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Designing an Ontology-based Mobile Learning System for Introductory Computer Science

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Abstract As Computer science education becomes an essential part of the curriculum in secondary schools there is a need for appropriate tools and methods that make learning simple and accessible especially for beginners. This research in progress aims to design and develop an ontology-based mobile learning system that can assist teaching, learning, and assessment of programming skills. An ontology model for learners based on the constructivist learning theory is proposed together with a domain knowledge model of chosen fundamental programming concepts. These ontology models will be incorporated in a mobile-based learning system for introductory computer science. The learning system is being further developed in order to make it adaptive to the learner's style and abilities.

Keyword Computer Science Education, Mobile Learning, Ontology

1. Introduction

A number of secondary school curricula now incorporate computer science in the same level as the other traditional STEM [1]. Studying computer science early on is necessary for those who plan to pursue computing-related degrees [2] and can have repercussions on the current high attrition problem among computer science majors and the poor performance of students in programming [3].

As mobile devices such as tablet PCs and smartphones become popular, more research on online distributed or mobile learning are being currently done. The paper of Sheard, et.al., posed the question on how to place these new technologies in programming education. Their paper proposed that researches on programming education can be categorized as research on: (1) Ability, aptitude, understanding, (2) Teaching, learning and assessment techniques, (3) Teaching, learning and assessment tools, (4) Teaching, learning theories and models [4]. This research in progress falls under the third and fourth categories.

2. Objective of the Research

The aim of this research is to design and develop a tool that assists teaching, learning and assessing programming skills for beginners. The main research question is "how to utilize mobile devices for learning fundamental programming concepts?" This research would also like to propose models for the learner and the corresponding programming concepts fundamental for beginners. Thus, another objective of this research is to design learner and knowledge ontology models for a mobile learning system that can be used in an introductory computer science course for secondary level students. The system aims to provide a user-centered service and adaptive learning paths that incorporate programming and algorithmic skills and learning and cognitive theories.

3. Proposed Methods

The initial components proposed for this research are shown in Figure 1. There is a plan to incorporate an adaptive learning model, learner model, fundamental programming concepts and mobile

programming as components of the research.

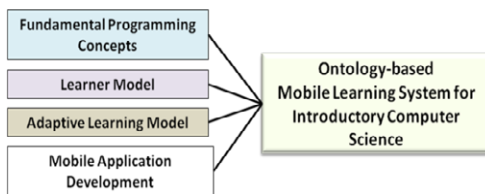


Figure 1. Proposed Research Components

The fundamental programming concepts to be included in the learning system are the following: (1) Basic program structure, (2) Expressions (3) Control structures (4) Functions and Procedures, (5) Arrays. Corresponding learning objects are designed for these programming topics. A sample ontology model for the topic on expressions is shown in Figure 2.

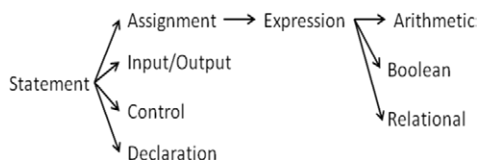


Figure 2. Sample Knowledge Ontology Model

The design of the learner model is based on constructivism where learners actively construct new ideas or concepts based on both their previous and current knowledge. This will be actualized in the system through program simulations based on the learner's goal. A future plan for this research is to also make the system adaptive to the learner's style, aptitude and cognitive ability. An initial design of the learner's model is shown in Figure 3.

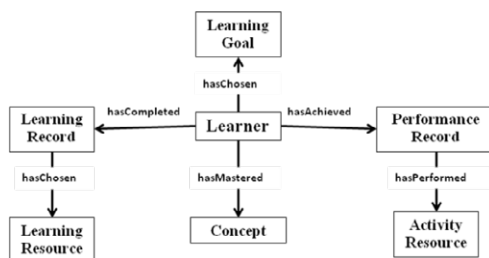


Figure 3. Sample Learner Ontology Model

The plan is to have the learning system run in mobile devices whether a table PC or a

smartphone. The chosen platform for this research is an Android device because it is open source and AppInventor is being considered as development tool because it provides easy deployment of applications.

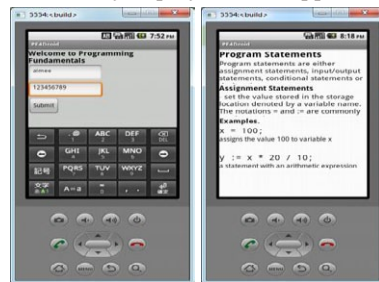


Figure 4. Sample of Screenshots of the System

Designing the system to be adaptive to the learner's style and abilities and readily available in a mobile device will hopefully make learning of programming simple and accessible for beginners.

4. Future Work

The design of the Domain Knowledge Ontology Model, Adaptation Model and the Learner Model has to be completed. This includes refining the programming topics and the corresponding exercises and activities. A diagnostic test that will ascertain the learner's current knowledge has to be designed. After completing the design of the ontology models, the learning system will then be fully developed and will be tested by high school students who are in an introductory computer science course

5. References

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