Nexus Learning Grant 2017

1) Project Title
Author(s)

Student Engagement during Game-Based Learning
Jack Suss and Damon Orsetti

2) ABSTRACT

This project focuses on engaged learning. Nexus Learning involves students being active and engaged, and often these terms are used synonymously when they really mean different things. In order to properly say that an active and engaged classroom improves learning outcomes, we should first be able to accurately address whether the classroom is both active and engaged. This proposal aims to introduce and assess engagement through game-based learning (GBL) in a non-majors science class. We plan to develop a physical manipulation game to scaffold systems modelling using a non-technological approach prior to application of computer based modelling. We will develop a rubric based on the National Survey of Student Engagement (NSSE) to assess student engagement in classes with and without GBL intervention.

2) Explanation of How the Project Advances Nexus Learning

Major tenets of Nexus Learning involve students being active and engaged. In order to properly say that an active and engaged classroom improves learning outcomes, we should first be able to accurately address whether the classroom is both active and engaged. We will examine efficacy of GBL as an engagement strategy in the classroom. By developing rubrics based on NSSE, we will test the hypothesis that games are an effective strategy to engage non-majors in science.

3) Literature Review

In the DECSYS program, we have been developing strategies to actively engage students in Systems Thinking. Course-level learning outcomes include defining, explaining and mapping the attributes, boundaries, and interrelationships of a system. In-class activities to these outcomes have included building system diagrams using software (Vensim, InsightMaker) or simulating mathematical models (Vensim, InsightMaker, Forio), and while these active learning components achieve the learning outcomes, it is less clear if the students are engaged. While active learning (as opposed

to passive learning) is fairly easy to assess with direct observation and lesson plans that are not solely lecture-based, assessment of engagement should require a combination of student reflection (Ahlfeldt, Mehta and Sellnow, 2005) and direct observation (Johnson, 2012). Only after we have rigorously established both active and engagement criteria can we begin to assess whether an active and engaged pedagogical approach has improved learning outcomes.

In order to achieve the DECSYS systems learning outcomes, we use computer-based programs, currently InsightMaker, a cloud-based, free, modelling and simulation program. The format works well, but many students struggle with the simultaneous learning of new concepts and a new program. This scenario lends itself well to scaffolding interventions to layer in concepts skills in a non-technological setting first. This is especially important for non-traditional and low-income students (Henson, 2014), which gives us reason to scaffold basic systems modelling concepts in order to reduce the biases of previous technological ability from student learning. When scaffolded properly, non-technological skills can increase confidence and motivation toward using technological solutions for all students (Henson, 2014). We have had previous success implementing scaffolding techniques to systems modelling by using Forio systems gaming to introduce modelling in Vensim (Suss and Klemens, 2016), but shifting the burden to a separate technological format may have posed more barriers to learning in that students were not as metacognitively aware of differences between simulation platforms as professors expected (personal observation). We hypothesize that non-technological scaffolding will improve student concept learning.

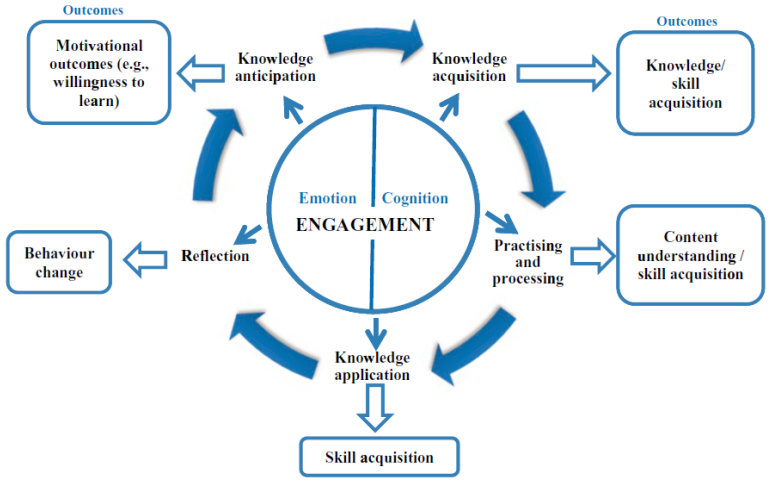

Figure 1) Learning phases and outcomes during student engagement (from Abdul Jabbar and Felicia, 2015)

Confidence and motivation are crucial components of student engagement. Engagement involves eliciting a motivational response that affects learning (*Figure 1*, Abdul Jabbar and Felicia, 2015). Game-based learning (GBL) has been shown to

engage students in their ability to think and create meaning (Ermi and Mayra, 2005). We have previously had success introducing GBL into the DECSYS environment when we introduce decision-making into the structure of the activity (Pastore and Suss, 2016; Suss and Pastore, 2016). Learning outcomes of DECSYS include spatial mapping and interrelationships of system elements. Physical manipulatives can improve conceptual metaphors by providing a tangible correlative to symbolic elements (Manches and O'Malley, 2009). Scaffolding physical manipulatives in GBL could also provide further classroom resources as elements in the game have the potential to be re-tooled for model diagrams later in the class.

We propose to develop a physical manipulation game to engage students in basic components of system modelling. This game will act as a scaffold to provide students with tangible correlates with elements in technological modelling techniques.

4) Specific Project Goals and Learning Outcomes

Do GBL activities increase student engagement?

