TECHNOLOGICAL GAMES AS A TOOL FOR TEACHING ENGINEERING

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Abstract *— This work in progress presents a pedagogical methodology for teaching some engineering courses in using computer games and applying critical thinking methodologies. These games could be used in theoretical and practical courses. For example, games can be applied to illustrate some programming techniques and laboratory applications in courses such as signal processing and digital systems. Additionally, students could develop new games in the laboratories or as homework to demonstrate the mastery of some techniques relevant for each course. The faculty are preparing new didactic units mixing the classic methodology with this new use of playing and developing computer games. Assessment of outcomes for Computer Science and Engineering education will be performed and presented. Evaluations will be obtained from students and faculty on effectiveness and engagement will compare the academic results using old and new techniques.*

Index Terms — Engineering Education, Games, Tools for Teaching,

CRITICAL THINKING MODELS

The University of Louisville has adopted an "Ideas to Action" initiative aiming to expose students to the Critical Thinking (CT) and improve students' CT skills throughout undergraduate education. Certain assignments or activities are presented as "critical thinking," and students cannot easily connect the concepts from class to class. It is an educator's job to make these connections transparent and departments' expectations explicit, so that students can begin to transfer CT skills across assignments, courses and professional experiences. Teaching CT effectively requires that professors plan on how they phrase, model, and assess the CT skills that they want students to master. Specific actions applied to courses include a) Introduction of new strategies for promoting critical thinking, b) innovative techniques for student engagement, c) group work, d) curriculum enhancing resources, e) application of the Paul-Elder [1] critical thinking model to engineering, in addition to course-specific assessment instruments.

We have targeted several courses for Specific *thinking skills* (Elements of Thought). We wanted to give to our students: Purpose (goals, objectives), Question at issue (problem, issue), Information (data, facts, observations, experiences), Interpretation and Inference (conclusions, solutions), Concepts (theories, definitions, laws, principles, models), Assumptions (presuppositions, axioms, taking for granted), Implications and consequences. A central question in our programming is "How to instruct a computer to do what you want it to do not what you tell it to do?"

We did a baseline assessment to incorporate critical thinking in course assignments, homework, and activities. We also introduced students to the concept of critical thinking and distributed related literature (The Miniature Guide to Critical Thinking Concepts and Tools [2]). Reflecting purposely on the reasoning process leads to valuable realizations about how to improve one's thinking. Asking students to reflect on and report about what they have learned about themselves as a learner or what they have learned about learning in the process of trying to solve a new problem is an aspect of the CT process.

GAMES AND GAME DEVELOPMENT

Using a Games development theme would encourage students and reinforce concepts. In the introductory programming course, using Tic-Tac-Toe as an assignment keeps the student's attention and allows them to apply CT concepts. In other courses such as the one introducing concepts of computer science and engineering, a simulated machine language is used and it is *practically* a game and allows for experimentation for various low level programming concepts. At higher-level courses, such as performance modeling and evaluation of computer systems, simulation models are used as interactive games to promote CT and understand concepts of parameter tuning and sensitivity analysis.

CONCLUSIONS

CT concepts and Games are not new to education. What we present here is mainly an effort and analysis of purposely introducing them to engineering disciplines. We also share specific examples of applications to computer science and engineering.

REFERENCES

[1] R. Paul and L. Elder, *How to study and learn a discipline*, Foundation for Critical Thinking Press, 2001.

[2] R. Paul and L. Elder, *The miniature guide to critical thinking: Concepts and tools*, Foundation for Critical Thinking, 2005.

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