ARC '16

Towards World-class
Research and Innovation

Information Communications Technology Pillar

Alice-based Computing Curriculum for Middle Schools

Saquib Razak, Huda Gedawy, Don Slater, Wanda Dann

Carnegie Mellon University, QA

Email: srazak@cmu.edu

Alice is a visualization software for introducing computational thinking and programming concepts in the context of creating 3D animations. Our research aims to introduce computational thinking and problem solving skills in the middle schools in Qatar. To make this aim accessible, we have adapted the Alice software for a conservative Middle Eastern culture, developed curricular materials, and provided professional development workshops for teachers and students in the Middle East. There is a trend for countries, to evaluate curriculum from other cultures, and then try to bring the successful curriculum to their own school systems. This culture is a result of societies beginning to realize the importance of education and knowledge. Qatar's efforts towards building knowledge-based society and upgrading their higher education infrastructure are proofs of this realization. The challenge is to recognize that although a strong curriculum is necessary, simply porting a successful curriculum to a different environment is not sufficient to guarantee success. Here we share our attempt to take a tool with associated curriculum that has been very successful in several countries in the West, and apply it in an environment with very different cultures and social values.

The Alice ME project is targeted at middle school (grades 6–8) teachers and students in the Middle East. The overall goal of the project is to adapt the Alice 2 software to the local cultures, develop new instructional materials appropriate for local systems, and test the effectiveness of the Alice approach at the middle school level. The "Alice approach" – using program visualization to teach/learn analytic, logical, and computational thinking, problem solving skills and fundamental programming concepts in the context of animation – remains the same.

In the formative phase of this project, our goal was to understand the environment and local culture and evaluate the opportunities and challenges. The lessons learned in this phase are being used to formulate the future direction of our research. Although the Middle Eastern countries are rapidly modernizing, the desire to maintain traditional norms is strong. For this reason, we compiled two lists of models. One list was of existing models in the Alice gallery that are not appropriate for the Middle Eastern culture. Qatar (and Middle East in general) is a religious society

that follows conservative norms in dress for both men and women. The second was a list of models that would be interesting and relevant to the Qatari society. These two lists helped us determine those models that might be modified, removed, or added to the gallery. We found that Qatar is a cultural society with a lot of emphasis on local customs. Local hospitality, religion, and traditional professions like pearl diving, fishing, and police officers have special place in society. We also discovered that people in general and boys in particular, have a special respect for camels and the desert.

We created the curriculum in collaboration with one private school and the Supreme Education Council. Creating artifacts in isolation and expecting the educational systems to adopt them is not a prudent approach. Due to this collaboration, we learned that a majority of existing ICT and computing curriculum is based on step-by-step instructions that students are expected to follow and reproduce. There is a lack of stress on student learning, creativity, and application.

Most ICT teachers in Qatar, both in public and private schools, are trained ICT professionals. At the same time, most of these teachers are not familiar with program visualization tools such as Alice and have not taught fundamental programming concepts in their classes. As a result, the need for professional development workshops is urgent. We have conducted several workshops for teachers to help them use Alice during the pilot study of the curriculum. During these workshops, we focus on two main concepts – learning to use Alice as a tool, and learning to teach computational thinking using Alice.

We have piloted the curriculum, instructional materials, and the new 3-D models in the Alice gallery for middle school students in one private English school and two public Arabic schools. The pilot test involved more than 400 students in the three schools combined. During the pilot testing, we conducted a survey to obtain initial feedback regarding the 3D models from the Middle East gallery (students have access to all models that are part of Alice's core gallery). Through these surveys, we learned that those objects that students use in everyday life were more popular when it came to using models in Alice.

As part of the curriculum to teach computational thinking using Alice as a tool, we have created several artifacts which are made available to the schools. These items include:

1. Academic plan for the year

2. Learning out comes for each lecture, PowerPoint presentation, class exercises, and assessment questions

3. Student textbook – One English book for grade 8, one Arabic textbook for grade 8 and one Arabic textbook for grade 11.

One of the most important skills that is essential for building the future generation is critical thinking. Although, we are currently only looking at the acceptability of the newly created 3-D models and usability of our curriculum and instructional material, we are still curious about the effectiveness of this curriculum in teaching computational thinking. We analyzed the results of an exam conducted at a local school and it was observed that students in grade 7 with Alice based curriculum performed better than those in grade 9 on the same exam. This exam was designed to measure the critical thinking skill in problem solving without any reference to Alice. We hope that this result is directly related to the students' experience with Alice, as it works on making the students think about the problem from different perspectives. We acknowledge that still more formal work needs to be done in order to support our hypothesis.

This academic year (2015–2016), Alice based curriculum is being used in Arabic in six independent schools and in English in four private English schools. There are more than 1400 students currently studying this content.