- We will develop a game to implement in DECSYS classes consistent with the course learning outcomes that can be assessed through student quizzes.
- We will develop an assessment of engagement rubric based on NSSE (Ahlfeldt, Mehta and Sellnow, 2005; nsse.indiana.edu) and the Roadmap Project (Bylsma, Werner and Lobdell, 2013).

Does scaffolding physical manipulation during GBL improve spatial and interrelational learning outcomes in system diagrams?

- Physical manipulation during GBL of systems models.

5) Description of Activities and Timeframe

SM 2017 - Game development with student.
Develop Engagement Assessment Rubric.
FL 2017 - Deployment 1 in DECSYS Classrooms.
Engagement Assessment and feedback.
Prototype revisions.
SP 2018 - Deployment 2 in DECSYS Classrooms.
Engagement Assessment.
Spring EduSeries.
Submissions for conferences.
SM 2018 - Conference Presentation/Publication.

6) Project Assessment

Do GBL activities increase student engagement?

- We will develop a game to implement in DECSYS classes consistent with the course learning outcomes that can be assessed through student quizzes.
- We will develop an assessment of engagement rubric based on NSSE (Ahlfeldt, Mehta and Sellnow, 2005; nsse.indiana.edu) and the Roadmap Project (Bylsma, Werner and Lobdell, 2013).
- **Assessment:** During GBL classroom implementation, a reviewer from CTiNL will assess student engagement using the rubrics.
    - 4 GBL treatment classrooms and 4 non-GBL classrooms.
- **Assessment:** Student reflection questions in post-exercise quizzes.

Does scaffolding physical manipulation during GBL improve spatial and interrelational learning outcomes in system diagrams?

- **Assessment:** Comparison of Pre-quizzes (from lecture only) and post quizzes (from classroom exercises) in treatment and non-treatment classes. An additional quiz applied later in the term (Midterm and/or Final Exam) will assess long-term retention of skills.

7) Documentation and Dissemination

Plans for documentation and dissemination include gameplay and testing in DECSYS classes and local secondary schools (Penn Charter, Strath Haven Middle School). Report on results at education conferences (SABER, Lilly, Teaching Professor, Nexus Spring Edu Series.) and educational gaming conventions (Pax, Origins)

8) Project Personnel

Jack Suss is a Teaching Assistant Professor in Kanbar College and has taught the DEC Systems classes since 2013. He has previously developed GBL (Suss and Pastore, 2016) and presented findings at national and international conferences from GBL classroom activities (Pastore and Suss, 2016), scaffolding (Suss and Klemens, 2016), and systems thinking as a method for teaching non-majors biology (Klemens and Suss, 2015).

Damon Orsetti is an Adjunct Instructor in Kanbar College and has taught DEC Systems classes since 2015. He has experience in game design and workable game mechanics, and has used interactive and game-inspired teaching methods while teaching at Delaware County Community College, the Delaware Museum of Natural History, and the Delaware Nature Society.

9) Budget Narrative and Worksheet

Both investigators (Suss and Orsetti) request $2000 for work during Summer 2017 to develop an educational physical manipulation game and a student engagement rubric for implementation in DECSYS classes beginning Fall 2017. The remaining $2000 will be for hiring a student worker and materials to design the game components.

Budget Worksheet is attached.

10) Attachments

A final report from Klemens and Suss for Nexus Online Learning Grant 2015 is attached. This final report was submitted to CTiNL on 31 Aug 2016.

11) References

Abdul Jabbar, A. I., & Felicia, P. (2015). Gameplay Engagement and Learning in Game-Based Learning: A Systematic Review. Review of Educational Research, 85(4), 740-779. doi:10.3102/0034654315577210

Ahlfeldt, S., Mehta, S., & Sellnow, T. (2005). Measurement and analysis of student engagement in university classes where varying levels of PBL methods of instruction are in use. Higher Education Research & Development, 24(1), 5-20. doi:10.1080/0729436052000318541

Bylsma, P., Werner, J., & Lobdell, G. (2013). Special Educational Needs: Student Engagement and Motivation. WERA Conference. doi:10.4135/9781473935655

Ermi, L., & Mayra, F. (2005). Fundamental components of the gameplay experience:Analysing immersion. In S. De Castell & J. Jenson (Eds.), Proceedings of DiGRA2005 conference: Changing Views—Worlds in Play (pp. 15–27). Vancouver, BritishColumbia, Canada: Simon Fraser University.

Henson, A.R. (2014). The success of nontraditional college students in an IT world. Research in Higher Education Journal. Volume 25.

Johnson, B. (2012, March 01). How Do We Know When Students Are Engaged? [Web log post]. Retrieved from https://www.edutopia.org/blog/student-engagement-definition-ben-johnson

Klemens, J.A., J.S. Suss. (9-14 August 2015). Systems modeling as a framework for active learning in non-majors environmental science. Ecological Society of America, Baltimore, MD. USA.

Manches, A., & O'Malley, C. (2011). Tangibles for learning: A representational analysis of physical manipulation. Personal and Ubiquitous Computing, 16(4), 405-419. doi:10.1007/s00779-011-0406-0

Pastore, C.M., and J.S. Suss. (7-9 January 2016). The importance of game play in engaging students in serious gaming. Lilly Conference on Evidence-based Teaching and Learning. Austin, TX. USA.

Suss, J.S., and Klemens, J.A. (14-17 July 2016). Does procedural scaffolding of technological skills improve concept learning in a non-majors biology class? National Meeting for Society for the Advancement of Biology Education Research. Minneapolis, MN. USA

Suss, J. and Pastore, C. (2016) The Red Queen's Menagerie, The Game Crafter, Madison, WI