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Modeling Student Behavior and Affect in Different Learning Environments

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Abstract: In this paper, the author describes a summary of her early career research, this includes work in building and empirically validating student cognitive and affective models using sample sets from various locations in the Philippines. These student models have extended the operationalization of similar models of researchers from other Universities in western cultures like the U.S. In constructing these models, the methods used include supervised, unsupervised and semi-supervised machine learning using the appropriate machine learning algorithms as required by the characteristics of the feature sets and the research problems. The author's research findings corroborate, and to some extent, expand existing models that allow generalization of prior findings to Philippine sample sets.

Keywords: Student modeling, affect, cognitive models, machine learning

1. Introduction

In recent years, Artificial Intelligence in Education (AIED) research has developed predictive models of a variety of affective and cognitive constructs such as gaming the system, wheel spinning, help-seeking, frustration, and other on-task and off-task behavior (Baker, D'Mello, Rodrigo, & Graesser, 2010), (Baker, Walonoski, Heffernan, Roll, Corbett, & Koedinger, 2008), (Beck, & Rodrigo, 2014). Machine learning has been used to automate the construction of these student models and other representations of various student behaviors. Some of these constructs are more challenging to model than others because they need to be defined and operationalized in quantitative terms.

2. Research Goals

The principal objective of my work is to create a detector for the above constructs among students using different learning platforms, e.g. Physics Playground (Shute, Ventura, & Kim, 2013), Simstudent (Matsuda, et al., 2011), etc. We use Philippine sample sets to investigate if similar models using Western samples scale to the Philippine educational system. Aside from the empirical validation of previously established models using Philippine sample sets to address cultural factors, my work also attempts to expand the work of researchers by including other indicators from the broader social science and education literature.

3. Significance of the Study

UNESCO's guidelines on intercultural education indicate that respecting the cultural identity of the learner and encouraging the provision of culturally-appropriate education as factors like self-regulation, collaboration, competition, personal values and various aspects of perception and interpretation have been shown to vary across cultures (Neuner, 2012). The AIED Community resonated with this policy. Blanchard and Mizoguchi (2008) advocate the development of intercultural learning in AIED systems and culturally-aware educational technologies. At present, most AIED literature and research emanate from western and industrialized countries, this, in effect,

underrepresenting cultures like that of the Philippines. As culture has an impact on the design, processes, structures and objectives of the system, there is a challenge for a more inclusive approach in the continued design and development of AIED technologies. Existing AIED research has already found culture-based differences in student learner variables like affect, behavior, cognition, etc. It is in this area that I hope to contribute by providing empirical validation of student models using Philippine sample sets, hence, expanding the field by adding the Philippine culture to related findings in AIED research.

4. Theoretical Framework

Machine learning is a field in computer science, specifically artificial intelligence where the use of algorithms that automatically learn from data are used (Kohavi, Provost, 1998*)*. Machine learning in student modeling has been used to automate the construction of student models and other representations of various student behavior. Machine learning techniques used in student modeling are supervised, unsupervised and semi-supervised learning. Machine learning in AIED allows us to collect, represent, and implement the intelligence that will monitor and help develop the skills that the learner need in the 21st century. The process begins with the identification of proxy indicators, based on literature, and continues with the development, validation, and refinement of models or detectors using these features. The resulting models and the accompanying analyses probe into the constructs that are being modeled and their predictors.

5. Methods

We gather data from deployment sites in various locations in the Philippines this include: interaction logs, pre and post test results, demographics data, gameplay clips, replay files, etc. Data cleaning and preprocessing are performed usually includes missing value replacement, error-handling, normalization, aggregation and summarization, coding and annotation, etc. The next stages involve feature engineering and selection as may be required by the specific research questions to be answered and the machine learning algorithms used. This is, then, followed by model training, testing and validation. With the built models, analysis is done and findings and insights are derived to contribute to the AIED body of knowledge.

6. Major Findings and Achievements, to date:

Initial work has been done in building various affective, behavioral and other cognitive models. These include: carefulness models using semi-supervised learning (Banawan, Rodrigo & Andres, 2017a) using support vector machines (Banawan, Rodrigo & Andres, 2017b), affect models (Banawan, Villamor, Paredes, et.al, 2014), cognitive models (Dumdumaya, Banawan & Rodrigo, 2017), and frustration model (Banawan, Rodrigo, & Andres, 2014), among others.

7. Future Plans

This researcher would like to pursue the aforementioned field of research and continue the collaboration with her mentor, Professor Rodrigo of the Ateneo de Manila University, and other researchers in the same field from other parts of the world.

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