted positively the supported synchronous communication tool and appreciated the provided facilities. It seems that the ACT tool can serve the context of the activities and the supported self-regulation mechanism can help students in improving their collaborative behaviour.

Keywords: Collaboration, Education, Exploration, Learning Programming, Web-Based Teaching & Learning

INTRODUCTION

Contemporary learning theories give emphasis on students' active involvement in teaching and learning and stress the significant value

of exploratory and collaborative approaches (Vosniadou, 2001). The exploratory approaches enable students to meaningfully incorporate new knowledge into their cognitive structure and develop exploratory skills while collaborative approaches give students the possibility to argumentate on their thoughts, reflect on and

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refine their ideas, feel more confident about their work and develop collaborative skills (Njoo & de Jong, 1993; Vosniadou, Ioannides, Dimitrakopoulou, & Papademetriou, 2001; Dillenbourg, 1999; Gibbs, 2000). Researchers and research results point out that students participation in team-based and/or collaborative pair programming activities result in enhancement of problem solving and teamwork skills, giving students the opportunity to discuss their opinions, to give explanations and to comment on others' work (Webb & Lewis, 1988; Wills, Deremer, McCauley & Null, 1999; Williams & Kessler, 2001; Williams, Yang, Wiebe, Ferzli, & Miller, 2002; Goel & Kathuria, 2010).

A lot of research effort is devoted to the improvement of the educational setting concerning teaching and learning in introductory programming courses. A number of didactical approaches are proposed and evaluated in real-classroom environments (Haberman & Kolikant, 2001; Williams & Upchurch, 2001). Additionally, educational programming environments have been developed aiming to help students in the design process, in program writing or in the debugging process, etc. For example (i) environments that provide a reduced set of programming commands and constructs and give students the chance to program by handling a familiar object like a turtle or a robot (Brusilovsky, Calabrese, Hvorecky, Kouchnirenko, & Miller, 1997; Papert, 1980; Patis, Roberts, & Stehlik, 1995), (ii) environments that aim to facilitate the debugging phase (Evangelidis, Dagdilelis, & Satratzemi, 2001), (iii) environments that provide visual/audio animation of program execution (Sajaniemi & Kuitinen, 2003), and (iv) environments that aim to promote personalized learning (Weber & Brusilovsky, 2001; Hsiao, Brusilovsky, & Sosnovsky, 2008) or support collaboration in problem solving learning (Vizcaino, Contreras, Favela, & Prieto, 2000).

Towards the direction of supporting teaching and learning in introductory programming courses, an integrated didactical framework for the design of learning activities which may cover both the comprehension and the applica-

tion level of learning goals (Mayer, 2002) has been designed. The so-called ECLiP framework (Exploratory + Collaborative Learning in Programming) exploits characteristics from exploratory and collaborative learning and aims to promote students' active involvement and the cultivation of programming skills. The e-ECLiP environment realizes the framework in a web-based learning environment.

For students' collaboration it is essential to provide appropriate means. Especially, in computer-based collaborative settings students need guidance and support to collaborate effectively and achieve the learning goals successfully. Regarding students' communication, the structuring and regulatory approaches contribute to the development of tools that support and guide them in the development of communication skills and in having a fruitful collaboration (Andriessen, Baker, & Suthers, 2003; Jermann, Soller, & Lesgold, 2004). Structuring collaboration aims at creating the appropriate conditions before the interaction begins whereas regulating aims at supporting the collaboration/communication during students' interaction (Jermann et al., 2004). In the context of text-based synchronous communication, the structuring of the collaborative process is achieved following the structured dialogue (Dillenbourg, 2002), which is implemented through the so-called sentence openers (e.g., 'I disagree because...', 'I mean ...', 'OK'). As far as the regulation approaches are concerned, research efforts focus on the design and implementation of interaction analysis indicators that mainly concern the social dimension of the collaboration and the provided feedback is given at one level i.e., awareness or metacognitive or guiding level (Dimitrakopoulou, 2005b).

In the context of the e-ECLiP environment, we facilitate students' synchronous communication through ACT (Adaptive Communication Tool). ACT takes advantage from the structuring and regulatory approaches proposed in literature (Dillenbourg, 2002; Jermann et al., 2004), and supports mechanisms for adaptation and personalization of the communication and students' self-regulation so that they have

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