# Modeling the Affective States of Students using SQL-Tutor

Thea Faye G. Guia<sup>1</sup>, Ma. Mercedes T. Rodrigo<sup>1</sup>, Michelle Marie C. Dagami<sup>1</sup>, Jessica O. Sugay<sup>1</sup>, Francis Jan F. Macam<sup>1</sup>, Antonija Mitrovic<sup>2</sup>

<sup>1</sup>Ateneo Laboratory for the Learning Sciences Department of Information Systems and Computer Science, Ateneo de Manila University Loyola Heights, Quezon City, Philippines theafayeguia@yahoo.com, mrodrigo@ateneo.edu, rhyzz\_craig\_08@yahoo.com, jsugay@ateneo.edu, f\_macam@yahoo.com <sup>2</sup>Department of Computer Science and Software Engineering, University of Canterbury Private Bag 4800, Christchurch, New Zealand tanja.mitrovic@canterbury.ac.nz

**Abstract.** We attempted to build models of affect of students using SQL-Tutor. Most exhibited states are engaged concentration, confusion and boredom. Though none correlated with achievement, boredom and frustration persisted. Using linear regression, we arrived at a parsimonious model of boredom.

Keywords: SQL-Tutor, observation, performance, models of affect, boredom.

Constraint-based tutors (CBT) are distinguished from other ITSs by knowledge representation. Others require detailed models while CBTs use constraints to limit this specificity [3]. A constraint identifies feature of correct solutions and specifying implicitly the solutions that violate it as incorrect. SQL-Tutor [2] is a CBT.

#### 1 Methods

74 juniors in 3 sections from Ateneo de Manila University used SQL-Tutor for 60 minutes. Observations were carried out by a team of 4 observers who worked in pairs. One is an assistant instructor who was highly experienced in observations. Others are one undergraduate and two graduate students in training. Each pair observed 10 students per section. Every student was observed for twenty seconds. If two distinct states are seen, only the first was coded. Cohen's  $\kappa$ =0.91 which is considered to be a high level of agreement.

Learning science researches used features as indicators of learning. Learning indicators for SQL-Tutor that were based on these studies are: SolvedProblems, AttemptedProblems, LearnedConstraints, ConstraintsUsed, SeenMessages, NumOfLogins, TotalTime, AvgTimeToSolve, TotalAttempts and AvgNumOfAttemptsPerSolvedProb.

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### 2 Results and Discussion

Engaged concentration (57.9%) was most common affect. Confusion (23.9%) and boredom (8.1%) followed. When correlated with achievement, none was significant. Using *L* [1], boredom persisted (*L*=0.11, t(33)=2.3, p=0.03). Frustration persisted marginally significant (*L*=0.22, t(12)=2.18, p=0.05). In linear regression models of two states, only boredom (*r*=0.647; p<0.001) was significant. It had -14.27 BiC' [4].

Affective state	Incidence	Correlation with acheivement	
Boredom	8.1%	-0.021	
Confusion	23.9%	-0.006	
Delight	4.1%	-0.320	
Engaged concentration	57.9%	0.073	
Frustration	2.1%	0.152	
Neutral	3.9%	-0.262	

Table 1. Incidence of affective states and correlation with achievement.

Table 2. Model of boredom within SQL-Tutor.

MODEL	r	р	BiC'
Boredom = -0.002 * SeenMessages +	0.647	< 0.001	-14.27
-0.002 * <i>TotalTime</i> +			
0.031 * AvgTimeToSolve +			
0.007 * TotalAttempts +			
-0.068			

## 3 Conclusion

We attempted to build models of affect of students using SQL-Tutor. Most exhibited states are engaged concentration, confusion and boredom. Though none correlated with achievement, boredom and frustration persisted. We built models of both states but only boredom was significant. Boredom can be predicted by amount of feedback received, total interaction time, average time per solved problem and total attempts.

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