Journal of Cases on Information Technology
Volume 21 • Issue 1 • January-March 2019

The Impact of a 3D Visual Programming Tool on Students' Performance and Attitude in Computer Programming: A Case Study in Jordan

Khalid Al-Tahat, Arab Open University, Kuwait City, Kuwait

ABSTRACT

Learning programming can be challenging, particularly object-oriented programming (OOP). However, using visualization could be useful in enhancing students' learning OOP concepts. In this study, the impact of using a 3D visual programming tool – Alice 2 – on student performance and attitude was explored in an introductory computer programming course using Java. Research participants were undergraduate computing students at Arab Open University – Jordan branch. Quasi-experimental design was adopted in this research, where two groups of students were chosen. The findings of this research showed that using Alice has positively impacted on students' performance and attitude towards computer programming and learning OOP concepts. The study suggests the incorporation of Alice in teaching introductory programming courses.

KEYWORDS

3D Visual Programming Tool, Alice 2, Attitude, OOP Programming, Performance

ORGANIZATION BACKGROUND

The Arab Open University (AOU) is a regional non-profit university with eight branches in the Arab world. Since its inception, almost 16 years ago, AOU has adopted a flexible open education system. This system is based on using a blended learning approach that relies heavily on the tutoring process, thus promoting proactive learning. AOU's delivery methodology is based on programmed and progressive course lectures. It also supports other forms of delivery, such as internet-based learning blended with various components that aim to offer an environment of supported blended learning (http://www.arabou.edu.kw). The university currently uses the Moodel Learning Management System (LMS), supported by a number of online tools. In its eight branches, AOU has more than 30,000 students; many of them are mature students with family and work responsibilities. Many of the AOU students also come from rural and remote communities with low socioeconomic backgrounds.

This work is part of a project sponsored the university at Head Quarters to investigate the effectiveness of using 3D visual programming environments in making computer programming appealing and accessible to students in an introductory programming course.

DOI: 10.4018/JCIT.2019010104

The introductory programming course in the Faculty of Computer Studies is an object-oriented course that is taught using the Java language. Traditional programming languages such as Java, C#, or C++ are challenging to learn (Yang, Lee, Hicks, & Chang, 2015). Like other novice programmers, our students in the introductory programming course normally suffer from the complexity of understanding the rigid syntax requirements of programming languages, where they could initially struggle before learning how to build a runnable program. This case study is performed at the AOU-Jordan branch aimed at investigating the impact of a 3D visual environment, Alice, on students' attitude and performance in the introductory Object-Oriented Programming (OOP) course in the Faculty of Computer Studies.

SETTING THE STAGE

Computer programming is often presented to students as an abstract discipline that looks uninspiring (Kelleher, Pausch, & Kiesler, 2007) and socially isolating (Kelleher, & Pausch, 2005). The use of mathematics-based material in teaching computer programming makes it hard for students to learn programming (Kelleher, & Pausch, 2005) and pushes them to lose interest in learning programming (Nakashima, Matsuyama, & Ishii, 2007) and lose confidence in learning programming (Daly, 2011). The percentage of university freshman listing computer science as a probable major is massively declining (Skyes, 2007). In fact, an introductory programming course should build a good understanding of basic programming principles, attract students towards computer programming, and create a good impression of programming to encourage them to major in computing.

Computer science educators are aware of students' low tendency towards programming and have already explored various tools, techniques and methods to motivate students to learn programming and to make computing appealing and accessible to more students (Kelleher, & Pausch, . 2005).

One of the most common approaches was the use of visual 3D environments (Maloney, Mitchel, Rusk, Silverman, & Eastmond, 2010; Kölling, 2009; Cooper, Wanda, & Pausch, 2000; Chang, 2014; Yang et al., 2015; Chao, 2016). Alice, a 3D visual programming environment, has been used to innovatively teach the most challenging topics in computer programming and for learning OOP concepts. It has been used as one of the preferred programming environments at both high school level (Huang, Yang, & Cheng, 2013) and at university level (Cooper, Dann, & Pausch, 2003; Ma, Teng, Du, & Zhang., 2014). Actually, computer science educators (Bishop-Clark, Courte, & Howard, 2006; Al-Tahat, 2010; Cooper et al., 2003) have reported the benefits of using Alice as an object-first tool and its positive impact on both students' confidence and in their programming ability and understanding of basic programming concepts.

Alice (http://www.alice.org) is a 3D programming environment that was created and distributed by Carnegie Mellon University. The Alice environment has an object-oriented focus and supports programmers with a huge set of 3D visual objects. The environment is equipped with a rich set of properties, functions, and methods which would facilitate objects' behaviors and interactivities. Alice has recently gained attention as a moderate tool that can be used in teaching introductory courses in OOP ((Mullins, Whitfield, & Conlon, 2009). The special characteristics of Alice such as 3D animation, real-life experience of dealing with objects, a direct-manipulation editor for instantiating objects, simple event handling mechanism, multi-media capabilities and 'syntax-free' Integrated Development Environment (IDE), are very important in engaging students and increasing their interest in learning programming (Mullins et al., 2009; Al-Tahat, 2010). An Alice programmer can use these objects to learn basic programming concepts such as looping, selection, and parallel execution through building fully interactive stories of all kinds visually, without the need to write any code as in the case of traditional programming languages such as Java, C#, and C++.

Alice allows users to manipulate 3D objects in a 3D world in order to create 'program-animated' movies. Information about each individual object can be accessed and manipulated independently of any written code. Alice allows students to write code that is always in a runnable state (Powers, 2007).